EDUCATOR'S GUIDE

MONTEZUMA CASTLE NATIONAL MONUMENT
TUZIGOOT NATIONAL MONUMENT

Post Office Box 219
Camp Verde, Arizona 86322-0219
(928)567-3322

NATIONAL PARK SERVICE
DEPARTMENT OF THE INTERIOR

JULY 2005

ACKNOWLEDGMENT

This Educator's Guide is the result of a strong vision and much labor. Hundreds of children visit the monuments annually as part of their educational curriculum. Steve Sandell, former chief ranger, created the idea of the guide to teach about Montezuma Castle, Montezuma Well, and Tuzigoot and other archeological sites and surrounding natural environments by using appealing exercises for school children and their teachers. Park rangers who prepared the various lessons from their own experiences and modeling other guides were John Reid, Bob Del Carlo, Jose Castillo, Sandra Breach, and Tanya Morgan. Susan Wells and Trinkle Jones, archeologists, reviewed the cultural lessons. Park ranger Greg Webb compiled the mailing list from the many school groups that visited us during the past years. Park ranger Skip Larson worked with the design artist on the final version. Amanda Summers of Amanda Summers Design used her layout and graphics skills to design this artful product. Finally, we would not have been able to make the Educator's Guide without the financial donations from Western National Parks Association and support of Jon Fistler, field manager in the monuments, and from the Tucson main office LeAnn Simpson, executive director and Scott Aldridge, chief operations officer. This was a team effort and thanks to you all.

—Kathy Davis, Superintendent

United States Department of the Interior
NATIONAL PARK SERVICE
Montezuma Castle and Tuzigoot National Monuments
Post Office Box 219
Camp Verde, Arizona 86322

September 1, 2003

Dear Educator;

We are glad to provide this guide to assist you in preparing for your visit to Montezuma Castle and Tuzigoot National Monuments. All activities meet State of Arizona Curriculum standards.

Your students will learn more from their visit if they spend some time preparing for it. As an educator, you are the essential link to a successful program. This guide contains information on selected topics, classroom exercises, and suggested readings. Its purpose is to:

1. Provide educators ideas to assist in the development of units on the National Park Service, Montezuma Castle and Tuzigoot National Monuments, the cultural and natural resources of the Verde Valley, and the prehistoric Sinaguan culture.

2. Increase interest and anticipation among your students.

3. Provide a foundation of knowledge that you can build upon.

We are looking forward to having you and your students visit the monuments, and hope the information provided will be of benefit for all involved.

Sincerely,

Kathy M. Davis
Superintendent

PARK RECOMMENDATIONS

The mission of the National Park Service is two-fold: to protect park resources and to provide for an enjoyable and educational experience for all visitors. Please remember that natural and cultural resources are fully protected by law. Nothing can be removed from the monuments.

Please stay on trails. The ecology, landscape, and archeological sites of the monuments are extremely fragile.

Elementary school groups should strive to provide one adult chaperone for every five students to ensure adequate supervision. One chaperone for twelve high school students is recommended.

If staffing permits a Ranger will present a brief orientation to the site upon request.

CONTENTS

Introduction

"To conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such a manner and by such means as will leave them unimpaired for the enjoyment of future generations."

The above quotation is an excerpt from the 1916 organic act that provided for the formation of the National Park Service as a separate bureau of the Department of the Interior. This statement expresses the basic concept of preservation that is integral to the National Park Service

The Park Service preserves and protects the spectacular natural wonders, wildlife, and places of historical and cultural significance that are a part of the rich heritage we enjoy in this country.

National parks offer exciting opportunity to enrich curriculum and provide authentic learning experience for students. These experiences give students a sense of place and encourage them to take greater responsibility for protecting their natural and cultural heritage. Education is the National Park Service's best hope for a bright and protected future.

Montezuma Castle and Tuzigoot National Monuments have undertaken the production of this educators' guide to provide teachers with the tools and ideas for the development of classroom lessons that will enhance students' understanding and appreciation of the National Park Service mission, and of the vast cultural and natural heritage of the Verde Valley of Arizona.

Information in this guide is designed to build anticipation for visits to the monuments through pre-visit, on-site, and post-visit activities. Students who are unable to visit in person will have an opportunity to experience the monuments' resources through the activities and audiovisual resources available in this guide.

This educators' guide contains educational aids pertaining to several themes and disciplines, including the Sinagua and other Southwestern cultures; archeology and pre-historic agriculture; and natural history topics, including riparian habitats, geology, mammals, birds, and reptiles. The National Park Service concept of preservation will also be covered.

The materials in this guide will be geared to provide tools for grades 3–8, and will be applicable to multiple disciplines, including science, history, math, reading, writing, and spelling.

The National Park Service

The establishment of Yellowstone National Park on March 1, 1872, began a unique American tradition of preserving nationally significant resources in a system of federally protected and administered areas.

The National Park Service ensures that American's most spectacular natural and cultural features will remain secure for the use, enjoyment, and inspiration of future generations. Marveling at the awesome view from the rim of the Grand Canyon, gazing at the clouds swirling around the towering white summit of Mount Rainier, and reveling in the beauty of the vast deciduous forest cloaking the mountains of the Blue Ridge all provide opportunities for reflection. Enjoying the thrill of viewing wildlife as diverse as grizzly bears and bald eagles, and experiencing places of historical and cultural significance such as Gettysburg Battlefield National Military Park and the ancient cliff dwellings of Mesa Verde National Park are all part of what the national parks are about.

These places are a part of the rich heritage we enjoy in this country, and are protected and preserved for the enjoyment of our generation and generations to come. Students should remember that it is not only harmful, but also illegal, to deface or remove any plants, animals, rocks, or artifacts from the parks. "Take only pictures, leave only footprints."

There are over 380 National Park units in the United States, including two parks in the Verde Valley of Arizona. The National Park Service is dedicated to preserving America's special places. These are places where we can connect with our heritage. They comprise a wonderfully diverse group of classrooms in which people of all ages can learn about the timeless processes of nature, the evolution of American society, and the importance of stewardship. The national parks are our legacy and our future.

MONTEZUMA CASTLE AND TUZIGOOT NATIONAL MONUMENTS

Instructions for an Educational Fee Waiver

For an uncomplicated application process, please submit the following four items at least 2 weeks in advance:

1. Provide the course number, description and/or a copy of the course description from your school catalog or an outline of student work required for K-12.
2. Provide a copy of the course curriculum or lesson plan (only the portion that describes your studies in the Monuments; no travel itinerary)
3. Documentation of your official recognition as an educational institution.
4. Completed application form (on page 10).

NATIONAL PARK SERVICE REGULATIONS

These guidelines are to be followed in granting an educational fee waiver. Bona fide educational or scientific institutions may qualify if the following conditions are met.

1. **Current official documentation of recognition as an educational institution by a Federal, State or local government entity.** Generally, the government body is the one that is responsible for education or accreditation activities. You may also provide **current official documentation attesting to an educational tax exemption by the State tax authority or the Internal Revenue Service.** It is insufficient to state or imply your accreditation on official letterhead.

2. There must be a direct relationship between the visit purpose and the use of the Monuments. A general statement to the effect that the visit is for "educational purposes" is ***insufficient***. **An explanation of your educational objectives and how they relate directly to resources located within the Monuments is required.** (Course outlines, lesson plans, or a curriculum copy meet this requirement.)

3. The applicant is **providing educational credit hours based on a specific course of instruction.** (Catalog description with course number and credits or an outline of student work meets this requirement.)

APPLICATIONS MUST BE RECEIVED AT LEAST 2 WEEKS IN ADVANCE OF THE ANTICIPATED VISIT. APPLICATION FORM IS ON PAGE 10.

If the application is approved, the group's official will receive a copy of the application with an approval signature. Please present the approved application at the visitor center front desk(s) upon your arrival.

Mail application to: Montezuma Castle and Tuzigoot National Monuments
P.O. Box 219
Camp Verde, AZ 86322
FAX: 928-567-3057 or 928-567-3597

United States Department of the Interior

NATIONAL PARK SERVICE
Montezuma Castle and Tuzigoot National Monuments
Post Office Box 219
Camp Verde, Arizona 86322

IN REPLY REFER TO:

EDUCATIONAL FEE WAIVER APPLICATION

The National Park Service will grant a fee waiver to a school group or other bona fide educational institution. To obtain a waiver certain criteria must be met.

1. **Is this group recognized by a Federal, State, or local government as a bona fide educational or scientific institution?**

If yes, please provide documentation from that government body stating your group's official recognition (accreditation certificate or letter from a government body attesting to the legitimacy of the school).

Note: An applicant who has been granted an educational tax exemption by the Internal Revenue Service or similar State tax authority will qualify for a fee waiver.

2. The applicant is **required to provide a statement as to the educational purpose of the visit. The visit must relate to the resources of either Montezuma Castle or Tuzigoot National Monuments.**

A general statement to the effect that the visit is for "educational purposes" is **insufficient** by itself. Please explain below **WHAT** the educational purpose entails and **HOW** it relates to the monument resources.

_____

_____

_____

Applicant Signature _____ National Park Service Approving Official

DATE _____ _____

FAX: 928-567-3057 or 928-567-3597

Name of Organization _____

Number of Students _____ **Date and Time of Visit** _____

Number of Faculty/Sponsors _____

Address_____

Please circle all locations to visit: **Montezuma Castle** **Tuzigoot** **Montezuma Well**

Telephone (_____) _____

Please Note: If a fee waiver is not granted, the admission fee to Montezuma Castle or Tuzigoot National Monument is $3 per adult; children 16 and under are free. If you have any questions, please contact the Educational Fee Waiver Coordinator at (928) 567-3322 ext. 23.

YOU MUST HAVE THIS FEE WAIVER IN YOUR POSSESSION WHEN YOU ARRIVE.

The National Monuments

Montezuma Castle National Monument

Nestled into a limestone recess high above the floodplain of Beaver Creek in the Verde Valley stands one of the best-preserved prehistoric structures in North America. The five-story, 20-room cliff dwelling was home to a creative and resilient people called the Sinagua. The Sinagua were part of a culture that flourished in the American Southwest long before Columbus landed on these shores.

With heightened concern over the possible vandalism of fragile prehistoric sites, Montezuma Castle became a major force in the nation's preservation movement with its proclamation as a national monument. The castle was described in the December 1906 proclamation as "of the greatest ethnological and scientific interest."

Early settlers to the area assumed that the imposing structure was connected to the Aztec emperor Montezuma, but in reality the cliff dwelling had been abandoned almost a century before Montezuma was born.

Sinaguan culture was a synthesis of borrowed elements adapted from surrounding ancestral Pueblo, Mogollon, and Hohokam cultures.

The Sinaguan made their living from farming, hunting, and gathering. They adopted irrigation techniques from their Hohokam predecessors, and grew crops of corn, beans, squash and cotton. They took advantage of the rich diversity of the Verde Valley to supplement their crops by hunting and by gathering native plants. Construction of Montezuma Castle began in the early 1100s. The castle reached its present size by the 1300s; and it was occupied for another century after that. In the early 1400s, the Sinagua abandoned the valley for reasons that remain unclear to this day.

Montezuma Castle is located along the banks of Beaver Creek, a small tributary of the Verde River. The green ribbons of trees, shrubs, and grasses that grow along water courses like Beaver Creek are called riparian zones, and are among the most productive ecosystems in the world, supporting a wide variety of plant and animal life. Riparian areas have been called "streams of life," providing food, water, breeding grounds, wintering habitat, and migration corridors for a variety of birds, and serving as a refuge for mammals, reptiles, and amphibians. The Sinaguan culture took advantage of this rich riparian habitat along Beaver Creek for more than 600 years, utilizing the diversity of plant and animal life to provide for their livelihood.

Montezuma Well, a detached unit of Montezuma Castle National Monument is a limestone sinkhole formed long ago by the collapse of an immense underground cavern. Over 1.5 million gallons of water a day flow continuously, providing a lush, verdant oasis in the midst of a desert grassland. The waters of the well contain several forms of plant and animal life not found anywhere else in the world. This unique habitat may be due to constant, large quantities of warm water, which enter through fissures fed by underground springs. The constant water level and temperature create a stable environment that supports this unique habitat.

Prehistoric Hohokam and Sinaguan cultures made use of this abundant and reliable water source to irrigate their crops. Remains of their ancient irrigation canals can still be seen today. The surrounding uplands provided them with diverse wildlife and native edible plants as a supplement to their agricultural products.

Tuzigoot National Monument

Overlooking a sweeping view of the Verde River, Tuzigoot National Monument is one of the largest pueblos built by the Sinagua. Tuzigoot, an Apache word meaning, "crooked water," was built and inhabited between A.D. 1100 and 1400.

The pueblo consisted of 110 rooms, including second- and third-story structures, and may have housed more than several hundred inhabitants. Within sight of Tuzigoot are the ruins of six other pueblos that give

some indication of the concentration of population in the Verde Valley at the beginning of the 14th century.

The Sinagua people who lived at Tuzigoot made their living through a combination of hunting, gathering, and farming. The importance of the Verde River to the Sinagua is quite evident, because its waters helped to create the fertile floodplain necessary for agriculture. The river also provided the mud and clay utilized in the mortar for plastering the limestone walls of the village.

Tuzigoot National Monument reveals excellent examples of Arizona Uplands plants and animals, as well as examples of the riparian ecosystem of the Verde River. Tavasci Marsh, an altered wetland area adjacent to the river below Tuzigoot, is one of the few freshwater marshes found in Arizona. It is managed by the Arizona Game and Fish Department as a wildlife sanctuary, and is presently undergoing restoration. The marsh is a critically important habitat for birds and other wildlife.

A highlight of a visit to Tuzigoot National Monument is the unique,

small, old-style museum. The museum houses many original Sinaguan artifacts as well as historical artifacts. The displays and coverage of the archeology and history truly magnify the importance of this special site in the Verde Valley of Arizona.

YOUR VISIT

Montezuma Castle National Monument

Montezuma Castle National Monument is located near Camp Verde, Arizona, approximately 50 miles south of Flagstaff, Arizona. The park can be reached by taking Exit 289 off Interstate 17.

The park is open every day of the year. Winter hours: 8:00 am to 5:00 pm. Summer hours: 8:00 am to 6 pm. Over 700,000 visitors come to Montezuma Castle National Monument each year. The heaviest visitation occurs during the spring, while December and January are the slowest months of the year.

Educational groups that wish to visit the site may qualify for a fee waiver. Accredited educational groups must submit in writing a brief statement describing the educational purpose and relevance of the visit and request a fee waiver form. Please mail or fax request to park headquarters at:

National Park Service
Montezuma Castle National Monument
P.O. Box 219
Camp Verde, Arizona 86322
Fax: (928)564-3597

Fee waiver forms may also be requested by calling (928)567-3322. Off-site programs for Verde Valley area schools are also available on request.

Upon arrival at Montezuma Castle National Monument, school groups receive a short orientation program from park rangers. A junior ranger program is available upon request and children can complete several activities from the junior ranger booklet and earn their badge.

The park visitor center contains a small museum displaying artifacts found on the site. Rangers are available to provide information and assistance. Programs are provided as staffing levels permit. There is a level, paved trail ⅓ mile in length. Wayside exhibits along the self-guiding trail describe the cultural and natural history of the site. A diorama/audio program depicts the interior view of the cliff dwelling.

The visitor center and most of the paved trail are handicapped accessible. A portion of the Castle A trail is too steep for wheelchairs, and is so marked. Audiocassettes and braille text are available for the visually impaired.

Allow approximately 45 minutes to one hour to visit the Castle. Generally the heaviest visitation to the site occurs between 10:00 am and 1:00 pm, due to heavy commercial tour-bus activity. To more fully enjoy your visit, try planning around this time period.

Montezuma Castle National Monument protects and preserves the cultural and natural resources that you come to see and enjoy. Students are requested to stay on the paved

trails to protect these fragile resources. Remember, it is not only harmful to the site but also illegal to deface or remove any plants, animals, rocks, or artifacts from the monument. *"Take only pictures, leave only footprints."*

Montezuma Well is a detached unit of Montezuma Castle National Monument located approximately 11 miles from the park. Take Exit 293 from Interstate 17 and drive four miles. No entrance fee is charged. There is a ⅓ mile loop trail that is not recommended for wheelchair use. A lush, shaded picnic area is also located at the well. This picnic area is adjacent to an environmental study area, and is especially appropriate for school group use.

Tuzigoot National Monument

Tuzigoot National Monument is located 50 miles south of Flagstaff, Arizona, via U.S. Alternate Highway 89A; or 90 miles north of Phoenix, via Interstate 17 and Highway 260 West.

The park is open daily, except Christmas Day. Winter hours: 8:00 a.m. to 5:00 p.m. Summer hours: 8:00 a.m. to 6:00 p.m.

Educational groups visiting the site may qualify for an entrance fee waiver (please refer to fee waiver information under Montezuma Castle). Junior ranger program activity guides are provided upon request. A school group orientation may be given by a park ranger; inquire at visitor center for availability.

The park visitor center is a small, old-style museum with a large number of artifacts on display. It is one of the few museums interpreting ancient Sinaguan culture in Arizona. The Ruins Trail, which is ¼ mile in length, loops around the pueblo, allowing visitors to closely view the structures. An additional trail of ¼ mile leads to Tavasci March, one of the few freshwater marshes found Arizona. Rangers are available to provide information and assistance.

The visitor center and the Tavasci Marsh Overlook Trail are handicapped accessible. Wheeled vehicles are not recommended on the Ruins Trail. The park trail guide is available in braille, and large print, and tape. These materials are available on request.

The walls of the Tuzigoot ruins are fragile. Climbing or sitting on the walls is prohibited. Students are encouraged to stay on the trail for their safety and for the protection of the cultural and natural resources.

CULTURAL HISTORY

Activities

Background on Cultural History

Archeology is the scientific study of the past. Archeologists study what people have left behind to reconstruct how they lived in the past. Things that people made or used in the past become buried after people have left them behind. Wind, water, and other natural forces cover over places where people have lived, farmed, hunted, etc., in the past. When archeologists locate and excavate these places, they can interpret what people did there and how they lived.

Archeologists call the things that people have made "artifacts." They study artifacts to figure out what they were and what they were used for. People have used other things that they did not make, such as animal bones and hides, plant parts, and stones. Before such items are made into an artifact, archeologists call them "ecofacts." When all these things are found at the same place or site are studied together, an archeologist can interpret how the people lived at that place at a certain time. Although archeologists can learn a little from just an artifact or ecofact by itself, they learn much more from a collection of artifacts and ecofacts found at one place together. Thus, it is very important that artifacts and ecofacts are left where they are found.

Artifacts and ecofacts found in relation to one another help archeologists put people of the past in context with place and time. If an archeologist cannot put a culture in a certain region or in a certain time, it is very difficult to interpret relationships between cultures through time. Groups of artifacts and ecofacts from a particular region and time help archeologists better describe cultures or peoples of the past.

Because placing a culture in specific time period is crucial, dating a site is very important. Archeologists use a number of dating techniques, such as stratigraphy, dendrochronology, ceramic cross-dating, radiocarbon dating, and archaeomagnetic dating. Once sites and groups of sites are dated and cultures are defined, archeologists can interpret a culture's history. As new research is done and new evidence is found, the interpretation of culture history continues to change.

During the last Ice Age (Pleistocene), 10,000 B.C., people migrated south from the arctic regions of Asia to North America. They ranged over large areas following herds of large game animals and collecting plants. Archeologists call these peoples PaleoIndians. Later, after the glaciers receded and environments changed, Archaic peoples were limited in the areas they hunted animals and gathered plants.

Between 8,000 to 1,000 B.C., Archaic peoples learned to use the plants and animals in their environments very well, and in some areas they began cultivating certain plants. Bands of PaleoIndians and Archaic peoples moved through, camped in, and utilized the plants and animals of the rich environments of the Verde Valley. Eventually, knowledge about growing corn and squash worked its way north from Mexico. Many bands in

the Southwest took up gardening to supplement their hunting and gathering. Eventually people began settling near their gardens for longer periods of time and building more substantial shelters. Between A.D. 0–700, beans were added to corn and squash, and people over much of the Southwest became farmers.

By the end of this time, people diversified into the cultures archeologists call the Ancestral Puebloans (Anasazi)*, Mogollon, Hohokam, and Sinagua. People began living in villages of pithouses, cooking and storing their food in pottery, and hunting with bow and arrow. Trading in goods and ideas was very important between the different cultures. Both the Mogollon and the Hohokam disseminated many ideas and items from Mexico north to the Ancestral Puebloans. Because the Sinagua were between all three of these cultures, they adopted and passed on many ideas and items from all three groups. They lived both in the mountains around Flagstaff and in the Verde Valley. The Sinagua adopted many Hohokam ideas and styles, such as shell jewelry, irrigation farming, paddle and anvil pottery, ballcourts, and small platform mounds.

Between A.D. 700–1000, the Ancestral Puebloans developed above ground masonry pueblos, which filtered south to the Mogollon, Sinagua, and Salado. By A.D. 1100, the Hohokam had adapted the idea into adobe platform mounts, "big houses," and compounds.

After the great drought of the late 13th century, many of the Ancestral Puebloans and Sinagua of the Flagstaff area moved south. During the 14th century, the population of the Verde Valley increased significantly, which increased use of the available resources. The 14th century was a time of migration, amalgamation, and conflict. The Sinagua of the Verde Valley and Anderson Mesa to the northeast sustained themselves against outside pressure until the 15th century. Due to possible overuse of the environment, flooding, and cultural instability, the Sinagua, Salado, Ancestral Puebloans, Hohokam, and Mogollon ceased to exist as they had before. Instead, they moved and/or lived simpler lives. They became the Pueblos, such as the Hopi, Zuni, Acoma, and Tohono O'odham (Pima and Papago) that the Spanish met in the 16th century.

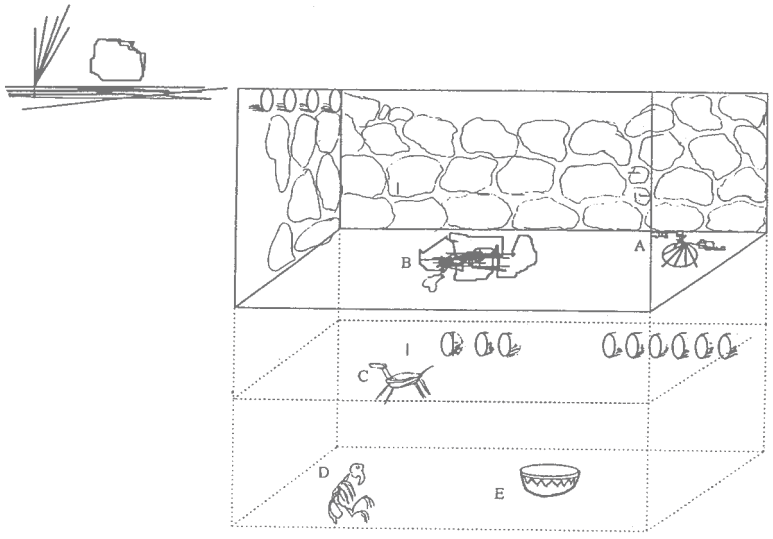
With the aid of the following activities, students can learn about archeology and the native peoples of the Verde Valley and the Southwest. Feel free to use and adapt any of the information and activities in this section to help you in your units on native peoples and archeology. These activities meet the following Arizona State Curriculum Standards (AIMS).

These activities may be used to enhance field trips to the monuments, or may be used on their own. We hope that you will find them helpful in your endeavors to teach children about the great heritage of our country. If you need any further assistance, feel free to inquire directly to the monuments for more information.

* The name "Anasazi" is being replaced by the name "Ancestral Puebloan" in recognition of their modern ancestors.

Educator's Outline for

DIG THAT PAD!



OBJECTIVES

After completing this exercise the student will be able to

1. define the Rule of Superposition.
2. discuss the amount of information that can be obtained by one artifact and its position.

GRADES: 6 to 8

AZ CURRICULUM STANDARDS:
Science Standard 1 – Science as inquiry

GROUP SIZE: 20 to 30

DURATION: 30-60 minutes

SETTING: Classroom

MATERIALS: Pencil and paper

SET-UP AND PROCEDURE: Following is a cross-section of an excavated archeological site found in central Arizona. The artifacts found in the rooms have been marked with a letter. Have the students answer the questions about the sketch after discussing the background information. Discuss the answers to the questions.

DIG THAT PAD!

Archeology is the scientific study of past cultures. Many compare it to detective work, because archeologists deduce when, where, and how people lived by studying what they left behind. Archeologists excavate a site in an organized way. They map the area, and carefully record everything that is found there. The location of objects and what they were used for are valuable clues about how people of the past lived. By comparing artifacts or objects made by people from different sites, archeologists can surmise which cultures lived at which sites and how they interacted with one another through time.

Placing cultures and artifacts in time is essential to making any interpretations about people of the past. Layers of soil accumulate naturally over time. Depending on which layer an artifact is found in, an archeologist can tell how old it is compared to another artifact found at the same site. Because the layers of earth on the bottom were laid down before the ones on top, anything found in the lower layers should be older than anything found in the upper layers. Thus an archeologist knows that an artifact found at the bottom of a site is usually older than the one found near the top of a site. The fact that lower layers of soil are usually older than upper layers is the rule of superposition. By studying groups of artifacts found together in different layers, an archeologist can see changes that take place within a culture through time or the change of cultures in one place over time.

Archeologists date artifacts and the layers of earth where they were found using other methods too. Any once-living thing, such as wood, seeds, bone, etc., can be dated by radiocarbon dating. The radiocarbon testing of a small piece tells when the thing was alive. Because people usually used it soon after its death, an archeologist assumes that the people must have lived about the same time. Charcoal is a very important source of radiocarbon dates, because many plant and animal remains are preserved when they have been burned.

The magnetic north pole moves over time. When the clay of a fire pit or hearth is baked, the magnetic particles in it line up with the true magnetic north of that time. By comparing the alignment to the known location, archeologists can date a sample of baked clay. This is called archaeomagnetic dating.

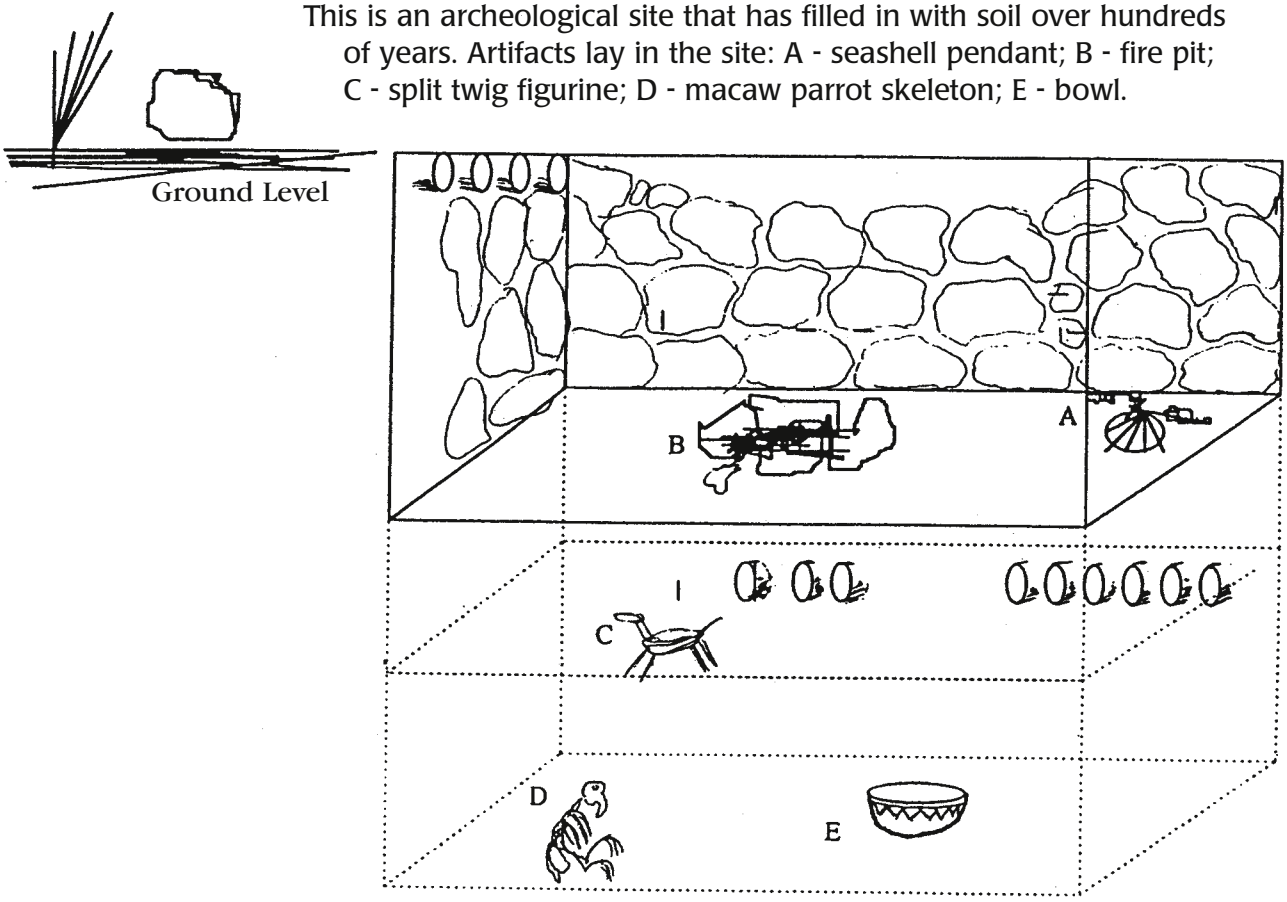
In the Southwest, whole tree limbs and logs have been preserved in ancient pueblos, cliff dwellings, and other structures. Southwestern archeologists and other scientists have figured out a calendar of tree rings by studying samples from structural beams, stumps, and living conifer trees. By matching patterns of annual tree rings, scientists have created a master tree ring or dendrochronology calendar.

Because pottery styles change through time and can be dated to a certain range of years, pottery sherds can be used to date a site or layers of earth at a site. This is ceramic cross-dating.

Archeologists can also learn about

changes in climate from pollen. Pollen in the soil or in rooms can tell them what type of plants were in the area and what the climate may have been like. Archeologists can tell what plants and animals people were using from pollen and other plant and animal remains, too. By studying pieces of pottery and stone tools, archeologists can tell where the raw materials to make them came from and what they were used for. Archeologists have many ways to learn about people of the past—but they can not learn anything new if people do not leave artifacts where they find them.

This is an archeological site that has filled in with soil over hundreds of years. Artifacts lay in the site: A - seashell pendant; B - fire pit; C - split twig figurine; D - macaw parrot skeleton; E - bowl.



QUESTIONS:

1. Which artifact is older, A or E? Why?

2. Was there another room under the floor of the exposed room? How can you tell?

3. Was this living quarters or a storage room? How can you tell?

4. What can archeologists learn from examining the fire pit?

5. Was this a nomadic hunting and gathering culture or an agricultural community? Why do you think that?

6. What different items or features in this picture can archeologists use to date this room?

7. Artifact A is a shell pendant. Where can you find seashells? What does this tell us about this culture?

8. Artifact D is a macaw parrot skeleton. Where can you find this kind of parrot? What does this tell us about the culture's trade network?

Educator's Outline for

TREES OF TIME

OBJECTIVES

After completing this exercise the student will be able to

1. define the concept of dendrochronology or tree ring dating.
2. apply a tree ring calendar to a sample beam cross section and solve time-related problems.

GRADES: 3 to 8

AZ CURRICULUM STANDARDS:
Science Standard 1 – Science as inquiry
Mathmatics Standard 1 – Number sense

GROUP SIZE: 1 to 30.

DURATION: 1 hour.

SETTING: Classroom.

MATERIALS: Paper, pencil, and magnifying glasses.

SET-UP: On the following student activity sheet is a calendar strip section and sketches of roof timbers showing annual tree ring growth. Clusters of dry years have been numbered and spaces of wet years have been exaggerated for the purpose of illustration. The year A.D. 1300 has been marked. A and B are the timbers taken from the roofing of ancient rooms. We know that timber B was cut down in the year A.D. 1300.

PROCEDURE: Cut out the calendar strip section at the top of the page and distribute a copy of it to each student to use with a the sketch of two beam sections from the roofs of two pueblo rooms. Have the students slide the calendar strip across the beam sections until the lines most closely match. Have the students answer the following questions based on the given information.

Trees of Time

Archeologists have produced a calendar by comparing tree rings from dated stumps and sections from progressively older trees. By comparing where the rings overlapped between sections, they were able to put together a calendar of tree rings. In dry years the tree rings were closer together, and in years with much rainfall the tree rings were farther apart. This produced a pattern of narrow and wide lines. By matching the pattern of tree rings on a segment from a roof beam with the master calendar, the archeologists can tell how old it is

Using the diagram of tree rings, answer the following questions:

1. Which tree is older?

2. Which tree lived longer?

3. What year was tree A cut down?

4. What does this tell us about the pueblo room the beam was found in?

5. How many years later was tree B cut down after tree A had been cut down?

6. According to the calendar, was the year A.D. 1300 a wet or a dry year?

7. Was A.D. 1294 a good year for growing crops? Why do you think that?

8. Was A.D. 1274 a good year for growing crops?

9. Were the years A.D. 1300 to 1303 wet years or dry years?

10. Was A.D. 1300 to 1303 good years for planting crops?

11. Do you think there were many marshlands during A.D. 1300 to 1303?

12. Were A.D. 1300 to 1303 a good time to hunt waterfowl? Why or why not?

13. How long did this period last?

14. Assuming the "+" marks the center of the beam, what year did tree A germinate?

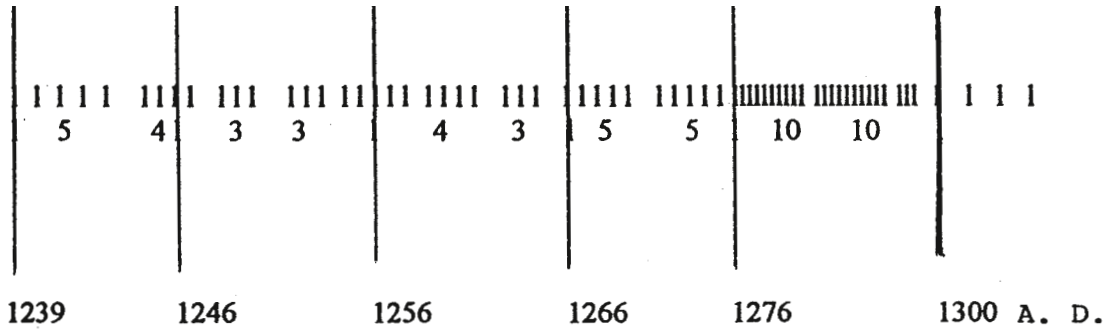
15. About what year did tree B germinate?

16. How many years did tree A live before it was cut down?

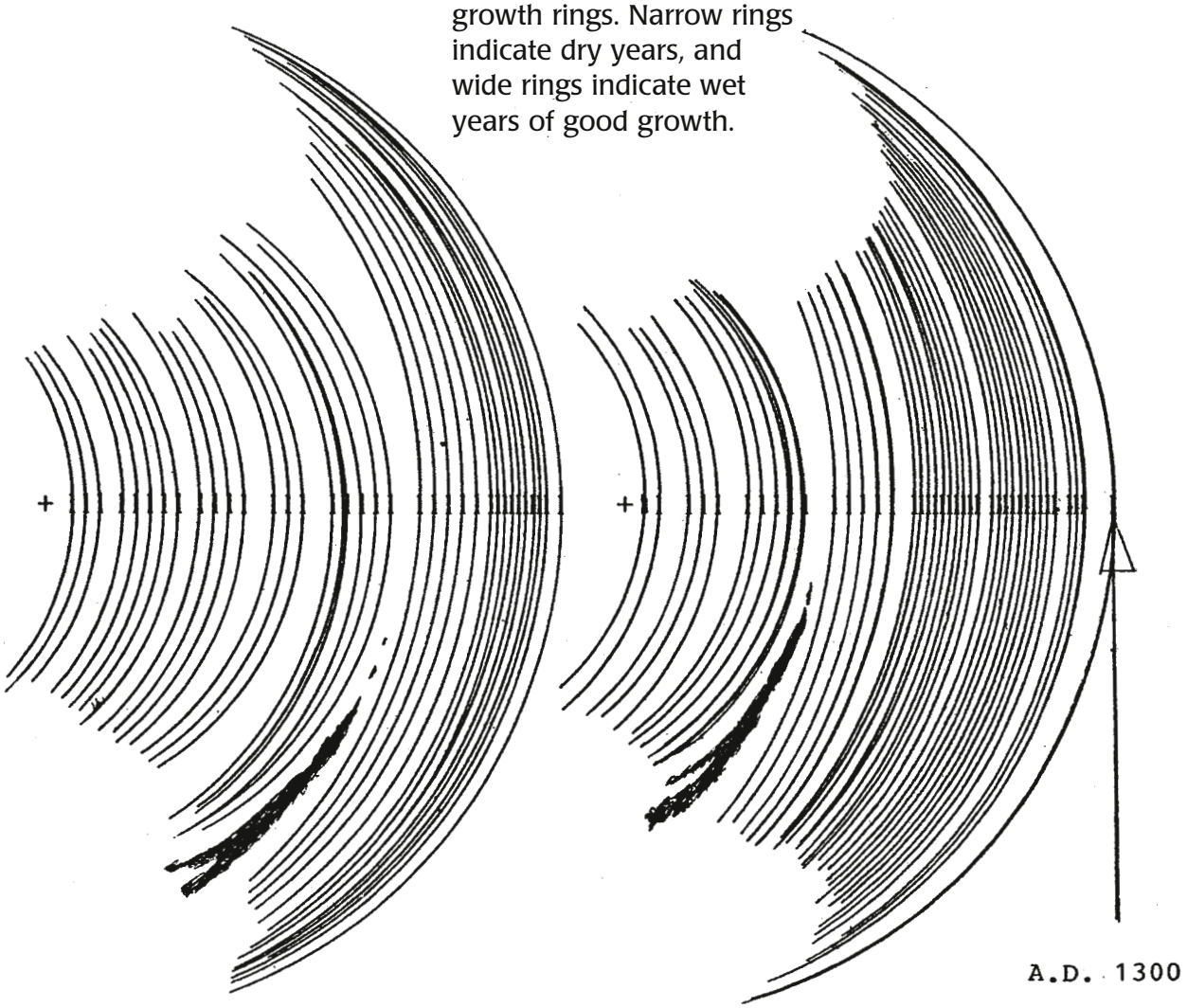
17. Both tree A and tree B have a burn scar in the same year. What year was it?

18. Was the year from question 17 a wet year or a dry year?

Calendar Strip and Roof Beam Sections



Sections of roof timbers showing annual tree growth rings. Narrow rings indicate dry years, and wide rings indicate wet years of good growth.



A B

Educator's Outline for

WHAT DOES IT MEAN?

SET-UP: This exercise can be done in the library before or after a field trip to a national monument or museum and then discussed in the classroom. The research for this exercise can also be done as homework and discussed in class the following day.

PROCEDURE: Give the class the names of the Southwest cultures and sites, and ask them to find their meanings. After the class has been given sufficient library time, the definitions and origins of these names can be discussed in the classroom. Interesting questions to ask regarding these names are, "Who named these ancient cultures or places?" and "Why did they choose that name?" Often archeologists have asked the people living in the area what they called the ancient people.

OBJECTIVES

After completing this exercise the student will be able to

1. define the meanings and origins of names given to cultures or archeological sites of the southwest.
2. understand that many names were given to ancient cultures or sites by people of other cultures.
3. conduct research using the library or the Internet.

GRADES: 3 to 8

AZ CURRICULUM STANDARDS:
Language Arts Standard 1 – Reading;
Language Arts Standard 4 – Viewing and Presenting

GROUP SIZE: 1 to 30

DURATION: 1 to 2 hours

SETTING: Library or computer lab with Internet access

MATERIALS: Pencil, paper, and reference material

Canyon de Chelly
Hohokam
SALADO
Ancestral Puebloan
Tuzigoot

What Does It Mean?

When the ancient peoples of the Southwest left their homes, they did not leave a written record. Modern people gave names to the ancient sites and to the peoples who had lived there. Some of these names were adopted from the modern native people living in the area, while others come from the Spanish language.

QUESTIONS: Can you find out what these names mean and where these southwest cultures and sites came from?

1. Anasazi/Ancestral Puebloan

2. Hohokam

3. Sinagua

4. Salado

5. Mogollon

6. Casa Grande

7. Montezuma (Castle and Well)

8. Tuzigoot

9. Wupatki

10. Canyon de Chelly

11. Tonto

12. Gila Cliff Dwellings

Educator's Outline for

YOUR VISIT TO THE NATIONAL MONUMENTS!

SET-UP: Remember that one of the missions of the National Park Service is to protect the natural and cultural resources found at all national parks and national monuments. You may not take or disturb anything, including potshards, plants or wildlife. Because the walls of the pueblos are very old and fragile, please do not climb or walk on them. For your own safety and the preservation of the resources, please stay on the trail.

Some school groups that visit Tuzigoot National Monument or Montezuma Castle National Monument have their own program activities, while other groups can be provided with a ranger-guided tour or orientation by prior arrangement. Below is a list of questions and activities that you might consider while you are visiting the monuments.

OBJECTIVES

After completing this exercise the student will be able to

1. discuss what the daily life of a Sinagua boy or girl may have been like.
2. discuss the methods and materials the Sinagua people used in order to survive and meet their daily needs.

GRADES: 3 to 8

AZ CURRICULUM STANDARDS:
Social Studies Standard 1 – History
Social Studies Standard 3 – Geography
Language Arts Standard 1 – Reading
Language Arts Standard 3 – Listening and speaking

GROUP SIZE: 1 to 50

DURATION: 1 to 2 hours

SETTING: Field trip to Tuzigoot National Monument or Montezuma Castle National Monument

MATERIALS: Paper and pencil.

PROCEDURE: If you are visiting with a small group, you may want to visit the museum first, and then walk to the pueblo or cliff dwelling. If you have arranged for a ranger-guided walk or orientation, you may want to do this first, and then return to the museum to see if the class can find the answers to the questions. If you have a large group of 50 or more, you may want to take half to the structures and the other half to the museum, then switch the groups.

Your Visit to the National Monuments!

These national monuments are archeological sites. Here you will find the remains of ancient pueblos, a cliff dwelling, and many artifacts on display. The people who built these places were members of a culture we call the Sinagua. They were basically farmers, but they also hunted game and collected plants for food, tools, and clothes. We know that they traded far and wide and had peaceful relationships with their neighbors. They were contemporaries with the Anasazi/Ancestral Pueblo, Hohokam, Salado, and Mogollon. They eventually left the Verde Valley to join the Hopi and other modern Pueblo tribes.

QUESTIONS:

1. What does "Tuzigoot" mean?

2. How did Montezuma Castle get its name?

3. What does "Sinagua" mean?

4. When were the villages first built?

5. When did the Sinagua people leave the Verde Valley?

6. Where did macaws originally come from?

7. Where did seashells come from?

8. What is a metate?

9. What is a mano?

10. What mineral did the Sinagua have most of?

11. What kind of pottery designs did the Sinagua make?

12. Where did the decorated pots come from?

13. What are those big yellow fields near Tuzigoot?

14. What kinds of crops did the Sinagua grow?

15. Most of the rooms in the pueblos had no doorways, why might the people have come in through the roof?

16. Did the Sinagua have any enemies?

17. Where did they get their water?

18. Name three plants and two possible uses that the Sinagua may have had for each.

19. Name two tools or items the Sinagua made of bone.

20. Name two tools they made of stone.

21. Why do you think the Sinagua left the Verde Valley?

22. What did the Sinagua use for string?

23. Did the Sinagua wear clothes? Why do you think that?

24. What did they make their clothes out of?

25. What are those tiny beads made of?

26. How did they make those beads? What did they use to drill those holes?

On a separate piece of paper:

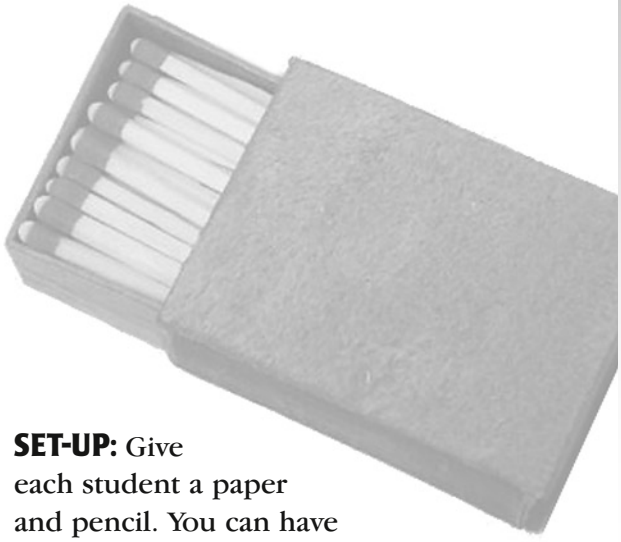
27. Draw a sketch of a bowl or a pot that you see.

28. Draw an ancient tool that you see.

29. Draw yourself doing something that you think a Sinagua boy or girl would have done between A.D. 1100 and 1400.

Educator's Outline for

WILL I SURVIVE?



OBJECTIVES

After completing this exercise the student will be able to

1. discuss the challenges the early cultures faced in order to survive.
2. see the advantage of teamwork in a survival crisis.

GRADES: 2 to 8

AZ CURRICULUM STANDARDS:
Language Arts Standard 2 – Writing
Technology Standard 1 – Fundamental operations and concepts

GROUP SIZE: 5 to 30

DURATION: 1 to 1.5 hours

SETTING: Classroom

MATERIALS: Paper and pencil.

SET-UP: Give each student a paper and pencil. You can have students work by themselves or in teams of five. Otherwise you can have them work on the problem alone first, hold on to their answers, and then put them in teams. Tell them the scenario and give them 15 to 30 minutes to write down what they would do in order to survive until help arrives. Tell them they need food, water, and shelter to survive. After the exercise, discuss what they did to deal with the problem. Usually teams of students will think of better strategies to survive that students working alone will.

PROCEDURE: After the students have worked on the problem, have the whole class discuss the options for survival and any observations that they may have.

Will I Survive?

SCENARIO:
Your airplane has crashed in the desert 200 miles away from any town. It is 120 degrees Fahrenheit outside. Your radio is broken. You cannot call for help. You don't know how long it will be before someone comes to look for you.

You see:

- no water
- no trees
- a few large banana yucca plants
- lots of prickly pear cactus
- a few large agave
- lots of creosote bushes
- some salt bush
- lots of rocks
- a mountain about 30 miles away

You have:

- a knife
- plastic garbage bags
- a parachute
- airplane parts
- one flare
- one pistol with six bullets
- 3 matches

What will you do to survive?

EXTRA CREDIT: Think of the early nomadic hunting and gathering cultures that were here. What did they eat? Where did they get their water? How did they keep cool? Think of the early traders. The traders walked hundreds of miles, crossing mountains and deserts. In their travels, they had to obtain food and water along the way. How did they do it? What did they eat? Where did they get their water?

Educator's Outline for

THE REAL NATURAL FOOD AND SUPPLY MARKET

OBJECTIVES

After completing this exercise the student will be able to

1. identify two of the skills and two details of the knowledge the early hunting and gathering cultures needed in order to survive.
2. identify the names and possible uses of at least three of the native plants of the Verde Valley.

GRADES: 2 to 8

AZ CURRICULUM STANDARDS:
Social Studies Standard 1 – History
Social Studies Standard 3 – Geography
Science Standard 4 – Life science

GROUP SIZE: 5 to 40

DURATION: 1 to 2 hours.

SETTING: Classroom or outdoor natural area

MATERIALS: Pencil and paper, plant sketches or actual specimens of the listed plants

SET-UP: Make copies of the following plant drawings and distribute them to the class, or you may collect a few samples of these plants to show the class. Remember to obtain prior permission to collect on private or public land.

If you take the class on a field trip to a local marsh or nature area, you may want to locate these plants ahead of time.

PROCEDURE: Ask the students:

1. Where they can find each of these plants.

2. To list and describe how many different ways these plants can be used.

3. If you go to a nature area, ask the students to point out these plants and tell how they would make use of them.

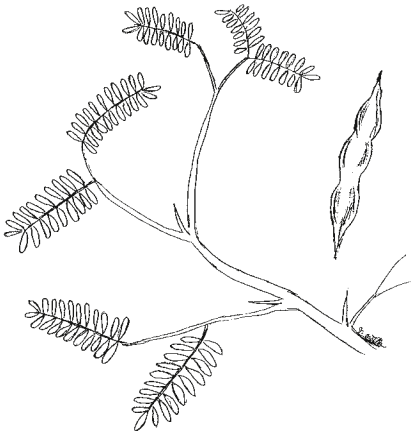
As you can see, the study of the uses and exploitation of native plants by prehistoric cultures is a science in itself. It is called *ethnobotany.*

The Real Natural Food and Supply Market

Early Hunting and Gathering Cultures
Thousands of years ago, people entered the Verde Valley to hunt animals and gather plants from along the Verde River and its tributaries. Because Clovis points have been found in the Verde Valley and Flagstaff area, we know that PaleoIndians were in the area in 10,000 B.C.. After the Ice Age, in 8,000 B.C., Archaic peoples ranged through the Verde Valley hunting animals and gathering plants, and established themselves in the high desert, upland, and riparian environments of the valley. During this time, people became experts at collecting and making what they needed from the native animals, plants, and stones of the area. Their food, medicine, clothes, shelters, tools, containers, decorations, games, etc., came from materials they collected.

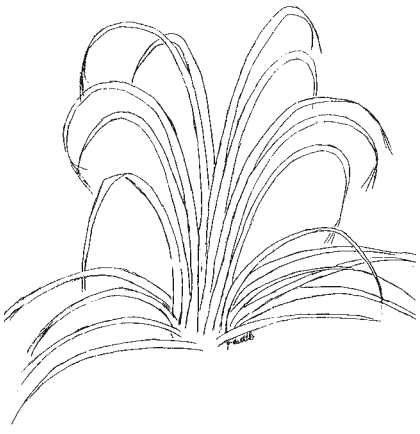
1. Name of plant:

Things it can be used for:



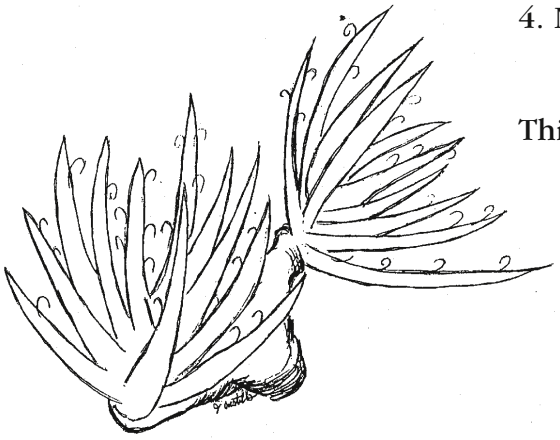
2. Name of tree:

Things it can be used for:



3. Name of plant:

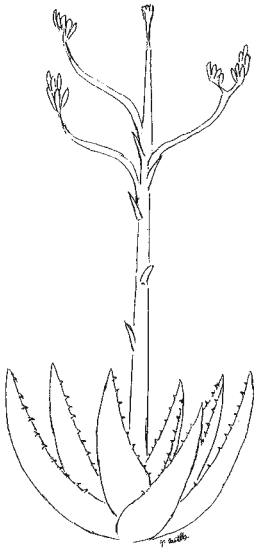
Things it can be used for:



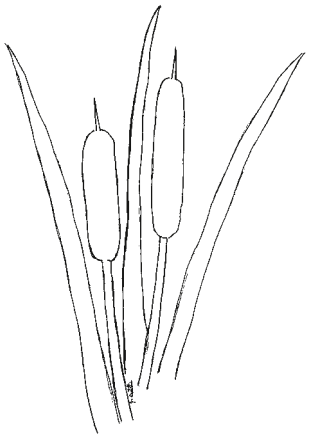
4. Name of plant:

Things it can be used for:

5. Name of plant:



Things it can be used for:



6. Name of plant:

Things it can be used for:

7. Name of plant:

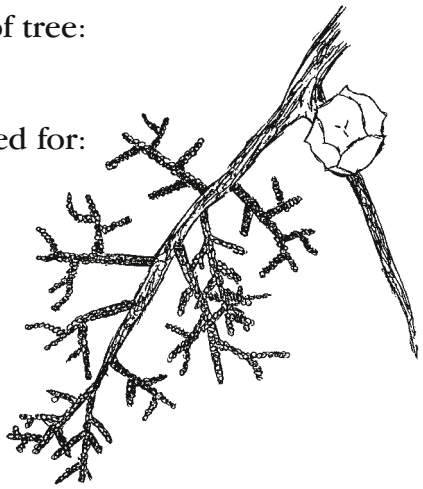
Things it can be used for:

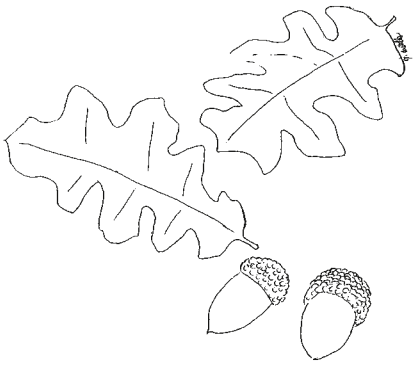
8. Name of tree:

Things it can be used for:

8. Name of tree:

Things it can be used for:





8. Name of tree:

Things it can be used for:

EXTRA CREDIT: Try weaving mats with construction paper, braiding rope out of twine or string, or making split-twig figurines out of pipe brushes or cleaners.

Split-twig figurines were replicas of animals made out of willow or other twigs that Archaic people may have used for hunting ceremonies. They have been found at many Archaic rock shelters in the Grand Canyon, Sycamore Canyon, and other places. You can see an example in the Tuzigoot National Monument museum.

Educator's Outline for

AGRICULTURE

OBJECTIVES

After completing this exercise the student will be able to

1. understand the factors that need to be considered in order to grow crops.
2. understand how agriculture allows the development of complex societies.

GRADES: 4 to 8

AZ CURRICULUM STANDARDS:
Science Standard 4 – Life science
Social Studies Standard 3 – Geography
Social Studies Standard 4 – Economics

GROUP SIZE: 5 to 10

DURATION: 1 to 2 hours or two 1 hour sessions

SETTING: Home Economics lab or classroom

MATERIALS: Depending on the size of the class you will need: 5 lbs. of corn meal or masa, water, salt, stove top with griddle or electric griddle or flying pan, 1 small can of baking powder, 1 small jar of sugar. Optional: several ears of corn, a calculator

SET-UP: Depending on the size of the class, you will need to acquire the ingredients of the tortillas, cooking facilities, utensils, paper plates, and napkins.

Depending on the amount of time you have with the students, you may need to lead the discussion during a separate session. Otherwise, you may give the students the questions as homework and then discuss the answers in class the following day.

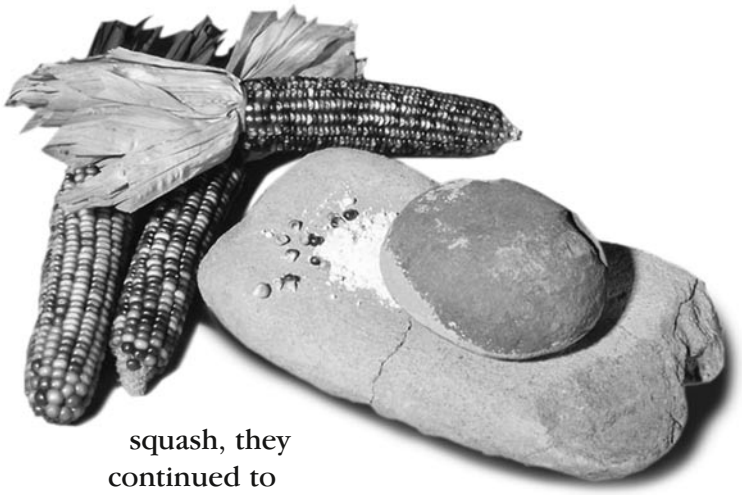
PROCEDURE: Bring water and salt to a boil. Then mix equal amounts of boiling water and cornmeal together into dough. Knead the dough into thin, flat cakes/tortillas and grill until grown on both sides.

After the bread is done and served, have the class answer the following questions, and discuss the answers as a group.

EXTRA CREDIT: Shell several ears of corn to see how many kernels weigh the same as one cup of cornmeal. You will need to know the answer to this activity to do the math questions 10 and 11.

You can have students plant a corn kernel in a small flowerpot or a large cup, and have them take care of it every morning at the beginning of class.

Agriculture



Many early native peoples experimented with growing and modifying native plants after the Ice Age. Archaeologists believe that in about B.C. 5000, people in Mexico had already modified a wild grass called teosinte into an early variety of popcorn. Through experimentation, they bred for bigger seeds, and eventually developed many varieties of corn/maize. Through trial and error, gourds, squashes, chiles, beans, cotton, potatoes, pineapples, tomatoes, and other plants were domesticated in several areas of the Americas, too. Eventually, knowledge of many of these cultivated crops spread throughout the American continents.

Between A.D. 0 to 1,500, corn/maize and squash were adopted from Mexico by hunting and gathering peoples throughout the Southwest. Whether the crops were traded north from group to group or brought by migrating people is not yet clear. Once people began growing corn/maize and squash, they had to remain near their crops for part of the year to plant, tend, and harvest them. Thus they began to limit their wandering, and to build more substantial shelters for at least part of the year.

Storage of the harvested crops and gathered wild plants and animals became an important issue, too. Once beans were added to the other two crops, about A.D. 0 to 500, farmers had staples that they could rely upon for a dependable diet. The Southwestern farmers settled down in one place to farm full time. Although they grew staples of corn, beans, and squash, they continued to hunt and gather wild plants and animals to supplement their diet and make other necessities.

The early farmers of the Verde Valley adopted irrigation farming, pottery making, and ritual from the Hohokam. Some Hohokam moved up the Verde River from the Salt and Gila valleys to occupy the Verde Valley. The first villages appear about A.D. 700. Some villages had just a few pithouses, while several had nearly a hundred pithouses surrounding ballcourts and small platform mounds. Many items, skills, and ideas were traded by many different ethnic groups throughout the Hohokam regional network. The network seems to have been held together by the ritual and exchange that occurred near the ballcourts and small platform mounds.

QUESTIONS:

1. How do you suppose the early farmers made bread?

2. How did they get water to their crops?

3. How do you think they kept animals away from their fields?

4. What do you think they would have eaten if all the corn had died before it was ready for harvest?

5. How much corn bread do you think they ate in one day?

6. How many different kinds of food can you think of that are made of corn?

7. Do you think the early farmers could leave their crops and go live somewhere else for a while? Why, or why not?

8. How many people do you think it would have taken to plant, weed, tend, and harvest a field of corn/maize?

9. How did farming allow groups of people to live in large villages and have enough food to feed people who did not farm?

10. If one cup of cornmeal makes 5 tortillas, and the weight of the ground cornmeal is equal to the same weight of shelled corn kernels, how many ears of corn does it take to make five tortillas?

11. If a corn plant produces an average of 3 ears, and a person ate 5 tortillas a day, how many corn plants would one need to feed one person for one year? Use the answer to #10 in your calculations.

OBJECTIVES

After completing this exercise the student will be able to

1. discuss the differences and similarities between pithouses and pueblos and some reasons for changing from one to the other.

GRADES: 3 to 8

AZ CURRICULUM STANDARDS:
Social Studies Standard 1 – History
Language Arts Standard 3 – Listening and speaking

GROUP SIZE: 5 to 20.

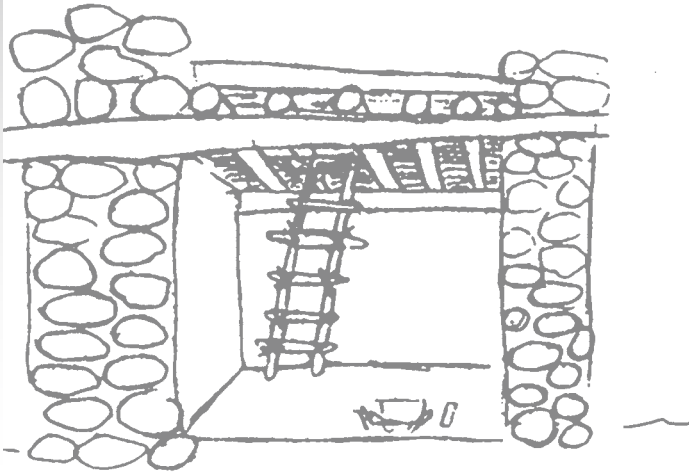
DURATION: 30 to 60 minutes.

SETTING: Classroom.

MATERIALS: Pencil and paper

Educator's Outline for

PITHOUSE TO PUEBLO

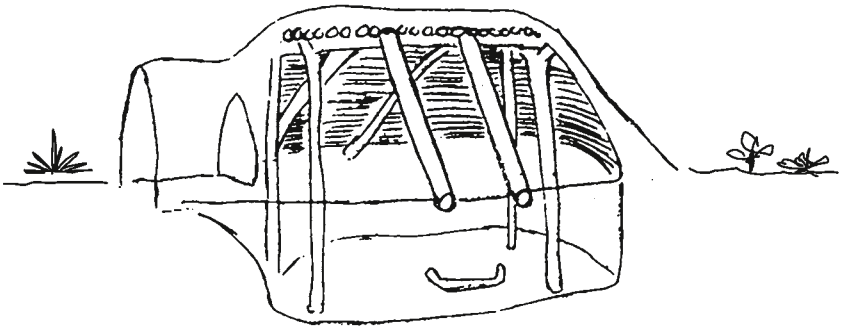


SET-UP: Discuss the background information and any other research you may wish the students to do.

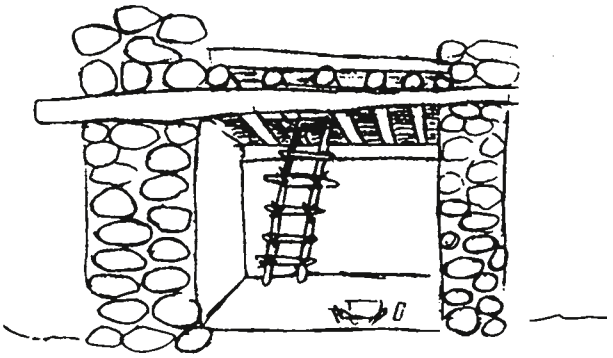
PROCEDURE: Have the students answer the following questions, and discuss their answers to the questions.

Pithouse to Pueblo

PITHOUSE



PUEBLO



The Rise of Villages and Towns. Once Archaic hunters and gatherers adopted corn, squash/pumpkins, and beans and began farming full time, they settled near their crops all year round. Thus they needed strong, permanent houses.

Between 200 B.C. to A.D. 700, most people in the Southwest lived in pithouses. A pithouse is a semi-subterranean house built of poles, woven branches, grasses, and clay. Different people living in different regions of the Southwest built different styles of pithouses. Some were deeper than others. They ranged in shape from round to oval to rectangular. Deeper pithouses were built in the uplands, where winters were often cold, while shallow pithouses were built in the hot deserts. Villages of pithouses ranged in size from several pithouses in the uplands to hundreds of pithouses in the low deserts.

Usually the sizes of villages grew over time as more crops were grown on more land. Storage pits inside and outside pithouses and community/ceremonial structures were important elements of these early villages, too. People began making pottery to store and cook the crops they were raising. Stored crops allowed families and groups of families to live in one area for the whole year. Extended families and clans lived together in villages. Because larger groups of people were living together, they chose leaders to make decisions, gain spiritual assistance, and set aside structures for those purposes.

About A.D. 700, the people of the Colorado Plateau began building aboveground storage rooms of stone, clay, logs, and branches near their pithouses. Eventually, they moved out of the pithouses into masonry rooms, which they connected together into a village. Subterranean rooms/kivas, similar to pithouses, were used mainly for community/ceremonial rooms.

Gradually the idea of building masonry villages moved south until most people of the Southwest were living in stone/clay towns of connected houses. Villages and towns of connected rooms housed more people in less space than pithouses. By the 12th

century, there were many villages and towns, dependent on full time agriculture and complemented by hunting and gathering, all over the Southwest.

The early farmers of the Verde Valley lived in pithouses like other farmers in the Southwest. By A.D. 700, the three major cultures of the Southwest are distinguishable within three geographical regions: the Anasazi/ Ancestral Puebloans on the Colorado Plateau; the Mogollon in the mountains; and the Hohokam in the low desert. The Verde Valley is a transitional zone between the Colorado Plateau, the mountains, and the lower desert, so people living there were influenced by trends from all three regions.

It is not clear whether the early farmers of the Verde Valley were indigenous Archaic peoples influenced by the Mogollon and Hohokam or immigrant Mogollon/ Hohokam. They had some traits of both groups. Their pithouses varied in depth and shape, even within the same village. Even their pottery is a curious mixture. The color, shapes, and clays are similar to Mogollon pottery, but the construction techniques are like those of Hohokam pottery. Although the Verde Valley farmers definitely participated in the Hohokam ritual/exchange network based around villages with ballcourts and small platform mounds, they retained simpler styles and mixed mortuary practices, including both extended burials and cremations.

The early farmers around Flagstaff, who were named the Sinagua, and the early farmers of the Verde Valley had contacts with one another and with the Ancestral Pueblos. Ballcourts, clay figurines, palettes, stone bowls, and shell jewelry moved north to the Sinagua, while turquoise, argillite, obsidian, and Anasazi pottery moved south to the Verde Valley and the Gila and Salt valleys of the Hohokam. Once the Ancestral Pueblo began building masonry pueblos, the idea soon filtered through the Flagstaff area to the Verde Valley. After A.D. 1100, the farmers of the Verde Valley, who are known as the Southern Sinagua, built masonry pueblos and cliff dwellings along the Verde and its tributaries.

EXTRA CREDIT: EXODUS

About A.D. 1400, the Sinagua left the Verde Valley. It is still not entirely clear why they left. Some theories proposed by archeologists suggest that their reasons for leaving might have included one or a combination of the following: drought, warfare, disease, famine, disruption of trade, and/or depletion of the natural resources. Although all or some of these reasons are plausible, more research is necessary to find the answer to this ancient riddle. That is why it is so important to leave artifacts where they are found. They can help archeologists piece together the puzzle.

Although we are not absolutely sure where the Sinagua went, archeologists have found some evidence that suggests they went north and joined the Hopi or other Pueblo peoples. Some Hopi clans also have traditions in which their ancestors live in the area at one time. A few people may have stayed in the area and intermingled with other incoming groups such as the Yavapai.

STUDENT WORKSHEET: PITHOUSE TO PUEBLO

QUESTIONS:

1. What is the advantage of living in a pithouse with a sunken floor?

2. After looking at the drawing of a pithouse and a pueblo room, which do you think could be lived in longer?

3. Why do you suppose the only entrance to some pueblo rooms was through the roof?

4. Why do you think Southwest farmers built rooms and villages in caves, too?

5. Why do you think most farmers in the Southwest eventually adopted masonary/adobe pueblo/villages?

EXTRA CREDIT QUESTION: Why do you think the Sinagua left?

OBJECTIVES

After completing this exercise the student will be able to

1. appreciate the importance of trade for the survival of a culture.
2. discuss the importance of trade to the development of culture.

GRADE: 3 to 5

AZ CURRICULUM STANDARDS:
Social Studies Standard 3 – Geography
Social Studies Standard 4 – Economics

GROUP SIZE: 5 to 30

DURATION: 1 to 2 hours

SETTING: Classroom

MATERIALS: large bag of oranges, 5-pound bag or corn, 5-pound bag of beans, 2 jars of jerky, squash, plastic knives, plastic hatchets, plastic cups, 5 bows and arrows, beads, chamois, cotton balls, bag of seashells, bag of feathers, 50 ice cream sticks

- Alternative: If the items necessary for this game are unavailable, they can be substituted for by having the items sketched and colored on 3″ x 5″ cards and then copied and distributed. You can have a class session before the game and have the students produce these pictured cards.

Educator's Outline for

LET'S TRADE!

SET-UP: Give all the students, except the hunters, a hand full of corn, 3 slices of squash, and a handful of beans.

Give 1 student a bag of oranges, too.

Give 2 students a jar of jerky, 2 bows and arrows, a stack of chamois for animal skins, and 2 plastic knives each.

Give 1 student the plastic hatchets.

Give 10 students 5 ice cream sticks.

Give 2 students a bag of cotton balls.

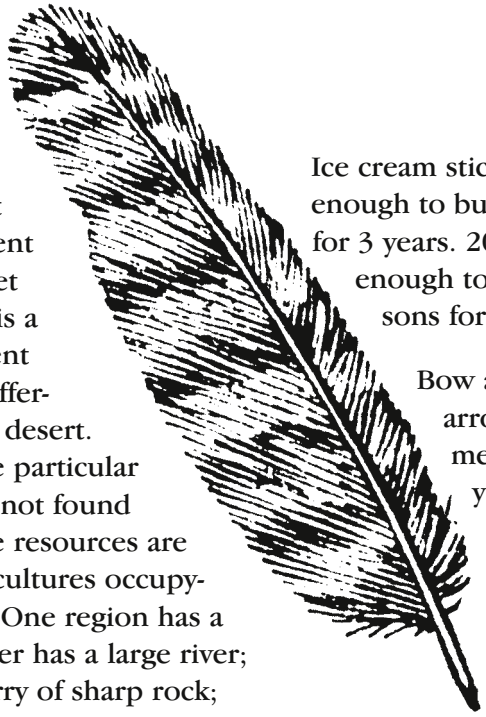
Give 1 student a bag of seashells, a bag of beads, and a bag of feathers.

Optional: 3 students will have plastic cups.

PROCEDURE: Students must acquire what they need to survive and live comfortably through trade. Everything in the exercise is tradable. At the beginning of the exercise tell the students that the minimum they need to survive is shelter, food, and water. Post on the board the list of what everything is worth or give each person or team a copy. The details of what they need will be discussed at the end of the game. Give the students 15 to 30 minutes to trade and acquire what they need from each other. At the end of the exercise, see who survived and who did not. Individuals or teams of 3 to 5 can play this exercise. This game will test the student's knowledge about the physical necessities for human survival. A discussion should follow about the necessities for human survival, specialization, depletion of resources, and the importance of trade to a culture.

EXTRA CREDIT: Like many ancient groups, the Sinagua traded far and wide for many things, such as minerals, pottery, shells, copper bells, and macaws. Notice the decorated pottery in the museum. Archeologists believe that most of these decorated types were traded from other cultures such as the Anasazi/Ancestral Puebloans. The Sinagua usually made plain red/brown undecorated pottery. The Sinagua received seashells, copper bells, and macaws from the south and turquoise, argillite, and obsidian from the north and west.

Let's Trade



SCENARIO: The students represent members of different cultures at a market place. The region is a vast desert. Different cultures occupy different regions of this desert. Some regions have particular resources that are not found in other areas. The resources are controlled by the cultures occupying those regions. One region has a thick forest; another has a large river; another has a quarry of sharp rock; and a faraway region has citrus fruit, shells, and exotic birds. Because firewood has become scarce in populated areas, it has become a tradable commodity, too. Some cultures specialize in producing certain products for trade.

VALUES:

Corn: 10 kernels of corn represent enough corn to last 1 person for 1 year.

Beans: 10 beans represent enough to last 1 person for 1 year.

Squash: 2 slices (or one zucchini) are enough to last 1 person for 1 year.

Jerky: 1 slice of jerky is enough meat to last 1 person for 1 year.

Oranges: 1 orange is enough to last 1 person for 1 year.

Cotton: 3 cotton balls are enough to make clothes for 1 person for 1 year.

Skins: 1 skin is enough to clothe 1 person for 1 year. 3 skins are enough to build a shelter for 1 year.

Ice cream sticks: 5 ice cream sticks is enough to build a shelter for 3 people for 3 years. 20 ice cream sticks are enough to cook and heat for 2 persons for 1 year.

Bow and arrow: 1 bow and arrow is enough to hunt meat for 3 people for 1 year.

Knife: 1 knife is enough to cut meat and vegetables for 3 people for 1 year.

Hatchet: 1 hatchet is enough to cut wood for 3 people for 2 years.

Seashells: 4 shells are enough to make 1 necklace.

Feathers: 2 feathers are enough to make 1 headdress; 5 feathers are enough to make 1 robe; 10 feathers are enough to make 1 pillow. 20 feathers are enough to make 1 insulated blanket for 3 people.

Optional: Plastic cups: 1 plastic cup represents enough water to last 1 person for 1 year.

SURVIVAL: In order to survive for one year, each player needs:

10 beans or 1 slice of jerky: All people need protein found in animal or plant products in order to survive. Without protein brain function will suffer and eventually the individual will die.

3 slices of squash: Humans cannot live on meat alone. A diet of only meat will lead to protein toxicity. Some

greens or vegetables are required in order to survive.

1 orange: Vitamin C is necessary to keep from getting scurvy. This vitamin is present in a variety of different fruits. Without this vitamin an individual will get sick and probably die.

3 skins or 5 ice cream sticks: A person needs shelter to get out of the heat or the freezing cold. A person needs wood to burn for heat (20 more ice cream sticks) or can survive by having a shelter and lots of blankets.

1 hatchet or 1 knife: These tools are necessary in order to cut wood and build a shelter. A person can build a temporary shelter by cutting material with a knife.

We will assume that all individuals have enough water to survive. But, if you want to make water a tradable item, you can use the plastic cups to represent stored or rights to water access.

A rich person or culture will have a minimum of all of the above and:

• Extra corn, beans, squash, and jerky to last for the winter and lean years. This will ensure the food supply and allow goods to trade for other items.

• Extra beads, shells, and feathers: Once the needs for survival are met, a person or culture can acquire extra material to trade for other necessities or to express themselves through art and ritual. In some cultures, a few individuals control access to necessities and some valuable items in order to legitimize their position or status.

QUESTIONS:

1. What do you think the Sinagua may have traded for the decorated pottery?

2. Where do you think the seashells came from?

3. Where do you think macaws (parrots) came from?

For Question 4 and 5: Ancient Southwestern traders traveled hundreds of miles on foot. They crossed barren deserts and rough mountains during both day and night to reach the Gulf of California and other areas. They did not have compasses. They probably used landmarks and the sun and stars to find their way around.

4. Look outside at night. Which way is north, south, east and west?
   Hint: Find the Big Dipper.

5. During the day go outside. Which way is north, south, east and west?
   Hint: Which directions does the sun rise and set from?

OBJECTIVES

After completing this exercise the student will be able to

1. discuss the differences and similarities between the ancient Southwest cultures.
2. identify the general regions that were inhabited by the early Southwest cultures.
3. identify the different pottery styles characteristic to particular prehistoric Southwest cultures.

GRADES: 4 to 8

AZ CURRICULUM STANDARDS:
Social Studies Standard 1 – History
Social Studies Standard 3 – Geography
Social Studies Standard 4 – Economics

GROUP SIZE: 5 to 30

DURATION: 30 to 60 minutes

SETTING: Classroom or museum

MATERIALS: Paper, pencil, map of Southwest cultures, and pottery pictures

Educator's Outline for

WHO WERE THE PREHISTORIC SOUTHWEST PEOPLE?

SET-UP: This exercise can be done before or after a field trip to a museum or a national monument. Discuss the background information on the various Southwest cultures, including their names, locations and styles of pottery. You will need a map of Southwest cultures for the students to refer to.

PROCEDURE:

EXERCISE 1. Give the students a blank map of the Southwest. Have them draw the general regions inhabited by the five prehistoric Southwest cultures.

EXERCISE 2. Show the students a series of sketches and photographs of prehistoric Southwest pottery. Given the information included in the questions about each vessel and the information in the background section, have the students guess which ancient Southwest culture created the pieces of pottery.

Who Were the Prehistoric Southwest People?

The Ancestral Pueblo or Anasazi

The Ancestral Pueblo peoples are best known for their stone pueblos and cliff dwellings, which they built over much of the Colorado Plateau. The Anasazi are also known for kivas, which are usually round subterranean structures used for ceremonies and community gatherings. During the late Pueblo periods, the Western Ancestral Pueblos used square kivas. They were excellent dry farmers, who survived in areas today many consider impossible to live in. The Anasazi were skilled potters, who painted black geometric designs on white pottery. They also made plain and corrugated gray pottery. After A.D. 1300, the Ancestral Hopi, or Hisatsinom, made a black-on-yellow pottery by firing the same gray clays at high temperatures with coal. This was some of the best Native American pottery ever made, and was highly prized all over the Southwest and beyond. It was traded into many other areas.

The Mogollon

The Mogollon dwelt in villages of deep pithouses. Some large villages had large community pithouses called "great kivas." After A.D. 1000, the Mogollon built stone pueblos and cliff dwellings similar to those of the Anasazi. Their kivas were usually square rather than round. The Mogollon farmed in the mountains of Arizona and New Mexico and into southern New Mexico and northern Chihuahua. They made plain brown or red pottery. Sometimes the plain pottery was corrugated or painted with red, black, or white geometric designs. After A.D. 1000, they began painting black and white geometric designs on red pottery. Black and white designs on red background formed what is called polychrome pottery, which is pottery with three or more colors. The Mimbres, a subgroup of the Mogollon of southern New Mexico, made a well-known style of black-on-white pottery incorporating portrayals of animals and people with geometric designs.

The Hohokam

The Hohokam lived along the Salt, Gila, Santa Cruz, and San Pedro rivers near the present cities of Phoenix and Tucson, Arizona. They used the rivers to irrigate many fields of corn, beans, squash, cotton, barley, amaranth, and agave. The Hohokam lived in small villages of clustered shallow pithouses. Some large villages had plazas with earthen ball courts and small platform mounds. After A.D. 1200, during the Classic period, the

Hohokam moved into walled adobe villages. They built larger platform mounds with buildings on top. These platform mounds may have been temples, community storehouses, and /or the homes of important priests or leaders. Large three-or four-story "great houses" were built at the most important villages, too. A major pottery ware made by the Hohokam was red-on-buff with geometric, animal, and human designs. The Hohokam traded for shell, copper bells, mirrors, and macaws from Mexico. They also made beautiful jewelry out of the shell obtained from the Gulf of California and the Pacific coast, and carved beautiful stone palettes, and bowls. All these items were traded among Hohokam villages and to other Southwest cultures. Trading probably occurred at markets set up when ball games and other ceremonies were taking place at the ball courts and the platform mounds.

The Salado

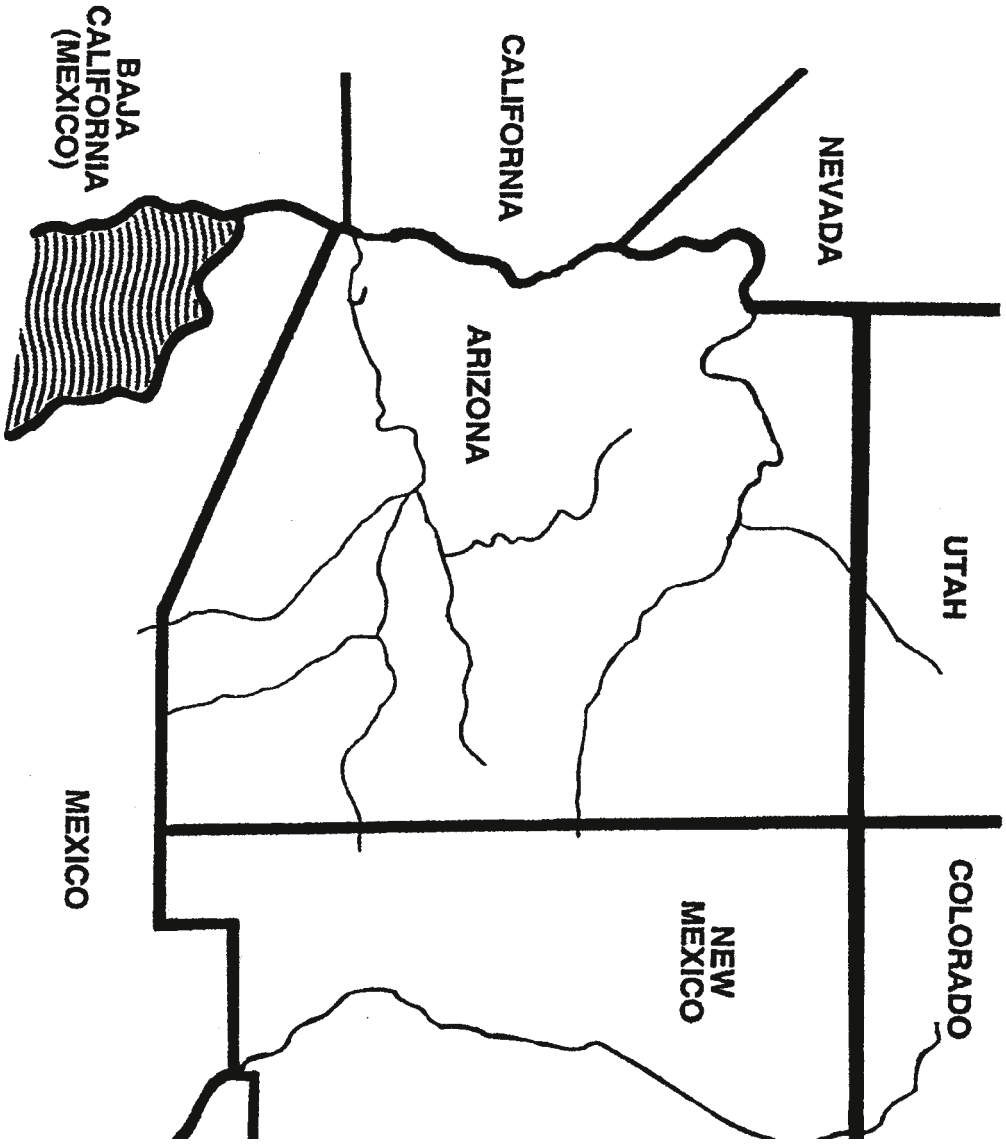
The Salado built both cliff dwellings and walled pueblos with platform mounds similar to those of the Hohokam. They inhabited and farmed the area along the Salt River from the 12th to 15th centuries. Their distinguishing feature was their polychrome pottery. This style consisted of bold geometric designs in three or more colors. This black/white/red style was so popular that it was traded and copied among the Hohokam and Mogollon.

The Sinagua

The people we call the Sinagua lived in central Arizona near present-day Flagstaff and in the Verde Valley. Before A.D. 1100, they had adopted Hohokam-style plain red pottery, shell jewelry, clay figurines, stone palettes and bowls, ballcourts, and irrigation farming along the Verde and its tributaries. They also continued dry farming in the uplands away from the river and its tributaries. The Sinagua lived in small pithouse villages. Some large villages also had large communal pithouses, ballcourts, and small platform mounds. They traded with both the Anasazi and the Hohokam. About A.D. 1100, they began building pueblos and cliff dwellings similar to the ancestral Pueblo villages. Unlike the Anasazi, they continued to use community rooms in their pueblos rather than round kivas. A few pueblos bordering the Anasazi region had both community rooms and square kivas. Although the Sinagua began building Anasazi-like pueblos and cliff dwellings and using Anasazi black-on-white trade wares, they still continued to make and use plain red or brown pottery with little or no decoration, and also other simplified Hohokam-style items

EXTRA CREDIT: Choose an ancient pottery style. Make your own pot or bowl out of papier-mache. Use a balloon to form the bowl and then paint a design you like on it.

EXERCISE 1: On the map of the Southwest, draw the general regions inhabited by the five prehistoric Southwest cultures.



STUDENT WORKSHEET: WHO WERE THE PREHISTORIC SOUTHWEST PEOPLE

EXERCISE 2: Which Southwest culture made each of these pieces of pottery?

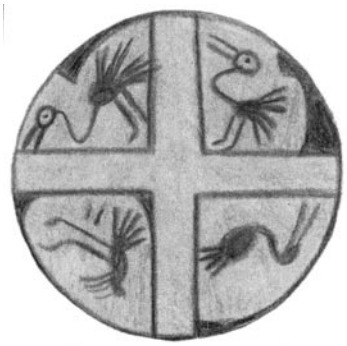
a. This is a black on white mug found at Mesa Verde National Park, Colorado.

b. This is a plain corrugated jar from the Colorado Plateau.

c. This is a polychrome pot with a black/red/white design found at Tonto National Monument near the Salt River in Arizona.

d. This bowl has a red-on-buff design.

5. Here we see a black-on-white bowl with a person and two parrots portrayed on it that was found in southern New Mexico.



6. This bowl has a red-on-buff bird design.

7. This plain brown jug with a corrugated neck was found in southern New Mexico.

8. What culture made this red-on-buff platter?

STUDENT WORKSHEET: WHO WERE THE PREHISTORIC SOUTHWEST PEOPLE

9. This is a set of two bowls and one pot. Each vessel has more than two colors.

10. This is a plain red bowl with no decorations on it. It was found in the Verde Valley.

11. This is a black-on-white mug found in the Verde Valley.

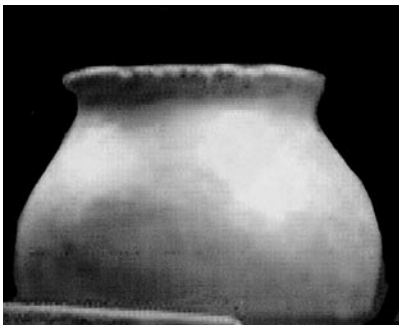
12. This black/white/red jar came from the White Mountains of Arizona.

13. This black-on-white bowl with a hole was found in southern New Mexico.

14. Here is a black-on-yellow bowl found at Tuzigoot National Monument, which has been dated after A.D. 1300.

15. This plain red mug was found in the Verde Valley.

16. This black-on-white jar came from the Colorado Plateau.



17. This plain brown jar came from Tuzigoot.

18. This black-on-yellow bowl was traded to Montezuma Castle.

Educator's Outline for

TO PLANT OR NOT TO PLANT

PROCEDURE: Distribute background information and questions from the following student worksheet. Give students 30 minutes to read the information and answer the questions, and then discuss the answers with the whole class.

OBJECTIVES

After completing this exercise the student will be able to

1. discuss the pros and cons of farming and hunting-gathering life styles.
2. discuss which life style is better suited for the development of a complex society.

GRADES: 4 to 8

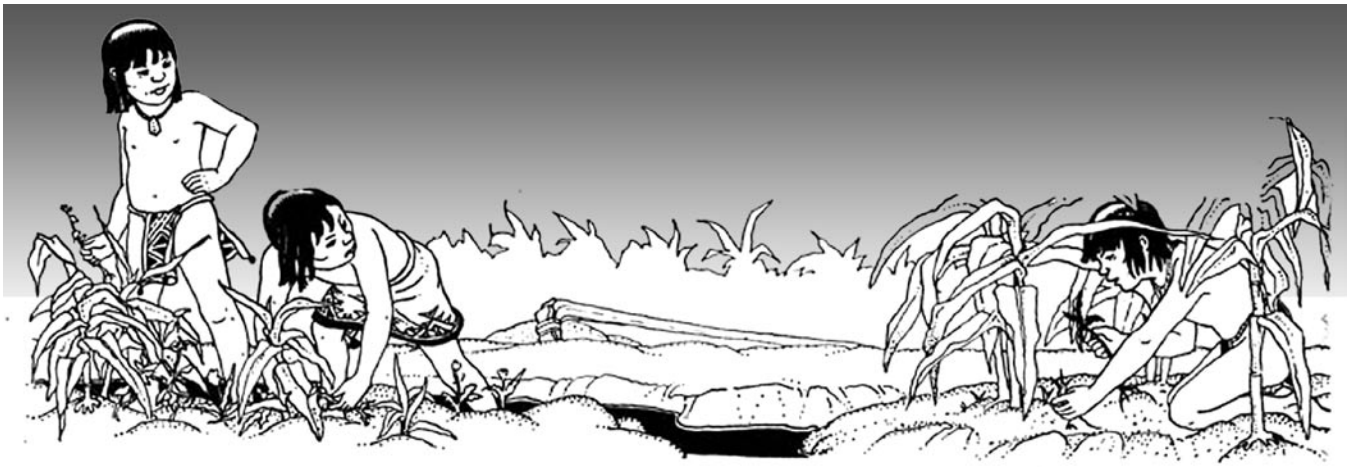
AZ CURRICULUM STANDARDS:
Technology Standard 5 — Technology research tools
Social Studies Standard 1 — History
Science Standard 4 – Life science

GROUP SIZE: 20 to 30

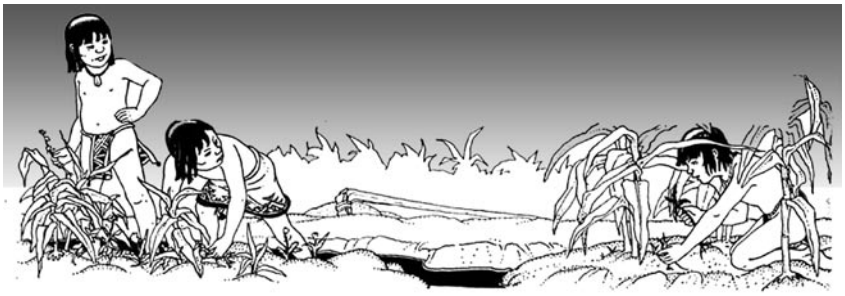
DURATION: 30 to 60 minutes

SETTING: Classroom, library or computer lab with Internet access

MATERIALS: Paper, pencil, and reference materials.



To Plant or Not to Plant



While the Sinagua and other Southwest cultures practiced agriculture, some Southwest cultures maintained a nomadic hunting-gathering life style, or a combination of hunting, gathering, and gardening life style. When the first Europeans came to the Verde Valley, the Yavapai and Apache were practicing a combination hunting, gathering, and gardening life style. Only a few hundred of them survived off the same land that thousands of Sinagua had subsisted on several hundred years before. Although both the Yavapai and Apache grew a little corn, beans, and squash in small gardens, they spent most of their time gathering wild plants and hunting animals. In order to collect plants that ripened seasonally, they moved around and in and out of the Verde Valley at different times of the year. They lived in brush huts that could be constructed quickly from materials close at hand. Although they did store some food in baskets in their huts or caves, they usually ate what was available and easy to carry back to camp. They usually lived in small family groups most of the year. Occasionally the whole band gathered to collect seasonal harvests of wild plants, animals, and crops. Healing, hunting, and war rituals performed by a shaman were important at family and band gatherings when they were not involved in food collecting. Raids on their enemies were another off-season pastime.

In contrast, the Hopi and other Pueblo peoples lived in stone villages of several hundred to several thousand. They spent most of their days planting, tending, or harvesting their crops. They also conducted communal hunts and gathering trips during the off-season. Ritual and elaborate ceremonies based around the agriculture cycle took up much of the rest of their time. Although they defended their villages against raids and occasionally waged formal war on other villages, most of their time was involved in agriculture and the village life that supported it.

QUESTIONS:

1. Why did some groups maintain a hunting-gathering existence, while most were mainly farmers?

2 .Which life style would require more work in order to survive?

3. Which life style would allow more spare time?

4. Would hunter-gatherers or farmers have a greater variety of food in their diet?

5. Which life style would be exposed to more risks?

6. Which would feel more secure about their food source?

7. Which life style would be more subject to periods of feast and famine?

8. Who would require larger groups in order to survive?

9. Which would be more mobile?

10. Which group would be required to stay in one location for longer periods of time?

11. Which group would tend to build permanent structures?

OBJECTIVES

After completing this exercise the student will be able to

1. discuss the differences and similarities between the Yavapai and Apache cultures.
2. discuss some cultural traits adopted by modern U.S. society from the different cultures of the Southwest.

GRADES: 3 to 8

AZ CURRICULUM STANDARDS:
Technology Standard 5 — Technology research tools
Language Arts Standard 1 — Reading
Social Studies Standard 3 – Geography

GROUP SIZE: 5 to 30

DURATION: 2 to 3 hours

SETTING: Library, classroom, or computer lab with Internet access

MATERIALS: Paper and pencil, and

Educator's Outline for

MODERN CULTURES OF THE VERDE VALLEY

SET-UP: This exercise can best be done in a library, or computer lab with internet access, or as home work , which is then discussed in class the following day. This exercise has two parts:

1. The origins of common items of the Southwest

2. The meaning and origins of common names we use today

PROCEDURE: Through interaction, many Southwestern cultures adopted methods and ideas from each other. In modern times, we have seen Native and African American cowboys, "Buffalo Soldiers" (African American soldiers); adobe homes; and many ethnic restaurants. Given a list of Southwestern items and names, have the students define them, and name what culture they first came from.

Modern Cultures of the Verde Valley

Yavapai

The Yavapai traditionally lived in thatch huts, and they were hunters and gatherers. They collected wild plants and hunted the wild animals of the area. They also planted crops, which they left unattended until they returned to harvest them. The Yavapai are related to the other Pai tribes of the Southwest. The Pai people followed the Colorado River and its tributaries north and east to northern Arizona. Eventually they diversified and became different tribes such as the Yavapai, the Hualapai, and the Havasupai of the Grand Canyon area.

Apache

The Apache have been traditionally nomadic to semi-nomadic hunting-gathering people. Some Apache bands did grow crops, too. Apache was a general name given to many groups of hunting-gathering people, whether Athabascan-or Yuman-speaking peoples. Today the term is usually applied to Athabascan-speaking cultures. It is believed that bands of Athabascan hunter-gatherers migrated south from Canada into the Southwest sometime between A.D. 1300 and 1500. These groups diversified and became the Navajo and the various Apache bands of today. Some were raiding societies, while others were quite peaceful.

Yavapai-Apache

It is not certain when the Yavapai and the Apache arrived in the Verde Valley. Some will say the Yavapai arrived soon after the Sinagua had left. Others will say the Yavapai were living here as friends alongside the Sinagua. Whatever, they were definitely living in the Verde Valley by A.D. 1583, when Spanish explorers recorded their presence. The Tonto Apache probably did not range into the Verde Valley before A.D. 1700. They were friendly with the already-established Yavapai, and intermarried with them. Since archeological sites of the Yavapai and Apache are not easy to find, date, or distinguish from each other or earlier Archaic sites, archeologists have not been able to date the Yavapai's or the Apache's arrival into the Verde Valley. Although the Yavapai and Apache were separate cultures speaking different languages, the U.S. military treated them as one tribe and forced both groups to move to the San Carlos Reservation. Later members of both tribes and mixed families returned to the Verde Valley and formed the Yavapai-Apache Nation of today. Some archeologists will say they arrived shortly before the Spanish in the 1500's. It is not certain when they arrived because both cultures lived lightly on the land. They did not make permanent structures or manipulate the land very much. Both generally constructed thatch huts. The Apache in particular traditionally were nomadic. These circumstances make their arrival very difficult to date.

Spanish and Mexican

Spanish explorers from New Mexico arrived in the Verde Valley in A.D. 1583. Here they found the Yavapai and Apache living peace-

fully. Spanish and other people from Mexico had been colonizing the Southwest since A.D. 1540. The Spanish dominated and allied with some tribes, and fought with others at various times. They established missions and presidios among the Pueblos and the O'odham (Pima and Papago). Although they colonized most of New Mexico and Southern Arizona, the Spanish only explored the Verde Valley several times. Spanish rule ended in 1821, when Mexico won its independence from Spain. The Spanish and the Mexican people brought a rich cultural tradition into the Southwest. They were generally deeply religious peoples. The Mexican people specialized in extensive farming and ranching operations throughout much of the Southwest. After the Mexican-American War and the Gadsen Purchase, the Southwest, including Native American and Mexican residents, became part of the United States of America. Then both Mexicans and Americans came to settle in the Verde Valley for the first time in the 1850s.

People of the U.S.

The first people of the U.S. who came into the Southwest were mountain men, who trapped furbearing animals and traded with native peoples after the Lewis and Clark expedition of 1804. After the treaty of Guadalupe Hidalgo, ending the Mexican-American war in 1848, many settled in the Southwest. Large numbers of prospectors passed through on their way to California during the Gold Rush of 1849. Later they returned to prospect for gold in Arizona, too. Mormons, the military, settlers, and immigrants came to settle the new territories. This led to many conflicts between the new settlers and peoples already here. Gradually the U.S. dominated the Southwest, but the people of the U.S. adopted much from the previous residents, which gives the modern Southwest a very distinctive flavor.

QUESTION: Where did it come from?

1. Tortilla
2. Pueblo
3. Horse
4. Chaps
5. Moccasins
6. Sombrero
7. Cowboy hat
8. Kokopelli
9. Katsina
10. Maize, or Corn
11. Cotton
12. Tomato
13. Potato
14. Chile pepper

QUESTION: What does the name mean? Where did these names come from?

1. Coyote
2. Arizona
3. California
4. Mexico
5. Colorado
6. Utah
7. Coconino
8. Lariat
9. Chaps
10. Coati
11. Metate
12. Mano
13. Yuma
14. Tucson
15. Mesa
16. Phoenix
17. Palo Verde
18. Mingus
19. Prescott
20. Sedona
21. Mesquite

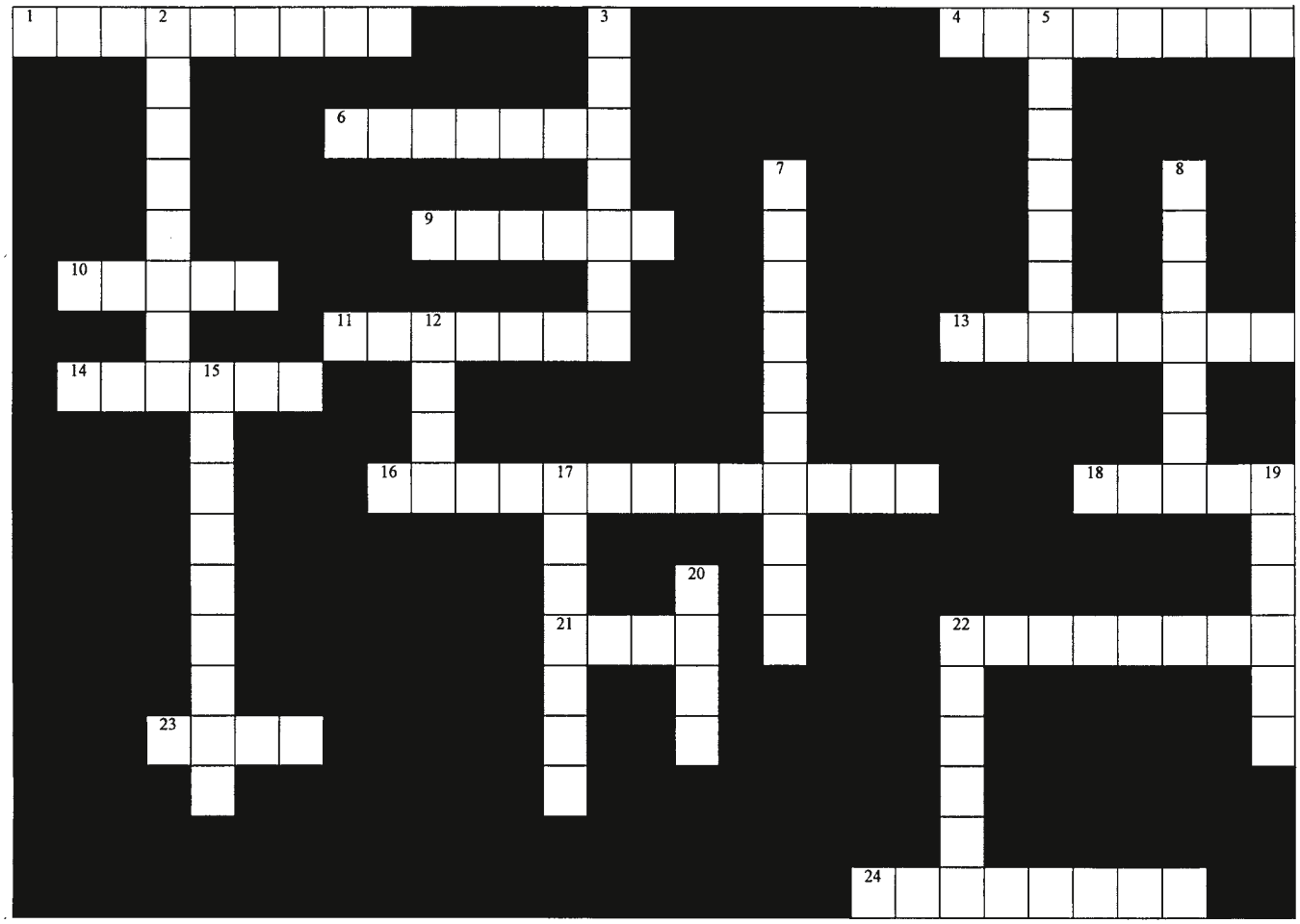
EXTRA CREDIT:

- The Apache word for people is "-nde'"
- The Yavapai word for people is "pai"
- The Navajo word for people is "dine'"
- The Hopi word for people is "senom"

Which two cultures are most closely related to each other?

Do you have any friends who speak a language other than English? Ask them how to say "How are you?" and "I am fine" in their language.

Archeology Crossword



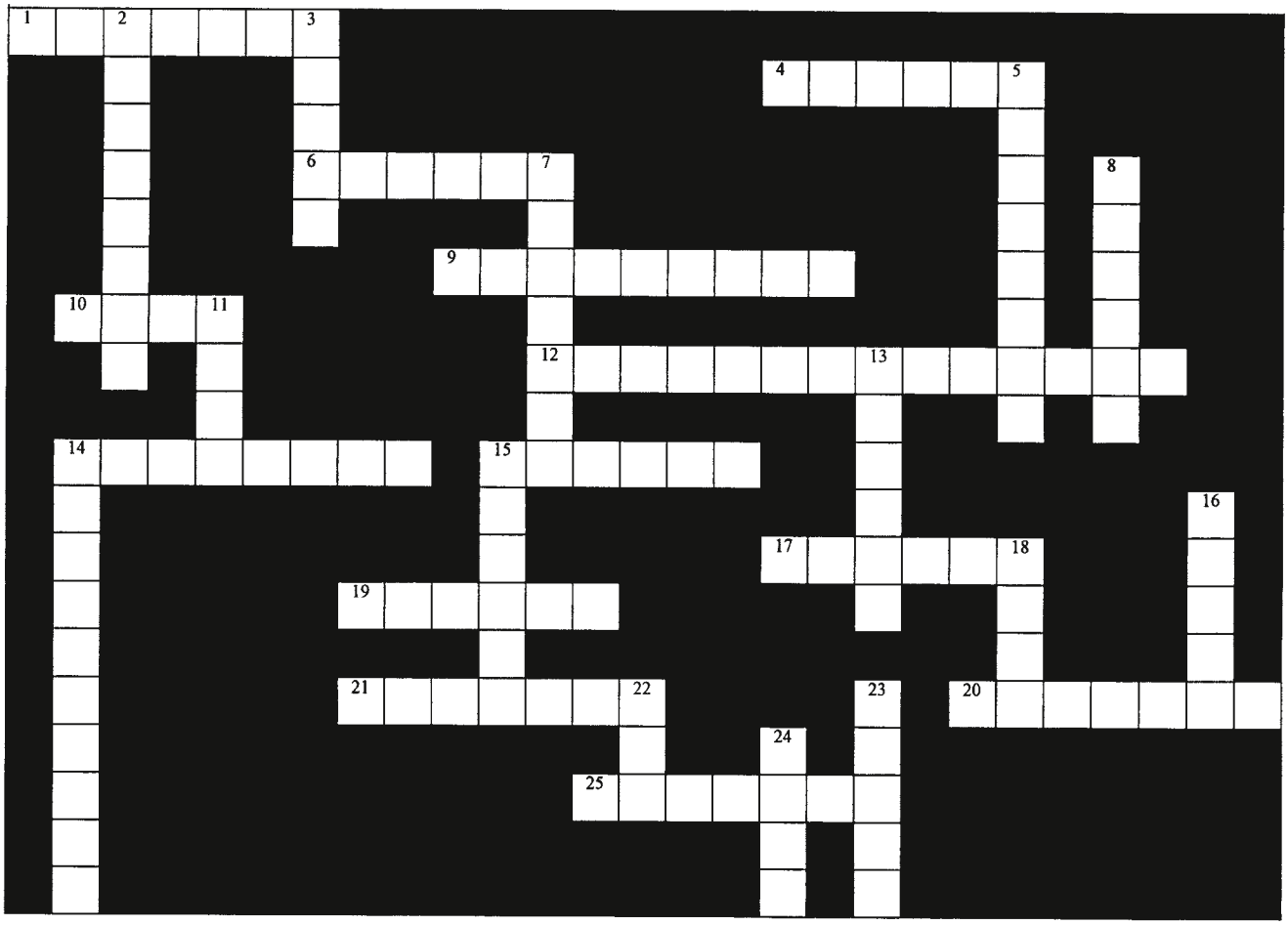
Across

1. Aztec king
4. Decorative wrist ornament
6. Place where ashes are found
9. Wooden climbing device
10. Implements used for work
11. Art made for wearing
13. Something old left behind
14. Stone, grinding bowl
16. Home in a cave
18. Ornamental neckwear
21. Grinding stone held in hand
22. Broken pieces of pottery
23. Hole in a stone cliff
24. Ancient chopping tool

Down

2. "Crooked water"
3. Baked clay containers
5. Very, very old
7. A design pecked into stone
8. People of the Verde Valley
12. Steadily flowing spring
15. Projectile point
17. Cultivating plants for food
19. Open footwear, woven
20. Food grown on a stalk
22. Stone house with many rooms

Ancient Sinagua Crossword



Across

1. Baked clay containers
4. Hunting projectiles
6. Prickly desert plant
9. Aztec king
10. Food grown on stalks
12. Small, bushy-tailed rodent
14. Broken piece of pottery
15. Wooden climbing device
17. Stone house with many rooms
19. Stone grinding bowl
20. Cultivating plants for food
21. Open footwear
25. Very, very old

Down

2. "Crooked water"
3. Long-leafed plant, used to make rope
5. Large, strong, thirsty tree
7. People of the Verde Valley
8. National park protector
11. Food produced by walnut trees
13. Container for carrying arrows
14. Design pecked into stone
15. Small, long-tailed reptile
16. Large black bird
17. Water jug, in Spanish
22. Ball of fire in the sky
23. Fluid, necessary for life
24. Natural flowing spring

Word Search

All of the following terms play an important role in the story of Montezuma Castle, Montezuma Well, and Tuzigoot. Try to find as many words as possible in the following word search. Words may be found up, down, across, at an angle, and backwards.

limestone	ladders	Sinagua	weaving
rock squirrel	Hohokam	metate	Tuzigoot
Montezuma	mano	Yucca	salt bush
mesquite	gray fox	irrigation	Arizona sycamore
snake	pottery	farming	lizard
corn			

R E L A D D E R S T N Q A S R I

O Y I R L K C M E S Q U I T E R

C R M I S O V S D N U K P L G R

K E E Z T A T D R A Z I L I H I

S T S O G E O I Q K X R Q Z O G

Q T T N N M O N T E Z U M A H A

U O O A I M G E P G G S N X O T

I P N S V N I Y C O R N O D K I

R F E Y A U Z J A E A F X E A O

R A T C E L U F T U Y C R S M N

E R L A W T T A F E G E C C L R

L M Y M N S T F R I H A T U I T

Y I O O K E N G S O R C N D Y L

T N B R M A N O L K S B V I R D

S G K E P G K H S U H T L A S E

Answers to Cultural History Section

ANSWERS TO "DIG THAT PAD":

1. The Rule of Superposition applies to these layers. Artifact E is older than artifact A. The bowl was deposited first. After many years, layers of dust and rock covered it up. After the layers of earth built up, the shell pendant was left on the floor of the younger room.

2. There was another room under the exposed room, because you can see the ends of roof beams sticking out of the layer.

3. The upper exposed room was probably a living quarters, because a fire pit was used there for cooking and warmth.

4. Archeologists can learn much from the fire pit by examining bone and plant fragments in the ash., They can determine what kinds of animals lived in the area, and which ones people were eating. Burned pieces can be radiocarbon dated, too.

5. The builders of this dwelling were probably members of an agricultural community, because usually only farmers would take the time and energy to build a house of stone that they lived in near their fields all the time.

6. Many things in the room can be used to date it. The roof beams can be tree ring dated. Animal and plant remains from the fire pit can be radiocarbon dated. A sample of the fire pit clay can be archaeomagnetically dated. Probably more than one of these would be done. If the dates gathered from all the dating methods were around the same time, then archeologists would be very sure when the room was built and lived in.

7. The shell pendant is made of seashells. The Gulf of California, the California Pacific coast, and the Gulf of Mexico are the nearest source for shells. These ancient people traded for shells from one or more of these distant places or traveled there to collect shells themselves.

8. Macaws are found in the rainforests of Mexico and South America. Like the shell pendant, the macaw skeleton tells us that these people traded/traveled far to the south.

ANSWERS "TREES OF TIME":

1. Tree A is older. It was cut down in A.D. 1286, while tree B was cut down in the A.D. 1300.

2. Tree B lived longer. It lived 38 years before it was cut down while tree A lived 36 years.

3. Tree A was cut down in A.D. 1286.

4. The pueblo roof that this beam was found in was probably also built in A.D. 1286.

5. Tree B was cut down in A.D. 1300, while tree A was cut down in the A.D. 1286. 1300 – 1286 = 14. Tree B was cut down 14 years later.

6. According to our calendar, the year A.D. 1300 was a wet year with abundant rainfall. The wide space between A.D. 1299 and 1300 tells us that there was much rainfall during that year. The tree was able to absorb more water, nutrients, and minerals. This allowed the tree to build more tissue in its stem, causing the space between the rings to be wider.

7. No. A.D. 1294 was within a severe drought that lasted about 23 years. Archeologists are sure of this because of tree ring dating. This is the only part of our calendar that is factual. The rest is hypothetical.

8. A.D. 1274 was probably a year with average rainfall. The early cultures probably had a sufficient harvest that year.

9. The years A.D. 1300 to 1303 were very wet years with abundant rainfall. Probably, major flooding was occurring near rivers. Structures that were situated near riv-

ers or on the lowlands were probably flooded out.

10. These were good years for planting crops, but the houses and the crops probably had to be situated away from water, because there may have been flooding. Crops near the rivers were probably washed away.

11. Yes. During this time of abundant rainfall, existing marshes were more extensive and new marshes probably formed in low areas.

12. Yes. Large, shallow standing bodies of water produce more plants and attract more waterfowl.

13. Our calendar shows at least four years before it ends.

14. Tree A germinated about A.D. 1250.

15. Tree B germinated about A.D. 1260.

16. Tree A germinated about A.D. 1250 and died in A.D. 1286. 1286 – 1250 = 36. Tree A lived 36 years.

17. Both tree A and tree B were burned in the year A.D. 1271.

18. This was a very wet year.

Some of the answers above are purely speculative, and could be wrong. But these are the kinds of clues that archeologists use to try to piece together the story of the past. Many times archeologists have little to go on, but dendrochronology is a science that can give them definite and precise numbers relating to spans of time between events.

ANSWERS FOR "WHAT DOES IT MEAN":

1. Anasazi is a Navajo, or Dine', term translated as "ancient enemy" or "ancient foreigners." When archeologists wanted to name this culture, they asked the Navajo people what they called the ancient people who had lived in the sites nearby. The Navajo, viewed them as strangers and called them "Anasazi." The Hopi, who consider the Anasazi their ancestors, prefer to call them Hisatsinom, which means "people of long ago."

2. Hohokam is a Pima or Akimel "'okham phrase meaning "those who have gone" or "all used up." Archeologists named the ancient farmers of the Arizona desert the Hohokam after excavating Snake Town with the help of Pima workers.

3. Sinagua is a Spanish phrase meaning "without water." Spanish explorers noticed that the San Francisco Peaks area did not have water, so they called the mountains, sierra sinagua. When archeologists discovered ancient sites in the Flagstaff area, they took the Spanish name given earlier to the peaks for this culture.

4. Salado is a Spanish word meaning "salty." The Salado culture was named after the Salt River in Arizona where these people had lived.

5. Mogollon: Juan Ignacio Flores Mogollon is the name of an early Spanish governor of New Mexico. His name was given to the Mogollon Rim, Mogollon Mountains, and ancient Mogollon culture. The Mogollon lived in the mountainous regions between the Mogollon Rim and the Mogollon Mountains and southeast into Chichuahua, Mexico.

6. Casa Grande is a Spanish word that means "big or grand house." It is the name given to a Hohokam structure near the Gila River by Spanish explorers.

7. Montezuma (Castle and Well): "Montezuma" actually refers to Moctezuma II, the last Aztec emperor. Settlers from the U.S. gave this name to Montezuma Castle and Montezuma Well because they believed that Montezuma and the Aztec people had once occupied this area.

8. Tuzigoot is an Apache phrase, which has been roughly translated as "crooked water." It refers to the oxbow with Pecks Lake, which is near the pueblo. When archeologists excavated Tuzigoot pueblo, they were looking for a name for

the site. An Apache worker named Ben Lewis suggested "Tuzigoot." The archeologists liked the name and used it for the pueblo.

9. Wupatki is a Hopi phrase translated as "long house." Archeologists adopted this Hopi name for the Anasazi/Sinagua sites of Wupatki National Monument north of Flagstaff.

10. Canyon de Chelley (de shay): "Canyon de Chelly" is a mispronunciation of the Navajo word, 'tsegi," which means "rock canyon." Although the Navajo considered this canyon to be the heart of their homeland, it was the location of many Anasazi cliff dwellings before the Navajo moved to the area.

11. Tonto: "Tonto" is a Spanish word that means "fool." The Spanish had given the name "Tonto" to a group of Apache west of the White Mountains. Early settlers adopted the name, and called the lands where the Tonto Apache had lived that, too, including Tonto Basin, Tonto National Forest, and Tonto National Monument.

12. Gila Cliff Dwellings: The cliff dwellings were named for the Gila River, whose headwaters are nearby. The Gila River was named by the Spanish and means "a steady going to and from a place."

ANSWERS TO "YOUR VISIT TO THE NATIONAL MONUMENTS":

1. "Tuzigoot" is an Apache phrase. It has been translated as "crooked water." It refers to Pecks Lake, which is less than a mile north of the monument.

2. When settlers first saw Montezuma Castle, they did not think the local Apache had built it. They thought the Aztecs had come north and built the cliff dwelling for their emperor Montezuma.

3. "Sinagua" is a Spanish term meaning "without water." Dr. Harold Colton, who first studied this culture, named it after the Spanish name for the San Francisco Peaks, sierra sinagua.

4. The villages were first constructed approximately in the 12th century. The dates are based on pottery cross-dating and tree ring dates.

5. The Sinagua left the Verde Valley around A.D. 1400.

6. Macaws are native to Mexico and South America.

7. The seashells originated from the Gulf of California or the Pacific coast.

8. A metate is a trough-shaped mortar used to grind corn.

9. A mano is the hand-held stone used to grind corn on the metate.

10. The Sinagua mined salt from large deposits outside the present town of Camp Verde and traded it throughout the valley and to other regions.

11. The Sinagua generally did not usually decorate their pottery. Once in a while they experimented with simple designs on their red or brown plainware, such as the one at Tuzigoot decorated with white lines.

12. All but one of the decorated types were traded into the region from other cultures.

13. Those fields are modern copper tailings, the refuse left from smelting copper. They have nothing to do with the ancient Sinagua or Tuzigoot.

14. The Sinagua cultivated corn/maize, beans, squash and cotton.

15. Most archeologists surmise that it was protection from animals, enemies and/or drafts.

16. The Sinagua may have had enemies, but little evidence of warfare has been found.

17. The Sinagua got their water from the Verde River and its tributaries, such as Beaver Creek, and from springs, such as Montezuma Well.

18. Many answers are possible. Examples would be banana yucca for rope and food, mesquite for flour and fuel,

desert willow for baskets and building material, etc.

19. Some examples could be an awl and a hairpin.

20. An axe head and a hand hoe are possible answers.

21. Many answers are possible. Archeologists have many theories, such as soil depletion, warfare, disease, drought, flooding, overuse of the environment, or a combination thereof.

22. Cotton, yucca, and bear grass may have been sources of fiber for twine string or rope.

23. Yes. It gets very cold here during the winter. During the summer they may have worn fewer clothes. Pieces of cotton clothing and blankets have been found at the monuments.

24. They probably made their clothes out of cotton, animal skins, bear grass, and yucca.

25. They made beads out of argillite, turquoise, and shell.

26. They ground the roughly shaped stone or shell on a harder stone, and drilled the holes using stone drill bits and a bow drill.

27. Many answers are possible here.

28. The answer is left to the imagination.

29. The answer is left to the imagination.

ANSWERS TO "WILL I SURVIVE":

WATER: There is no water. You need to acquire water in order to survive. Your best source is the prickly pear cactus. If the fruit is in season, you can cut, peel and eat it with your knife. Although there is not very much moisture in prickly pear cactus pads, you can cut up and mash the pulp of many pads to get a very refreshing juice. Depending on how long you are in the desert and how many prickly pear cacti are available, you should be able to get enough moisture to survive. If there are any areas where many plants are growing, such as a dry wash, there may be water underground that you can dig for. Another option is to construct a still. Dig a pit about one to two feet deep. Get cactus pads and crush them in the hole. Hang a plastic sheet over the hole and put a pebble in the middle of the plastic to make it sag. Put a cup or other container underneath the plastic where the pebble sits. The sun's heat will cause water from the cactus and the dew to evaporate and condense on the plastic. Droplets will roll down the plastic and drip into the cup over night. When the cactus seems dry, cut more and crush them in the hole.

FOOD: Again, you can eat the prickly pear fruit and pads. They will not only provide water but also sugar for energy. If you can make a fire with the matches, you can also cook the cactus pads until they are tender. If the stems of the agave are green, you can also cook that and eat them. Salt bush leaves can be added to the agave or prickly pear pads to add seasoning and replace salt. Many other plants are probably available to eat, but you should not try them unless you know they are safe.

Don't use your flare to start a fire, you need that to signal a plane that may come looking for you.

Eat only foods that have some moisture in them, and that do not require much exertion to collect and process. The human body uses water to digest and process food. Because digestion and exertion will dehydrate you, eat only if you have enough water available. A person can go many days without food while sitting in one place, but only four days without water.

SHELTER: At 120 degrees Fahrenheit, your body will lose lots of water through perspiration. You can find a shady spot near the plane or build a lean-to with rocks and branches to create shade. You can use the parachute to make a small

tent for shade and to keep the moisture of your sweat close to your skin. This may reduce the amount of water evaporating from your body. You can use the agave poles or part of the plane to suspend the parachute. Besides shelter, the opened parachute may be easily spotted by passing aircraft.

STRATEGY: Sit in that one location. If you try to travel on foot in 120-degree weather, without water, you will probably die. Help will probably arrive to look for the plane in a few days. If they find the plane and you are not there, they may not find you if you are hurt or dying miles away. Tracking dogs do not work in extreme heat.

Don't use the flare, except to signal a low-flying plane. An airliner or other high-flying aircraft will not see the flare.

The open parachute can be easily spotted from the sky.

You have a gun with six bullets. Don't use those bullets unless absolutely necessary. Three shots in a row—or three of anything—is a universal signal of distress: it is a simple SOS signal. Use the first three shots only if you are injured and in need of medical attention or if you hear or see people or vehicles far away.

ANSWERS TO THE REAL NATURAL FOOD AND SUPPLY MARKET

Name the plant and possible ways it could have been used:

1. Prickly pear cactus: The prickly pear fruit is edible. It is sweet and pulpy, and a good source of energy and moisture. The new pads can be skinned, diced, and boiled. This is a common dish for many cultural groups in the Southwest. The pads can also be used as medicine to reduce swelling or inflammation.

2. Mesquite: The mesquite is in the bean family *leguminosae.* The pods can be cut like green beans and boiled, or they can be ground into a meal, which can be eaten raw, baked into bread, or made into porridge. This meal is high in protein, and could be dried into cakes that were stored for the winter.

3. Bear grass: Bear grass can be used as fiber for basket weaving, or even making a soft fabric.

4. Banana Yucca: Banana yucca leaves can be stripped into fiber to make string, rope, baskets, sandals, or mats. The pointed end of the leaf can be used as a needle or chewed to form a paintbrush. The fruits are good raw or cooked. Roots of this and all yuccas can be made into soap and shampoo.

5. Agave: The agave, also known as century plant, maguey, or mescal, can be used in many different ways. The seeds can be ground into flour. The blossoms are edible. The stalk can be chopped, and the sections boiled and eaten. The hearts of the plant can be cut out and roasted into a nutritious meal. The fibers of this plant are also tough and can be used for making rope or woven into sandals.

6. Cattails: The cattail is a marsh plant. The new shoots are edible. It tastes like cauliflower and smells like licorice. The roots are starchy and can be boiled like potatoes. The new seed heads can be boiled and eaten like corn on the cob. The mature seed heads can be used as insulation for pillows or blankets.

7. Bulrush: The roots of the bulrush can be boiled and eaten. The hollow stems can be bound together to make a boat.

8. Willow: Willow branches can be used as building material. The pliable limbs can be used for basket weaving. The leaves can be used as medicine for headaches.

9. Arizona cypress: The branches of this tree can be used as building material. It also produces a sticky sap

that can be used as a strong adhesive.

10. Gambel oak: The acorns of this tree are edible but need to be ground into a meal; and then the meal is leached with water for several days to a month to draw out the tannic acid. This meal can then be made into a mush or bread.

ANSWERS TO "AGRICULTURE":

1. They probably used the same ingredients that were used in class, but juniper or salt bush ashes may have been added for leaven, and the bread heated on stone griddles.

2. They may have carried water from the creek or river, dug irrigation ditches, or diverted runoff with check dams.

3. They may have had to watch their fields all the time to chase animals away.

4. If they had stored enough corn from the previous year, they may have lived on that. If not, they may have lived on their other crops and the animals and plants they had hunted and gathered. Yet it would have been difficult for them to have made up for the lost corn crop by hunting and gathering, because they would not have time to hunt and gather many more wild plants and animals. Otherwise, they could have traded with their neighbors or moved in with them.

5. This answer will vary.

6. Many answers are possible here, such as corn on the cob, corn tortillas, corn flakes, nachos, corn dogs, popcorn, cornbread, corn mush, corn fritters, corn chowder, corn soup, corn chips.

7. No, not unless someone stays behind with the crops. They needed to be tended, watered, and protected from animals or enemies.

8. In general, the more helpers, the better attention and protection the crops had. Small families would have had a hard time tending the crops alone.

9. Farming allows large groups of people to live in one place together, because enough food can be grown and stored to feed them from year to year. Eventually, some farmers grew more than they needed, and could feed people who do other things besides farming, such as crafts, religion, and politics. Some farming societies with specialists may eventually become civilizations.

10. This answer will vary, since corn ear sizes vary. Add the weight of the kernels from each shelled ear to each other until they equal or are greater than the weight of one cup of cornmeal. The number of ears you used is the answer.

11. Divide the answer to #10 by 3 to find out how many plants would feed a person for one day. Then multiply that answer by 365. This is the number of corn plants it would take to feed one person per year.

ANSWERS TO "PITHOUSE TO PUEBLO" :

1. The earth around the sunken floor acts as insulation. It will keep the house warmer in the cold, and cooler in the heat. Also, fewer building materials are needed.

2. A pueblo could last hundreds of years with repairs, while a pithouse often caught fire or deteriorated from insects and other natural causes after only 15 to 20 years.

3. Some archeologists believe that having no door was a form of defense against people or animals. It may also have been to reduce drafts and to maintain the insulation properties of the thick stone-and-mud walls. The pueblo room would have been similar to a basement, cave, or ancestral pithouse.

4. Caves are naturally insulated shelters. They are cooler in the summer and warmer in the winter. Also they are a safe, dry place to store food.

If someone builds in a cave, they do not have to build all the walls, since the cave walls are already there.

5. Although we do not know for sure, they may have done so, because pueblos are more durable, hold more people in less space, and provide protected storage for crops.

EXTRA CREDIT ANSWER:

Many answers are possible. Archeologists have proposed many theories based on what they have recovered from excavations. Yet they continue to revise theories as they find new evidence. One of the newer theories states that the Sinagua left in the 15th century, because they could not sustain the large immigrant population that had come to the Verde Valley after the "Great Drought" of the 13th century. Famine, disease, and warfare resulted after decades of high flooding interspersed with drought. The remaining population gradually left to go to other places where they could continue a similar life style.

ANSWERS TO "TRADE" :

1. The Sinagua may have traded many different things for decorated pottery, such as salt, minerals for paint and dye, cotton, and shell, turquoise, and/or argillite jewelry.

2. Sea shells were traded from the Gulf of California.

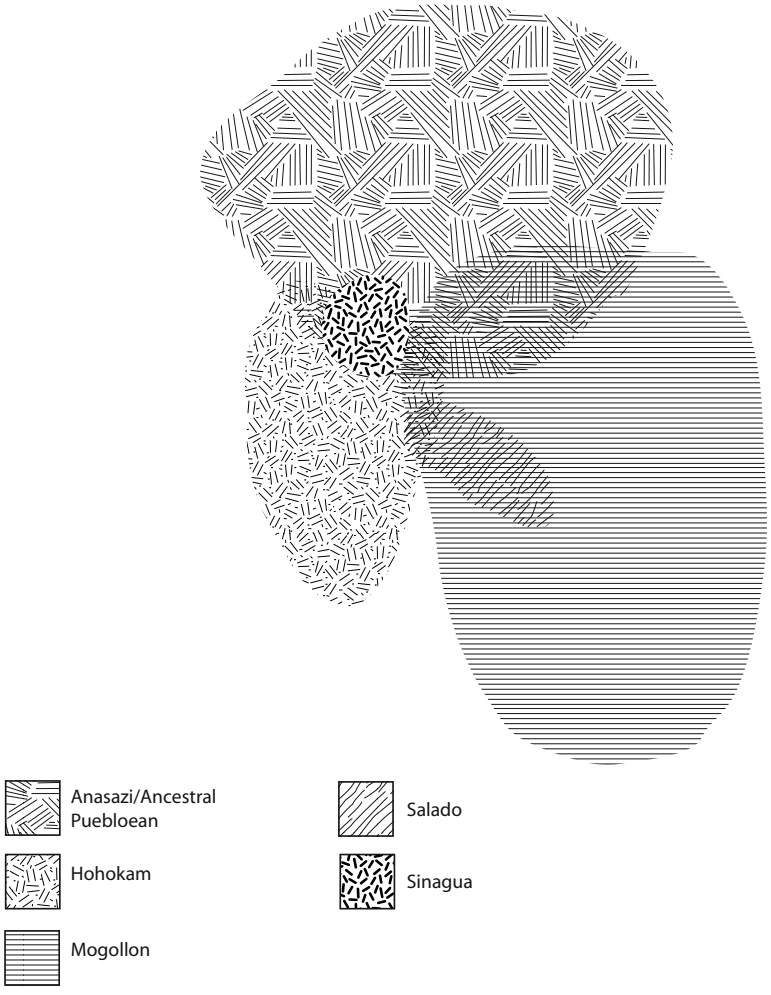
3. Macaws are found naturally in the rainforests of Mexico and South America. This shows that the Sinagua had trade connections at least as far south as Mexico. Remember that all travel back then was done on foot!

4. One side of the Big Dipper points to Polaris, the North Star. The North Star always points to true north. If you are facing north, east will be to your right, west to the left and south will be behind you.

5. The sun always rises on the eastern horizon and sets in the west. If your right hand is pointed toward the sun rise, that would be east and your left would be west. You will be facing north. South will be behind you.

ANSWERS TO "WHO WERE THE PREHISTORIC SOUTHWEST PEOPLE?" :

EXERCISE 1: Following is a map with the regions that the Southwest cultures inhabited.



EXERCISE 2:

1. Anasazi or Ancestral Pueblo
2. Anasazi or Ancestral Pueblo
3. Salado
4. Hohokam
5. Mimbres of the Mogollon
6. Hohokam
7. Mogollon
8. Hohokam
9. Salado
10. Sinagua
11. Ancestral Pueblo or Anasazi traded to the Sinagua
12. Mogollon
13. Mimbres of the Mogollon
14. Hisatsinom or ancestral Hopi, traded to the Sinagua
15. Sinagua
16. Ancestral Pueblo or Anasazi
17. Sinagua
18. Hisatsinom, or Ancestral Hopi, traded to the Sinagua

ANSWERS TO "TO PLANT OR NOT TO PLANT" :

1. Although there is no definitive answer, archeologist often look at an environment's resources and changes in environment over time. For instance, after environmental changes in the 13th and 14th centuries, large populations of farmers decreased or were replaced in many areas by hunter-gathers or combination gardeners and hunter-gatherers such as when the Yavapai and Apache replaced the Sinagua.
2. Anthropologists have found that usually farmers need to work almost all the time tending, tilling, harvesting, and guarding their crops in order to survive.
3. Anthropologists have found that usually hunting-gathering bands all over the world have more spare time than any other life style. The work comes in spurts of high-energy consumption followed by long periods of idleness.
4. Due to the diversity of the natural environment, hunter-gatherers have usually had a more varied diet. Agricultural communities tend to concentrate their diet on one or several staples.
5. Because most hunter-gatherers are nomadic to seminomadic, they are exposed to more dangers in terms of enemies, competitors, and natural hazards.
6. Because farmers would be able to see their crops in front of them, they may believe the illusion that their food supply is under their control, while in actuality it is still subject to the fluctuations of the weather. Yet they developed strategies to maintain their food supply, such as multiple farming techniques, storage of food surpluses, trade, migration, and raiding.
7. Hunter-gatherers would be more subject to periods of feast and famine, but they moved more frequently to find other food sources.
8. In general, agriculture requires larger families or groups in order to tend and protect the crops. In general, hunting- gathering bands tend to be composed of small groups of several families, because it takes a variety of resources collected from a large area of land to feed just one person.
9. Hunter-gatherers are more mobile. They are not tied to one place, but rather range over a large territory. They will go where the food and resources are most abundant. Hunter-gatherers readily adapt to the conditions of their environment.
10. Of course, farmers would be required to settle in one location for long periods in order to tend and protect their crops.
11. Agricultural communities tend to build permanent structures. In contrast, hunting-gathering bands tend to build temporary shelters.

ANSWERS TO "MODERN CULTURES OF THE VERDE VALLEY" :

1. Tortillas: Are a flat, unleavened bread. Ancient Mexican people first made them after they domesticated maize. After the Spanish introduced wheat into Mexico, Mexicans made tortillas out of wheat flour, too.

2. Pueblo house: The Anasazi, or Ancestral Pueblo, cultures first utilized this type of communal construction in the Southwest. Later, other cultures such as the Spanish and Americans copied this style.

3. Horse: Modern horses were introduced into the southwest by the Spanish, who brought them by ship to Mexico. Spanish and Mexican explorers and colonists brought horses and other livestock into the regions north of the Rio Grande from Mexico.

4. Chaps: Because the deserts of the Southwest were covered with brush and sharp, piercing plants, Spanish and Mexican vaqueros, or cowboys, developed leather leggings to protect their legs while herding livestock.

5. Moccasins: Many native cultures had their own style of soft hide footwear for walking and hunting. Moccasins may have been introduced into the Southwest by the early nomadic cultures, such as PaleoIndian or Archaic, thousands of years ago.

6. Sombrero: This broad-brimmed, high-crowned hat was worn in Spain and first introduced into the Southwest by the Spanish.

7. Cowboy hat: Although many styles of hats were worn by American cowboys, one known as the Stetson was specifically designed for the Western outdoors by John B. Stetson in 1865.

8. Kokopelli: The character of the hump backed flute player has been portrayed in Native American art throughout the Southwest. Some researchers believe that the character was a trader who traveled among the pueblos. Legend says that he was very popular with the maidens. This character has become a popular icon of the modern Southwest.

9. Katsina: To the Hopi, katsina are spirits that come down from the San Francisco Peaks to the Hopi villages to bring rain and bountiful blessings to the earth and the people. Portrayals of katsina have been found on kiva murals and pottery made by the hisatsinom as long ago as the 13th century.

10. Corn: Maize, or corn, was first domesticated from a wild grass by the ancient cultures of Mexico between 4000 and 3400 B.C. The ancient Mexicans produced many different varieties and colors. Through trade, this crop was adopted throughout the Southwest and everywhere else it could be grown in the American continents. Other Native Americans developed other varieties, too.

11. Cotton: Cotton was first domesticated from a wild cotton plant by the ancient cultures of Mexico about 5000 B.C.. Legend tells that the Toltecs were able to produce cotton in many different colors. Many ancient cultures throughout the Southwest learned to cultivate and weave cotton. In the Southwest, at least three different varieties of native cotton were developed by the Pima and Hopi or their ancestors. North American cotton is different from both Egyptian and South American cotton, although they are related species.

12. Tomato: Tomatoes were domesticated from wild cherry-sized berries in ancient Mexico. Eventually this crop was cultivated by many cultures throughout the American continents. The Spanish spread them throughout the world.

13. Potato: Although wild varieties of potato grow throughout much of the Americas, ancient peoples of the Andes domesticated it. Then the Spanish intro-

duced it to North America and the rest of the world.

14. Chile pepper: Chile peppers were domesticated from very small wild chiles in tropical America. Many different varieties of chile were developed and grown by many native cultures all over Mexico and Central and South America. At this time, it not certain if chiles came into the Southwest before the Spanish and Mexicans come north from Mexico.

ANSWERS: What's in a name?

1. Coyote: The Spanish borrowed the Aztec word "Coyotl" from the Nahuatl language.

2. Arizona: It comes from the name given to a Saric mission, in what is now Pima County, known as the Arizonac. It is derived from the Tohono O'odham words "ali shonak" or "place of the small spring." The Spanish borrowed the phrase and modified it to "Arizona."

3. California: This name came from the old Spanish novel "Las Sergias de Esplandian," by Garcia Ordanez de Montalvo, published in the year 1500. In this story is an island called California. Hernando Cortez knew this story and named the Pacific region north of the Rio Grande "Alta California," meaning "upper California."

4. Mexico: This name came from the Aztecs. When the Aztec people settled in the region that is now central Mexico, they changed their name to Mexica (pronounced "meshica"). Later, the Spanish and Mexican people named all their territory above Central America "Mexico."

5. Colorado: It is the Spanish word meaning "red."

6. Utah: It is a Spanish pronunciation of the Ute tribe.

7. Coconino: This is an assimilation of the term "cojnino" which is Lt. Sitgreaves' understanding of the Hopi name for the Havasupai and the Yavapai. Many places in northern Arizona bear this name.

8. Lariat: This word for a rope used to lasso cattle is derived from the Spanish "la riata," which means "the rope."

9. Chaps: The name for these leather leggings is short for the Spanish word "chaparajos."

10. Coati: Portuguese name for the animal coatimundi, which was borrowed from the Tupi language.

11. Metate': It is the Nahuatl word for the grinding stone used to grind maize.

12. Mano: It is the Spanish word means "hand," used for the hand-held grinding stone used with a metate.

13. Yuma: This name is from the Spanish word "humo" which means "smoke." The Spanish noticed that this tribe made many fires in the belief that it would cause rain. Thus they named the Yuma tribe. Later, the county and city were named after the tribe.

14. Tucson: It is derived from the Tohono O'odham phrase "chuk shon" which means "black base" and refers to Sentinel Mountain.

15. Mesa: It is the Spanish word for "table." It refers to flat-topped landforms.

16. Phoenix: The name for the capitol city of Arizona comes from a Greek myth. The phoenix was a mythical bird that lived in the desert lands of Arabia. When it died, it would be reborn from the ashes of its funeral pyre.

17. Palo verde: It is the Spanish name for a desert tree, which means "green trunk or stick."

18. Mingus: Mingus Mountain near Cottonwood, Arizona, was named after a miner named William Mingus, who lived and owned a mine on the mountain (1851 – 1911).

19. Prescott: In 1864, the citizens of this town named it after William Hickling Prescott (1796 – 1859), a historian from the eastern United States, who wrote

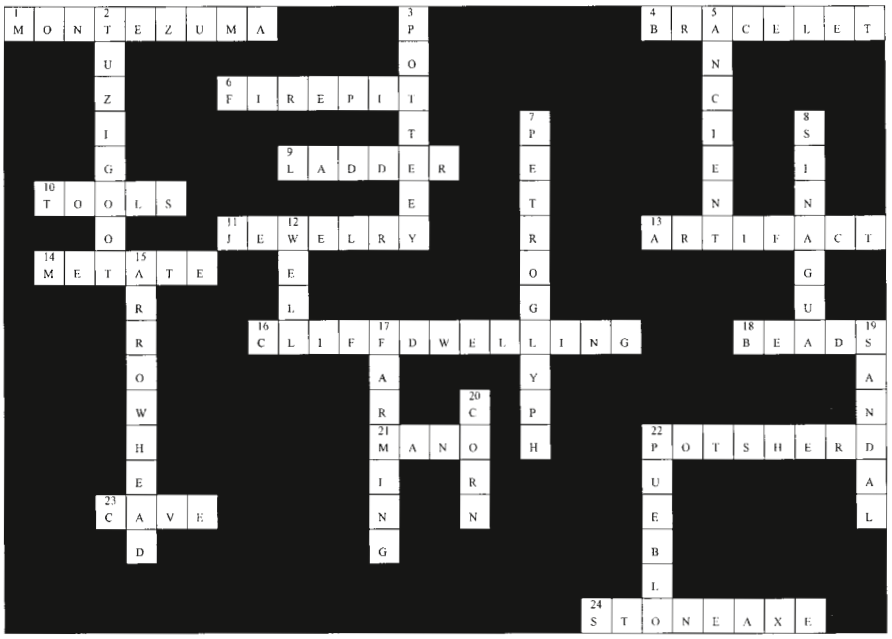
about the Aztecs and translated Spanish literature, including a journal of the "Conquest of the Aztecs."

20. Sedona: This town is named after Sedona Schnebly, who was the wife of Theodore Schnebly. In 1901, he applied for the first post office there, but the name he chose was too long. His brother suggested using Sedona, which the U.S. Postal Service accepted for the name of the town.

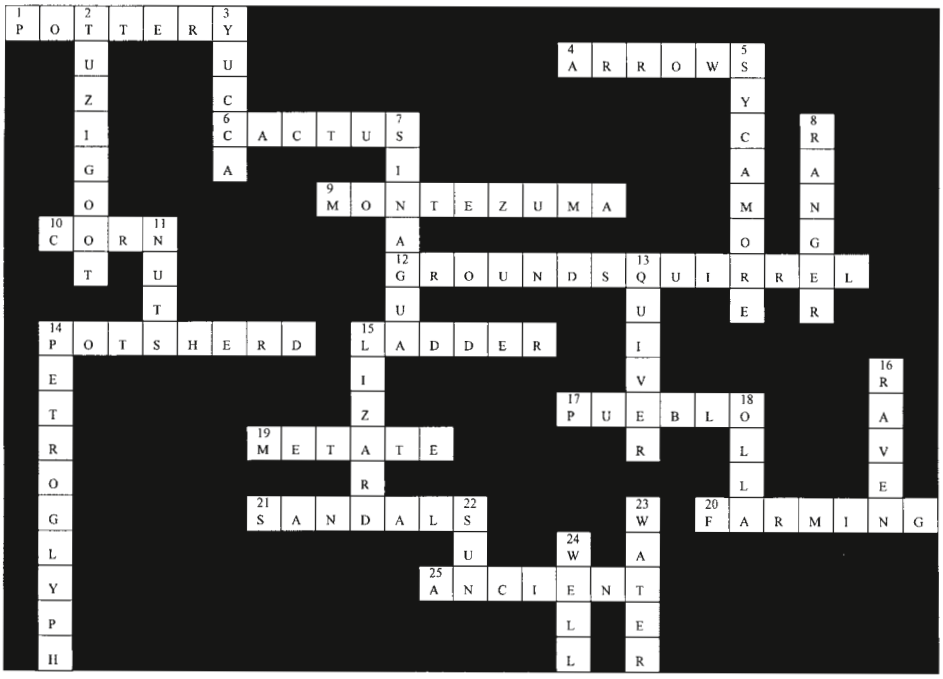
21. Mesquite: The Spanish name for this bean tree is derived from the Nahuatl word "mizquitl."

EXTRA CREDIT: The Apache and the Navajo languages are from Athapascan language family. These two cultures are more closely related to each other than to any of the others listed. That is why their words sometimes sound similar.

ARCHEOLOGY CROSSWORD SOLUTION



ANCIENT SINAGUA CROSSWORD SOLUTION



NATURAL HISTORY

Activities

Background on Natural History

Below the massive escarpment of the Mogollon Rim of Arizona, the land tumbles down to the desert through spectacular canyons and sweeping valleys. One of these valleys is bisected by a beautiful flowing river named after the Spanish word for "green" – the Verde River.

The Verde River starts from forested pine-clad slopes along the Rim and flows southward to join the Salt River through over 150 miles of flat grasslands, lush floodplains, and rolling canyons, mesas, and desert. With elevations ranging from 6,000 feet on top of the Rim to 3,000 feet at the river, the Verde Valley is an immense biological transition zone between the desert lands to the south and the pine flats to the north.

Biologically, the Verde Valley is an ecozone, or zone of contact between two major life zones: the Lower Sonoran to the south and the Arizona Uplands to the north. Here plants from the two zones meet and intermingle, attracting birds and small animals in their search for food. This intermingling of plants and animals in a relatively small area creates a rich diversity of life that influenced human occupation of this valley for hundreds of years.

The Lower Sonoran life zone includes the area of grasslands and riparian areas below the Mogollon Rim. They offer a different variety of plants and animals, including rabbits, porcupine, raccoon, skunk, ground squirrel, antelope, fish, beaver, and fox. Some common plants include the creosote bush, mesquite, cactus, rice grass, hackberry, and walnut. Cottonwoods, sycamore, willow, and ash flourish along the streams and washes of the riparian habitats of the valley, along with a variety of bird life, including threatened and endangered species such as bald eagles, and the Southwest Willow Flycatcher.

The Upper Sonoran life zone includes the area along the Mogollon Rim and its foothills. It consists primarily of pinyon-and-juniper forest and contains a wealth of wild plant and animal resources, including deer, elk, mountain sheep, agave, yucca, pinyon nuts, oak, and prickly pear.

The rich variety of plant and animal life found in the Verde Valley creates a reservoir of biological diversity. There are over 167 species of plants representing 49 families at Montezuma Castle National Monument. This diversity of inhabitants is critical to protecting and preserving the wealth of life found in the Verde Valley. Without biological diversity the valley would be far less able to sustain the population of animals and plants that we have today.

The following natural history activities will focus on getting students to understand and appreciate complicated natural systems. Several critical ecological issues threaten our local and global environment: acid rain, ozone depletion, overpopulation, air and water pollution all threaten our future on this planet. Education is the key to our survival.

The theme of biological diversity and the unique riparian habitat found at both Montezuma Castle National Monument and Tuzigoot National Monument will be highlighted. Concepts of habitat, niche, adaptation, ecosystem, overpopulation, and the reality of extinction will be explored. The activities will provide students with the opportunity to investigate the complexity of human interactions with nature through a combination of classroom and park activities stressing a "hands-on" approach to learning.

The material on biological diversity was taken from the National Park Service Biological Diversity Program. All activities are linked to Arizona State curriculum standards.

Natural History: Geology

Geology of Montezuma Castle

The Verde Valley geology is quite a bit different from that of the rest of northern Arizona. The biggest difference can be seen in the Verde limestone. This is the pale to white stone that you see at Montezuma Castle. In a cave in the Verde limestone is where the Sinagua built Montezuma Castle. The Sinaguans lived in these dwellings from about A.D. 1125 to 1425, about 875 to 575 years ago.

There are three basic types of rocks: igneous, sedimentary, and metamorphic.

1. Igneous rock is formed either when magma cools below the ground surface or when magma forces its way to the surface (as lava) and then cools to form rocks. One example of an igneous rock is granite.

2. Sedimentary rock is the type of rock that you see all around you at Montezuma Castle. Sedimentary rock is formed by the wearing away and removal of other rocks. The eroded rock gets transported by water or wind to lakes and oceans; this rock debris and other organic debris from plants settle to the bottom of the lakes and oceans and eventually turn into a rock layer.

3. Metamorphic rocks form far under the earth's surface. These rocks are created when other rocks get buried under a lot of other layers of rock. Eventually, the rock that got buried is changed into a different type of rock. This is because the more material that builds up over the buried rock, the more heat and pressure there is to squish and change the buried rock into something new. Remember, metamorphosis means "to change or alter form."

The white Verde limestone that forms the cliffs you see at Montezuma Castle is a sedimentary rock. It started to form about eight million years ago. That was when a volcanic eruption dammed the Verde River at the southern part of the Verde Valley, where it left the valley. For the next six million years, the Verde River was backed up, and because the water had nowhere to go, numerous swamps and lakes formed. (Compare that to the desert you see today!) Rivers were coming in from northern Arizona to keep the lakes filled. These rivers were full of debris from other rocks up north; this debris and other plant debris settled to the bottom of the lakes. About two million years ago, the natural lava dam finally broke because the lake had gotten so big and had eroded so much of the dam that it was not strong enough to hold back all that water anymore. The lakebeds eventually dried out, and all the debris turned into sedimentary rock. Today we call that rock the Verde limestone, the same rock that the Sinagua built their homes in.

Geology of Montezuma Well

Montezuma Well is another place in the Verde Valley where the Sinagua lived. The same white Verde limestone

that is found at the Castle is also found at the Well. When you climb up to the main overlook at Montezuma Well, make sure you look to your left. You will see a cave in the Verde limestone where the Sinagua built their homes.

The Well is a limestone sinkhole that was formed in the Verde limestone. It was created about 10,000 years ago when the roof of a large underground cavern collapsed. There is a natural spring underneath the lake that brings 1.5 million gallons of water into the Well everyday. If so much water is coming into the Well, then why doesn't it fill up and spill over with water? The answer is that there is a hole in the Well. If you follow the trail down into the Well, you will come to a big cave. By this cave the water goes underground and escapes from the Well. Incredibly, the amount of water coming into the Well and the water leaving the Well are just about equal. Therefore, the level of the Well always stays the same.

Red Rock Country

The northern part of the Verde Valley is often referred to as "Red Rock Country" because as you look around the landscape, most of the rocks are red. The red rocks have been sculpted by millions of years of erosion, which is the wearing away and movement of rocks by wind and water. They now stand as spectacular rock formation: the mesas, buttes, and pinnacles of the Sedona area. Why are the rocks red? These rocks are red because they were formed in an environment similar to seashores in a desert. There was lots of water, and that means lots of oxygen. There were also other rocks in the area that contained the metal iron. When you mix together the iron and the oxygen, you get a metal that scientists call hematite. When enough hematite is present in the soil, it turns the rocks red. Have you ever seen what rust looks like? It's the same idea. When you leave things that have iron in them outside in the rain for a long time, the oxygen in the water reacts with the iron and turns the metal red, or "rusts" it.

The people who built Montezuma Castle and other Southwestern cultures used the mineral hematite as a pigment. When you crush hematite you get a reddish powder that can be mixed into paint. Prehistoric people used this paint to color objects like baskets and pottery. More recent groups have also used it as body paint or for other skin decoration.

Educator's Outline for

IS IT LIMESTONE?

OBJECTIVES

After completing this exercise the student will be able to

1. determine if a rock is limestone by discovering the presence of calcium carbonate.
2. learn how limestone is formed in a natural environment.

GRADES: 5 TO 8

AZ CURRICULUM STANDARDS:
Science Standard 1 – Science as inquiry
Science Standard 6 – Earth and space science
Language Arts Standard 3 – Listening and speaking

GROUP SIZE: 5 to 30

DURATION: 1 hour

SETTING: classroom

MATERIALS: household vinegar, eye-dropper, samples of limestone and basalt

PROCEDURE:

1. Divide students into small groups. Have enough vinegar, eye-droppers, and rock samples for each group.
2. Have one student in the group dip the eyedropper into the vinegar, and then drop a small amount on the limestone rock. Have the students watch carefully and record any observations. Now have another student drop a small amount of vinegar on a basalt rock, while the others watch and record their observations.
3. Ask the students to discuss with their groups the results of each test. Why did the vinegar bubble on one of the rocks and not the other?

Limestone is deposited by water — in this case by an ancient lake in the Verde Valley.

Through photosynthetic activity of plants, carbon dioxide was removed from the water, causing the precipitation of lime, (calcium carbonate) which deposited on the bottom of the lake. The sedimentary material became limestone. When an acid is placed on the surface of a rock that contains calcium carbonate, the carbonate gas is released and can been seen as bubbles on the rock. Limestone is a very common rock in the Verde Valley.

Montezuma Castle was built in an alcove carved by weathering in the Verde limestone. Montezuma Well was made when a cavern in a limestone mound collapsed, forming a sinkhole around a natural spring. The many pockets and holes in the limestone were weathered out by slightly acidic water. When atmospheric carbon dioxide and organic material are diluted in water, it creates a weak acid called carbonic acid. This acid dissolves the limestone and carries the lime in solution. It is re-deposited farther downstream along the irrigation ditches, resembling concrete.

OBJECTIVES

After completing this exercise the student will be able to

1. understand what an evaporate is and how it is produced
2. appreciate the importance of salt as a trade item.

GRADES: 5 TO 8

AZ CURRICULUM STANDARDS:
Science Standard 1 – Science as inquiry
Science Standard 5 – Physical Science
Science Standard 6 – Earth and space science

GROUP SIZE: 5 to 30

DURATION: 1 hour

SETTING: classroom

MATERIALS: salt, water, clear dish

Educator's Outline for

EVAPORATES

PROCEDURE:

1. Divide the students into small groups. Each group should be supplied with a clear dish, warm water, and table or Epsom salt.

2. First, have the students add the salt to the warm water. What happens to the salt? Next, pour the salty water into a clear, shallow dish. Set the dish in a sunny place until all the water evaporates. What does the dish look like? What is left in the dish?

Salt has been mined in the Verde Valley near Camp Verde both prehistorically and historically. Mineral salts are left behind when a body of water without an outlet evaporates. There are many basins in the West that contain very salty water or dried beds of mineral salts called playas. The Sinagua mined salt. They traded it, possibly for pottery or shells. Salt has been an important trade item for many cultures around the world.

Natural History: Biological Diversity

BIological diversity, or biodiversity, refers to the variety and variability of living organisms on the planet. Ecologists tend to focus on three levels of biological diversity: genetic, species, and ecosystem diversity.

Species diversity is the most common level of diversity. Species is a word used in biology to refer to a type of organism different from all others. Species diversity is a measure of the number of species at a location. It varies greatly from place to place.

Ecosystem diversity is a complex level of biodiversity. An ecosystem is a system in which a community of organisms and their physical environment interact. Each ecosystem (e.g., a park) contains characteristic plants and animals. Some examples of ecosystems are grasslands, deserts, rainforests, conifer forests, and deciduous forests. In a large area, there may be several different ecosystems. This is ecosystem diversity.

Genetic diversity is a less obvious level of biological diversity. Genes are inherited from parents and transmitted to offspring. Genes affect how organisms look, and how they work. Genes also make each individual at least a little different from every other member of the species. These differences are what we call genetic diversity.

Today there is great concern about the loss of biodiversity. In the foreword to *Technologies to Maintain Biological Diversity,* John H. Gibbons, Director of the Office of Technology Assessment, states, "The reduction of the Earth's biological diversity has emerged as a public policy issue in the last several years. Growing awareness of this planetary problem has prompted increased study of the subject and has led to calls to increase public and private initiative to address the problem.

"One major concern is that loss of plant, animal, and microbial resources may impair future options to develop new important products and processes in agriculture, medicine, and industry. Concerns also exist that loss of diversity undermines the potential of populations and species to respond or adapt to changing environmental conditions. Because humans ultimately depend on environmental support functions, special caution should be taken to ensure that diversity losses do not disrupt these functions. Finally, esthetic and ethical motivation to avoid the irreversible loss of unique life forms has played an increasingly major role in promoting public and private programs to conserve particular species or habitats."

HABITAT ALTERATION: Five hundred years after Columbus came to the New World, America's plants and animals are seriously depleted. More than 140 kinds of animals and approximately 60 kinds of plants have been declared extinct. Another 204 kinds of plants are probably extinct. The U.S. Fish and Wildlife Service (FWS) has listed 464 kinds of plants and animals as threatened or endangered; 3,800 additional kinds of plants and animals

are in such danger that the FWS has designated them as "candidates" for listing as endangered or threatened.

The leading cause of these extinctions has been habitat alteration by humans for purposes of converting land to more immediately recognized, productive uses. Habitat alteration by humans is also responsible for endangering plants and animals.

Encroaching on habitat has been the principal cause of decline of a number of different kinds of organisms. In the Southwestern United States, logging operations threaten the Venus' flytrap. The Houston toad is endangered by loss of habitat from urban-industrial expansion. Attwater's prairie chicken is in trouble because of overgrazing and cultivation of its prairie habitat.

It is difficult to understand the full meaning of the term "habitat alteration" without having a good understanding of the terms "habitat" and "niche."'

Habitat is the place where an organism lives — its home address. It is the organism's physical living place. The niche is a plant's or an animal's profession, occupation, or job — it's role in life. The niche of an organism is about relationship, its relationship to the place where it lives, as well as to other organisms living there.

The profession, or niche, of an organism has a great deal to say about where the organism lives. The niche of the earthworm includes feeding on decaying plant and animal parts in the soil. However, there are many things that have to be right for the earthworm to occupy that niche: climate, soil conditions, and natural enemies. But the niche is about more than food; it is everything the organism must do to survive and to leave its young.

Another perspective on niche is provided by the work of Robert MacArthur. He studied five different kinds of warblers, which live in the spruce forests of Maine and Vermont. The five birds eat roughly the same kind of food — spruce budworms. MacArthur's painstakingly careful research showed that the five warblers find their food at different places in spruce trees. One habitat; five different niches. Each bird had different behaviors and hunting methods, allowing it to survive and leave babies.

EXTINCTION: Extinction is a way of life for all organisms on our planet. Species appear, and then in time, die out. However, once an organism disappears — becomes extinct — it never reappears again.

The rate of extinction has changed. Never before, in all of the earth's long and varied history, has there been the massive disappearance of plants and animals that is occurring today. Within the next 30 years, perhaps as many as one million different plant and animal species will vanish forever. This is a loss of two to three species an hour. According to Paul Opler, "since the arrival of the Puritans at Plymoth Rock over 500 types of animals and plants have become extinct." Contrast this with three species per hundred years during one 3,000-year period of Ice Age extinction. During the demise of the dinosaurs, the rate of loss was only one species every 10,000 years.

Why are we losing so fast? It is because of direct or indirect human interference, in the form of habitat

loss, commercial exploitation, extermination of feared species, and pollution. While pollution and over-harvesting have had some effect, the main reason for this greatly accelerated and unnatural pace of extinction is habitat loss. This is especially true in the tropics, here at least half of all life forms on earth may reside.

OBJECTIVES

After completing this exercise the student will be able to

1. learn what biological diversity means
2. learn that varied habitat is the key to biodiversity
3. recognize factors that determine habitat such as elevation, aspect, slope, soil type, and rainfall
4. be able to name threats to habitats from human activities
5. be able to identify three factors involved in the extinction of a species and describe the finality of extinction
6. recognize the importance of national parks in protecting habitat

GRADES: 6 TO 8

AZ CURRICULUM STANDARDS:
Language Arts Standard 3 – Listening and speaking
Science Standard 4 – Life science

GROUP SIZE: 5 to 30

DURATION: 1 hour

SETTING: classroom, museum, outdoors

MATERIALS: Information from introduction to biological diversity on page 87, "The Educator's Role in Biological Diversity" page 91, and activities in this section.

Educator's Outline for

BIOLOGICAL DIVERSITY

PROCEDURE: As a pre-site activity, perhaps in a classroom setting, go over the background information from the biological diversity curriculum. Discuss what is meant by biological diversity and habitat. Talk about the characteristics of habitat (food, water, shelter, and space), and why certain plants and animals live in certain areas.

Discuss how humans fit into the biodiversity equation. How have habitats changed due to human activities? Why is biodiversity important? What role do national parks play in protecting habitats?

Continue the curriculum in the field, perhaps at either the Montezuma Well Environmental Study Area (ESA) or another site (e.g. schoolyard). Have students describe the habitat and ask them to guess what types of animals and plants live there. At the Well, compare the pasture habitat with the streamside riparian habitat along Wet Beaver Creek.

Observe the changes in habitats; ask students to speculate about the factors that contribute to these changes. Where is there more biodiversity? Where is there less? Why?

THE EDUCATOR'S ROLE IN BIOLOGICAL DIVERSITY ... A MESSAGE FROM THE NATIONAL PARK SERVICE

Dear Teacher and Interpreter.

Crows, jays, warblers, pelicans, sparrows, ducks, eagles — all different varieties of birds. Lions, tigers, bears, mice, rabbits, dogs — all different varieties of mammals. Maples, elms, pines, palms, oaks — all different varieties of trees. These you can see, but there are thousands of different varieties of micro-organisms that you can't see that are the beginning of the food chain for the animals, birds and plants. The earth abounds with variety. Almost anywhere you travel you will find an incredible variety of plants and animals. This variety of life is called biological diversity. It includes ecosystems and their interacting communities of plants, animals, and microorganisms, as well as species, and their genetic composition and variation.

Why is biological diversity important? Why should we care about preserving as much of it as possible? Our lives, and life on earth as we know it, are dependent upon the complicated interactions and interdependency of the myriad species of life forms with which we share this planet. Ecosystems are composed of both living and non-living elements. Control of climate and the quality of the atmosphere are services provided freely by natural ecosystems. So too are the cycling of nutrients and the natural disposal of wastes, pollination and the supply of foods, the maintenance of soils, and water storage in forest watersheds.

This renewal and recycling process is the power nature has to cleanse and rebuild ecosystems, but there is a balance that must be maintained and, as good stewards, we must maintain species of plants and animals that affect our lives everyday and in ways few people realize. Foods that we eat, medicines we take for illnesses, industrial products we use, and pets and houseplants, may all owe their origin to living wild plants and animals. Developed

and developing countries alike are dependent upon a species richness embodied in a common, shared heritage of biological diversity It has been stated that the loss of biological diversity is second only to nuclear warfare in its threat to human and other life on this planet. This loss of the diversity of life, and other related environmental concerns, may well be the most significant issue facing mankind as we approach the beginning of the 21st century. As the 20th century ends, we face the loss of many species which were present at its beginning.

A critical part of the problem is that we just don't know how many species of living plants, animals, and microorganisms there are. A few years ago five to six million would have been a common estimate. Today, a conservative estimate would be thirty million plus. When you don't know how much there is of something, you can't accurately assess what you're losing. The tropical areas of the world contain the greatest biological diversity, and it is there where the greatest loss of plants, animals and microorganisms is occurring.

The threats to biological diversity include the loss of places where plants and animals naturally grow; pollution; direct elimination of animal and plant species; introduction of alien species; and climate change, especially global warming. Our hope — the earth's hope, lies in a concerned, educated, and motivated public. It begins with education. Hence, we are happy to endorse and support this environmental education curriculum on biological diversity. The future is in our hands, our hearts, our minds.

James M. Ridenour
Director
National Park Service

Paul C. Pritchard
President
National Parks and
Conservation
Association

"...When the last individual of a race of living things breathes no more, another Heaven and another Earth must pass before such a one can be again."

—W. BEEBE (1877-1972)

Educator's Outline for

AND THEN THERE WERE NONE

This is a pre-visit activity

OBJECTIVES

After completing this exercise the student will be able to

1. describe the impact of humans on other living things as a result of human social, economic, and political activities
2. define the terms endangered and extinct

GRADES: 6 TO 8

AZ CURRICULUM STANDARDS:
Science Standard 4 – Life science

GROUP SIZE: 20 to 30

DURATION: 1 to 2 hours

SETTING: Classroom

MATERIALS FOR THE CLASS: "I AM" and "SURVIVAL" student activity sheets

MATERIALS FOR EACH STUDENT: Tape and 6 small slips of paper

PROCEDURE:

1. Copy and cut the I AM and SURVIVAL FACTORS into cards. Have the students arrange their chairs in a circle. Tape the name of an animal or plant to their blouses/ shirts. The plants and wildlife found on the Activity Sheet I AM are mostly endangered species. They are all native to the United States. (If you prefer, have students choose plants and animals growing in their area.)

2. Distribute six slips of paper to each student. Tell them that this represents a population of organisms. If necessary, review the population concept. Write the word POPULATION on the chalkboard. Remind them that a population is two or more organisms of the same kind; that there are plant and animal populations; and that the size of a population is determined by the number of individuals. The student populations are all the same size. Point out that organism size makes no difference in the size of populations. Population is about numbers of organisms. Tell them that each of their slips represents millions of organisms.

3. Tell students that you are going to read some statements. Give them the following directions:

"Everyone stand up in a circle. Each time I read a statement that limits or reduces your chances of survival, put one of your slips on the floor in front of you. Whenever I say 'human population growth,' everyone turns in a slip. When you have two slips left, sit down on the floor and say, 'I'm in big trouble.'"

Continue to play until everyone is sitting.

4. Discuss the game, asking questions such as:
   How many of you have slips left? How many have none?
   Is this game life-like? Why, or why not?
   What are the important ideas in this game?

5. Write the words EXTINCT and ENDANGERED on the chalkboard. Tell students that their populations became endangered when they became small in number. Endangered refers to any population of plants or animals in danger of extinction. There are still some left. Extinction is final. The plant or animal is "gone forever."

6. Ask students whether they have even seen a building being torn down, or whether they have ever lost something they have never found. If so, they have some idea and feeling about extinction.

Tell students there is an official list of endangered species. Plants and animals are placed on this list after careful study and review by the Office of Endangered Species, U.S. Fish and Wildlife Service.

7. Summarize this lesson with a discussion. Use these kinds of questions:

- What are factors that influence the survival of populations of plants and animals? Can you of some factors that this game did not consider?
- Does this game contain any facts? What are they? Are they accurate? How could you find out?
- Did populations have any choices? Why or why not?
- How could this game be changed to make it even more like real life?
- How would you change this game to have winners? (Does this game have any winners?)
- Do populations lose this game by chance? Is this life-like?

I AM

I AM a Gray Wolf (mammal)	**I AM** an American Crocodile (reptile)
I AM a Florida Panther (mammal)	**I AM** a San Francisco Garter Snake (reptile)
I AM a Utah Prairie Dog (mammal)	**I AM** a Houston Toad (amphibian)
I AM a Key Deer (mammal)	**I AM** an Indiana Bat (mammal)
I AM a Woodland Caribou (mammal)	**I AM** a Grizzly Bear (mammal)
I AM a Northern Swift Fox (mammal)	**I AM** an Alabama Beach Mouse (mammal)
I AM a Peregrine Falcon (bird)	**I AM** a Sea Otter (mammal)
I AM a Brown Pelican (bird)	**I AM** a Fresno Kangaroo Rat (mammal)
I AM a Hawaiian Honeycreeper (bird)	**I AM** a Bald Eagle (bird)

I AM a California Condor (bird)	I AM a Green Pitcher (plant)
I AM an Eskimo Curlew (bird)	I AM a Prairie Bush Clover (plant)
I AM a Hawaiian Moorhen (bird)	I AM a Short's Goldenrod (plant)
I AM a New Mexico Ridge-Nosed Rattlesnake (reptile)	I AM a Noonday Snail (snail)
I AM a Red Hills Salamander (amphibian)	I AM a Nashville Crayfish (crustacean)
I AM an Apache Trout (fish)	I AM a Smith's Butterfly (insect)
I AM a Bonytail Chub (fish)	I AM a Minnesota Trout Lily (plant)
I AM a Judge Tait's Mussel (dam)	I AM a Furbish Lousewort (plant)
I AM a Delta Green Ground Beetle (insect)	I AM a Ruth's Golden Aster (plant)
I AM a Tree Cactus (plant)	I AM a Virginia Round Leaf Birch (plant)

SURVIVAL FACTORS

People are afraid of you or think you are a pest. They trap and shoot you.	Human population growth increases.
Your habitat is used for recreation — snowmobiles, off-the-road vehicles, beach buggies.	Your habitat is threatened from oil/ gasoline spills, ocean drilling, or run-off from gas stations into wetlands, streams, and ponds.
A trapper has set out some traps and you have gotten caught in one.	Silt from logging and agriculture pollutes the water.
Your habitat is used for construction projects-highways, housing, shopping centers.	A poacher has shot you illegally.
Your marsh is drained.	A city expands and builds an office complex in your meadow.
A dam was built and the valley where you live is now under deep water.	An oil tanker has spilled thousands of gallons of oil into the ocean.
A timber company has cut an area in patches, leaving critical habitat for you.	Chemicals used on lawns have been washed into the water.
A timber company has clear-cut an area where you find food.	An oil company has paid to test the effect of oil drilling on an area where you live.
A cabin is built as a vacation home in your forest.	New zoning allows development nearby, but protects your critical habitat.
A fire has burned your forest.	Pesticides have polluted the water.

OBJECTIVES

After completing this exercise the student will be able to

1. describe an organism
2. describe living and non-living environmental factors that may affect an organism
3. hypothesize on the effects on environmental factors
4. define an organism as any living thing, plant or animals

GRADES: 6 TO 8

AZ CURRICULUM STANDARDS:
Science Standard 1 – Life science
Science Standard 4 – Life science
Language Arts Standard 3 – Listening and speaking

GROUP SIZE: 20 to 30

DURATION: 2 hours

SETTING: Outdoor

MATERIALS FOR THE CLASS: "FINDING OUT WHAT LIVES HERE" student activity sheet

MATERIALS FOR EACH STUDENT: magnifier, metric ruler, plastic or paper cup, 5 to 10 plastic spoons, 5 to 10 bug boxes/ plastic cups. Optional for aquatic habitats: nets

Educator's Outline for

ORGANISM SEARCH

This is a pre-visit activity

PROCEDURE:

1. Choose an outdoor site for students to study. It should be within walking distance and be as diverse as possible.

2. Divide the class into teams of two. Tell students that they will be exploring an outdoor study area to find out what lives there. Distribute two copies of the Natural History Activity Sheet, FINDING OUT WHAT LIVES HERE, to each team and review it with them.

3. Once outside, point out the boundaries of the study site. There is no reason to dig up plants. Some animals may be easier to study if they are temporarily housed in either a bug box or a cup. Emphasize that one animal is enough. Tell students that you want them to find and observe as many different plants or animals as they can. Ask team working close to one another to make different choices.

4. When the class is finished, have the teams return any plant parts or animals to where they were found. (Students may have used bug boxes or cups for pondweed, snails, crickets, ants, earthworms, and isopods.)

5. When you return to the classroom, have the teams describe what they have found.

6. Summarize the work by asking these kinds of questions:

- Did we get them all?
- If we went back out again do you think we could find new plants or animals? Where would you look?
- If we were to do this at the national park, what would you expect to find?

- What are some of your observations?
- What are some examples of living environmental factors? What effect do you think they might have?
- What are some examples of nonliving environmental factors? What effect do you think they have?
- How many different kinds of environmental factors did we find? Which are there more of, living or nonliving?

7. Tell students that any living thing, plant or animal, is an ORGANISM. Write it on the board where everyone can see it.
   - How many organisms did we find?
   - How many different kinds of plants? Animals?
   - Did we find more plants or animals?
   - If we were to spend more time doing this study, what other organisms do you think we would see?
   - Suppose you were to conduct this work in a field or wooded area at the national park. Would you expect to find the same kinds of organisms? Why, or why not? Would it be easier to find different kinds of organisms? Why, or why not?
   - How could we change the environment to see more organisms? (What if we were to add a bird feeder to the schoolyard a plant or garden?)

FINDING OUT WHAT LIVES HERE

Team Members:

1. Choose a plant or animal to observe.

   a. If you know the plant or animal, name it. If you don't know its name, invent one that describes either what it looks like or something that it does.

   b. Describe the plant or animal. Use the other side to make a drawing.

   c. Describe the place the plant or animal lives — its habitat. Is it sunny, shady, in the open, surrounded by many plants, on the ground, 10 feet in the air, 30 feet in the air, under a rock, in a moist or dry place, under water, other?

2. What might change this animal or plant home? Give three examples and tell how the habitat might change.

   a.

   b.

   c.

Educator's Outline for

SPACE FOR A NICHE

This is a pre-visit activity

OBJECTIVES

After completing this exercise the student will be able to

1. describe the niche of a park species
2. identify a critical feature of that organism's niche
3. cite threats to biological diversity and ways that preservation of biological diversity can be promoted

GRADES: 6 TO 8

AZ CURRICULUM STANDARDS:
Science Standard 4 – Life science

GROUP SIZE: 20 to 30

DURATION: 1 to 2 hours

SETTING: Classroom, outdoors

MATERIALS: Class set of 3 x 5 inch cards, student activity sheets "NICHE OF A BALD EAGLE," "SOME BALD EAGLE NICHE DIMENSIONS" and "NICHE NOTES"

BACKGROUND: Niche has been defined as all interrelationships of an organism with its environment. Fairly large lists follow from such a definition! They suggest a complexity of relationships that few of us can even begin to appreciate or understand.

PROCEDURE: Develop a set of cards that describes the niche of an organism; endangered, if possible; and/or one for which the park provides critical habitat. There should be one niche characteristic per card. One of the cards should have name of the organism. This card is for you or for one of the students. Some of the niche dimensions of a representative species, the bald eagle northern habitats, have been provided as an example that you may choose to use. (Activity Sheets: NICHE OF A BALD EAGLE and SOME BALD EAGLE NICHE DIMENSIONS provide some background.) The niche dimensions emphasize nesting habitat. Fall and winter habitat are important, too. Add these details if you can.

1. Gather students around you. Tell them that you have in your backpack the niche of an organism.

3. Have students quickly take a card from your backpack and form a circle, shoulder-to-shoulder. Tell students this is your niche. Have them quickly read their card aloud and as they finish; you squeeze into the circle and ask them to guess who you are. Students will be guessing what animal belongs to the niche described.

4. Ask, "What might happen if ...?" (E.g. the food of eagles is polluted by chemicals, or if the eagles were disturbed by logging operations.) The card holder(s) can either step away from the circle or collapse to the ground. A gap is left. Children may think that this gap can be hurdled or breached somehow — after all, it

appears quite small. This isn't the point. It's either gone or damaged. The right combination of things has been changed and the organism is in trouble. In the case of the eagle, you can recount the history of the bald eagle and the role of parks in its recovery. The student playing the part of "critical feature" can fill the gap and make the circle whole, emphasizing the role of the park in the preservation of biological diversity.

5. Ask students to give you some examples of threats to biological diversity. Then ask them to list some ways in which they can contribute to preserving biological diversity.

NICHE OF A BALD EAGLE

The bald eagle is the only eagle unique to North America. According to the U.S. Fish and Wildlife Service, thirty-five years ago, bald eagles were in danger of extinction. Loss of habitat, shooting for feathers and poisoning by the pesticide DDT all contributed to the near demise of this bird. Since that time, DDT has been banned in the United States and the bald eagle has been protected by the Endangered Species Act and other federal laws. Today, thanks to the efforts of the American people, the bald eagle once again soars the skies above our country. Because the bald eagle is doing so well in the United States, the U.S. Fish and Wildlife Service has proposed to remove it from the list of threatened and endangered species.

The greatest threat to the bald eagle's existence arose with the widespread use of DDT after World War II. DDT was sprayed on croplands throughout the country and residues washed into lakes and streams. There, they were absorbed by aquatic plants and small animals that were eaten by fish. The contaminated fish, in turn, were consumed by eagles, contaminating them. DDT interfered with the development of strong eggshells. Bald eagles and many other bird species began laying egg whose shells were so thin that they broke during incubation or otherwise failed to hatch. By the early 1970s, there were perhaps less than 3,000 left in the lower 48 states. This chemical was banned for most uses in the U.S. in 1972. Since the banning of DDT, bald eagle populations have been increasing, though more than 90% of the nesting places are centered in populations in Florida, the Chesapeake Bay area, Maine, the Great Lakes, and the Pacific Northwest. While DDT is not used in the U.S., it is still used in other countries. There is evidence that some of it is deposited in the U.S. through the air. The effects of these levels of contaminants on reproductive success in bald eagles, if any, are not known. There is some evidence that other persistent contaminants (e.g., polychlorobiphenyls and mercury residues), as well as non-persistent, but moderately to highly toxic, contaminants may cause adverse effects on bald eagle populations.

In a major effort to return eagles to the world, the U.S. Fish and Wildlife Service established a captive colony. The eagles' first clutch of eggs was removed and artificially incubated.

The eagles then laid a second clutch themselves. Two methods of reintroduction to the wild were used. In one, 3-week-old eaglets were placed in the nest of adult pairs whose own eggs failed to hatch. The "foster" parents readily adopted the chicks and raised them as their own.

The ancient falconry technique known as "hacking" was also used. The term comes from the hack — the board on which the hawk's meat was laid, and to which it returned. At 8 weeks of age, birds were placed on human-made towers, located in wilderness areas where eagle populations are low. Great care was taken to ensure that the birds have no direct human contact. Gradually, over a period of several weeks, progressively less food was provided to force the young eagles to hunt their own prey and learn to fend for themselves.

From fewer than 3,000 birds and only about 400 known active nests in the early 1970s, there are now more than 5,000 bald eagles and 1,400 breeding pairs in the continental United States.

Why pay so much attention to a species that is clearly on the comeback? There are a variety of reasons. The bald eagle is sensitive to environmental conservation, habitat deterioration, and human harassment. An interesting answer is found in "Restoring the Bald Eagle" (American Scientist, May-June 1988). One of the authors is Dr. Ted Simons, Gulf Island National Seashore, NPS. Simons and his associates note that bald eagles "are not on the verge of extinction, and when viewed in the context of global conservation needs and of other critically endangered species, the attention may seem misplaced. In fact, it is precisely the symbolic nature of widespread species like the bald eagle — with their ability to capture the imagination of the public — that makes them such worthwhile conservation investments. As symbols of wilderness and of the freedom wilderness represents, bald eagles have the unique capacity to inspire people and to foster a sympathetic attitude toward the needs of other threatened species and toward related environmental issues such as habitat destruction and water quality. Clearly, without that sympathy and the political will it engenders, the needs of more obscure species will go unmet. It may be trickle-down conservation, but in the light of the ever-increasing pressure on global resources, it may prove to be one of the more fruitful conservation strategies available in the years ahead."

SOME BALD EAGLE NICHE DIMENSIONS

NESTING Southern U.S. populations breed in the winter	MATING Pair for life; if one dies, the survivor will take a new mate	FOOD Live fish
NEST TREES Widely spread in forest; not close to others	YOUNG During first year after leaving nest, young are larger than parents	FOOD Live mammals
NESTS Often reused year after year (may reach 10ft across, weigh up to 4,000lbs.)	Requires a clean environment	FEEDING Large area with many fish
YOUNG After leaving nest, young remain with parents during first summer	NESTING A spring that is warm enough in April each year so that animals can nest	SUMMER Large bodies of open water or wetlands
Once common through much of North America	NEST TREES Strong limbs	NESTING Tall trees
Few natural enemies	YOUNG Remain in nest for 10 to 11 weeks	NESTING Form attachment to place where raised; tend to return when ready to breed
NESTING Both male and female help in building nest, incubating and caring for young	YOUNG Takes over three years before young look like parents	FOOD Live sea birds
NEST TREES Easy to get in and out from the air	Female is larger than the male	FOOD Carrion (dead animals)

STUDENT WORKSHEET: BALD EAGLE NICHE DIMENSIONS

WINTER Near large, ice-free bodies of water	FOOD Live water birds	NESTING Little or no human disturbance
NESTING Variety of trees	FOOD Water	NESTING Reluctant to nest right at the shoreline
NESTING Close to shorelines	NESTING Winter Roosts Protected from wind	
NESTING If eggs are destroyed will lay a second nest	NESTING Mature forest	

NICHE NOTES

Name _____

Organism _____

What does it eat? _____

What eats it? _____

What does it do? (Its profession)_____

_____

What effects does this organism have on other organisms in its community?

_____

_____

What effects do other organisms in its community have on this organism?

_____

_____

OBJECTIVES

After completing this exercise the student will be able to

1. recognize that humans are animals with adaptations that make us different from other animals;
2. identify two adaptations and tell how these adaptations help them in their habitat.

GRADES: 6 TO 8

AZ CURRICULUM STANDARDS:
Science Standard 4 – Life science

GROUP SIZE: 20 to 30

DURATION: 1 to 2 hours

SETTING: Classroom

MATERIALS: Chalkboard, markers, 15-20 adaptation cards, 3x5 index cards, watch, student actvity sheet "GAME CARDS"

Educator's Outline for

WIN, LOSE OR ADAPT

PROCEDURES: Copy and cut the Natural History Activity Sheet GAME CARDS, or use the following list with your class to prepare a set of 15 to 20 adaptation cards. They may be modified to meet your unit goals.

Insects

Antennae — used to feel, smell, and, in some insects, to hear

Compound eyes — often the biggest; many lenses

Mouthpart — female mosquito's is needle-like

Hard outer covering exoskeleton — protection from enemies; keeps from drying out, waterproof

Camouflage — moths, walking sticks; for protection

Biting jaws — ants; for working and carrying food

Stingers — bees, wasps; for protection

Eyespots — moths often have huge eyespots on their wings to scare off predators

Reptiles

Slimy skin — frogs; keeps skin moist and helps them breathe

Long, fast tongue — lizards use it to zap food

Forked tongue — snakes use it to "smell" their environment

Hard shell — turtles; protects body

"Fifth hand" — a chameleon can wrap its tail around a twig or branch for support

Birds

A. Beaks

Hooked beak — hawks, eagles; for tearing up food

Pouch-like beak — pelican; for carrying food

Long-hollow beak — hummingbird; reach nectar deep inside blossoms

Short, cone-shape beak — cardinals, sparrow; strong for opening seeds

Long thin beak — many shore birds such as curlew, godwits, snipes; to probe for food in mud

B. Feet

Feet for climbing — woodpecker; two toes in front and two in back

Feet for grasping — hawks and owls; large, curved claws, called talons, to dig into and hold prey

Feet for perching — robins, chickens; three toes forward, one long hind toe, sit on branches

Running feet — two toes on the ostrich; three on the killdeer; all pointed forward

Swimming feet — ducks; aid in swimming, walking on mud

Mammals

Paws with claws — most meat eaters; climb, dig for food or a home, hold their prey

Long pointed canines — most meat eaters; to stab and kill prey

Hooves — deer, antelope; for running

Teeth that never stop growing — mice, rats, squirrels, beavers, muskrat; teeth to last a lifetime of eating nuts, trees, snipping off stems /branches

Fur covered feet — rabbits and hares; good grip on slippery surfaces

Spine- or quill-covered bodies — porcupines; protection from predators

Horns — bighorn sheep, bison; permanent, slow-growing, for defense, mating fights

Antlers — deer, moose, elk, caribou; used for defense, mating fights, fast-growing

Whiskers — lions, wolves, coyotes; help animal to feel the environment when going through brush or small places, especially in the dark

Eyelashes — wolves, coyotes; keeps dust and other material out of eyes

Hair — all mammals (some have more than others to, keep heat in or cold out, protection — porcupine quills are hair

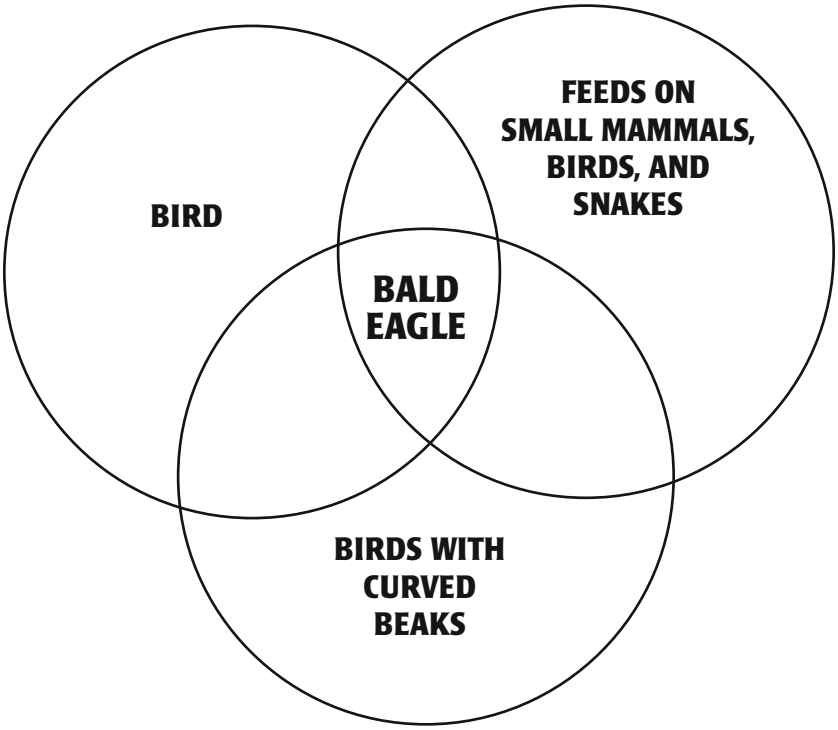
Ask students to suggest adaptations of humans and list them on the board. As students list them, ask them to describe the adaptation and how it is useful to humans. Some possible examples might include: upright posture (carrying objects, seeing distant objects, holding and throwing objects); eyes face forward (helps judge distance); movable neck; ear lobes (help gather sound); big brains (intelligence); thumbs (the specialty is an opposable thumb — it can touch the tips of the fingers, allowing very precise and delicate hand movements.); touch (fingers and hands are very sensitive); live in groups (cooperation, safety in numbers); speech (conversation, cooperation).

WIN, LOSE OR ADAPT

1. Describe three problems an animal you saw at the national park would have if it were suddenly transferred to the area of your school. Could these problems be solved? Why or why not?

2. Give three examples of animal adaptations. Which one is most similar to human adaptations? Explain your reasoning.

3. Write down everything you can about the bald eagle, based on the following diagram.



4. What are two things you can do to help prevent extinction of the earth's biodiversity?

GAME CARDS FOR WIN, LOSE OR ADAPT

COMPOUND EYES Often the biggest, with many lenses	STINGERS Bees, wasps, for protection	LONG POINTED CANINES Most meat eaters, to stab and kill prey
EXOSKELETON Hard outer covering, protection from enemies, keeps insect from drying out, waterproof	RUNNING FEET- Two on the ostrich and three on the killdeer, all toes point forward	SHORT, CONE-SHAPED BEAK Cardinals and sparrows, strong for opening seeds
EYESPOTS; Moths often have huge eyespots on their wings to scare off predators	FEET FOR GRASPING Hawks and owls, large curved claws, called talons, to dig into and hold prey	SWIMMING FEET Ducks, aids in swimming, walking on mud
LONG, FAST TONGUES Lizards use them to zap food	FORKED TONGUES Snakes use it to "smell" their environment	LONG, HOLLOW BEAK Hummingbirds, reach nectar deep inside blossoms
HARD SHELL Turtles, protects the body	POUCH-LIKE BEAK Pelican, carrying food	HORNS Bighorn sheep, bison, permanent, slow growing, used for defense, mating fights
HOOKED BEAK Raptors (hawks, eagles) for tearing up food	PAWS WITH CLAWS Most meat eaters, to climb, dig for food or a home, hold their prey	WHISKERS Lions, wolves, coyotes, helps feel surroundings when going through brush or small places, especially in the dark

OBJECTIVES

After completing this exercise the student will be able to

1. describe their impressions of the extinction of a species
2. identify the factors involved in the extinction of a species
3. have some feeling of "gone forever," that once a species has disappeared it does not reappear

GRADES: 6 TO 8

AZ CURRICULUM STANDARDS:
Science Standard 4 – Life science

GROUP SIZE: 20 to 30

DURATION: 1 to 2 hours

SETTING: Classroom

MATERIALS FOR CLASS: student activity sheet "MARTHA"

MATERIALS FOR STUDENT: Art and writing materials

Educator's Outline for

PASSING IN CINCINNATI, SEPTEMBER 1, 1914

PROCEDURE:

1. If you have a wooded area near the classroom where it is reasonably quiet and where there are nuts and berries, use it. You can give each student an acorn/berry — the food of the passenger pigeon — to hold during the story (Activity Sheet: MARTHA).

2. Students can sit or lie down. Begin the story of MARTHA. Ask students to relax quietly and sit or lie quietly and close their eyes. Ask them to imagine the sights and sounds of the story.

3. When you have completed the story, ask them to write their thoughts and feelings about Martha. They can use poetry or sentences. Be sure to give them enough time. Then ask them to draw or paint a picture to illustrate the story.

4. Discuss the pictures. Use these kinds of questions:

- How do you feel about losing this animal?
- Are you familiar with any other incidents of this kind?
- Is the extinction of the passenger pigeon a disgrace? No one says this about the extinction of the dinosaurs. Is anything different?
- What factors contributed to the extinction of the passenger pigeon? (e.g. hunting, habitat destruction)
- In 1857, a bill was introduced in Ohio to protect the passenger pigeon. A committee of the state legislature reported, "The passenger pigeon needs no protection.... no ordinary destruction can lessen them." Why do you think the committee made that decision?
- What lesson can we learn from the extinction of Martha?

- Do you think we have learned the lesson? What is your evidence?
- Can organisms become extinct today? How do you know?
- Have any organisms ever become extinct in the area where we live? How do you know? How could you find out?
- What do you think other people know about extinction? How could you find out?

MARTHA

Close your eyes.

Relax.

Get as comfortable as you can.

I am going to read you a story. As I read it, I want you to try to imagine the scenes and events.

When European explorers first came to America, they saw large flocks of birds known as passenger pigeons. There were millions and millions and millions of them. The passenger pigeon was a large and graceful bird. Including its long tapering tail, it was about 16 inches long. The head and back of the male were a glossy bluish gray. Underneath, the breast was red. The female was light brown above, and her breast was gray. They had sparkling red eyes. Some have described the eyes as "bright, fiery orange." They nested in northern forests in the summer and flew south in the fall. They usually laid only one egg on a flimsy platform of sticks and twigs someplace in a tree.

Usually more than a hundred other passenger pigeons nested in the same tree. Sometimes there were so many nests that limbs would break and fall to the ground. Passenger pigeons nested in large groups that covered large areas. A nesting area found in Michigan was 28 miles long and three to four miles wide. These were loud noisy birds. They sounded like a huge army of bullfrogs. Their droppings killed the plants underneath and stripped the trees of their leaves. In describing their nesting area, one person said it looked as though the forest had been struck by a tornado.

The food of the passenger pigeon consisted mainly of beechnuts, acorns, berries, and seeds. It was a fast flyer and could fly a mile a minute. It was known as the "blue meteor." Passenger pigeons flew in enormous flocks and could even block out the light of the noon-day sun, "their wings roaring like thunder."

They were also very tasty. Expert hunters killed large numbers. One hunter killed 1,200 a day over a week-long period. Upright nets were often used to capture them. Pigeons struck the nets with such force that they either fell dead to the ground or became entangled in the netting. Pigeon-netting was such a common practice that almost every town was equipped to net pigeons. At night, they could be quickly prodded from their roosts with long poles. They were so numerous that some people hunted them with sticks or stones.

Trappers caught thousands. These pigeons were kept in boxes and

released to be used as living targets for shooting practice. Grain was soaked in alcohol and used as bait. As pigeons lay helpless, fluttering on the ground, hunters could walk among the trees and fill their bags. Trees were cut down so that nestlings could be captured for market.

The shooting and hunting continued for years. When asked whether these birds needed any protection, officials would say no, there are millions of them. However, the United States was growing. There were more and more people. Railroad ties were beginning to crisscross the land. Forests were being cut down for timber and to clear the land for farming. The pigeons had to find new routes for migrations. Their food, acorns, beechnuts, and wild fruit became harder and harder to find. Gradually the flocks of pigeons became smaller and smaller. The flocks were scattered widely over the United States and Canada.

Finally protective laws were passed prohibiting the hunting of passenger pigeons. People thought they were safe, but each year fewer and fewer pigeons were seen. Their habit of producing only one egg at a time did not result in many offspring. On September 23, 1907, the last passenger pigeon in the wild was shot.

But there were still some kept in zoos. And there was hope that they would survive. However, even in zoos they didn't produce enough eggs. The older birds died faster than young birds hatched.

Eventually there was only one left. Her name was Martha, and she lived in the Cincinnati Zoo. Not much was known of Martha's past. She probably was born from a pair of captured pigeons in Wisconsin. She arrived at the Cincinnati Zoo in 1902. Her age is a mystery. No one knows for sure how old she was when she died. She might have, been 14 or as old as 29.

Martha is now mounted in a display case at the Smithsonian Institution in Washington, DC. The label on the museum reads: "Martha, last of her species, died at 1 p.m., 1 September 1914, age 29, in the Cincinnati Zoological Gardens."

When you are ready, open your eyes.

OBJECTIVES

After completing this exercise the student will be able to

1. describe the consequences of shrinking habitat
2. understand and describe the role of parks in preserving biodiversity
3. understand the role that all humans have to play in preserving biodiversity (letting Joe or Jane do it isn't enough)

GRADES: 5 TO 8

AZ CURRICULUM STANDARDS:
Science Standard 4 – Life science

GROUP SIZE: 25

DURATION: 1 to 2 hours

SETTING: Classroom

MATERIALS: 5 frisbees, 20 popsicle sticks, 25 name tags, rope/string

Educator's Outline for

THE INCREDIBLE SHRINKING HABITAT

Based on "Islands," The New Game Book, Doubleday and Company

THIS IS AN ON-SITE ACTIVITY

PROCEDURE:

1. Round One. Place the rope in a large circle and have students stand just outside of it. Tell them they can choose to be any plant or animal they would like to be. Have them make a nametag so that the others will know what plant or animal they are.

Place the frisbees inside the circle. Distribute 20 popsicle sticks among the five frisbees. Have Students walk or trot slowly around the perimeter of the rope circle. When you yell out "Home Address" students rush to get a popsicle stick. There is a rule: No pushing or shoving. Those who don't get a stick stand outside the circle.

2. Round Two and Round Three. Collect the popsicle sticks, reduce them by five, and redistribute them.

Do you have any ideas what the various rounds and frisbees represented? Round One = before Columbus and settlement of the U.S. by Europeans. Rounds Two and Three = Changes in habitat by Europeans, e.g., for agriculture, wood, cities. Frisbees = habitat. Diminishing number of frisbees = decreasing amount of habitat available for plants and animals. Elimination of species by bumping = interference by humans that decreases the amount of habitat available.

Organisms eliminated may be either endangered or have become extinct. The remaining frisbee(s) represent a national park. They provide habitat protection, and for many species provide critical habitat. Reinforce this concept and use a local example, if possible. Ask:

What are some ways humans "bump" into plants and animals and cause them to become endangered?

What are our views on what should be done about this?

Educator's Outline for

SCENERY SEEN

PROCEDURE:

1. During the interpretive walk through various habitats, stop and have students describe the habitat they are in. Take only a few moments and then gather students together to share what they have observed. Students have had a learning experience with the microhabitats of isopods. During the sharing and your discussion of the habitat, describe and point out microhabitats. Point out the examples in your park of critical habitat for endangered wildlife and plants. It may be something as "simple" as space; it may be a suite of specific requirements provided only by the park.

2. Use these kinds of questions:

   - What do we mean by habitat?
   - What are the characteristics of this habitat?
   - Have you ever seen this kind of habitat outside the park?
   - How is it similar to the habitat we just walked through? Different from that habitat?
   - What dangers do organisms face in this habitat?
   - How does this habitat meet the needs of organisms?
   - What is a descriptive name for this kind of habitat?
   - Could his habitat ever change? How? What are your ideas about what would happen then?

OBJECTIVES

After completing this exercise the student will be able to

1. describe the characteristics of particular habitat
2. compare differences between habitat
3. define critical habitat

GRADES: 6 TO 8

AZ CURRICULUM STANDARDS:
Science Standard 4 – Life science
Language Arts Standard 3 – Listening and speaking

GROUP SIZE: 20 to 30

DURATION: 1 to 2 hours

SETTING: Classroom

OBJECTIVES

After completing this exercise the student will be able to

1. identify some of the biodiversity of a particular area (habitat/community/ ecosystem)
2. describe some differences between separate areas (habitats/ communities / ecosystems)

GRADES: 6 TO 8

AZ CURRICULUM STANDARDS:
Science Standard 4 – Life science

GROUP SIZE: 25

DURATION: 2 hours

SETTING: Outdoors

MATERIALS: Student activity sheet "HUNTING FOR BIOLOGICAL DIVERSITY." Optional: Flagging

Educator's Outline for

BIOLOGICAL DIVERSITY HUNT

PROCEDURE:

1. Make a copy of HUNTING FOR BIODIVERSITY and cut it into cards. Place them in a sturdy envelope. Make up your own cards that are relevant to your field trip.

2. Use a trail that goes through a variety of habitats/communities /ecosystems. Select two or three sites that are different and are easily supervised. Point out the boundaries of the area. You may want to use flagging to mark boundaries. Remind students that they should not collect or damage anything.

3. Divide the class into teams of three curious naturalists. Give each team two cards.

4. Give each team 10 minutes to find what their cards ask for. Have the teams take the class to the "finds." Collect the cards or have students exchange them for use on the next site.

5. Ask students these kinds of questions:
   - What are some words that describe the plants growing on this site? (This is a good time to remind students that all the plants and animals living together here make up a community. If it has a name, name it.)
   - What did you learn about animals on this site?
   - What are some ways we could learn more about the animals on this site?
   - How would you describe the biological diversity of this site? Rich or poor? What is your evidence?
   - Did anyone find a plant or evidence of an animal that no one else found?
   - Are some plants more abundant than other plants?
   - What would you say is the least abundant plant on the site?
   - How is this habitat/ community/ecosystem similar to the one we just studied? How is it different?
   - What are some words you would use to describe this place?
   - If appropriate, which team found evidence of species diversity? Individual variation?
   - Which of us is best dressed for hiding in this area? Break the class into small groups. Give them a minute to invent a game to test this.

HUNTING FOR BIOLOGICAL DIVERSITY

FIND THREE DIFFERENT-SIZED LEAVES FROM THE SAME PLANT	FIND AT LEAST THREE DIFFERENT KINDS OF HOLES MADE BY ANIMALS
FIND AT LEAST THREE DIFFERENT KINDS OF PLANTS GROWING UNDER A TREE	FIND THREE DIFFERENT SIGNS OF AN ANIMAL HAVING EATEN SOMETHNG
FIND AT LEAST THREE DIFFERENT ORGANISMS AND GIVE THEM DESCRIPTIVE NAMES	FIND AT LEAST THREE DIFFERENT KINDS OF LEAVES
FIND AT LEAST THREE DIFFERENT KINDS OF PLANT "SKINS"	FIND AT LEAST THREE LEAVES WITH DIFFERENT TEXTURES
FIND A PLANT THAT HAS THREE DIFFERENT COLORS	FIND AT LEAST THREE DIFFERENT PLANTS
FIND AT LEAST THREE DIFFERENT KINDS OF SEEDS	FIND THREE DIFFERENT KINDS OF CONSUMERS (ANIMALS OR EVIDENCE OF THEM)
FIND THREE DIFFERENT SPIDERWEBS	FIND THREE DIFFERENT KINDS OF DECOMPOSERS
FIND AT LEAST THREE DIFFERENT KINDS OF LEAF STALKS	FIND AT LEAST THREE PLANTS WITH DIFFERENT ODORS
FIND THREE DIFFERENT LICHENS	FIND BIODIVERSITY IN AT LEAST THREE DIFFERENT SHAPES: SQUARE, TRIANGLE, OVAL, HEART, RECTANGLE
FIND THREE DIFFERENT FLOWERS	FIND AT LEAST THREE DIFFERENT INSECTS

OBJECTIVES

After completing this exercise the student will be able to

1. investigate biodiversity at many levels
2. make comparisons
3. make observations about numerical and spatial aspects of biodiversity
4. become a sharper observer of their outdoor surroundings

GRADES: 6 TO 8

AZ CURRICULUM STANDARDS:
Science Standard 4 – Life science
Language Arts Standard 2 – Writing
Language Arts Standard 4 – Viewing and presenting

GROUP SIZE: 25

DURATION: 2 hours

SETTING: Outdoors

MATERIALS: Rings or yarn, hole punch, and student activity sheet "BIOLOGICAL DIVERSITY."

Educator's Outline for

SCAVENGE FOR BIOLOGICAL DIVERSITY

PROCEDURE:

1. Copy the BIOLOGICAL DIVERSITY CARDS (onto heavy paper if possible) and cut them up to cards. Punch a hole in the upper left-hand corner of each card and place them on a ring or thread yarn through them. Group them into categories, or into small bunches if you want.

2. Place students in groups of four or five. Give each group five to ten minutes to develop a way to express biodiversity. It may be a dance or a play or a reading. Afterwards, ask questions like:

- What are some reasons that there is less biodiversity in human communities than in natural communities?
- How is human diversity similar to biodiversity? How is it different?
- What is the chief characteristic of a place that has more biodiversity than another place?
- What things does your community have in common with the park community? In what ways do the two communities differ?
- What question has been raised by our study of biological diversity?
- You may have heard someone say, "Variety is the spice of life." What does this have to do with the biodiversity of plants and wildlife?

3. Use the cards to investigate the biodiversity of your schoolyard or immediate neighborhood. How many can your class complete in a day or a week or a month? If you take students camping, use the cards.

4. There are a variety of ways these experiences can be summarized. Students can write descriptions; write poems/haiku; contribute their observations to a class book or chart on biological diversity; or make an illustrated report or make a large group/class mural. You might ask the class to develop a list of words that describes the different plants and animals they found and studied. Then use the same cards in a different place — another community. Develop another descriptive list of words, then ask students: What does this community we just studied have in common with the community we studied two days ago? In what ways do the two communities differ?

SCAVENGE FOR BIOLOGICAL DIVERSITY CARDS

Find something in nature ready to burst.	Find a rock with things living on it.	Find as many animal homes as you can.
Find a smooth bud. A sticky one.	Find 10 fruits, (must be the same kind), each one different in some way.	Find a plant or animal in the shape of a triangle. A circle. An oval. A square.
Turn over a rock. How many different living things can you find?	Find an animal with more than six legs.	Listen to the woods. What sounds do you hear?
Find an animal with no legs.	Place an obstacle in the way of an animal. What does it do?	Make a mask of your favorite wild plant or animal outdoors.
Find a plant that is smooth. Rough. Prickly.	Name three benefits of biodiversity 1. 2. 3.	Find the five most common plants in two different communities. How are they alike? How are they different?
Find an evergreen your age. How are You alike? How are you different.	Find the opposite of a biodiverse place.	Be an animal detective. Find evidence that animals have been in a particular spot.
Find a biodiverse place.	Find an animal with six legs.	Find three different kinds of buds (with different colors, shape, size, scales, shininess, wooliness, etc.)

SCAVENGE FOR BIOLOGICAL DIVERSITY CARDS

Find the five most common plants in two different communities. How are they alike? How are they different?	Find the three most common plants on the ground in the woods. In a field. In a wet place. In your schoolyard.	Find animals living in the soil.
Find animals living on shrubs. Place paper or plastic on the ground and brush or shake the shrub with a stick.	Find animals living in leaf litter.	Find three different ways that plants climb.
Find three different kinds of buds (with different colors, shape, size, scales, shininess, wooliness, etc.)	Find three different animals. What words describe their shape?	Find the largest and the smallest leaves from a lawn. A tree. A shrub.
Find animals living on shrubs. Place paper or plastic on the ground and brush or shake the shrub with a stick.	What words describe the texture of two different trees, an earthworm, two different shrubs, a snail, a grass blade.	Find three different shrubs with different colored stems.
Be an animal detective. Find evidence that animals have been in a particular spot.	Look under a tree. Find all the different parts that have been shed by the tree that you can.	In the fall, find a spiderweb. Examine the remains of their captives.
Find two different trees about your height. How do the branches grow from the trunk?	In an old field community, find all the dead plant parts you can..	Find a plant and describe its habitat.
Find plants of the same kind growing in a shady spot and a sunny spot. How are they alike? How are they different?	Find six plants with protective parts (a sting or thorns). Be careful!	Make a temperature map of a biologically diverse area.

SCAVENGE FOR BIOLOGICAL DIVERSITY CARDS

Make a moisture map of a biologically diverse area.	Make a sunshine/shade map of an area that is not biologically diverse.	Find an animal predator.
Make a sunshine/shade map of a biodiverse area.	Find a plant predator.	Find a human-like face in nature.
Find out how an organism reacts to another organism.	Put your pencil point on a sheet of paper. Trace the fall of three different leaves.	Find a common plant.
Find a place where there is a plant in front of, to the left of, to the right of, and behind you.	Find a change made by humans that increased biodiversity.	Draw pictures of the life cycle of a tree.
Find a change made by humans that decreased biodiversity.	Find a change made by human that has changed biodiversity.	How many of these live in your area? ☐ animals ☐ shrubs ☐ trees ☐ spiders ☐ insects ☐ ferns ☐ mushrooms
Make a temperature map of an area that is not biologically diverse.	Observe and record a changed an organism.	Collect wild seeds. Describe them. Label their parts.
Make a moisture map of an area that is not biologically diverse.	Find out how an organism changes its environment.	Find biological diversity in a jar of water.

SCAVENGE FOR BIOLOGICAL DIVERSITY CARDS

Find two flowers that look the same but smell different.	Find a decomposer.	Find an animal home.
Name some populations in your community.	Describe two differences between a young organism and an old organism.	Watch a plant for at least ten minutes. Record the amount of time and kinds of insects that visit it.
Find evidence of the presence of earthworms. Of ants.	Find evidence of the presence of a large animal.	Find a leaf whose veins start from a central vein.
Find evidence of a plant's response to a non-living factor.	Find evidence of a plant's response to a living factor.	Find a leaf that feels hairy.
Find evidence of a plant's response to an environmental factor.	Find something living in a wild place that is also living in your community.	Find a plant whose leaves grow right next to die ground.
From where you are standing, how many different plants can you see?	Find a seed that travels by wind.	Find a leaf with holes in it.
Find a place in your community where biodiversity is threatened.	Find a leaf with parallel veins.	Find a leaf with veins that start from a central point.

SCAVENGE FOR BIOLOGICAL DIVERSITY CARDS

Find a smooth leaf.	Find a leaf with bumps.	Find a leaf whose edge (margin) is smooth. Wavy. Saw-tooth. Lobed.
Find a seed that travels by sticking to things.	Find a shrub or tree with teeth marks on the stem.	Find at least three different ways evergreen tree needles attach to branches.

OBJECTIVES

After completing this exercise the student will be able to

1. describe the effects of habitat loss of migrating birds in another part of the world.

GRADES: 6 TO 8

AZ CURRICULUM STANDARDS:
Science Standard 4 – Life science

GROUP SIZE: 25

DURATION: 2 hours

SETTING: Outdoors

MATERIALS: Lengths of rope, each one long enough to comfortably encircle the class, tent pegs. Optional: hammer.

Educator's Outline for

GOING AWAY FOR WINTER – OR, WHAT DO WE MEAN BY "OUR?"

BACKGROUND: Protecting nesting areas may be only half the job for birds that winter in Central and South America. Wisconsin, for example, had a "watch list" of 32 bird species experiencing population decline or some other problem. Seven of these species must migrate to Central and South American rainforests for the winter, and seven others migrate to other parts of South America. In Wisconsin, many of what are referred to as "our" birds depend on jungles for their winter range. These include Eastern wood pewees, veerys, parula warblers, and Canada warblers.

PROCEDURE:

1. Select a large playing area about 50 to 75 feet in length. Make a circle from each length of rope at either end of the playing area. Each circle should have one end of the rope attached to a tent peg. One circle represents the summer home range, while the other represents the winter home range.

2. These are the rules of the game. The "birds" start in the summer range, in which they may freely "fly" about and make bird sounds. You call out months; when you call out the migrating month (pick one appropriate to your area), the "birds" must fly to the winter range. At the winter range, when you call out the migrating month (pick one), the birds must fly to their summer range.

After each round of migration, make the winter range smaller. Students must be inside the winter range to survive; they must be able to range around freely and comfortably. Those that bump into one another or step on the rope are out, and can stand at the sideline. Emphasize that there is no pushing or shoving. Summer range is also declining but at a much slower rate than winter range. You may want to include this change in the game.

3. You can carry the cycle of migration to its bitter end or stop at an appropriate point. Emphasize that many, perhaps all, of these birds are not endangered or threatened with extinction — yet. They are undergoing a population

decline. Winter habitat for migrating birds is declining rapidly. (Each year, an area about the size of Pennsylvania disappears from tropical rainforests.)

4. In discussion, ask these kinds of questions:

   - What is the difference between this kind of change and an outbreak of a forest disease in an area of a tropical forest? (Emphasize short- and long-term effects.)
   - Sometimes we refer to these birds as "ours." Whose are they?
   - Is habitat loss pollution? Describe similarities and differences.
   - These birds spend part of their lives in parts of the world that are not as developed as ours. People living there want a better way of life, and one way they see to do this is by logging forests and clearing for agriculture. Can you think of any arguments that might be used to help them reconsider the destruction of tropical rainforests?
   - Why might people in these countries resist some of our arguments on beauty or it's nice to have birds around? (Emphasize economic arguments on how plants and animals can "earn" money by promoting tourism, and providing medicines and foods.)

EXTRA CREDIT: Each second, we lose an area of rainforest the size of four-fifths of a FOOTBALL FIELD, or 54 acres cleared per minute. Have kids form a rectangle 80 yards long and 50 yards wide, and imagine that area is a rainforest in the tropics. It will help if you have the area premarked at each of the corners. Tell them by the time they count 1,001, this area, once a forested tropical rainforest, has been cleared. It's gone, more than likely forever. It may be gone for agricultural land or timber or city development or a highway. The area may have been winter habitat for some of our familiar birds, if so, they have been eliminated. There is not another place for them to move to or other food for them to eat.

To represent the difference in area between 1 and 2 seconds, have kids increase the area. One end of the line should move 80 yards in one direction, then count 1001, 1002, the tick of the habitat destruction clock. In a minute the area is equal to 10 CITY BLOCKS … GOING … GOING … GONE!

OBJECTIVES

After completing this exercise the student will be able to

1. describe plants and animals of special interest in the park.

GRADES: 6 TO 8

AZ CURRICULUM STANDARDS:
Science Standard 4 – Life science

GROUP SIZE: 25

DURATION: 2 hours

SETTING: Outdoors

MATERIALS: Masking tape and pen

Educator's Outline for

WHAT EXTINCT OR ENDANGERED SPECIES AM I?

PROCEDURE :

OPTION 1. Write the name of an extinct or endangered plant or wildlife species on masking tape. Stick it to a student's back. National Park examples should be used. Indicate whether it is extinct or endangered. The student should not be able to see what species s/he is. The student then asks five to ten other students questions that can be answered only with a yes or no. Several students may use the same species.

2. After students have asked their questions, have the students form a semi-circle so that all can see, and stand one of them (or all who are the same species) with his or her back to the circle. S/he should tell the group as many things as s/he can about the species, including which one s/he thinks it is. If the student is unsuccessful, have the class help by describing its characteristics.

3. When students learn the identity of their species, take some time to add interesting information about the species. Also discuss the lesson:

   - When we say an organism is extinct, what are its chief characteristics?
   - Can you define endangered/extinct?
   - What if someone were to suggest that eventually all animals and plants will become extinct?
   - S/he asks "What's all the fuss about an endangered species?" What would you say? What is another way of looking at this? Who has another view?

OPTION 2. During a trail walk, tie the theme of extinction/endangered plants or endangered wildlife to the topic of biodiversity, which you are pointing out and discussing biodiversity. From time to time, tape the name of an endangered or extinct species on the back of a student. Have the student ask questions of her or his classmates that can be answered only with a yes or no answer. If the park trail passes through habitat that is similar to habitat requirements of the extinct/endangered species, ask students to describe and name the habitat. Use this time to discuss such issues as species protection, reintroduction plans, and problems.

Natural History: Riparian Habitat

Winding through the seemingly hostile surroundings of the arid Southwest deserts are rare, shady, cool, moist green streamside ribbons of trees, shrubs, and grasses called "riparian corridors." It is in these attenuated oases that are found some of the most diverse plant and animal species in the world.

Beaver Creek, a small tributary of the Verde River that flows past Montezuma Castle and Montezuma Well, born from snowmelt high in the pine-clad mountains to the north, is one such riparian corridor. It is representative of the most common riparian community in the American Southwest, and is a globally endangered community, which is found in fewer than 20 places in the world. Only five extensive stands of this rare forest type remain in Arizona. Even though riparian communities make up less than two percent of the land area in Arizona, they are the most biologically diverse.

As much as 90 percent of the resident wildlife in Arizona depends on riparian areas such as Beaver Creek for their very survival. Because of the harsh arid surroundings of riparian corridors, they feature a greater variety of species than can be found in more hospitable regions, such as deciduous forests in the Eastern United States. This "stream of life" provides food, water, shelter, refuge, breeding grounds, wintering habitat, and migration corridors for an amazing diversity of birds, mammals, reptiles, fishes, and amphibians. Trees found here are primarily cottonwood, willow, and sycamore, with scattered stands of walnut, ash, and alder. Deer, mountain lion, javelina, mule deer, trout, leopard frogs, raccoons, beavers, and other animals, including threatened and endangered species, use riparian corridors like this one as they move across the desert areas and travel from low elevations to high-elevation habitats. At least 400 different bird species have been found in the Verde River/Beaver Creek riparian corridor. Many migrating birds, such as the summer tanager and hooded oriole, use this and other such corridors to migrate to Central and South America every winter. Several endangered, threatened, and candidate Arizona species, including the Southwestern willow flycatcher, bald eagle, and common blackhawk, depend upon the corridor to help sustain their populations. More than 1,000 pairs per 100 acres of breeding birds have been found along the Verde River and tributary riparian communities. In fact, scarce Southwestern riverways like Beaver Creek are home to more species of breeding birds than anywhere in the world outside of tropical rainforests, and are among the highest numbers reported in North America.

Riparian environments benefit all of us. They improve water quality by filtering out toxic compounds; stabilize water supplies and moderate floods; reduce soil erosion, and stabilize stream banks; increase biodiversity by providing plant and animal habi-

tats; and providing recreation sites for human visitors. With so much life relying on this fragile environment, the value of these systems to wildlife and people is now more extreme than ever. During the last 100 years, over 95 percent of the riparian habitat in Arizona has been lost or significantly altered due to human impacts including the pumping of ground water, which drains the water from underlying aquifers; land use practices such as grazing, farming, and recreational uses altering the vegetation and surface water supply; the building of dams and straightening of river courses (channelization); and the introduction of exotic plant species such as salt cedar. The last is especially damaging, because the proliferation of salt cedar and other exotics discourages the germination of highly significant native plants like cottonwood and sycamore. It is interesting to note that native riparian habitats have been found to support the greatest number of bird species outside of tropical rainforests; and that habitats dominated by salt cedar and other exotics support many fewer species, in part because exotics provide less shade and fewer food sources.

Visitors to Montezuma Castle today can marvel at not only the well-preserved cliff dwellings that people of the Sinaguan culture occupied for over 300 years, but also the rich and relatively natural riparian environment of Beaver Creek, with its diversity of animal and plant life, that made their lives possible and productive.

Educator's Outline for

RIPARIAN RETREAT

BACKGROUND: Riparian areas have many values, including important ecological values for entire communities of life. Riparian areas are like green ribbons of life on or near watercourses (streams, lakes, ponds, etc.). They are the areas that support plant communities that grow best when their root systems are near the level of high ground water. These zones range in width from narrow ribbons in desert and mountain areas to wide bands on the plains and lowlands.

OBJECTIVES

After completing this exercise the student will be able to

1. describe the characteristics of a riparian area
2. state its importance to humans and wildlife

GRADES: 6 TO 8

AZ CURRICULUM STANDARDS:
Science Standard 4 – Life science
Language Arts Standard 3 – Listening and speaking

GROUP SIZE: 25

DURATION: 1 to 2 hours

SETTING: Classroom

Riparian areas provide space, shelter, and food for both food and wildlife. Riparian areas create food for the plant and animal communities with which they are associated. For example, leaves and insects that have fallen from vegetation into a stream provide nourishment for some aquatic life. Vegetation may also provide shade from the sun for aquatic plants and animals and land-dwelling creatures at the water's edge.

The riparian zone may serve as a buffer between the uplands and the water. Riparian areas are also transportation corridors or highways for animals that depend on water bodies for food and shelter. The banks of riparian areas store water during periods of high flow such as rainstorms or snowmelt and release this water to the stream at low flow times. Riparian vegetation strengthens the stream banks. This tends to prevent erosion and maintains the stream channel, keeping the water clear. The riparian plant community, especially shrubs and trees, provides shelter for animals as large as deer. Trees and marshy areas provide shelter for nesting birds and the banks provide homes for burrowing animals.

Among the many values of riparian areas, they have esthetic and recreational values for humans. They are used for fishing, hiking, camping, picnicking, and resting.

The major purpose of this activity is to familiarize students with the characteristics of riparian habitats and ecosystems.

PROCEDURE:

1. Find out if anyone has ever been to a stream or riverbank. What was it like? Were there plants growing there? What did the area look like? Was it hot or cool? Encourage the students to talk and share descriptions of areas by a stream or riverbank that they have been to or that they have seen pictures of.

2. Next tell the students that the kind of area they have been describing has a special name. It is called a "riparian area." Riparian areas are important natural areas for people and wildlife. Next, ask the children to get comfortable and close their eyes and listen, and imagine the place you will be describing. They will be imagining these things from their own point of view, as themselves, in the setting you will describe.

"It is a hot summer day. You are in a meadow spread with knee-high grasses and, here and there, masses of tiny blue wildflowers. The ground beneath your feet is uneven, but you are not in a hurry as you walk slowly toward a grove of trees. As you near the trees, you notice the changing colors of green you see. A breeze whispers through, showing first shiny green, then dull green sides of the leaves. As you step into the grove of trees, you are surrounded by a welcome coolness. You immediately feel the protection of the canopy of green above your head. A tap-tap-tapping sound breaks into your thoughts. Searching about among the rough-barked trunks, your eyes finally spot a bird, black and white with a touch of red on its head, clinging to a vertical tree trunk and bobbing its head in time to the rhythmic tapping.

"Breathing deeply, you fill your senses with not only the vision and the cool, but now, the very scent of 'green.' The aroma of earth and growing things is strong, and you detect here and there almost a memory of the sweet perfume of the flowers, and once in a while a pungent but not unpleasant drift of wet soil and the deteriorating leaves and grasses of last season.

"Wandering, you notice once-closely-packed tree trunks becoming farther apart and grasses that come to your knees being overshadowed by chest-high bushes. Although these bushes have no thorns, they nevertheless snag your shirt and pant legs. Your exposed arms are lightly scratched by the fine twig ends. Several of the bushes are covered with small berries: pink and pale green, blushing into red in the warm sun.

"Farther on, the bushes are taller. You find yourself pulling aside thick, taut willows taller than your head. You carefully choose a safe path along the precarious trail beneath your feet. Suddenly your left foot drops six inches and, looking down to examine the terrain more closely, you note the tunnel of a burrowing creature collapsed by your weight. Moving on again you feel the whisper of an abandoned spider web touch the side of your face. Brushing it aside, you notice that the slope of the land is steeper. You pause, listening ... listening.

"You hear the high drone of insects ... it has come upon you so gradually that you are surprised that you didn't hear it before ... now it seems almost frighteningly loud. And beneath the buzzing drone, and lower in pitch and volume, is the sound of water gently spilling over rocks.

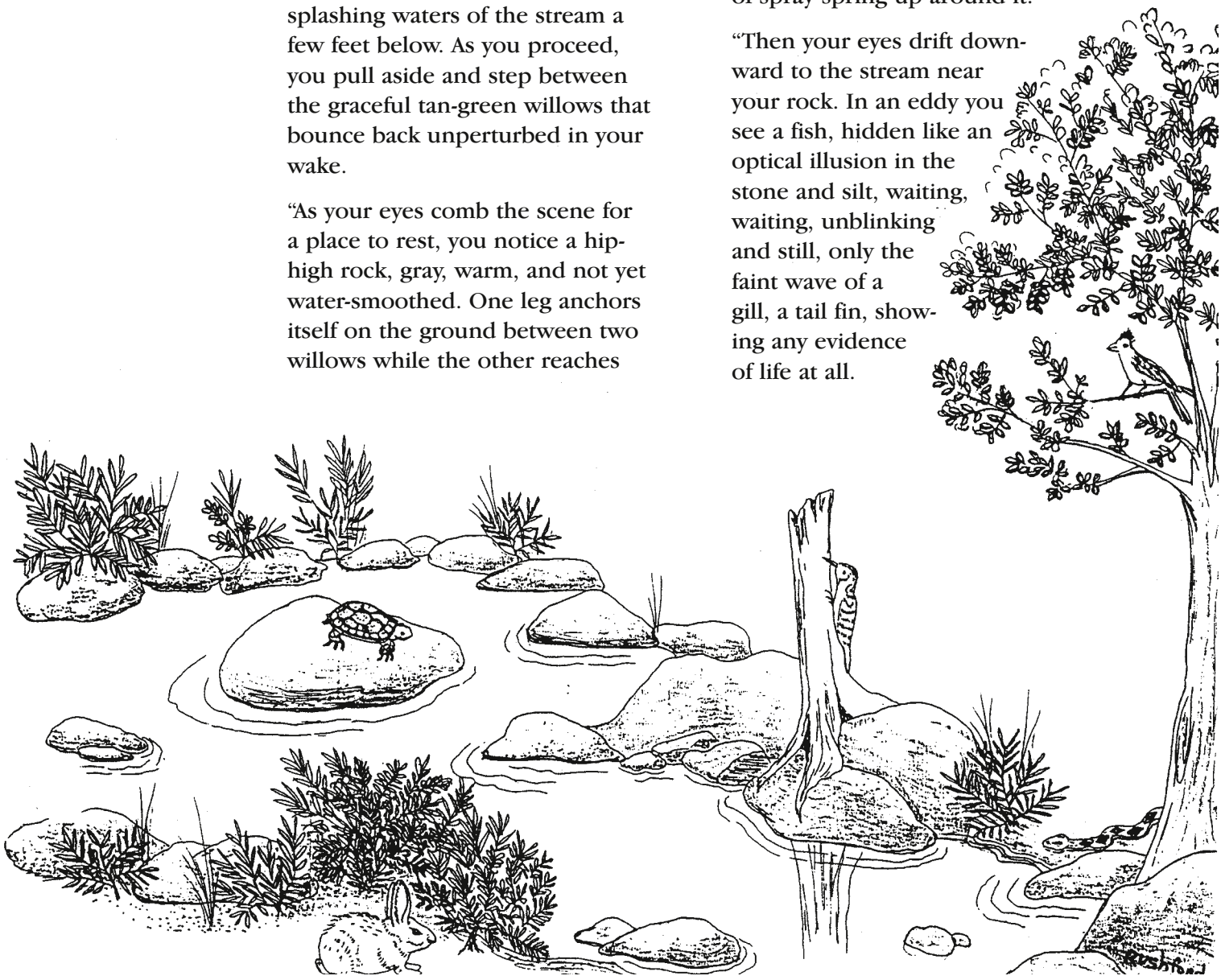
"Above the water you see thou-

sands of minute milling spots before your eyes, the creators of that high buzzing sound. It is made by hundreds of swarming insects in a mass, too thick to enter. A dragonfly flashes by with its iridescent pinks and greens, darting here, pausing, darting there, pausing, snatching dozens of the dots, relishing a meal in an unending bug buffet.

"You step aside, ducking beneath the swarming bugs. You smile as your eyes come to rest on the splashing waters of the stream a few feet below. As you proceed, you pull aside and step between the graceful tan-green willows that bounce back unperturbed in your wake.

"As your eyes comb the scene for a place to rest, you notice a hip-high rock, gray, warm, and not yet water-smoothed. One leg anchors itself on the ground between two willows while the other reaches over the water to the rock. You pause and bend toward the water, gathering a handful of pebbles from the streambed. With the pebbles in your hand you swing up onto the warm, gray perch of the rock. You settle down and look at the still-wet pebbles... gray, pink, tan, and cool in your warm hand. After you examine them carefully, you toss the stones one at a time into the stream, listening to the pleasing plop of stone on water and watching the white fountain of spray spring up around it.

"Then your eyes drift downward to the stream near your rock. In an eddy you see a fish, hidden like an optical illusion in the stone and silt, waiting, waiting, unblinking and still, only the faint wave of a gill, a tail fin, showing any evidence of life at all.



"You watch to follow the fish a few feet until it blends too much with rocks and ripples. As your eyes continue downstream, you catch sight of a small, brown animal sliding into the water. A slight splash on the stream's edge announces the disappearance of its paws, another splash a few feet away precedes a fur-slicked head plowing its way to the opposite bank. Again you see the sleek body as it disappears silently into a clump of reeds.

"As you continue to look downstream you notice that all kinds of small insects are now dancing across and above the water. A small ripple occurs in the water, then another and another. You realize that the fish are rising up from below their water homes and feeding on the bug hatch.

"Several yards downstream, a frog begins to croak. Much nearer, another frog offers a complacent reply. You look around to see if you can find the source of the reply, think that you spot it, but then realize, with a smile, that it is a small, gray-green frog hopping now through the brush.

"You search for a moment more as more frogs telegraph their messages back and forth. You slowly get up from your rock along the streamside and head back home."

3. Ask the students to continue to sit quietly with their eyes closed and review the whole experience. Ask them to pay particular attention to their favorite images. Tell them they are going to be asked to describe this setting as they saw it. Invite them to open their eyes.

4. Ask them to describe their favorite images. Optional: Once each student has done this, invite all of the students to select art materials. Each should draw or paint his or her favorite images on the paper provided. Once they are finished, have the students tape up their artwork on a display area.

5. Ask the students to identify some of the characteristics of riparian areas. Also ask them to hypothesize some of the many reasons that riparian areas are important and have value — intrinsically to wildlife, and to people.

EXTRA CREDIT:

1. Visit a riparian habitat. Look for things that you encountered on your imagery. List things that were not in your imagery.

2. Generate a list of things that could be done to make it possible for people to visit a riparian area without damaging or destroying it.

Educator's Outline for

BLUE RIBBON NICHE

BACKGROUND: Each animal in a community has a role — an "occupation." This role is called its ecological niche. The niche includes such things as the animal's preferences for food, shelter, and space. If niche is an animal's "occupation," then habitat is its "address." This activity is designed to focus on riparian niches and habitats.

OBJECTIVES

After completing this exercise the student will be able to

1. identify the ecological role (niche) of different organisms that live in riparian habitats
2. describe the basic characteristics of riparian habitats
3. describe conditions that affect riparian habitats

GRADES: 6 TO 8

AZ CURRICULUM STANDARDS:
Science Standard 4 – Life science

GROUP SIZE: 25

DURATION: 2 hours

SETTING: Outdoors

MATERIALS: A variety of art materials: e.g., paint, clay papier-mache, glue, wire, string, brushes, construction paper. Nature magazines for photos (optional), reference books.

Traditionally, a riparian zone has been defined as a distinctive habitat dependent upon the flowing water from a stream or river. However, some biologists extend the definition to include standing and even sub-surface water. Riparian zones contain a wide variety of wildlife and vegetation. Many animals that live here cannot survive without the special conditions that the riparian zone provides. Riparian areas often provide more shade, higher humidity, and more diversity in animals and plants than surrounding areas. The width of a riparian area depends on the amount of available water, soil types, minerals, water table, geologic structures, and many other factors. Riparian habitats are both aquatic and terrestrial, and are characterized by wide diversity in life forms.

In such settings, animals favoring riparian habitats fill niches. For example, frogs are commonly found in areas of calm waters in riparian zones. Frogs are predators, once they mature beyond their algae-eating tadpole stages. They need moisture, sunlight, and grasses or other vegetative shelter. Their eggs must be deposited in water that is permanent enough to allow a year-long period to hatch, grow into gilled tadpoles, and finally transform into insect-eating, air-breathing frogs. Fish and wading birds prey on both. Raccoons, foxes, and other animals eat both tadpoles and frogs, a well as fish. It is the interrelatedness of all these "occupations" and "addresses" that characterize the uniqueness and beauty of riparian zones.

Riparian areas are easily affected by natural and human-caused changes. Spring flooding and flash floods dramatically affect vegetation and wildlife. Excessive use of riparian areas by humans, livestock, and wildlife can result in destruction of riparian vegetation and destabilization of the stream or riverbank, causing

increased rates of erosion. In arid areas of the west, whole stream flows have been diverted from original channels to provide water for farming and livestock use. Development and recreational pressures also threaten this unique habitat. Riparian zones are fragile and can be destroyed easily.

The major purpose of this activity is for students to become familiar with some of the characteristics of riparian species, niches, and habitats.

PROCEDURE: This activity is designed to involve a visit to an actual stream site. If this is not possible, see the "variation" for an alternative approach.

1. Select a local stream or standing body of water that the students may have some familiarity with. Tell the students that dozens of different animals and plants live in, around, above, and below that aquatic habitat. Ask the students to generate a list of the animals that they think live in the water and its nearby environment. The water and its associated ecosystems may be considered a "riparian" area.

2. Assist the students in verifying which of the animals they list actually do live in your region and might live in this area. The list may be obvious, making it possible for you and the students to quickly decide. However, some animals may be in question, and you may want the students to consult references. Also, without additional research, many animals may not be identified which do live in the area.

3. Once the list is verified, have the students each choose an organism. Ask each student to create an artform. representation of his or her animal. They can use drawing, painting, collage, sculpture, magazine image, or any other art form of their choice. Be sure to ask the students to make their work durable enough to be displayed out of doors. Each art form should have a hook, string, or support to allow it to be hung on branches, stuck in the soil, or placed on a solid surface.

4. The students should be familiar with how the organism they have chosen "makes a living." That is, they should know its occupational role in the habitat. They should know what animals or plants their organism depends upon and which organism depends upon their animal. Discuss the concepts of niche and habitat with the students at this point for emphasis. Habitat is the animal's "address." Niche is the animal's "occupation" at that address.

5. The next step is to visit the riparian habitat that was selected in the first procedure. Emphasize personal safety and regard for the habitat. Select a "starting place" where the entire class can gather.

6. Ask the students to place their animals in appropriate places within the habitat. Tell the students to stay in a limited area so that all of the animals can be seen from the starling place. After each animal is placed in its appropriate spot in the habitat, have all the students return to the starting place.

7. Ask each student to go to his or her animal — one by one — to tell about the

animal and its niche in two or three sentences. Make sure all of the students can hear one another clearly during this process. Once each of the students has done this, gather the students together and discuss the concepts of niches and interrelatedness.

8. From the starting place, point out the effects the body of water has on the surrounding area. Introduce the word "riparian" to the discussion. Have the students identify and discuss the characteristics of riparian habitats. Ask them to consider things that might change this riparian habitat as a suitable place for their organism to live. Identify, if possible, examples of changes that would have negative consequences for one or more kinds of animals. Identify, if possible, examples of changes that would have positive consequences for one or more kinds of animals.

9. Have one or two students volunteer to demonstrate the consequences of a change that would damage the habitat for one or more of the animals. They could do this by removing the animals that would be immediately affected by the change. For example, severe pollution would affect the aquatic dwellers — fish, frogs, mosquitoes, etc. Ask the students to discuss the possible effects on the remaining animals in the area. Repeat with a different change; e.g. fire development, damming, stream diversion.

10. Ask the students to summarize what they have learned about niche, habitat, and riparian environments. Ask the students to gather their artwork animals from the environment and return to the classroom.

VARIATION: There is no substitute for the quality of experience gained from an actual site visit. If, however, a site visit is impossible, these alternatives are possible:

1. Create a simulated riparian area on the school grounds using chalk, paper cutouts, and other materials.

2. Limit the scale of a simulated riparian area to the classroom — or even a tabletop!

EXTRA CREDITS:

1. Have the students identify the basic niches found in all enviromments: producers, consumers, and decomposers. Break down the consumer category into predator and prey groupings. Identify animals in each grouping for local riparian and aquatic habitats.

2. Discuss what types of natural and human-caused changes could affect riparian areas.

3. Investigate what kind of repairs can be done to riparian zones after extensive damage has occurred. If it seems useful and appropriate, explore the possibility of a riparian restoration team working in your community to reinstate the health of any riparian areas that have been degraded.

OBJECTIVES

After completing this exercise the student will be able to

1. list and describe the effects of habitat loss on migrating waterfowl.

GRADES: 6 TO 8

AZ CURRICULUM STANDARDS:
Science Standard 4 — Life science

GROUP SIZE: 30

DURATION: 2 hours

SETTING: Playing field/Gym

MATERIALS: Large playing field or gym, paper plates–two for every three students, clearly marked to differentiate top from bottom.

Educator's Outline for

DUCKS LIMITED

BACKGROUND: Ducks are remarkable migrating waterfowl. They require the presence of wetlands in their breeding habitat and their wintering grounds. And because these two regions are often thousands of miles apart, they need wetlands to provide them with food and rest in between.

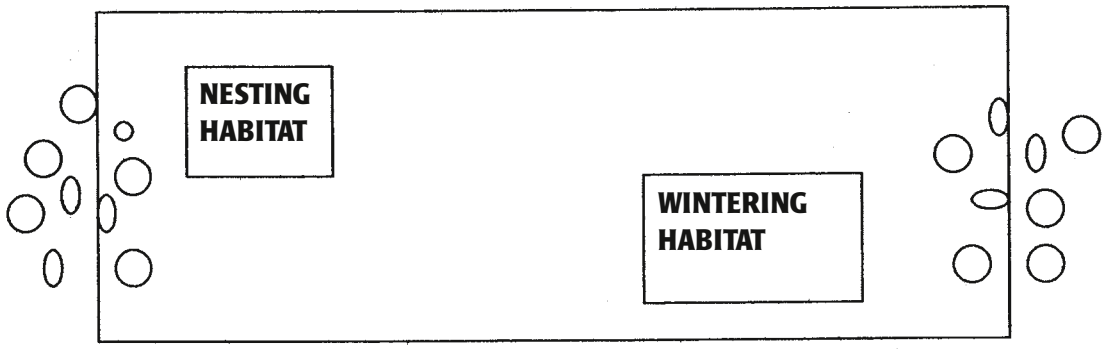
The primary threat to the welfare of waterfowl is the disappearance of wetlands. Without them, dozens of species of ducks, geese, and swans face loss of necessary habitat for survival. Wetlands are dominantly lost to agriculture and commercial development. Many federal, state, and private groups recognize the importance of wetlands to wildlife and are actively trying to preserve these habitats for local wildlife and the vast flocks of migratory birds that span continents on their journeys.

Migration is a mysterious topic for most. How do birds, fish, mammals, and insects travel the immense distances they do with such exactness? Some travel at night, some during the day and others deep within the sea. Yet, unerringly, they locate habitats necessary for the continuation of their species. Scientists proposed that they use the stars, the sun, even the earth's magnetic field for guidance. Other animals, such as salmon, seem to use smell to guide them home from the sea.

The migration routes of North American wildfowl are well known. Their journeys take them over lands in which human use is ever increasing. Agriculture, development, and industry are all diminishing the natural wetlands. Pollution, through pesticides and herbicides, as well as residual lead rather than steel shot from hunting, all take their toll. Natural conditions also affect the migratory birds. Predators, weather, disease, and fire influence both the animals and their habitat.

In this activity we have chosen to simplify the events of migration so as to keep the simulation manageable. In doing so, we have avoided increasing the complexity of involvement between nesting and wintering areas. In actuality, many of the hazards faced by migrating waterfowl are hazards en route. We guide the teacher to emphasize these in discussion rather than during the simulation. Each student (assuming a class size of 30) represents thousands, if not tens of thousands, of waterfowl. Thus the introduction of natural predators, hunters, and short-term contact events was avoided in favor of the long-term loss of habitat.

The major purpose of this activity is for students to dynamically experience some of the major habitat factors, which can affect the successful migration of aquatic birds.



PROCEDURE:

1. Select a large playing area about 70 feet in length. Place the paper plates in two patches on the playing field as shown below:
   Choose the number of plates so that you have one plate for each three students at each end of the field. Designate one of these areas the "wintering habitat" and the other the "nesting habitat." This means you have two sets of plate; one set at the nesting habitat and one set at the wintering habitat.

2. Explain to the students that they are waterfowl and will migrate between these two area; at your signal. Have them understand that the paper plates represent wetlands that provide suitable habitat for them. At the end of each journey they will have to have one foot on a paper plate in order to be allowed to continue. If they cannot get their foot on a plate, they have to move — at least temporarily — to the sideline and watch.

3. Explain to the students that many factors will be affecting these two habitats, causing changes. There will be times of abundant food, water, shelter, and space suitably arranged to meet the habitat requirements of the birds. There will be times when the habitat is stressed, with many factors limiting the potential for ducks to survive. Sometimes the area for available habitat is reduced. Tell the students that for the purposes of this activity only three ducks can occupy a "habitat haven" (paper plate) at any one time.

4. Begin the activity with all the students at the wintering habitat. Announce the beginning of the first migration. On the first try, all the ducks will successfully migrate to the nesting habitat.

5. Explain that there has been no loss in the area of available habitat. Thus, a successful nesting season is at hand. Repeat the instruction to migrate, and

send the ducks to the wintering habitat.

6. Before the students migrate toward the wintering habitat, remove a plate from the wintering habitat.

7. Explain that a large wetland area has been drained and used for agricultural purposes. Have three students stand on the sideline. Emphasize that the loss of habitat caused them to die.

Note: Remind these students that they have a chance to get back in the game. They can come back only if there is available habitat in the nesting ground. If so, they would represent new surviving hatchlings. Instruct them to move to the sidelines of the nesting habitat and wait.

8. Before the next migration to the nesting region, turn over four plates in the nesting habitat. This represents a catastrophic loss. Tell the students that this is the result of an oil spill in the local river, severely damaging shoreline habitat. Instruct the students to migrate.

Note: This results in a large number of students waiting on the sidelines to re-enter in the nesting habitat. Before many cycles are repeated, provide them with re-entry. Each time give the students examples of changes in the habitat conditions that could have taken place, making it possible for them to survive.

9. Repeat the process many cycles as you think are necessary to illustrate habitat variables. Add and subtract wetland, with indication of causes. Emphasize the variety of conditions that can affect habitat. For example:

Factors Limiting Survival of Populations of Migratory Birds

- wetland drainage
- drought
- pollution/contamination
- urban expansion
- conversion to farm land
- converting waterways to canals
- overhunting
- Lead shot in food supply
- disease
- etc.

Factors Conducive to survival of Populations of Migratory Birds

- preservation of wetlands

- high rainfall
- restoration of habitat
- dynamic balance with natural predators
- regulation of hunting and human predation
- etc.

Some limiting factors are a natural and dynamic part of any environment. However, the significant difference in the case of the survival of populations of migratory aquatic birds seems to be the loss of huge areas of suitable habitat, much of it loss by human intervention, e.g., the draining of wetlands.

Be sure to create one or more "disaster" years to illustrate the catastrophic loss of large areas of available habitat. Do remember that, overall, habitat for migratory aquatic birds is diminishing. The activity should end with fewer areas of available habitat that can accommodate all the ducks. The greatest long-term threat to populations of migratory waterfowl is loss of habitat.

10. In discussion, ask the students to identify the apparent causes of duck population decline from year to year. Ask them to imagine what seem to be the major factors contributing to the temporary and permanent loss of habitat for the ducks. Distinguish between short-term (temporary) and long-term (permanent) impacts. Distinguish between catastrophic impacts and gradual changes. Ask the students to support their hypothesis with evidence, seeking additional information through research if necessary.
11. Ask the students to summarize what they have learned about some of the many factors that affect the success of aquatic bird migration. Emphasize the difference between human-caused factors and natural factors.
12. What kind of things can and should be done to stabilize both nesting and wintering habitats and stabilize waterfowl populations? Discuss potential tradeoffs related to any recommendations.

DUCKS LIMITED

1. Explore habitat loss or gain in your community.

2. Research the causes for long-term habitat loss, as well as efforts underway in North America to prevent these increasing losses.

3. Research the natural history of a migratory bird species, including how they navigate.

4. Using a map, plot the major migratory route of North American birds.

5. Visit a wildlife refuge, park or other habitat for migratory waterfowl.

6. What other animals migrate? Are the problems they face similar to ducks?

Educator's Outline for

THE EDGE OF HOME

BACKGROUND: The idea of edges is an exciting concept. It evokes the image of exploration in our minds. It is a powerful metaphor in our culture — the cutting edge, the edge of space, are all commonplace expressions of the excitement of edges. The edges of ecosystems are exciting as well. They represent the places where the evidence of difference is most present. Ecology is the study of the interactions between living things and their environments. Ecology comes from the Greek word oikos, which means "home." The word ecosystem refers to an area where all the living and nonliving things share common interrelatedness — a place formed by the interaction of communities of life forms and their environments. When we use the phrase "edge effect" we are referring to the dynamic relationships that exist where the home territories of various organisms overlap — where habitat types come together. These edges are seldom distinct lines; instead they are usually places where overlap occurs. The whole area or place where there is overlap is called an ecotone. Traditionally, ecotone is defined as the place where two plant communities come together. Here we will use a more expanded definition and include all organisms. It is the ecotone and edge effects contained within it that we will explore in this activity.

OBJECTIVES

After completing this exercise the student will be able to

1. identify the characteristics of ecotones or edge conditions in wildlife habitat near their communities
2. evaluate alternatives for maintaining the habitat to support a diversity of wildlife

GRADES: 6 TO 8

AZ CURRICULUM STANDARDS:
Science Standard 4 – Life science

GROUP SIZE: 25 to 30

DURATION: 2 hours

SETTING: Outdoors

MATERIALS: Poster paints or watercolors, pencils, paper, clipboards, camera (optional). Varied resources as needed: maps, copies of local ordinances, names and phone numbers of officials, habitat specialists, etc..

In local communities, there are abundant edges and edge overlaps. The most accessible is the edge of the school ground. Others, such as stream banks, lake shores, and marsh edges, may be found within walking distance from many schools. Although exploring many edges involves only small parts of ecosystems, it does provide opportunities for understanding the dynamics of change, which take place in wildlife habitats.

In ecotones, direct or indirect evidence for the influence of dominant ecosystems is readily found. The area of overlap tends to be more complex than either ecosystem by itself. For example, in an overlap of forest and marsh, it is common to find forest species growing within the marsh. Trees of the forest, for example, are often malformed in a marsh due to the conditions of excess water.

On occasion they will die and the edges will be strewn with their remnants. In addition to the abundance of life forms commonly seen, indirect evidence abounds — footprints, scat, feathers, etc. — all testimony to the dynamics of such settings. The high activity of ecotones also assures diversity — and diversity means more wildlife. The absence of diversity of life forms in ecotones is often an indication of problems in the ecosystems involved.

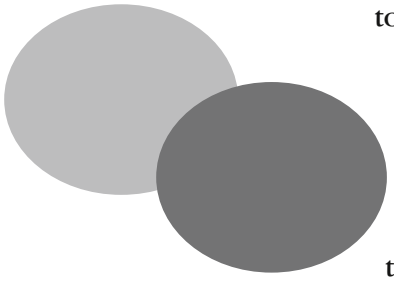
Since "edges" also attract humans, there is the possibility of damage to the ecotone that can affect wildlife. Marshes are often drained or filled in for construction or agriculture. Natural forest near homes is often removed for lawns and gardens. Streams are frequently damned or diverted and rivers channelized to allow boating or shipping.

Evidence of human litter and other refuse on a lakeshore or stream bank are indicators of other human-created problems. Fish kills and a prolonged absence of waterfowl may indicate contaminated water and loss of wetlands. In the face of such indicators, individuals can take action to make a difference. Particularly beginning with small ecosystems, efforts can be made to enhance the likelihood of meeting animals' needs for survival.

The major purpose of this activity is for students to examine the edges of a variety of wildlife habitats; analyze these edges; assess the appropriateness if taking action to enhance the characteristics of a habitat for its capacities to support diverse wildlife; and take action to put their plan into effect if it seems appropriate.

PROCEDURE:

1. Have the students paint two large spots of two different colors on a single piece of paper. Blue and yellow are good choices. Invite them to enlarge the spots until they "touch" each other but do not overlap. On a separate sheet of paper ask them to repeat the process so that the colors not only touch but also overlap. With blue and yellow the overlap produces green and is thus highly visible.



2. Tell the students that you are going to soon take them to a natural setting where there are places that overlap like their paintings did. Tell them that they are going to investigate these places, including the areas where there is some kind of "overlap." First, invite them to sit quietly with their eyes closed and imagine a place where two different environments have come together. Encourage them to visualize what things would be like in the middle of the area where the two environments have come together. Then ask them to concentrate their imagination on the edges of the places where the settings come together. Have them pay careful attention to what things would be like where the settings actually overlapped.

3. Next, ask the students to open their eyes and gather together in groups of

five. Ask them to discuss the concept of edges and the idea of how two different environments or ecosystems could overlap.

4. On the chalkboard draw two large overlapping circles. Put a large number of small squares and triangles in one circle. Avoid the overlap. In the second circle, draw many tiny circles and stars, again avoiding the overlap area. Ask the students to predict what kind of things they would expect to find in the overlapping circles. Draw circles, squares, triangles, and stars in the area of overlap.

Ask the students where the greatest diversity exists. Label the whole area of the overlap the Ecotone, (This is the area of greatest diversity.) Label the two circles as Ecosystem 1 and Ecosystem 2. Ask the students to point out the "edges" of the overlap. These are the places where the two ecosystems come together and interact. The process and results of this coming together, or interaction, are called the "edge effect."

5. Take the students to the edge of the playground to study the edge effect. Choose a place where plants are invading the playground area, or the edge of the lawn where it meets a sidewalk. Have the students consider these miniature ecosystems. Invite them to list the things they find on either side of the edge. Discuss the most pronounced differences. Next, ask them to carefully examine the edge. Have them determine the degree of overlap in characteristics and how wide the zone of shared characteristics is. Point out that this is a miniature ecotone.

6. Take a class to a site in the community that has aquatic edges. You may be able to find a place where a stream enters a lake, a beach, highway edges, the edge of town, and many more that are available in the community. Once there, ask the students to describe the ecosystems. Have them determine the zone of overlap — the ecotone. Stretch a length of rope or string from one ecosystem to another, and have the students make observations every few feet along the line. It helps to mark the string or rope with flow pen bands at one-foot intervals.

Encourage them to list characteristics and inhabitants of both "ecosystems," and to list the characteristics and inhabitants of the "ecotone." Be sure to help them acknowledge both direct evidence and indirect evidence.

7. While still at the site, ask the students to analyze the relative health of the area. Have them look on either side of the "edge," area. What wildlife, if any, is in evidence? Is there diversity in the kinds of vegetation in the area? Is there evidence of wildlife diversity? Ask the students to decide what things, if any, could be changed in order to improve the area as wildlife habitat? If the area could be improved for wildlife, are the limitations of the area the result of prior human action that reduced the quality of the environment? If yes, what do those actions seem to have been? If no, what factors do seem to have affected the quality of the area as wildlife habitat?

8. When you return to the classroom, ask the students to summarize their findings and recommendations. Ask them to identify a range of possible options, and then evaluate the appropriateness or inappropriateness of any actions they might take. Consider tradeoffs involved with each. If the students recommend that there are some changes that they believe can appropriately be made to improve the area for wildlife, ask them to develop an action plan. It is recommended that the action plan involve them personally first, and other people second. For example, if there is litter at the site, the action plan might involve the students attempting to clean the site first as an indication of their commitment before meeting with public officials involved with waste removal. A letter to announce their intent would not compromise this rule. If on the other hand, the area is in good health, the students could find a way to acknowledge any people who bear responsibility for having maintained and protected the quality of the habitat.

9. When their plan of action is underway — whether to improve the environmental quality of in area or to acknowledge those who have protected environmental quality — remind the students of the importance of taking positive action. Being for something tends to be productive and constructive than being against something.

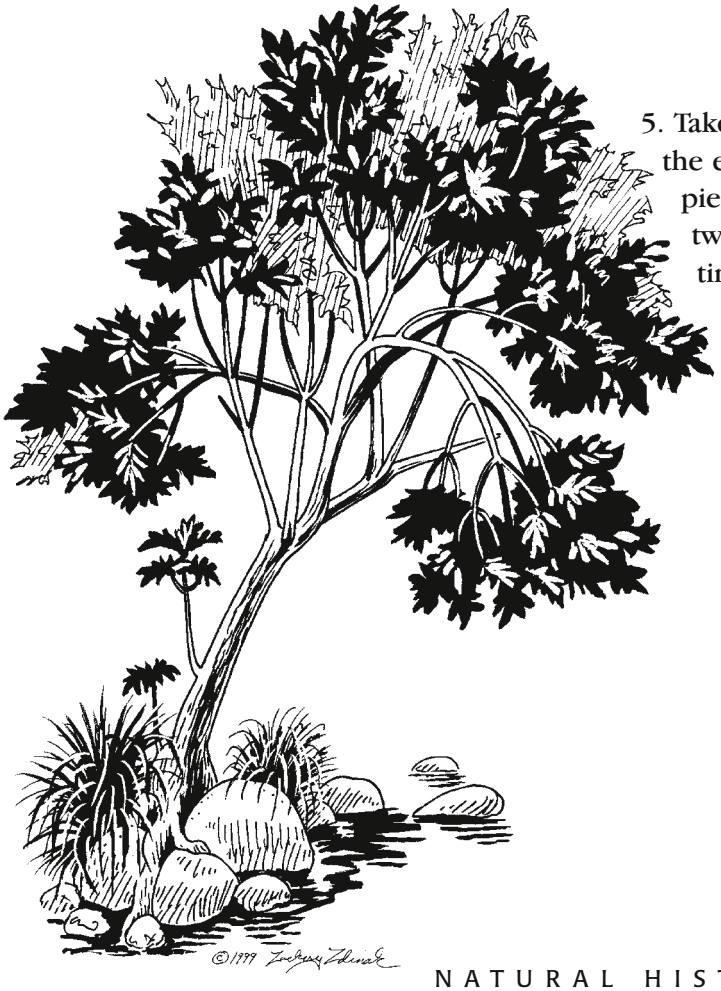
THE EDGE OF HOME

1. Continue the quest for edges! Take action to protect any in danger of being damaged or lost.

2. Identify one species of animal that lives in an aquatic habitat. Write an action plan for your community from the perspective of the needs of that animal.

3. Compare wildlife populations where aquatic and land edges meet. Determine which habitiat is most threatened.

4. Create an ecosystem map or model of your community. Indicate the location of the ecosystems and determine the relative health of the ecosystems.



5. Take a simple piece of paper and measure the edges. Cut the paper into four equal pieces; measure the edges again. Repeat twice again, measuring the edges each time. Support the idea that each new rectangle is a suitable habitat for some aquatic organism, and discuss how diversity is related to "edges."

OBJECTIVES

After completing this exercise the student will be able to

1. demonstrate their understanding of the variety of ways and reasons water is important

GRADES: 6 TO 8

AZ CURRICULUM STANDARDS:
Science Standard 4 – Life science
Science Standard 5 – Physical Science
Language Arts Standard 2 – Writing
Language Arts Standard 4 – Viewing and presenting

GROUP SIZE: 25 to 30

DURATION: 2 hours

SETTING: Outdoors

MATERIALS: Writing materials

Educator's Outline for

AQUA WORDS

BACKGROUND: Water has uses for humans and animals in our biological functions, health needs, agriculture, industrial production, recreation, esthetics, and many other areas. When students are given the time and opportunity, they can appreciate the importance of water for all living creatures.

The major purpose of this activity is for students to increase their appreciation of the importance of water.

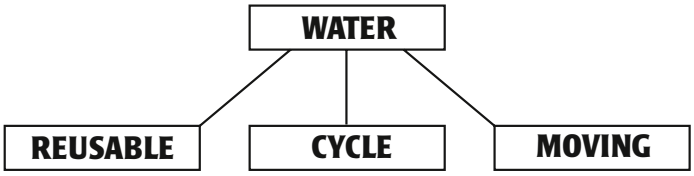
PROCEDURE:

1. Ask the students to think for a moment about some of the ways they have used water that day. Some examples may be suggested to get students warmed up for brainstorming.

2. On a long strip of butcher paper or spacious empty chalkboard, list all of the words connected to water and its importance to people and wildlife that students can name. Keep students stretching into new areas by suggesting new categories if they get bogged down. Don't quit until there are at least 100 words on the list.

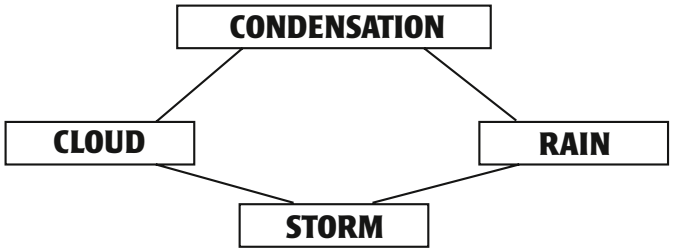
3. Have students complete several kinds of word trees using the words they have listed or others that come to mind. Begin with a simple word tree like this: Note: You could give them this example for a start if they need it.

(A)



Then move to a more diffcult word tree like this:

(B) 1 word

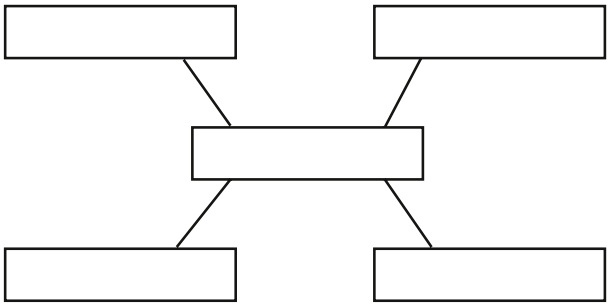


2 words related to #1

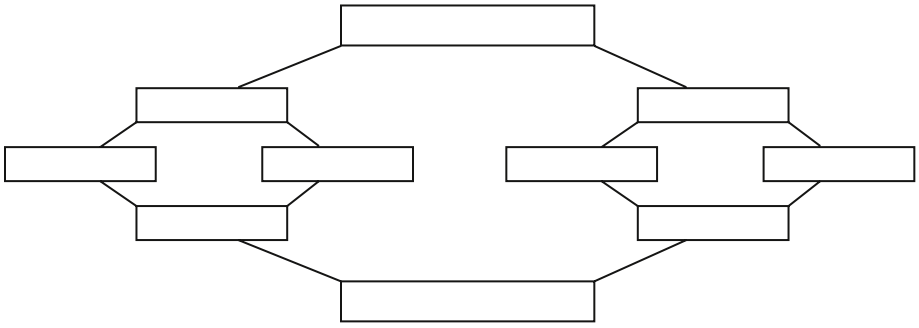
1 word that combines words #2 and #3

Finally, if possible, ask the students to create even more complex word trees like these:

(C)



(D)



In every case, words are either combined or separated, depending on how the lines link to the boxes.

Students can be provided with a handout similar to the attached form to facilitate making the word trees.

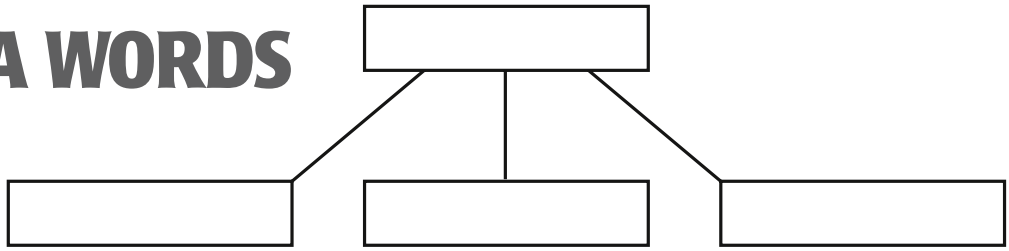
4. When students have finished several word trees, have them look at what they have done, and write one or two poetic definitions using a lot of description. These could begin: "Water..." or "Water is..." For example, using the word tree "B": "Water is gray clouds condensing into a loud summer storm."

5. When students have completed their ideas, have them write them onto various shades of blue, aqua, gray, white, and green construction paper cut in half vertically. Arrange the strips in a steam, river, pond, lake, or ocean shape, on a wall or window.

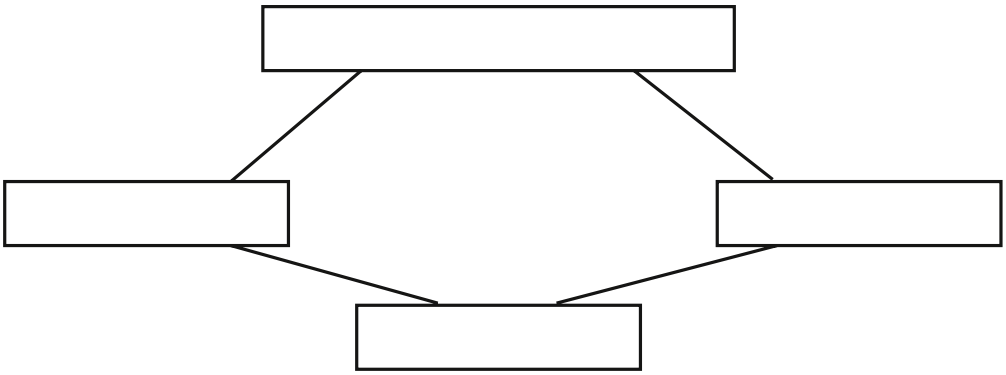
EXTRA CREDIT: An alternative project could be a class book with each student's page included. Students write their poetic definition at the bottom of the page, and illustrate — for example, with watercolors — the top of the page.

AQUA WORDS

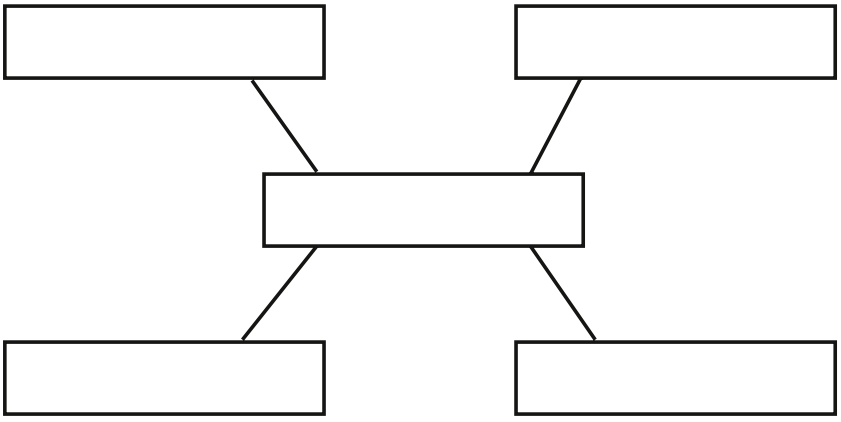
A.



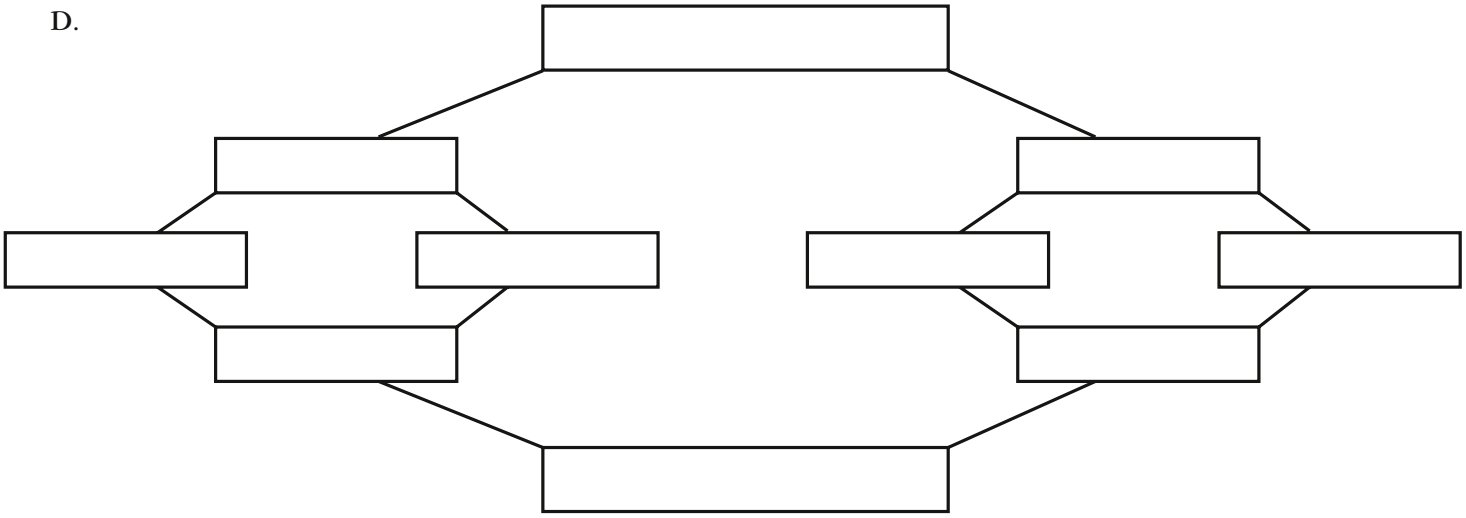
B.



C.



D.



Educator's Outline for

FASHION A FISH

BACKGROUND: Aquatic animals are the products of countless adaptations through the history of each species. These adaptations, for the most part, are characteristics that enhance the animals' likelihood for surviving in their habitat.

Often, as a habitat changes, either slowly or catastrophically, the aquatic animals with adaptations that allow them many options are the ones most likely to survive. Some creatures have adapted to such a narrow range of habitat conditions that they are extremely vulnerable to change. They are over-specialized, and are usually susceptible to death or extinction.

Fish have a variety of adaptations. Some of these adaptations are listed below.

OBJECTIVES

After completing this exercise the student will be able to

1. demonstrate their understanding of a variety of adaptations in fish

GRADES: 6 TO 8

AZ CURRICULUM STANDARDS:
Science Standard 4 – Life science

GROUP SIZE: 25

DURATION: 1 hours

SETTING: Classroom

MATERIALS: Five reproduction cards for each adaptation: mouth type, reproduction preference, body shape, coloration; art materials and paper.

MOUTH

1. Sucker-shaped mouth	algae eater
2. Elongated upper jaw	feeds on things below fish
3. Elongated lower jaw	feeds on prey above fish
4. Duckbill jaws	grasps prey
5. Extremely large jaws	surrounds prey

BODY SHAPE

1. Torpedo shape	fast-moving
2. Flat-bellied	bottom feeder
3. Vertical disk	feeds above or below
4. Horizontal disk	bottom dweller
5. Hump-backed	stable in moving waters

COLORATION

1. Light-colored belly	predators have difficulty seeing it from below
2. Dark upperside	predators have difficulty seeing it from above
3. Vertical stripes	can hide in vegetation
4. Horizontal stripes	can hide in vegetation
5. Mottled coloration	can hide in rocks and on bottom

REPRODUCTION

1. Deposits eggs on bottom	trout, salmon
2. Deposits eggs in nests	bass, stickleback
3. Floating eggs	striped bass
4. Eggs attached to vegetation	perch
5. Live bearers	guppies

The variety of fish found in aquatic habitats testifies to the number of adaptations these creatures have made. By examining the nature of adaptations in fish, students can gain greater insight into the characteristics of aquatic habitats.

The major purpose of this activity is for students to investigate the concept of adaptation in fish.

PROCEDURE:

1. Divide the adaptation cards into five groups of four cards each, one each of coloration, mouth type, body shape, and reproductive preference.

2. Pass these out to students working in groups of four to six.

3. Ask the students to "fashion a fish" from the characteristics of the cards. Each group should:

   a. create an artform that represents their fish

   b. name the fish

   c. describe and draw the habitat for their fish

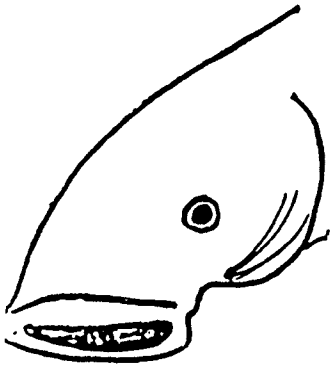
   4. Have each group report to the rest of the class about the attributes of the fish they have designed.

EXTRA CREDIT:

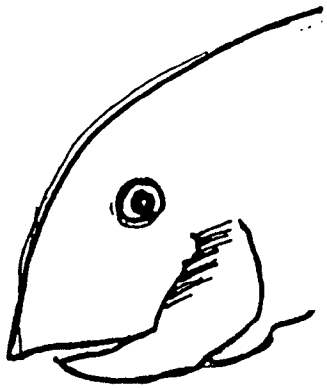
1. Provide each student with an adaptation card from any category and have him or her find real fish that have that adaptation. Note: A collection of books about fish would be necessary to gather. Do not be concerned about reading level as much as profuse illustrations.

2. Show examples of actual fish, and have the students use coloration, body shape, and mouth type to describe the fish's "lifestyle" and speculate on its habitat.

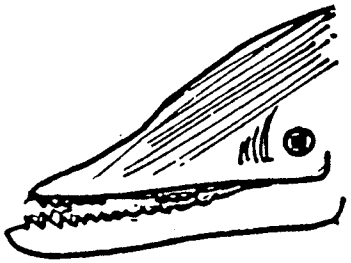
DIFFERENT KINDS OF MOUTH ADAPTATIONS



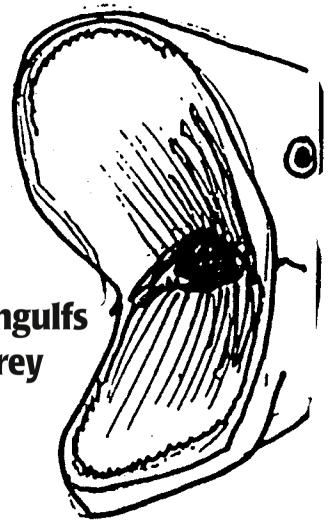
Bottom- and algae-feeders



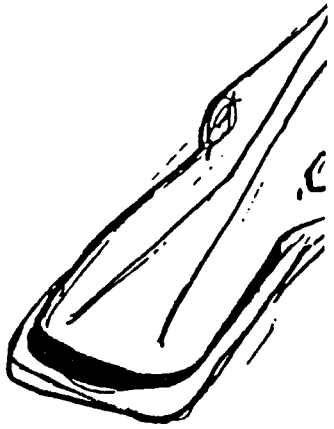
Feeds on prey below



Feeds on prey above

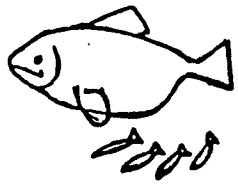


Engulfs prey

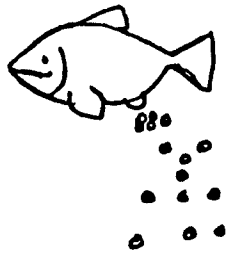


Grasps prey

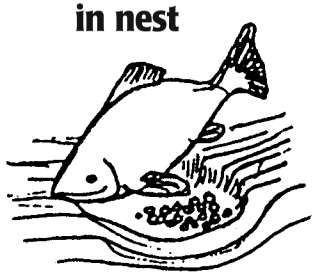
DIFFERENT KINDS OF REPRODUCTION ADAPTATIONS



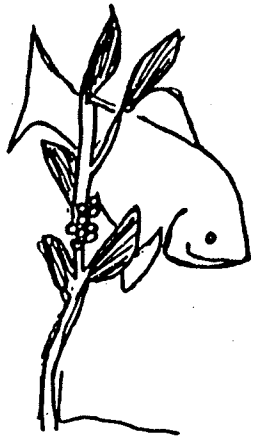
Live born young



Free-floating eggs



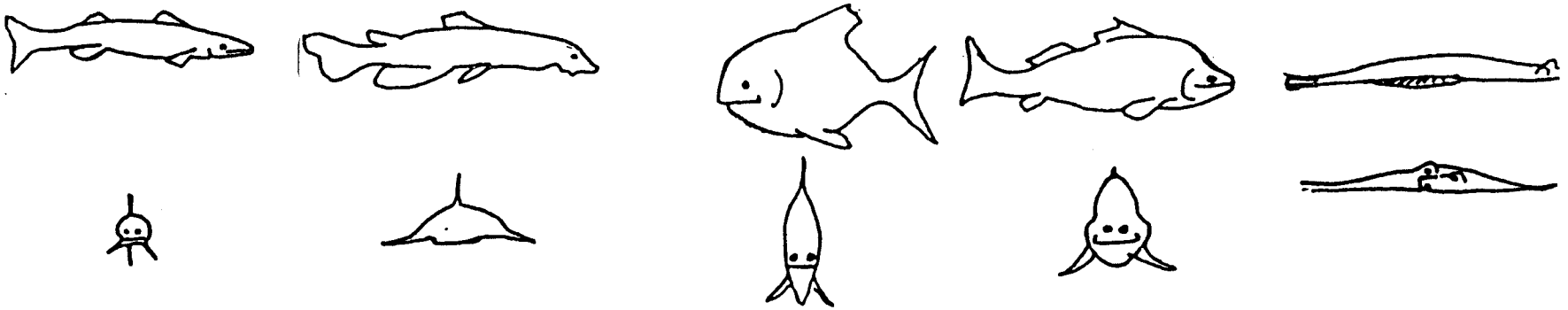
Deposits eggs in nest



Deposits eggs on vegetation

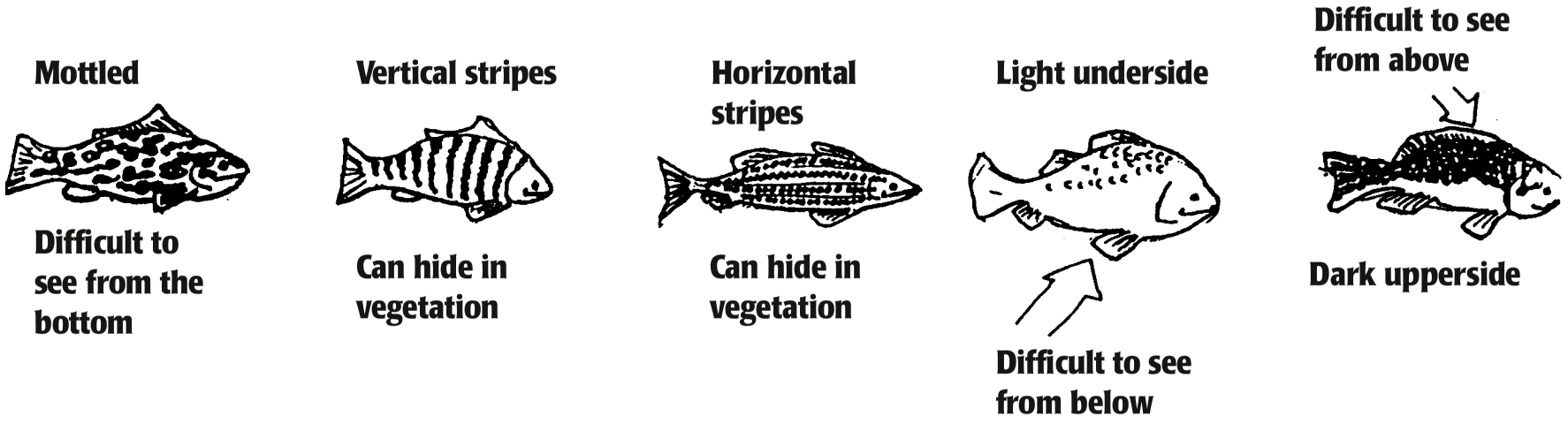
Deposits eggs on bottom

DIFFERENT KINDS OF SHAPE ADAPTATIONS



Torpedo | Flat-bellied | Vertical flat | Humpback | Horizontal flat

DIFFERENT KINDS OF COLORATION ADAPTATIONS



Background on Tavasci Marsh

Welcome to Tavasci Marsh, a natural wetland inholding of Tuzigoot National Monument presently owned by the Phelps Dodge Corporation and managed by the Arizona Department of Game and Fish.

Tavasci Marsh was named for the Tavasci family, which for many years had leased land from the mines for a dairy operation. During that time, the marsh was drained to provide grazing for cattle. Recently, management of the wetlands has been turned over to the Arizona Department of Game and Fish. Water control movements and the natural works of beaver in the area have helped the marsh return to how we see it today.

The marsh was originally formed thousands of years ago along with Peck's Lake from an old meander of the Verde River, which was left after the river cut through the limestone ridge south of where the Tuzigoot pueblo stands today.

The wetland areas of marsh and river, set in the midst of a desert landscape, are home to numerous species of plants and animals. Springs from under layers of limestone provide the water for a community of cattails and mosquito fish, as well as cottonwoods, osprey, beaver, and many other species of plants and animals.

The wetlands of Tavasci Marsh and its' environs are as valuable now as they must have been for the Ancestral Puebloan peoples of Tuzigoot. We can learn more by considering the value and function of wetlands in our world.

How was Tavasci Marsh formed?

Tavasci Marsh has probably existed for some thousands of years, and is an old channel of the Verde River. The Verde cut through the ridge south of Tuzigoot and left the meanders of what is now the marsh area and Peck's Lake cut off from the main stream. Today, Tavasci Marsh is fed by springs and augmented by water from Peck's Lake, which, in turn, has water diverted into the lake from the Verde River.

But the story has an earlier beginning, when the ancient Verde River began forming the Verde Valley almost 40 million years ago during the Oligocene epoch. In time, the river has eroded through many older layers of rock to form the Verde basin, now measuring some 20 miles wide by 30 miles long.

Around 6 to 8 million years ago, faulting and volcanic flows created dams across the river, resulting in a series of shallow lakes. Silt in the waters coming from highland limestone formations resulted in the creation of the Verde Formation, measuring some 3,000 feet deep in places.

Eventually, within the last two million years, the river cut through the dams and the lakes drained out to the southeast. Today, fossils of mollusks and other aquatic life, as well as bones and tracks of early elephant, horse, and other mammals, can occasionally be found in the Verde formation.

OBJECTIVES

After completing this exercise the student will be able to

1. understand how layers of earth are formed.

GRADES: 6 TO 8

AZ CURRICULUM STANDARDS:
Science Standard 1 – Science as inquiry
Science Standard 5 – Physical science
Science Standard 6 – Earth and space science

GROUP SIZE: 25 to 30

DURATION: 2 hours

SETTING: Tavasci Marsh

MATERIALS: I clear plastic storage tray per group of 3–4 students, 3 different blends/colors of earth, sand, rock, etc., 1 container of water.

Educator's Outline for

EARTH LAYERS

BACKGROUND: When observing earth layers, it is possible to imagine the forces of creation and destruction that aided in the arrangement of their present form, whether the layers are in a rock or a mountain. This exercise will enable students to see part of the larger picture drawn by geological study.

PROCEDURE:

1. Ask each student to pour a layer of their soil into the tray. Observe the layers, and compare with pictures of natural landforms.

2. Gently tilt the container to one side, and sprinkle water from the higher side down through the layers, washing the soil into piles.

3. Let dry for a while, then cut through the formation. What does it look like? Imagine rivers that cut through different age layers and deposited the material into a new layer younger than the old layers.

4. Have the students sketch/describe their findings.

Educator's Outline for

SOIL SAMPLES

BACKGROUND: Soil types vary and the different types are formed in different ways. Soil near rocky outcrops will reflect the nature of its origin. Beach soil along the river will show the polishing action of water.

PROCEDURE:

1. Select an area to gather soil samples from. Test areas should be selected with the approval of the land manager, and care taken to protect the area sampled from. Gather samples from three or more test areas; include soil from rocky ledges, sand from a river area, etc.
2. In the testing areas, have the students in each group take turns with the lens and view the samples, and then sketch/describe the material.
3. Measure and note the large particles, if possible.
4. Ask the students to consider how soil is made. What are the effects of wind and water, etc.?
5. Do the rocky layers show the same kind of rounding found in river samples?

OBJECTIVES

After completing this exercise the student will be able to

1. observe different characteristics from different soil plots
2. consider the different mechanisms of formation.

GRADES: 6 TO 8

AZ CURRICULUM STANDARDS:
Science Standard 5 – Physical science
Science Standard 6 – Earth and space science

GROUP SIZE: 25 to 30

DURATION: 1 hour

SETTING: Tavasci Marsh

MATERIALS: 3 containers per group of 3–4 students, hand lens, paper, pencil to sketch and describe findings, small measuring tape for each group.

OBJECTIVES

After completing this exercise the student will be able to

1. observe and consider water flow rates in different areas of the marsh/river environment.

GRADES: 6 TO 8

AZ CURRICULUM STANDARDS:
Mathmatics Standard 1 —Number sense
Science Standard 4 —Life science

GROUP SIZE: 25

DURATION: 1 hours

SETTING: Tavasci Marsh

MATERIALS: Paper and pencils for observation, watches with minute and second hand features, small floating objects that can be placed in water, measuring sticks/tapes, small compasses (optional)

Educator's Outline for

WATER FLOW

BACKGROUND: Marsh areas, streams, and rivers have their own rates of water flow, which can contribute to the different types of ecosystems associated with them. What kinds of plants and water life do we find in still ponds or fast streams? Students will observe objects in water to determine direction and rate of travel.

PROCEDURE:

1. Have the students get in small groups of 3 to 4 and go to designated areas to test the rate of water flow by measuring the distance a small floating object travels in a given time. Direction of flow may be noted with the use of a compass.

2. Ask questions of the students. What rate of flow for a given stream, marshy area, etc.? What types of plants and animals are observed in these different areas?

3. Discuss the differences between water flow rates and the kinds of plants and animals that are present in each area.

Background on Wetlands

Wetlands can be found in virtually every county of every state in the nation, from arctic tundra wetlands in Alaska, to peat bogs in the Appalachians, to riparian wetlands in the arid West. A wide variety of wetlands have formed across the country due to regional and local differences in climate, geology, topography, hydrology, soils, vegetation, water chemistry, and other factors. Although there are many different wetland types, they can be divided into two broad categories:

1. Tidal wetlands are found along our nation's coasts within reach of the ocean tides; typically vegetated by grasses and other emergent plants adapted to salt water, they can range from narrow fringes on steep shorelines to nearly flat expanses several miles wide.

2. Non-tidal wetlands account for most of the wetlands of the United States, and are found throughout the nation's interior beyond tidal effects.

Peat lands are inland wetlands containing thick deposits of slowly decaying plant material called peat. "Bogs" and "fens," the major types of peat lands, occur in old lake basins or other topographic depressions in the Great Lakes states, portions of the Northeast, the Appalachian Mountains, much of Alaska, and along the Southeastern Coastal Plain. Unusual plants such as sphagnum moss, pitcher plants, sundews, Venus flytraps, and a number of orchid species are uniquely adapted to the nutrient-poor acidic conditions found in bogs. Fens are richer in nutrients and less acidic than bogs, and are typically covered by sedges, willows, grasses, and reeds.

Southern deep water swamps are wooded wetlands of the Southeastern U.S. that have standing water for most, if not all, of the growing season. Characteristic trees in these swamps are bald cypress, Tupelo gum, and water oak.

Inland freshwater marshes, like Tavasci Marsh, include a variety of wetlands that are full of soft-stemmed plants like grasses, rushes, cattails, and water lilies. They can form in isolated depressions such as the "prairie potholes" of the upper Midwest, as fringes around lakes and ponds, or as nearly flat expanses of emergent wetlands such as those found in Everglades National Park. Wet "mountain meadows" are high-elevation freshwater wetlands found in forested and non-forested mountain regions.

Riparian wetlands form on the floodplains of rivers and streams, and are often dry for portions of the growing season. In the Southeastern U.S. "bottomland hardwood forests" are the most common type of riparian wetland. In the arid regions of the West they are common along rivers and springs and often contrast noticeably with the surrounding upland vegetation.

Environmental Quality

Water quality: Wetlands act as natural water purifiers, filtering sediment and absorbing many pollutants in surface waters. In some wetland systems, this cleansing function enhances the quality of groundwater supplies as well.

Shoreline and streambank stabilization: Shorelines and riverbanks reduce erosion by absorbing the energy of storm waves and slowing water currents.

Flood control and streamflow maintenance: Wetlands along rivers and streams store excess water during rainstorms. This reduces downstream flood damage, and lessens the risk of flash floods. The slow release of this stored water into rivers and streams helps keep them from drying up during periods of drought.

Erosion control: Wetland vegetation binds the soil and slows the downstream movement of sediment.

Wildlife habitat: Wetlands provide habitat for many species of amphibians, reptiles, birds, and mammals that are uniquely adapted to wet environments. Upland wildlife such as deer, elk, and bear commonly use wetlands for food and shelter. Wetlands are particularly vital to many migrating bird species. For example, wood ducks, mallards, and sandhill cranes winter in flooded bottomland forest and marshes in the southern U.S., and prairie potholes serve as breeding grounds for over 50% of North American waterfowl.

Fish and shellfish habitat: Freshwater and marine life, including trout, striped bass, pike, sunfish, crappie, crab, and shrimp, rely on wetlands for food, cover, spawning, and nursery grounds. Between 60% and 90% of U.S. commercial fisheries depend on wetlands.

Habitat for threatened and endangered species: About 35% of all plants and animals listed as endangered species in the United States depend on wetlands for survival, including the whooping crane, bald eagle, American crocodile, dwarf lake iris, and Eastern prairie fringed orchid.

Specialized plant habitat: Nearly 7,000 plant species live in U.S. wetlands, many of which can only survive in these wet environments.

Ecosystem productivity: Some wetland types are among the most productive ecosystems on earth. A stand of common cordgrass in a salt marsh can produce more plant material and stored energy per acre than any agricultural crop except cultivated sugarcane. Nutrients and plant material flushed from some wetland systems during storms provide essential food for plants, fish, and wildlife in estuaries and other downstream ecosystems.

Reduction of coastal storm damage: Coastal wetlands help to blunt the force of major storms. Mangrove wetlands, such as those along shorelines in Biscayne National Park in Florida, reduce flooding, coastal erosion, and property damage.

Recreational opportunities: Many wetlands contain a diversity of plants and animals that provide beautiful places for sightseeing, hiking, fishing, hunting, boating, bird watching, and photography.

Water supply: Some wetlands help provide clean, plentiful water supplies. For example, wetlands in Florida's Everglades help recharge the Biscayne aquifer, the sole source of drinking water for the Miami metropolitan area.

Education: Ecological, cultural, and historical resources are abundant in our nation's wetlands, providing countless opportunities for environmental education and public awareness programs.

Wetland origins: Although some of our wetlands have been created in as short a span as a human lifetime, many others took thousands of years to develop. Tavasci Marsh is a nontidal riparian wetland fed by springs from limestone layers of rock.

Flooding of coastal lowlands: Flooding from gradually rising sea levels has created broad coastal marshes in areas protected from wave action by barrier islands, harbors, or reefs. Coastal wetlands also form when silt is carried down river and deposited as it reaches the sea. Plants then take root and hold the soil deposits firm against the force of the tide.

River floodplains: Floodplains develop through erosion processes and through deposition of sediment or adjacent lands during floods. Wetlands form on floodplains where periodic flooding or high water tables provide sufficient moisture. These "riparian" wetlands may undergo constant change as rivers and streams form new channels and when floods scour the floodplain or deposit new material.

Glaciers: Glaciers helped to create wetlands in the northern states 9,000 to 12,000 years ago. Large wetlands formed when glaciers dammed rivers, scoured valleys, and reworked floodplains. Smaller wetlands were created when large ice blocks were left behind by receding glaciers and formed pits and depressions in the land.

Beavers: Beavers once played a more significant role in forming smaller inland wetlands by damming rivers and streams. Though trapping had greatly reduced the number of beaver in the U.S., recent wildlife protection measures have resulted in the recovery of beaver populations. Beaver dams may last in excess of 100 years, though many are shorter-lived.

Other forces of nature: Wind action in the sand hills of Nebraska formed depressions, many of which have become wetlands. Wetlands may also form in "sinkholes" and other areas where percolating water has dissolved in bedrock. Montezuma Well is a limestone sinkhole formed by the collapse of an underground cavern. Earthquakes can create wetlands by damming rivers or causing land to drop down near the water table or shoreline. Waterfalls often have lush vegetation under and around them, sustained by the spray.

People: Some "incidental" wetlands are formed when highway and dam construction, irrigation projects, or other human activities alter drainage patterns or impound water. In recent years government agencies, conservation groups, and individuals have been intentionally creating and restoring wetlands. Research is continuing to improve methods for replacing lost wetlands and the important functions and values associated with them.

OBJECTIVES

After completing this exercise the student will be able to

1. observe by using their senses
2. describe the nature of their environment

GRADES: 6 TO 8

AZ CURRICULUM STANDARDS:
Science Standard 1 — Science as inquiry

GROUP SIZE: 25

DURATION: 1 to 2 hours

SETTING: Tavasci Marsh

MATERIALS: Paper and pencil.

Educator's Outline for

WETLANDS ACTIVITIES

BACKGROUND: Observation is the focus for inquiry as inquiry is the basis for observation.

PROCEDURE:

1. Have the children walk through an area and write down what they observe with their senses, such as sunlight through leaves, a bird song, the rough texture of bark.

2. Perhaps have the children spread out in an area and sit or stand quietly while they observe and then come together in small groups to share their observations.

3. A focus may be provided, such as how many green things did we see or how many kinds of rocks or animal tracks.

4. As a classroom exercise, count the observations and note how many are visual observations and how many smells were counted, etc.

Educator's Outline for

CHAIN OF LIFE

BACKGROUND: One thing leads to another and we often forget how interactive our world is and how great things depend on the small. Students will observe the world around them and describe the relationships they see and what forces strengthen and weaken the links between those relationships.

PROCEDURE:

1. Have the students consider the food chain of who eats what.

2. Ask what would happen if a link were taken away in the food chain – for example, if one considers the mosquito larva eaten by fish, which in turn are eaten by herons, what would happen to the other links in the chain?

3. What would other factors such as pollution or dams have on the environment and the food chain?

OBJECTIVES

After completing this exercise the student will be able to

1. see and understand how the world is a vast network of links and interactions.

GRADES: 6 TO 8

AZ CURRICULUM STANDARDS:
Science Standard 4 —Life science
Science Standard 5 —Physical science

GROUP SIZE: 25

DURATION: 1 hour

SETTING: Classroom

MATERIALS: Paper and pencil, listing of plants and animals for a given area.

OBJECTIVES

After completing this exercise the student will be able to

1. use their imagination and observations to figure out how animals might perceive their environment.

GRADES: 6 TO 8

AZ CURRICULUM STANDARDS:
Science Standard 4 —Life science
Language Arts Standard 2 — Writing

GROUP SIZE: 25

DURATION: 1 to 2 hours

SETTING: Classroom

MATERIALS: Paper and pencil, imagination.

Educator's Outline for

HOW ANIMALS SEE THEIR WORLD

BACKGROUND: Animals live in and use the world in different ways. The students may use their imaginations to understand and describe the animals that live in an area and how they might live; for example, how a bird might choose nesting material, or how an owl might hear mice running through the grass at night.

PROCEDURE:

1. One way to proceed would be to have a grab bag of animals and plants in the area. Have children choose one and consider what the animal/plant must have to live—food, water, shelter, safety, etc.

2. Have students consider how various animals interact; e.g., a deer with various browse plants, a fish with predators such as a bald eagle, two birds in the same nesting area, etc.

3. Have the students create a world in which their animal or plant lives; they can do this through illustration or by writing a short essay or poem.

Educator's Outline for

WHAT WOULD HAPPEN IF?

BACKGROUND: In the arid Southwest water is often used faster than it can be replenished.

PROCEDURE: Students make use of a water table model. Set up trays with ice and soda or kool-aid. Replenish the liquid at a given rate (i.e. 1 cup per minute) while more and more students use straws to drain the reservoir.

- As the 'water table' drops encourage the students to think about how we are using our liquid resources.
- Are there other ways to recharge the ground water?

OBJECTIVES

After completing this exercise the student will be able to

1. learn about finite resources
2. the danger of over-use.

GRADES: 6 TO 8

AZ CURRICULUM STANDARDS:
Science Standard 4 –Life science
Science Standard 5 – Physical Science

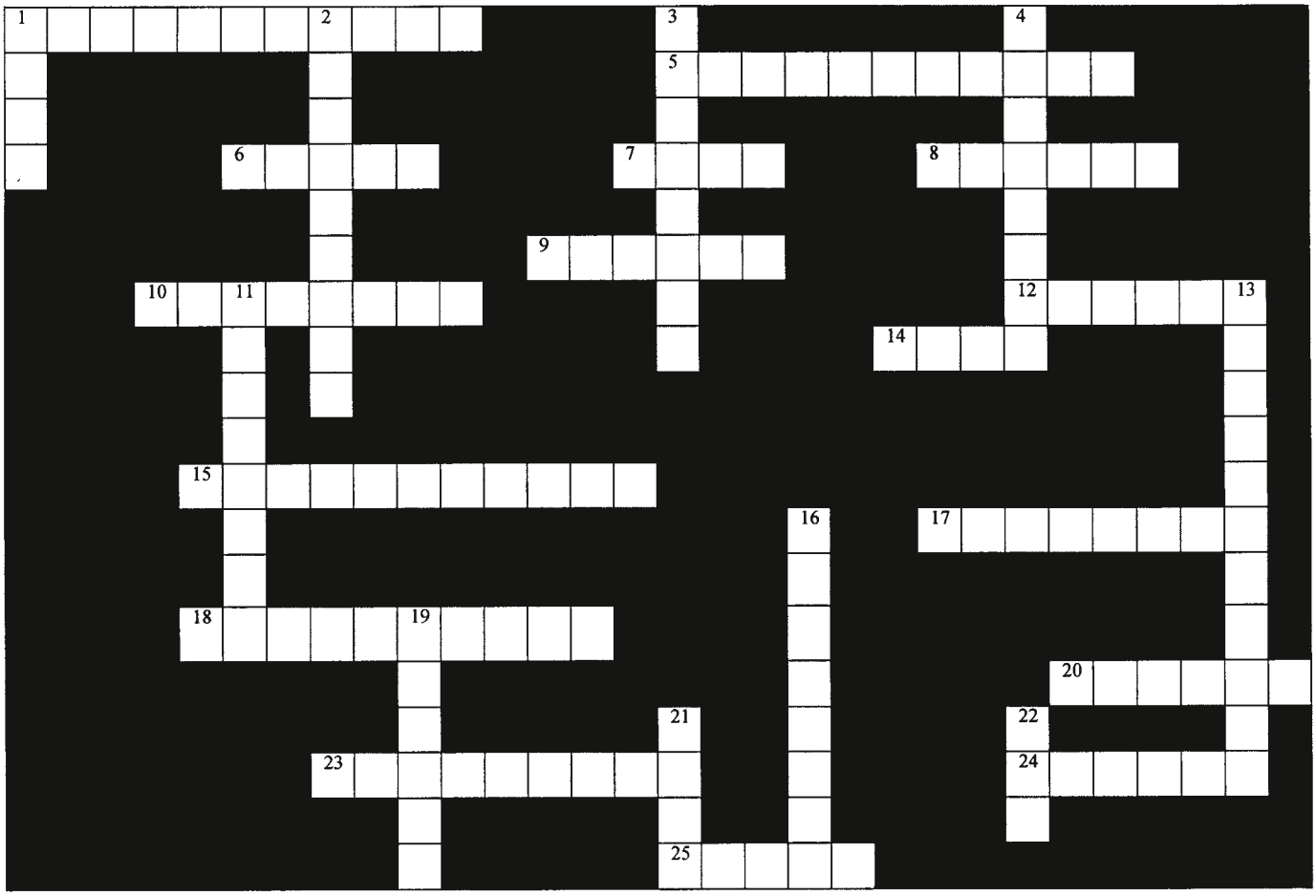
GROUP SIZE: 25

DURATION: 1 hour

SETTING: Classroom

MATERIALS: Trays of ice chips or cubes, straws, bottles of colored soda or kool-aid, water, paper and pencils.

PLANTS & ANIMALS CROSSWORD



Across

1 Cultivating crops for food
5 Poisonous viper
6 Food, "FRIJOLES"
7 Food grown on a stalk
8 Plant grown for weaving
9 Clever mammal
10 Tree with bean pods
12 Gourds grown for food
14 Food caught in the creek
15 Cactus with flat pads
17 Arachnid with tail-stinger
18 Poisonous "hour-glass" spider
20 Cotton-tailed mammal
23 Creepy crawler with 42 legs
24 Small, long-tailed reptile
25 Large black bird

Down

1 Picnic pests
2 Friendly, furry spider
3 Bush, "drugstore of the desert"
4 Bush with salty-tasting leaves
11 Small, long-tailed rock dweller
13 Tiny, colorful bird
16 Large, strong, thirsty tree
19 Black nut from a tree
21 Large mammal, "Bambi"
22 Large deer-like animal

Background on Conserving Our Natural Resources

Because of the role they play in conserving lands under their jurisdiction, national parks are often the last sanctuaries for many plants and animals. The role of the National Park Service as a protector of biological diversity is emphasized in the 1987 report of the Director's Task Force on Biological Diversity, which says, "National Parks within or containing natural areas should, first, protect biological diversity and underlying processes that maintain and generate natural biological diversity. Just about any park can be made adequate for preserving tourism, but no national park can be made adequate for preserving biological diversity without a superior investment in protection."

Many potentially important plants and animals exist within habitats protected by national parks. They are important for their economic as well as esthetic value. Their contribution to our daily welfare is tremendous: food and drink, medicines and pharmaceuticals, industrial products, transportation, energy, research, construction. We know surprisingly little about most of the earth's plants and the direct economic benefits we might enjoy from them, yet we are rapidly eliminating them. Presently, one species each day is being eliminated from the face of the earth, and that number is only expected to increase. Through the establishment of national parks, it is possible to assist in maintaining biological diversity in the natural world and slow down that elimination.

Yet scientists and park professionals realize that all of their efforts to preserve habitats and protect diversity within park boundaries will not be enough. External forces from around the world have a tremendous impact on what happens within national parks.

It is for this reason that this unit will examine the role that national parks play in maintaining and preserving biological diversity. More significantly, it will show your students why that role is an important one.

OBJECTIVES

After completing this exercise the student will be able to

1. introduced to the ideas of conservation, preservation, and protection
2. be able to determine what resources should be protected, and why

GRADES: 6 TO 8

AZ CURRICULUM STANDARDS:
Language Arts Standard 2 – Writing
Language Arts Standard 3 – Listening and Speaking

GROUP SIZE: 25

DURATION: 1 hour

SETTING:Classroom

MATERIALS: Paper, pens, pencils, various art supplies.

Educator's Outline for

DESIGN YOUR OWN NATIONAL PARK

BACKGROUND: The national park areas protect both natural and cultural resources. Parks that exhibit historic houses, grand canyons, waterfalls, battlefields, lakes, endangered species, lighthouses, marshes, and badlands can all be found within the protection of the National Park Service.

PROCEDURE:

1. On a sheet of paper, have the students design their own park. Have them represent park boundaries, and within those boundaries whatever special natural and cultural features that will be protected. These might include mountains, rivers, wetlands, canyons, springs, beaches, ancient ruins, or historic houses.

2.After the initial resource is represented, have the students include any visitor services that will be included in their park. Does the park have roads or trails? Are there campgrounds, visitor centers, gift shops, and restaurants? Remember, not all parks have visitor services. Some parks are purely wilderness areas, such as the National Park of American Samoa.

3. If time permits, have your students design a brochure that includes a park map, hours, etc

4. All parks have their own mission statement. Have the student write a mission statement for their park, including goals for preservation and visitor enjoyment.

5. Have the students introduce their park and explain why they chose to preserve the resources they did.

Educator's Outline for

CONSERVING THE PARKS

OBJECTIVES

After completing this exercise the student will be able to

1. list three ways biodiversity is preserved in national parks
2. list three threats to biological diversity in national parks.

GRADES: 6 TO 8

AZ CURRICULUM STANDARDS:
Language Arts Standard 1 – Reading
Science Standard 4 – Life Science

GROUP SIZE: 25

DURATION: 2 hours

SETTING: Classroom

MATERIALS: 1 manila folder, dice, 20 - 3x5 index cards, map of a national park (available at the park visitor center), student activity sheets GAME CARDS 1–3

PROCEDURE:

1. On an open manila folder have each group of two to four students draw the outline of the national park you will visit. Use the map you got from the park visitor center. Leave enough space so that another parallel outline about 2 inches outside the original one can be drawn. Include natural features found on the park map. Divide the space between the two outlines into 60 to 80 spaces. Designate a beginning and end point. Most game boards use a clockwise movement. It will help if the start square has a large arrow to indicate the direction of movement around the board.

2. Use about 20 cards from those provided on the Activity Sheet, GAME CARDS. As a result of reading, research, and a visit to a national park, encourage students to create their own biodiversity statements and add them to the suggestions listed.

3. To play the game, shuffle the cards and place them face down on the game board. Each player rolls a die, the player rolling the highest number starting the game. If an even number is rolled, the player moves forward that many spaces. If an odd number is rolled, the player selects a statement and moves either forward or backward, depending on the nature of the situation. The first player to reach the goal of biological diversity wins the game. The player has to roll the exact number to land on the winning space.

4. Discuss the game with the class and ask students to comment on these questions:

   - Why are national parks so important in preserving biological diversity?
   - In 1854, Chief Seattle of the Suquamish said, "If all the beasts were gone, we would die from a great loneliness of spirit ... All things are connected. Whatever befalls the earth befalls the children of the earth." What does the word "connected" refer to? What arguments can you offer to show that we are connected to plants and animals? What did Chief Seattle

mean by: "Whatever befalls the earth befalls the children of the earth?" How would Chief Seattle say the natural environment is to be treated?

- What are some things that happen to biodiversity as a result of people? If students list all bad things, ask whether there are any good things.

- Are most of the factors affecting biodiversity biotic or abiotic? (Examples of biotic factors are: presence of other living organisms, odors, sounds made by other organisms, and removal of something by another organism, e.g., leaves and twigs eaten by deer. Examples of abiotic factors are: rain, temperature, clouds, and weather elements.)

GAME CARDS 1

Scientists have money to do research on endangered organisms. Go ahead 3 spaces.	Cooperate with state, federal, and international organizations to preserve park biodiversity. Go ahead 3 spaces.
Maps of all features of the park — water, soil, land use — are completed. Go ahead 2 spaces.	A survey to learn all the plants and animals living in the park is completed. Go ahead 4 spaces.
There is not enough money to fund a plant and animal survey in the park. Go back 4 spaces.	Poaching in park. Go back 2 spaces.
Air pollution is a constant problem in the park. Go back 4 spaces.	Natural resources come first. Visitors are restricted to certain areas of the park. Go ahead 3 spaces.
Use of pesticides held to a minimum. Go ahead 3 spaces	Volunteers assist in restoration of critical habitat. Go ahead 3 spaces.
Management for endangered species is explained to visitors. Go ahead 3 spaces.	Non-native plants are removed. Go ahead 3 spaces.
Adjacent land owners protect non-park habitat important to endangered species. Go ahead 3 spaces.	Land development along park boundaries in such a way as to destroy critical habitat. Go back 3 spaces.
There are not enough park personnel to protect biological diversity. Lose your turn.	As much as possible, nature is relied upon to maintain park biological diversity. Go ahead 3 spaces.
Not enough is known about the natural history of an endangered species. Go back 4 spaces.	A migratory bird winters in an area where its habitat is being destroyed. Move back 4 spaces.
Curious visitors disturb an endangered organism. Lose your turn.	Visitors trample vegetation, cause soil erosion and water pollution. Go back 3 spaces.

STUDENT WORKSHEET

GAME CARDS 2

Mining and oil/gas exploration affect air quality and plant and wildlife habitat. Go back 2 spaces.

Not enough understanding of park habitats to make decisions about managing them. Go back 3 spaces.

Cooperate with a zoo or plant garden to return organisms to their natural habitat. Go ahead 3 spaces.

A native organism absent from the park is scientifically reintroduced. Go ahead 3 spaces.

Park needs additional staff to manage and protect endangered habitats. Go back 3 spaces.

Non-native animals destroy native plants and wildlife. Go back 3 spaces.

Rare endangered plants removed from park. Go back 3 spaces.

Returning habitat to its former condition saves an endangered organism. Go ahead 3 spaces.

Park has user fee, money to be used to expand their work on endangered species. Go ahead 2 spaces.

Lands added to National Park System that include new kinds of habitats. Go ahead 3 spaces.

Computerized data bases on endangered plants and animals are improved. Go ahead 2 spaces.

Conduct yearly surveys to determine numbers of rare plants. Go ahead 3 spaces.

Native predator reintroduced. Go ahead 3 spaces.

Conduct yearly surveys to determine numbers of rare plants. Go ahead 3 spaces.

Unnatural regulation of water level outside park destroys fish, water birds, and aquatic plants. Go back 3 spaces.

Citizens take pride in the land and its organisms everywhere. Go ahead 3 spaces.

Project to develop and maintain a native plant nursery is funded. Go ahead 2 spaces.

Pesticide use outside park causes water and land pollution, with loss of native plants. Go back 4 spaces.

Local Industry regularly collects information to determine changes in air and water pollution. Go ahead 3 spaces.

There is not enough information on habitat needs for many endangered organisms. Go back 4 spaces.

GAME CARDS 3

Programs to teach the public how we depend on biological diversity for food, medicine, and other products. Go ahead 3 spaces.

More and more humans have the ability to change the ecosystems, weather, and climate. Go back 3 spaces.

Organisms introduced by humans (exotic species) are removed whenever practical. Go ahead 2 spaces.

Parks became more and more like islands as the land outside parks is developed. Go back 4 spaces.

In land purchases, for park, biological diversity of the habitat is taken into consideration. Go ahead 3 spaces.

A common organism that uses the same habitat is trapped and removed to give an endangered species a "head start." Go ahead 3 spaces.

The park informs surrounding landowners about endangered species on their land and the importance of protecting the biological diversity on their property. Go ahead 3 spaces.

There is not enough money to do everything that needs to be done. Go back 4 spaces.

Where necessary, habitats are actively managed to protect species. This may include planting food, burning, controlling water levels, and possibly killing natural predators that are present in high numbers. Go ahead 3 spaces.

Park staff write newspaper articles about endangered species and why they are important. (Endangered gray bats that live in four caves consume "nearly a million pounds of insects in Alabama and Tennessee each summer.") Go ahead 2 spaces.

Habitat conditions for many parks before they were changed by early settlers is not known. Go back 3 spaces.

OBJECTIVES

After completing this exercise the student will be able to

1. read a map to find various locations
2. plot several locations on a map
3. work independently using map reading skills.

GRADES: 6 TO 8

AZ CURRICULUM STANDARDS:
Social Studies Standard 3 - Geography

GROUP SIZE: 25

DURATION: 1 hour

SETTING: Classroom

MATERIALS: PLOTTING PROTECTED PLACES student activity sheet, pencils, rulers.

Educator's Outline for

PLOTTING PROTECTED PLACES

ACADEMIC EXPECTATIONS: Use reference tools and research tools; make sense of a variety of materials they read; use mathematical ideas and procedures; organize information and use of classification rules and systems; understand and use number concepts; understand and use space and dimensionality concepts; understand and use measurement concepts; understand the democratic principles; recognize, apply and understand the relationship between people and geography; show their abilities to become self-sufficient individuals; show their abilities to become responsible members of a family, work group, or community; organize information to develop or change their understanding of a concept; use a decision--making process to make informed decisions; connect knowledge and experiences from different subject areas; use what they already know to acquire new knowledge, or skills, or to interpret experiences; and expand their understanding of existing knowledge.

BACKGROUND: The National Park Service originated with the passage of the Organic Act of 1916. Since that time, the National Park Service and the United States government have designated many places as valuable places to be protected. These places are selected because of their historical or natural significance to our nation. Today, there are over 384 National Park Service areas across the country. These areas include national parks, national monuments, national battlefields, national seashores, national recreation area, and national wild and scenic rivers. In Kentucky, there are four National Park Service areas, including: Mammoth Cave National Park, Abraham Lincoln Birthplace National Historic Site, Big South Fork National River and Recreation Area, and Cumberland Gap National Historic Park. Each National Park Service area has its own unique cultural, biological, and geological significance. Cultural heritage (people), vegetation (plants), wildlife (animals), and landforms (rocks) are the reasons the parks were set aside.

Mapping is a basic skill that requires taking information given in one area and correlating it with another. The correlation gives meaning to new information. As far back as human history can be traced, people have been making and reading maps. This unique way of communication can only be achieved through a medium such as a map.

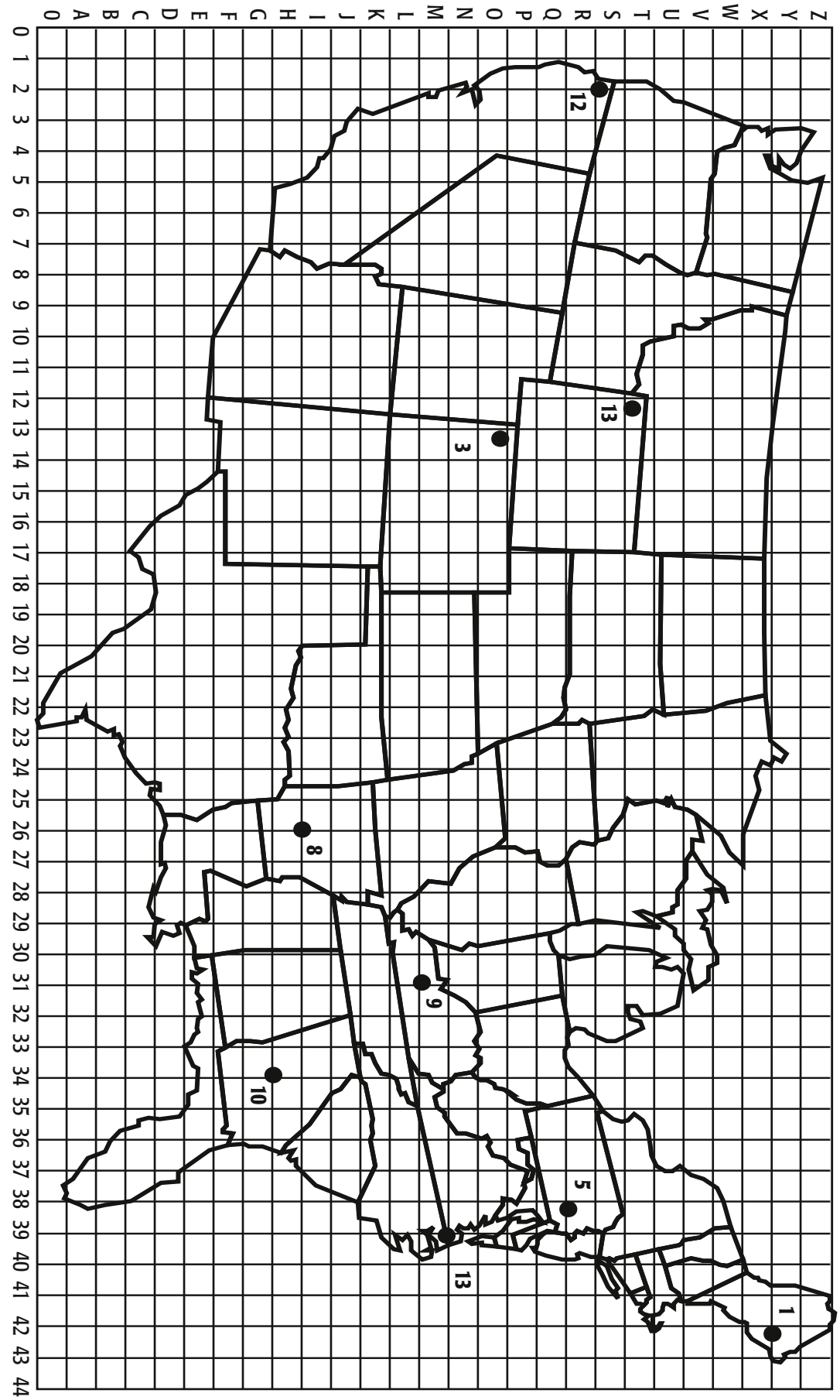
PROCEDURE:

1. The teacher presents the students with a map. The teacher asks the students if they can find a key on the map. The students should read the map and find the directional arrows for north, south, east, and west.
2. The teacher asks the students what National Park Service Area is at 31, M. The students should respond Mammoth Cave National Park.
3. The teacher asks the students, "Where is Yellowstone National Park?" A student responds 12, T.
4. The teacher asks the students to work on the first part of their activity page, numbers 1 to 4.
5. Together, the class reviews the answers to the first half of the activity sheet.
6. The teacher and students review the second half of the activity sheet. The teacher points out that there is a map that will help the student to plot the parks listed in the second half of the activity.
7. The students work individually on the second half of their sheet.
8. The class reviews this part of the activity sheet.
9. The teacher then asks the students one final question: If you could create a park anywhere in the United States, at what coordinates would you place it? What plants, animals, people, and rocks would your park protect? In a few sentences, describe your park at the bottom of your activity sheet.
10. The students share their created parks, if they choose to do so.

EXTRA CREDIT:

1. The teacher could have the students look at a United States road map, and map out a vacation to several different parks. The students could then list the coordinates from that map for each national park.
2. The students could create a graph of their classroom, plotting various items in the room.
3. The students could take a look at a Kentucky map and find the four national park areas that are within its borders. Then, they could look at the coordinates of the national parks found on that map. They could also find their town on the map. The students could then measure the distance from each park to their hometown.
4. The students could select a favorite National Park Service site, and could investigate that area via Internet or mail.

STUDENT WORKSHEET: PLOTTING PROTECTED PLACES



PLOTTING PROTECTED PLACES KEY

Name: _____ Date: _____

MAP INDEX:

INDEX #	NATIONAL PARK SERVICE SITE	COORDINATES
1	Acadia National Park	43, X
2	Big Bend National Park	17, D
3	Dinosaur National Monument	13, P
4	Everglades National Park	38, B
5	Gettysburg National Military Park	38, O
6	Glacier Bay National Park	11, Y
7	Grand Canyon National Park	10, K
8	Hot Springs National Park	26, I
9	Mammoth Cave National Park	31, M
10	Martin Luther King, Jr. National Historic Site	34, H
11	Mount Rushmore National Memorial	18, S
12	Redwood National Park	2, S
13	Wright Brothers National Memorial	39, N
14	Yellowstone National Park	12, W
15	Yosemite National Park	4, N

PLOTTING PROTECTED PLACES

DIRECTIONS:

1. Mammoth Cave National Park is the site of the longest know cave system in the world. Its' coordinates are 31, M. Find a dot on the map at these coordinates, and put Mammoth Cave National Park's index number by it. Index number _____.

2. National parks were developed to take care of all resources inside its boundary lines. These resources include vegetation (plants), wildlife (animals), cultural history (people), and landforms (rocks). Can you list a park from the index for each topic?

   Vegetation:

   Wildlife:

   Cultural History:

   Landforms:

Note: Each park protects everything in its boundary, but some answers are better than others.

3. On the map, which park is farthest east? What are its coordinates?

4. Name the two parks in California and their coordinates.

5. Add these parks to your map.

   - Everglades National Park
   - Grand Canyon National Park
   - Yosemite National Park,
   - Big Bend National Park
   - Mount Rushmore National Memorial

6. On the map, which park is farthest south?

   What are its coordinates? _____

7. Which park is known for its famous inventors?

   What are its coordinates? _____

   *BONUS: What was the famous invention?

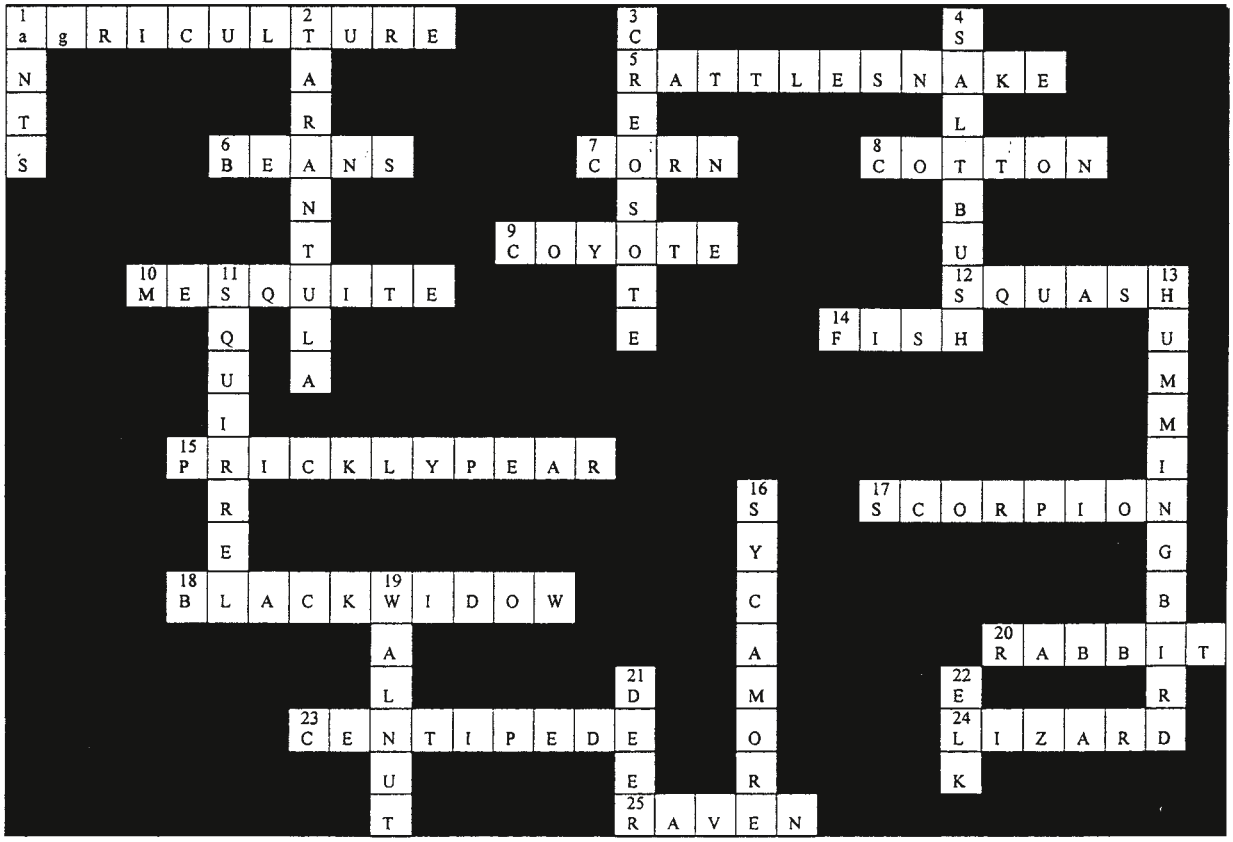
8. California is the state with the most National Park Service sites. Put parallel lines (/ / /) through the state to mark that it has the most sites.

9. Delaware is the only state without any National Park Service sites. Shade Delaware with your pencil.

10. Look at your index. There are no coordinates listed for Glacier Bay National Park. Can you find its index number on the map? Why or why not?

Your map shows only a few National Park Service sites. There are currently over 365 National Park Service areas.

PLANTS AND ANIMALS CROSSWORD SOLUTION



APPENDIX A

Common Plants of Montezuma Castle and Tuzigoot National Monuments

TREES	COMMON NAME	SCIENTIFIC NAME
	one-seed juniper *	*Juniperous monosperma*
	Utah juniper	*Juniperous osteosperma*
	cottonwood *	*Populus fremontii*
	peach leaf willow	*Salix amygdaloides*
	Gooding willow	*Salix goodingii*
	red willow	*Salix laevigata*
	Arizona Walnut *	*Juglans major*
	alder	*Alnus oblongifolia*
	Palmer oak	*Quercus palmeri*
	shrub live oak	*Quercus turbinella*
	netleaf hackberry *	*Celtis reticulata*
	Arizona sycamore *	*Plantanus wrightii*
	catclaw *	*Acacia greggii*
	mesquite *	*Prosopsis juliflora*
	false paloverde *	*Canotia holacantha*
	box-elder	*Acer negundo*
	soapberry	*Sapindus saponaria*
	velvet ash *	*Fraxinus velutina*

SHRUBS	COMMON NAME	SCIENTIFIC NAME
	four-wing saltbush *	*Atriplex canescans*
	goosefoot	*Chenopodium fremontii*
	winterfat	*Eurotia lanata*
	Russian thistle	*Salsola kali*
	red mahonia *	*Berberis haematocarpa*
	golden currant	*Ribes aureum*
	cliff-rose	*Cowania mexicana*
	joint fir *	*Ephedra trifurca*
	range ratany	*Krameria parvifolia*
	wait-a-bit (mimosa.)	*Mimosa biuncifera*
	indigobush	*Dalea formosa*
	creosote bush *	*Larrea tridentata*
	gray thorn *	*Zizyphus obtusifolia*

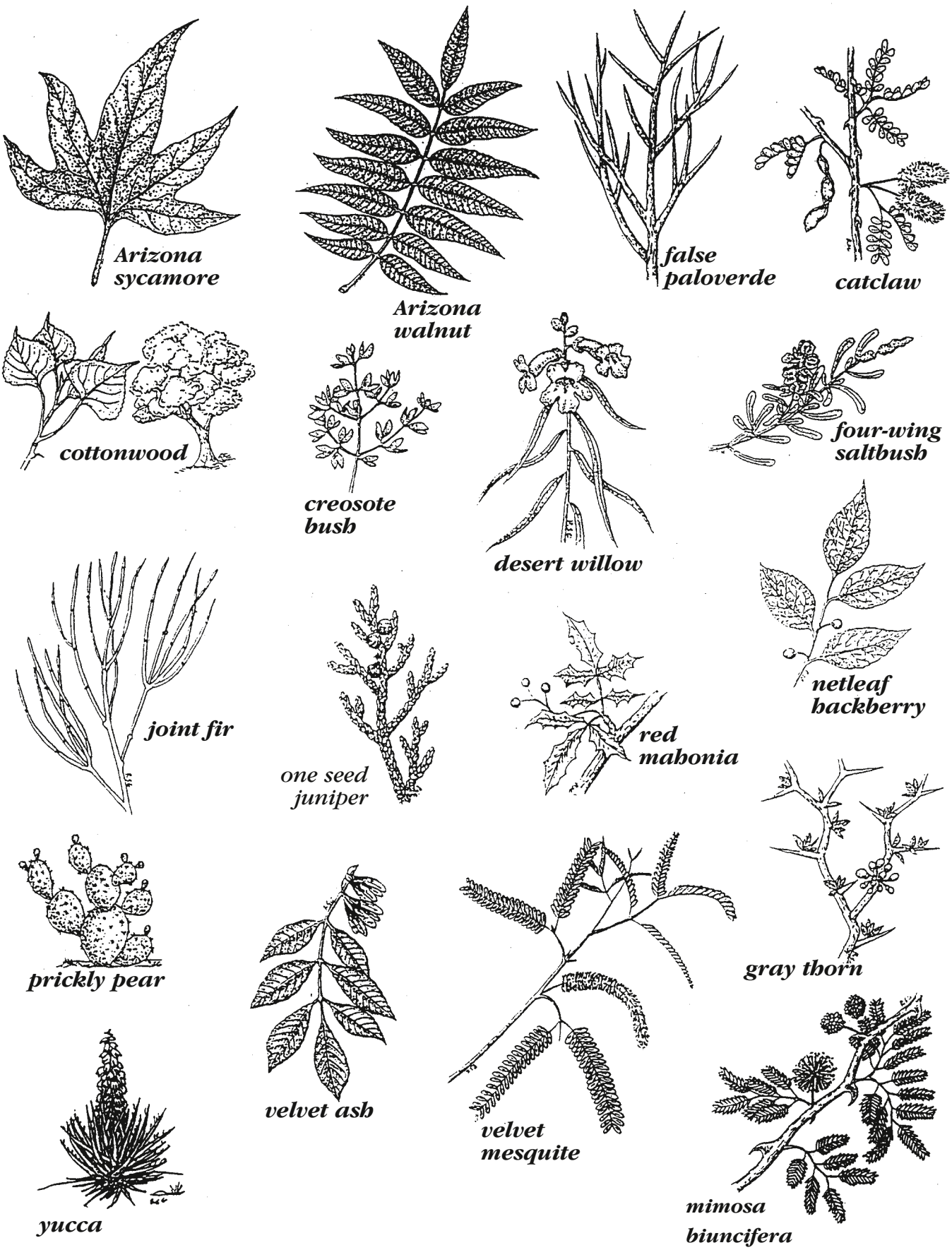
	tamarix	*Tamarix pentandra*
	sacred datura (jimsonweed)	*Datura metaloides*
	desert thorn	*Lycium pallidum*
	desert willow *	*Chilopsis linearis*
	desert broom	*Baccharis sarothroides*
	baccharis	*Baccharis emoryi*
	seep willow	*Baccharis glutinosa*
	mule fat	*Baccharis viminea*
	snakeweed	*Gutierrezia sarothrae*
	burrobush	*Hymenoclea monogyra*
	mariola	*Parthenium confertum*
	perezia	*Acourtia wrightii*
	brickellia	*Brickellia,californica*
	brickellia	*Brickellia atractyloides*
	crownbeard	*Verbesina encelioides*
	Mormon tea	*Ephedra viridis*
	skunkbush	*Rhus trilobata*

CACTUS	COMMON NAME	SCIENTIFIC NAME
	hedgehog cactus	*Echinocereus Boyce-Thompsonii*
	pricklypear *	*Opuntia engelmannii*
	pricklypear	*Opuntia macrocentra*
	desert Christmas cactus	*Opuntia leptocaulis*

OTHER COMMONLY SEEN PLANTS

	COMMON NAME	SCIENTIFIC NAME
	banana yucca	*Yucca baccata*
	soaptree yucca	*Yucca elata*
	century plant	*Agave parryi*
	allionia	*Allionia incarnata*
	four o'clock	*Mirabilis multiflora*
	pondweed	*Potemogoten illinoensis*
	buffalo gourd	*Cucurbita foetidissima*
	wild cucumber	*Marah gilensis*
	poison-ivy	*Rhus radicans*
	canyon grape	*Vitis arizonica*

* See following page for illustration


Arizona sycamore
Arizona walnut
false paloverde
catclaw
cottonwood
creosote bush
desert willow
four-wing saltbush
joint fir
one seed juniper
red mahonia
netleaf hackberry
prickly pear
velvet ash
velvet mesquite
gray thorn
yucca
mimosa biuncifera

APPENDIX B

Fishes, amphibians, Reptiles, and Mammal of Montezuma Castle and Tuzigoot National Monuments

RELATIVE ABUNDANCE AND STATUS CODES

R – rare; only known from a very few records

U – uncommon; occurring in relatively low numbers, or scattered distribution

C – common; present in relatively high numbers, generally widespread

A – abundant; a common species that is quite numerous

X – extirpated; a species that occurred in the area at one time, but is now absent

I – introduced; species not originally native to the area, introduced by man

FISH	COMMON NAME	SCIENTIFIC NAME	STATUS
	Sonora sucker	*Catostomus insignis*	U
	desert sucker	*Catostomus clarki*	C
	green sunfish	*Lepomis cyanellus*	C (I)
	smallmouth bass	*Micropterus dolomieui*	C/A (I)
	spotted bass	*Micropterus punctulatus*	X (I)
	largemouth bass	*Micropterus salmoides*	(I)
	longfin dace	*Agosia chrysogaster*	R
	red shiner	*Cyprinella lutrensis*	C/A (I)
	common carp	*Cyprinus carpio*	C (I)
	roundtail chub	*Gila robusta*	R
	spikedace	*Meda fulgida*	X
	speckled dace	*Rhinichthys osculus*	X
	loach minnow	*Rhinicthys cobitis*	X
	black bullhead	*Amelurus melas*	(I)
	yellow bullhead	*Ameiurus natalis*	U (I)
	channel catfish	*Ictalurus punctatus*	(I)

AMPHIBIANS	COMMON NAME	SCIENTIFIC NAME	STATUS
	red-spotted toad	*Bufo punctatus*	R
	Woodhouse's toad	*Bufo woodhousei*	C
	canyon treefrog	*Hyla arenicolor*	U
	bullfrog	*Rana catesbeiana*	R (I)

REPTILES	COMMON NAME	SCIENTIFIC NAME	STATUS
	common slider	*Trachemys scripta*	U (I)
	Sonoran mud turtle	*Kinosternon sonoriense*	A
	spiny softshell turtle	*Trionyx spiniferus*	R
	Arizona alligator lizard	*Gerrhonotus kingii*	U
	Western banded gecko	*Coleonyx variegatus*	R
	Gila monster	*Heloderma suspectum*	X?
	greater earless lizard	*Cophosaurus texanus*	U
	collared lizard	*Crotaphytus collaris*	U
	short-horned lizard	*Phrynosoma douglassii*	R
	Clark's spiny lizard	*Sceloporus clarkii*	U
	desert spiny lizard	*Sceloporus magister*	C
	eastern fence lizard	*Sceloporus undulatas*	U
	tree lizard	*Urosaurus ornatus*	C/A
	side-blotched lizard	*Uta stansburiana*	A
	Gila spotted whiptail	*Cnemidophorus flagellicaudus*	U
	little striped whiptail	*Cnemidophorus inornatus*	R
	Western whiptail	*Cnemidophorus tigris*	A
	desert grassland whiptail	*Cnemidophorus uniparens*	C
	plateau striped whiptail	*Cnemidophorus velox*	U
	glossy snake	*Arizona elegans*	R
	ring-necked snake	*Diadophis punctatus*	U
	night snake	*Hypsiglena torquata*	R
	common Kingsnake	*Lampropeltis getulus*	R
	coachwhip	*Masticophis flagellum*	R
	striped whipsnake	*Masticophis taeniatus*	U
	gopher snake	*Pituophis melanoleucus*	U
	long-nosed snake	*Rhinocheilus lecontei*	R

	Western patch-nosed snake	*Salvadora hexalepis*	U
	ground snake	*Sonora semiannulata*	U
	black-necked garter snake	*Thamnophis cyrtopsis*	U
	Western lyre snake	*Trimorphodon biscutatus*	R
	Sonoran coral snake	*Micruroides euryxanthus*	R
	Western diamond-back rattlesnake	*Crotalus atrox*	U
	black-tailed rattlesnake	*Crotalus molossus*	U
	Mojave rattlesnake	*Crotalus scutulatus*	R

MAMMALS	COMMON NAME	SCIENTIFIC NAME	STATUS
	desert shrew	*Notiosorex crawfordi*	R
	Mexican free-tailed bat	*Tadarida brasiliensis*	U
	palid bat	*Antrozous pallidus*	U
	big brown bat	*Eptesicus fuscus*	U
	red bat	*Lasiurus borealis*	R
	California myotis	*Myotis californicus*	U
	small-footed myotis	*Myotis subulatus*	R
	Arizona myotis	*Myotis occultus*	R
	fringed myotis	*Myotis thysanodes*	R
	cave myotis	*Myotis velifer*	U
	Yuma myotis	*Myotis yumanensis*	C
	Western pipistrelle	*Pipistrellus hesperus*	C
	Townsend's big-eared bat	*Plecotus townsendi*	U
	black-tailed jack rabbit	*Lepus californicus*	C
	desert cottontail	*Sylvilagus auduboni*	C
	Eastern cottontail.	*Sylvilagus floridanus*	U
	beaver	*Castor canadensis*	U
	white-throated woodrat	*Neotoma albigula*	C
	Mexican woodrat	*Neotoma mexicana*	R
	Stephen's woodrat	*Neotoma stephensi*	U
	muskrat	*Ondatra zibethica*	U
	Northern grasshopper mouse	*Onychomys leucogaster*	U

brush mouse	*Peromyscus boylei*	A
cactus mouse	*Peromyscus eremicus*	A
white-footed mouse	*Peromyscus leucopus*	R
deer mouse	*Peromyscus maniculatus*	U
Western harvest mouse	*Reithrodontomys megalotis*	U
Arizona cotton rat	*Sigmodon arizonae*	x
porcupine	*Erethizon dorsatum*	R
Bota's pocket gopher	*Thomomys bottae*	C
Ord's kangaroo rat	*Dipodomys ordi*	U
hispid pocket mouse	*Perognathus hispidus*	x
rock pocket mouse	*Perognathus intermedius*	U
Harris' antelope squirrel	*Ammospermophilus harrisi*	U
Arizona gray squirrel	*Sciurus arizonensis*	R
rock ground squirrel	*Spermophilus variegatus*	C
cliff chipmunk	*Eutamias dorsalis*	U
coyote	*Canis latrans*	U
gray fox	*Urocyon cinereoargenteus*	U
mountain lion	*Felis concolor*	R
ocelot	*Felis pardalis*	x
bobcat	*Felis rufus*	U
hog-nosed skunk	*Conepatus leuconotus*	U
striped skunk	*Mephitis mephitis*	U
Western spotted skunk	*Spilogalev gracilis*	R
river otter	*Lutra canadensis*	R
badger	*Taxidea taxus*	R
ringtail	*Bassariscus astutus*	U
raccoon	*Procyon lotor*	C
black Bear	*Ursus americanus*	R
pronghorn	*Antilocarpa americana*	x
American elk	*Cervus elaphus*	C (I)
mule seer	*Odocoileus hemionus*	C
white-tailed deer	*Odocoileus virginianus*	U
collared peccary	*Tayassu tajacu*	U

APPENDIX C

Common Birds Montezuma Castle and Tuzigoot National Monuments

ALL YEAR RESIDENTS

American kestrel

American robin

belted kingfisher

common raven

crissal thrasher

Gambel's quail

great blue heron

black-throated sparrow

red-tailed hawk

house finch

lesser goldfinch

mourning dove

Northern cardinal

great-horned Owl

Western screech Owl

black phoebe

Say's phoebe

roadrunner

scrub jay

vermillion flycatcher

song sparrow

Abert's towhee

Brown towhee

rufous-sided towhee

Gila woodpecker

ladder-backed woodpecker

Bewick's wren

canyon wren

rock wren

bridled titmouse

WINTER RESIDENTS

bald eagle

ferruginous hawk

Canada goose

dark-eyed junco

American goldfinch

lesser goldfinch

hermit thrush

chipping sparrow

red-shafted flicker

ruby-crowned kinglet

Western blue bird

white-crowned sparrow

yellow-rumped warbler

mallard

sage thrasher

American widgeon

SPRING/SUMMER RESIDENTS

common black hawk

black-chinned hummingbird

rufous hummingbird

Cassin's kingbird

Western kingbird

lesser nighthawk

Northern mockingbird

Northern (Bullock's) oriole

hooded oriole

phainopepla

summer Tanager

cliff swallow

rough-winged swallow

turkey vulture

white-throated swift

yellow-breasted chat

yellow warbler

brown-crested flycatcher

ash-throated flycatcher

myrtle warbler

Bell's vireo

brown-headed cowbird

white-throated swift

APPENDIX D

Sensitive Species
Montezuma Castle and Tuzigoot National Monuments

STATUS CODES

E – Endangered	T – Threatened
C – Candidate	Ex – Extinct in Arizona
S – Sensitive Species	N – Native Fish Species

FISH	COMMON NAME	SCIENTIFIC NAME	STATUS
	spikedace	*Meda fulgida*	T
	roundtail chub	*Gila robusta*	C/S
	loach minnow	*Rhinicthys cobitus*	T
	longfin dace	*Agosia chrysogaster*	N
	desert sucker	*Catostomus clarki*	N
	Sonora sucker	*Catostomus insignis*	N
	Speckled dace	*Rhinichthys osculus*	N

BIRDS	COMMON NAME	SCIENTIFIC NAME	STATUS
	bald eagle	*Haliaeetus leucocephalus*	E/S
	yellow-billed cuckoo	*Coccyzus arnericanus*	S
	common black hawk	*Buteogallus anthracinus*	S
	belted kingfisher	*Ceryle alcyon*	S

MAMMALS	COMMON NAME	SCIENTIFIC NAME	STATUS
	red bat	*Lasiurus borealis*	S
	Camp Verde cotton rat	*Sigmodon arizonae*	Ex
	river otter	*Lutra canadensis sonorae*	C/S

REPTILES	COMMON NAME	SCIENTIFIC NAME	STATUS
	Gila monster	*Heloderma suspectum*	S

PLANTS	COMMON NAME	SCIENTIFIC NAME	STATUS
	Arizona cliffrose	*Cowania subintegra*	E/S

APPENDIX E
Glossary

Agriculture: The science or art of cultivating land for the production of domestic plants or farming.

Ancestral Pueblo or Anasazi: Prehistoric Southwestern culture that lived and dry-farmed on the Colorado Plateau.

Aquatic: A plant or animal that lives or grows in water.

Aquifer: Any geological formation containing water, especially one that supplies water to wells, springs, etc.

Archeological site: Any concentration of artifacts, features, or ecofacts left by humans.

Archeologist: A scientist who studies people of the past.

Archeology: The scientific study of the human past.

Artifact: An object used or made by humans.

Arizona sycamore: Deciduous tree with lobed leaves, ball-like seed clusters, and white bark that flakes off in patches, used by the Sinagua for construction.

Beans: Varieties of domesticated legumes grown by peoples of the Southwest as one of three major staples.

Beaver Creek: A tributary of the Verde River that flows near Montezuma Castle NM and Montezuma Well.

Biodiversity: The wide variety of life forms that occur within an area.

Cliff dwelling: One or more rooms constructed within a cave or rock shelter by Southwest peoples.

Context: The location in which an artifact is found, both horizontally or vertically. For example, a ceramic pot may be found on a prehistoric room floor, where it was used for storage, or outside on the remains of a firepit, where it was used for cooking.

Corn/maize: A domestic grass that was the staple of the native peoples of the Americas.

Culture: All nonbiological aspects of human adaptation, such as behavior, language, ideology, artifacts, etc.

Ecosystem: The complex of living organisms and their environment functioning as a unit in nature.

Environment: All of the surroundings that influence the growth, development, and well--being of a living thing.

Erosion: The weathering and carving away of rocks by wind and water.

Estuary: An area where seawater mixes with fresh water.

Evaporation: The act or process of evaporating, or the change of water from a liquid state to a gaseous state.

Excavation: The systematic and scientific digging and recording of a archeological site.

Floodplain: A flat area along a river or creek often subject to overflowing.

Fossil: Any replacement, impression, or cast of a once-living organism found in the layers of rock in the earth.

Groundwater: Water within the earth that supplies wells and springs.

Habitat: The area in which a living organism usually lives.

Hackberry: A small deciduous tree of riparian habitats at elevations of 2,000 to 5,000 feet that produces small, sweet berries

Handaxe: A three-quarter grooved stone tool hafted to a wooden handle, to chop wood.

Heritage: A place, thing, or idea passed down from one generation to another, such as historic or cultural site; an heirloom; or a tradition, legend, or myth.

Historic: The time period following the introduction of writing in a particular location. In the North American Southwest, this date was about AD 1540.

Hohokam: A prehistoric Southwest culture that occupied the upper Sonoran desert and practiced irrigation farming.

Hunter-gatherers: A subsistence pattern based upon the collection of wild plants and animals.

Hydrology: The science of the occurrence and distribution of underground water.

Irrigation: The diversion of water from natural waterways through manmade canals and ditches to farm otherwise-dry areas.

Limestone: A sedimentary rock with a high calcium carbonate content.

Mano: The long rectangular milling stone used on a metate.

Metate: The base stone used by peoples of the Southwest and Mexico to mill or grind grain, seeds, and clay.

Migration: The periodic movement of animals and people from one region to another.

Mineral: Naturally occurring in organic substances that make up the rocks of the earth.

Mogollon: A prehistoric Southwest culture that farmed and lived in the mountainous regions east and south of the Mogollon Rim.

National Monument: A natural or cultural resource declared by the U.S. President and administered, preserved, and protected by the National Park Service.

Paleontologist: A scientist who studies fossils.

Pithouse: A partial subterranean house constructed of logs, limbs, grasses, and clay, inhabited throughout the Southwest by prehistoric farmers.

Pottery: Containers of fired clay used to cook and store food.

Prehistoric: A time period before written records. Because writing occurred at different times in different regions, it varies around the world. For the Southwest, it lasted until 1540 then the Spanish came into the area.

Pueblo: Masonry and clay houses connected together into a village or town, often more than one story high.

Riparian: Habitat ecosystem associated with a river or creek usually with an abundance of plant and wildlife.

Salado: A Southwest culture that farmed and built their villages along the Salt River.

Salt mine: The remains of a salt extraction site near the present town of Camp Verde that the Sinagua and later peoples mined for their use, and for trade.

Sedimentation: The deposition or accumulation of sediment: mineral or organic matter deposited by the forces of water, wind, and ice,

Sinagua: A prehistoric Southwest culture that farmed the uplands near present-day Flagstaff and the Verde River.

Sinkhole: A hole formed in soluble rock such as limestone by the action of water flowing to an under-ground passage, such as Montezuma Well.

Species: The basic biological classification of any group of organisms that are biologically similar and can only reproduce with one another.

Squash: A group of vegetables grown on vines of the genus Curcubita, which formed one of the three staples of the Americas.

Swallet: The name given to the passage through which water flows out of Montezuma Well into the irrigation canal.

Textiles: Woven fabrics made from plant and animal fibers.

Trade: The exchange of goods through buying, selling, and barter.

Verde River: The major perennial water source of the Verde Valley, which flows near Tuzigoot.

Yavapai-Apache: The present Native American tribe living in the Verde Valley, whose roots in the area are hundreds of years old.

APPENDIX F

Suggested Resources

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Montezuma Castle: Home of the Prehistoric Sinagua. Produced by Sandra Scott and directed by Lynda Bernal Reed. Tucson: Southwest Parks and Monuments Association, 1994.

Those Who Came Before:Southwestern Archeology in the National Park System. Produced by EastWest Media Productions. Tucson: Southwest Parks and Monuments Association, 1997.

INSTITUTIONS AND ORGANIZATIONS

Arizona State Museum
University of Arizona
P.O. Box 210026
Tucson, AZ 85721
(520) 6214695
www.statemuseum.arizona.edu

Arizona State Parks
1300 W. Washington
Phoenix, AZ 85007
(602) 542-4174
www.pr.state.az.u

Heard Museum
2301 North Central Avenue
Phoenix, AZ 85004
(602) 252-8840
www.heard.org

Mesa Southwest Museum
53 N. MacDonald Street
Mesa, AZ 85201
(480) 644-2230

Museum of Northern Arizona
3101 N. Fort Valley Road
Flagstaff, AZ 86001
(928) 774-5213

National Audubon Society
700 Broadway
New York, NY 10003
(212) 979-3000

National Forest Service
www.fs.fed.us
Local: Coconino National Forest (928) 282-4119
Prescott National Forest (928) 567-4121
National Park Service
www.nps.gov
Local: Montezuma Castle NM (928) 567-3322
Montezuma Well NM (928) 567-4521
Tuzigoot NM (928) 634-5564

National Parks and Conservation Association
1300 19th Street, NW, Suite 300
Washington, DC 20036
800-628-7275
npca@npca.org

National Wildlife Federation
1400 16th Street
Washington, D.C. 20036
(800) 822-9919
www.nwf.gov

North American Association for Environmental Education
P.O. Box 400
Troy, OH 45373
(513) 698-6493

Western National Parks Association
12880 North Vistoso Village Dr.
Tucson, AZ 85737
(520) 622-1999
www.wnpa.org