# JEBISCHPE!

### Overview

Students solve two cooperative logic problems related to xeriscape gardening. In the first problem. students learn some plants and their water needs in a simplified xeriscape for desert landscapes. In the second problem, they learn principles of gardening for wildlife and water conservation. Each problem provides the clues a team needs to solve a logic problem, and pictures to manipulate on a chart. Team members have different pieces of information, so everyone must cooperate to solve the problems.

Subjects: Science, Math, Comprehensive Health

**Group Size**: Teams of four to solve logic problem. Students may form jigsaw groups so that those with the same clues can read and study their clues together, then rejoin team to solve the problem and answer special questions about each.

Estimate Teaching Time: Two hours Curriculum Framework: IB1, VB, VIC

Environmental Education Framework: Goal IA, IIA, IIIA,

IVA, IVB, VA

Vocabulary: conservation, xeriscape

### **Objectives**

Students will:

- understand basic principles of xeriscape gardening.
- identify ways xeriscape methods help humans, animals and plants.

### Background

Throughout the desert southwest, water is the lifeblood for plants, humans and other animals. To sustain life in the desert, we must learn to conserve our water resources without compromising our quality of life.

More than half the water provided by cities in the Phoenix area is used outside to water lawns and landscape plants. If the landscapes in our Sonoran Desert are carefully planned and installed, we can reduce our outdoor water use and still have lovely, colorful yards that are water efficient and easy to maintain. This type of landscaping is called *xeriscape* (pronounced zeer-i-scape).

The xeriscape concept is built around seven sound horticultural practices that are appropriate for gardening in the Desert Southwest. They include: planning and design, limited turf areas, efficient irrigation, soil improvements, mulches, low water use plants, and appropriate maintenance.

The cooperative logic problems in this activity focus primarily on landscape planning for people and wildlife, and low water use plants suited for our hot, arid environment. You can learn about the other components of xeriscape from resources listed.

The first problem, XERISCAPE GARDENS, introduces xeriscape zones and focuses on three areas: mini-oasis, transition zones, and perimeter zones. Although xeriscape gardens also may include lawn or turf areas, plants featured in this activity are drought hardy, tolerant of heat and cold, adapted to our soil conditions, and vary in color, texture, form, and function.

"A **mini-oasis** is usually close to the house and may contain low, moderate and/or high water use plants. The area is often protected by shade during part of the day and can be used for recreation, conversation, and quiet relaxation.

A **transition zone** is placed between a mini-oasis (or a lawn) and an arid zone or natural desert area. Transition zones, which contain low and moderate water use plants, help to blend lush areas into the more arid parts of the landscape.

In the **perimeter xeriscape area**, plants rely on rainfall or infrequent irrigations once they are established. The area can be a combination of: 1) an arid zone containing low water use plants that either are native to the desert southwest or that blend well with native desert plants; and 2) a natural or revegetated zone consisting of natural, undisturbed desert or desert native plants that are replanted or seeded in the landscape."

From Arizona Municipal Water Users Association. 1991. **Xeriscape Gardens: Plants for the Desert Southwest**. Phoenix: AMWUA.

The second problem, WILDLIFE ON CAMPUS?, presents principles of designing a school yard habitat for animals and people. Students will learn that function, color and theme are important aspects of landscape planning. Students will also be introduced to the following concepts as they apply to landscaping:

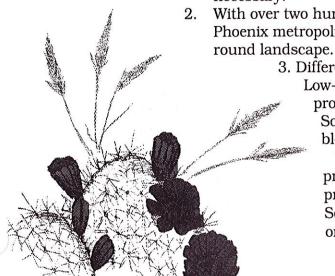
1. Shade, screening for privacy, and wildlife viewing are some examples of the functions landscape can provide people. To satisfy the basic habitat needs of animals, their food, water, and shelter must be arranged so that animals can safely get to them when necessary.

2. With over two hundred low-water-use plants available in the Phoenix metropolitan area, it is possible to have a colorful year-round landscape

3. Different themes can also be created using plants.

Low-water use plants can include groupings that provide a lush, green Mediterranean look or a Sonoran Desert image that is colorful and that blends with our natural surroundings.

The instructor should note that several design principles have been simplified for this logic problem. Designers would not normally plan both Sonoran Desert and Mediterranean themes into one landscape.



### Procedure

1. Introduce the first activity by explaining that students will work in teams to solve a problem

> about ways to save water and enjoy plants and animals in the Sonoran Desert. A problem statement and special questions are on one of four sets of information the students will have as clues. Each student will receive one set of clues, which should not be shown to the other team

2. Pass out the envelopes containing problem clues, pictures, and chart to students sitting in teams of four. (Save the extra clues for use when a team cannot solve the problems using the

members.

equally divided into fours, allow students in smaller groups to be responsible for more than one clue, or have one extra student provide the information from the extra clues.) Each team member should have a clue card that has a different symbol on the left-

Optional jigsaw method, designed to help new logic problem-solvers and lessconfident readers. All the students with the same clue cards (same symbols on the left

hand side.

four clues. If your class is not

side of their clues) will meet first to learn what their clues mean. Let students know that the pictures, chart, and extra clues will be used after students have met with others who have the same clue as they do. Have students move to four areas designated for jigsaw groups (or five areas if students are responsible for extra clues). In the jigsaw groups, the students should read their one clue card and discuss what the clues mean. One of the groups will have the problem; another will have a special question. All will have information that will help their team solve the problem and a special question. During ten to fifteen minutes, the students in the jigsaw groups should use their own knowledge, dictionaries, field guides, encyclopedias or other resources to make sure each of them understands what all the words on their clue cards mean. If resources are limited or the students seem really stuck on a word or concept, help them out. When the jigsaw groups feel each member of the group understands what their clues mean, have students return to their teams.

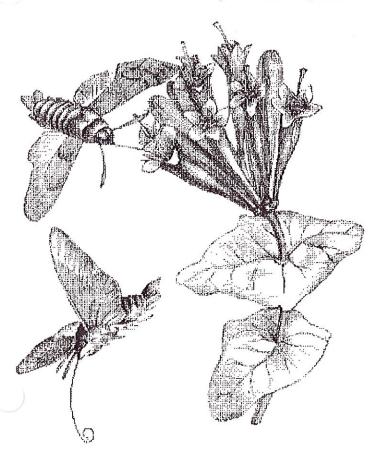
3. The team members should use the pictures, chart, and the bits of information on their clue cards to solve the problem and answer the special question(s). Remind the students that they may not show their clues to anyone on their team. They may only read the clues.

### Materials and Preparation

- Problem #1 Clues, make one copy per team; cut along dotted lines.
- Problem #1 Pictures. make one copy per team; cut along dotted lines.
- Problem #1 Chart, make one copy per team
- Envelope, one per team (includes chart, cut up clues and pictures)
- Optional, for each jigsaw group: dictionaries, field guides, encyclopedias, xeriscape resources

REPEAT MATERIALS AND PREPARATION FOR PROBLEM #2

- 4. Close the first problem solving session by asking students the answers to the special questions. Repeat the procedure for Problem #2 WILDLIFE ON CAMPUS?
- 5. After the students have solved the problems and answered the special questions, have them discuss these questions with their team members:
  - a. How could you use some principles of xeriscape to improve your school campus?
  - b. Name some ways xeriscape gardening helps people, plants, and animals.
  - c. Could you have solved the problems and answered the questions with just your one bit of information? How well did your team cooperate?



### **Extensions**

- 1. Invite an expert from your water conservation department or local nursery to help your class design and execute a plan for your school grounds using xeriscape principles.
- 2. Visit the Desert Botanical Garden, your city's xeriscape demonstration gardens, and other facilities to learn more about beautiful plants that have low water needs and satisfy varying needs of humans and animals.
- 3. Invite resource persons (such as landscape architects, botanists, horticulturists) to discuss xeriscape gardening and the varied careers associated with the science and art of landscaping and habitat management.

### Evaluation

- What is xeriscape?
- 2. Name two ways xeriscape methods can help people, plants, and animals.
- 3. A new student has just moved here from a wet, green, cool climate. What will you say to convince him that xeriscape landscaping is both wise and beautiful?

### Resources

Arizona Game and Fish Department. 1992. Landscaping for Desert Wildlife.

Arizona Municipal Water Users Association. 1993. Converting to Xeriscape: Renovate Your Landscape with Style. Phoenix: AMWUA.

Arizona Municipal Water Users Association. 1991. **Xeriscape Gardens: Plants for the Desert Southwest**. Phoenix: AMWUA.

Arizona Municipal Water Users Association. 1992. **Xeriscape: A New Look for Arizona Gardens**. Phoenix: AMWUA.

Arizona Municipal Water Users Association. **Xeriscape: Water Conservation Through Creative Landscaping**. Phoenix: AMWUA. Arizona-Sonora Desert Museum. 1989. "Common Sonoran Desert Butterflies and their Hostplants" in **sonorensis**, (vol.9, #3). Tucson: ASDM.

Arizona-Sonora Desert Museum. 1989. "Sonoran Region Plants Used as Food by Hummingbirds" in **sonorensis**, (vol.9, #3). Tucson: ASDM.

M.R. Duffield & W.D. Jones. 1992. Plants for Dry Climates: How to Select, Grow and Enjoy. Tucson: H.P. Books.

University of Arizona School of Renewable Natural Resources. 1990. **The Green Scene**. Tucson: Arizona Board of Regents.

Western Regional Environmental Education Council. 1993. WILD School Sites: A Guide to Preparing for Habitat Improvement Projects on School Grounds. Houston: WREEC.

### Answers

### Cooperative logic problem 1: XERISCAPE GARDENS

ANN - white - primrose (Oenothera caespitosa) - Texas ebony tree (Pithecellobium flexicaule) - saguaro (Carnegiea gigantea)

FAITH - yellow - columbine (Aquilegia chrysantha) - Arizona yellow bells (Tecoma stans) - foothill palo verde tree (Cercidium floridum)

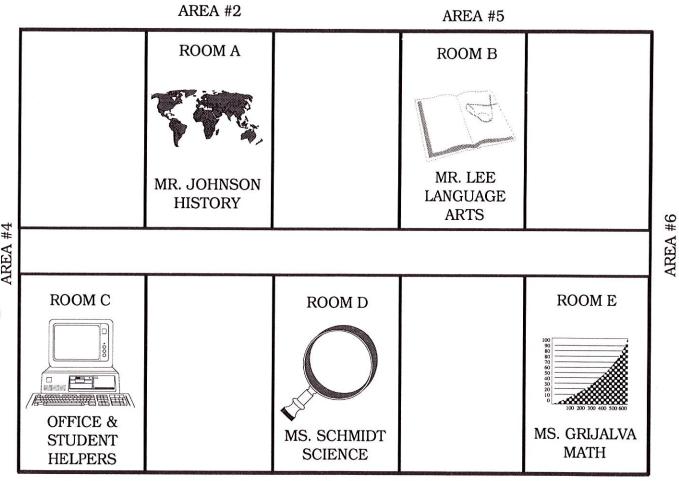
KAREN - red - red sage (Salvia greggii) - coral vine (Antigonon leptopus) - ocotillo (Fouquieria splendens)

ROBIN - purple - trailing lantana (Lantana montevidensis) - mescal bean (Sophora secundiflora) - desert ironwood (Olneya tesota)

### Answers to special questions #1:

- 1. Carnegiea gigantea
- 2. (any of these ideas is acceptable) A xeriscape (zeer-i-scape) is a creative landscaping approach designed to save water. The word, xeriscape, comes from xeros, the Greek word for "dry." Xeriscape principles include: good planning and design, appropriate turf areas, efficient irrigation, use of soil improvements, use of mulches, low water use plants, and appropriate maintenance. Three xeriscape zones include mini-oasis, transition, and perimeter. The mini-oasis zone uses the most water and is usually closest to the house. The transition zone requires less water. And the perimeter area requires no water after the plants are established. The perimeter zone is usually made up of native and low-water use plants from other parts of the world.

### **School Map**



### Answers to special questions #2:

More than half the water provided by Phoenix area cities is used outside to water lawns and landscape plants.

AREA #3

- 2. desert hackberry (Celtis pallida)
- blue palo verde (Cercidium floridum)

AREA #1

# XERISCAPE! YOU ESCAPE! - STUDENT PAGE PROBLEM #1: XERISCAPE GARDENS CLUES

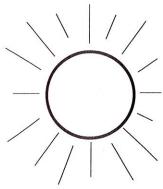
**CLUES - PROBLEM #1** These are clues to help solve your team's problem. You may read your clues to the team, but you may not show them. You may read your clues as often as you wish.



- Four friends were tired of their high water bills and the lawns around their homes. They decided to work together to design water efficient areas using their favorite plants.
- Xeriscape (zeer-i-scape) is a creative landscaping approach designed to save water.
- The flowers of each person's three favorite plants are the same color. For example, Faith's favorite plants bloom with yellow flowers.
- Karen's favorite transition plant is a vine.
- The Arizona state flower is the white blossom on the giant saguaro cactus (Carnegiea gigantea).

Flower

**CLUES - PROBLEM #1** These are clues to help solve your team's problem. You may read your clues to the team, but you may not show them. You may read your clues as often as you wish.



- The word, xeriscape (zeer-i-scape), comes from *xeros*, the Greek word for "dry." *Xeros* is also the root word for Xerox, the name of a company that uses a dry printing process.
- The problem you must solve is: What are the favorite water-saving plants of four Phoenix friends in each of three zones of their xeriscape gardens? Use the Xeriscape Gardens Chart and pictures to help you solve this problem.
- The plants that require the most water are: lantana, red sage, columbine, and primrose.
- Robin didn't care that two of her favorites, mescal bean and desert ironwood, grow very slowly.

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Sun

**CLUES - PROBLEM #1** These are clues to help solve your team's problem. You may read your clues to the team, but you may not show them. You may read your clues as often as you wish.

• Karen's favorite color is red.



- The special questions you must answer are: 1. What is the genus-species name of the saguaro? 2. What is xeriscape?
- The friends learned that many plants have similar common names and that they would most likely get the plants they wanted at the nursery with the two word names botanists use to classify plants.
- The genus and species names (and common names) of Ann's favorite plants are: primrose (Oenothera caespitosa), Texas ebony tree (Pithecellobium flexicaule), and saguaro (Carnegiea gigantea).

Rain

# PROBLEM #1: XERISCAPE GARDENS MORE CLUES

**CLUES - PROBLEM #1** These are clues to help solve your team's problem. You may read your clues to the team, but you may not show them. You may read your clues as often as you wish.



- The friends organized their gardens around three xeriscape zones: mini-oasis, transition, and perimeter.
- The mini-oasis zone uses the most water and is usually closest to the house. The transition zone requires less water, and the perimeter area requires no water after the plants are established. The perimeter zone is usually made up of native and low-water use plants from other parts of the world.
- · Columbine and palo verde trees have yellow blossoms.
- The plants that require the least amount of water and are furthest from the houses are: saguaro, ocotillo, desert ironwood, and the palo verde tree.

Tree

EXTRA CLUES - **PROBLEM #1** These are clues to help solve your team's problem. You may read your clues to the team, but you may not show them. You may read your clues as often as you wish.

### **EXTRA CLUES**

• Irrigation is most efficient when plants are grouped according to their water needs.

• Xeriscape (zeer-i-scape) principles include: good planning and design, appropriate turf areas, efficient irrigation, use of soil improvements, use of mulches, low water use

· Ocotillo is a Sonoran desert native with red blossoms.



- plants, and appropriate maintenance.
  Arizona yellow bells (Tecoma stans) is a good transition plant because it requires a moderate to small amount of water. Hummingbirds like it, too!
- Trailing lantana (Lantana montevidensis) can have purple blossoms.
- Ann's favorite flower color is white.

Star

# XERISCAPE! YOU ESCAPE! - STUDENT PAGE PROBLEM #1: XERISCAPE GARDENS

# CHART

FRIENDS	COLOR	MINI-OASIS	TRANSITION	PERIMETER
ANN				
			-	
FAITH				
			,	
KAREN				
ROBIN				
		5		

# XERISCAPE! YOU ESCAPE! - STUDENT PAGE PROBLEM #1: XERISCAPE GARDENS

# PICTURES

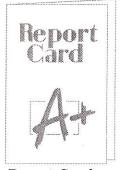
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	- And Andrews				
primrose Oenothera caespitosa	coral vine Antigonon leptopus	desert ironwood Olneya tesota	Texas ebony tree Pithecellobium flexicaule		
Arizona yellow bells Tecoma stans	columbine Aquilegia chrysantha	mescal bean Sophora secundiflora	foothill palo verde Cercidium floridum		
ocotillo Fouquieria splendens	saguaro Carnegiea gigantea	red sage Salvia greggii	trailing lantana Lantana montevidensis		
W   H   I   I   T   I   E   I	Y	P U R P L E	R E D		
cut pictures along dotted line					

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# XERISCAPE! YOU ESCAPE! - STUDENT PAGE PROBLEM #2: WILDLIFE ON CAMPUS?

### CLUES

**CLUES - PROBLEM #2** These are clues to help solve your team's problem. You may read your clues to the team, but you may not show them. You may read your clues as often as you wish.



Report Card

- Your class would like to make the school campus look better and attract animals near your classroom. The principal has a folder including notes gathered from book research, interview comments made by a few of the school staff, some plant pictures, and a campus map. You must figure out the clues, and use the map, place cards, and area descriptions to design a plan to attract animals to campus and make several people happy in the process.
- Plants that provide shade should be planted on the south and west sides of buildings, where the sun is likely to shine all day. This will also help reduce air-conditioning costs.
- Mr. Lee, a language arts teacher, dreams: "I'd like my students to be able to go outside and write or read. Privacy, grass, some shade and nice smells, if possible - that would be great."
- Water is a strong attractant for desert animals. Water belongs in open areas of the landscape where people can observe animals without disturbing them.

**CLUES - PROBLEM #2** These are clues to help solve your team's problem. You may read your clues to the team, but you may not show them. You may read your clues as often as you wish.



Cloud

- The problems you must solve are: In which rooms are the classrooms and office? Which plants should be planted in the six areas of land surrounding those rooms at the school? Use the SCHOOL MAP, STAFF PLACE CARDS, and AREA DESCRIPTIONS to help you solve this problem.
- The office staff and student helpers complain about how hot the offices are. You must use plants to make it cooler in the spring, summer, and fall.
- Ms. Grijalva has a corner classroom with windows on the east and south sides.
- The principal keeps saying, "More than half the water provided by Valley cities is used outside to water lawns and landscape plants. Both inside and outside, this school must save water and set a good example. I want grass on only one side of the building!"

**CLUES - PROBLEM #2** These are clues to help solve your team's problem. You may read your clues to the team, but you may not show them. You may read your clues as often as you wish.



Eagle

- Trees provide the best shade. Ground covers and shrubs can also provide insulation from our desert heat.
- Ms. Schmidt, a science teacher, states, "Looking out the window, I want to see only Sonoran Desert plants and as many animals as possible. We should have plants that give food to animals that are seed eaters, fruit eaters, insect eaters, and nectar feeders."
- The classrooms of Mr. Lee and Mr. Johnson are on the same side of the building.

### XERISCAPE! YOU ESCAPE! - STUDENT PAGE

### PROBLEM #2: WILDLIFE ON CAMPUS?

## MORE CLUES

**CLUES - PROBLEM #2** These are clues to help solve your team's problem. You may read your clues to the team, but you may not show them. You may read your clues as often as you wish.



Butterfly

- Ms. Grijalva, a math teacher, says: "I don't care what you do as long as it's colorful. I'd like to see flowers blooming with different colors all year, though. Butterflies and hummingbirds would be nice, too."
- The special question is: How much of the water provided by Phoenix-area cities is used to water lawns and landscape plants?
- Mr. Johnson, who teaches social studies, wants: "Green, green, green maybe a few flowers but deep green mostly, like around the Mediterranean Sea. It's really dry but very green there. It's cooler here on the north side of the building, so maybe plants that insulate. Evergreen, not deciduous plants plants that don't lose their leaves would be good."
- Sonoran Desert plants include cactus, annual wildflowers, shrubs, and trees native to our desert in Arizona and the Mexican state of Sonora.

EXTRA CLUES - **PROBLEM #2** These are clues to help solve your team's problem. You may read your clues to the team, but you may not show them. You may read your clues as often as you wish.



Water Drop

### **EXTRA CLUES**

- Turf or grass is the plant that requires the most water.
- A small, efficiently-irrigated, grassy area close to a building provides insulation and outdoor activity space.
- The basic needs of all animals are food, water, and shelter arranged so that the animal can safely get to them when it needs to.
- Hummingbirds feed on nectar in flowers and on insects. Butterflies feed on nectar, but their larvae need plant leaves.

### XERISCAPE! YOU ESCAPE! - STUDENT PAGE

### PROBLEM #2: WILDLIFE ON CAMPUS?

## AREA DESCRIPTIONS

#### AREA DESCRIPTION - PROBLEM #2



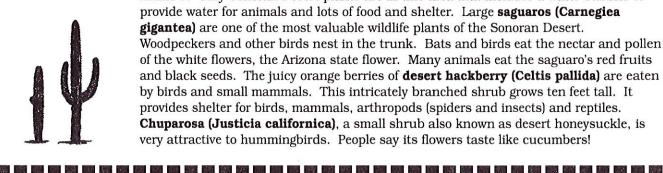
**AREA 1**: Key plants in this area provide shade, interesting shapes and some color. Shade trees include blue palo verde (Cercidium floridum), Chilean mesquite (Prosopsis chilensis) and shoestring acacia (Acacia stenophylla). Blue palo verde is the state tree of Arizona. Chihuahuan rain sage (Leucophyllum laevigatum) and other Texas rangers are shrubs with green-grey foliage that are very dense in summer. Besides people, animals enjoy the shade of these plants. These plants are used by birds for nests and insect prey. Seeds are food for javelina, ground squirrels, doves, quail, and desert rodents. Rabbits and deer eat the twigs.

### **AREA DESCRIPTION - PROBLEM #2**



**AREA 2**: The History teacher is especially happy about this area because it looks very green. The principal likes it because it does not use much water to irrigate. Plants include: white iron bark tree (Eucalyptus leucoxylon "rosea"), evergreen elm (Ulmus parvifolia), trailing rosemary (Rosmarinus officinalis), and Mexican bird of paradise (Caesalpinia gilliesii). Hummingbirds also seem pleased about the red flowers of the white iron bark tree. Bees visit the purple rosemary and yellow Mexican bird of paradise flowers.

### AREA DESCRIPTION - PROBLEM #2



**AREA 3**: Only Sonoran Desert plants are in this area that includes a water bubbler to provide water for animals and lots of food and shelter. Large saguaros (Carnegiea gigantea) are one of the most valuable wildlife plants of the Sonoran Desert. Woodpeckers and other birds nest in the trunk. Bats and birds eat the nectar and pollen of the white flowers, the Arizona state flower. Many animals eat the saguaro's red fruits and black seeds. The juicy orange berries of desert hackberry (Celtis pallida) are eaten by birds and small mammals. This intricately branched shrub grows ten feet tall. It provides shelter for birds, mammals, arthropods (spiders and insects) and reptiles. Chuparosa (Justicia californica), a small shrub also known as desert honeysuckle, is very attractive to hummingbirds. People say its flowers taste like cucumbers!

#### AREA DESCRIPTION - PROBLEM #2



**AREA 4.** The principal loves this living sculpture area because it shows that the school exists comfortably in the Sonoran Desert without wasting water. The key plant is Sonoran palo verde or palo brea (Cercidium praecox), which has lime green leaves, trunk, and stems. It is used by birds for nests and insect prev. Its seeds are food for javelina, ground squirrels, doves, quail, and desert rodents. Rabbits and deer eat the twigs. Another important plant is ruellia (Ruellia californica), a bright green shrub with purple flowers that blooms most of the year. It is a good cover plant for lizards and other small animals. Wildflowers include orange and yellow poppies (Eschscholtzia mexicana, E.californica) and pink and red penstemons (Penstemon parryi, P. subulatus and others). Doves and sparrows love poppy seeds. Hummingbirds drink nectar from the penstemons.

#### AREA DESCRIPTION - PROBLEM #2



**AREA 5**: This is the only grassy place around the school. **Bermuda grass (Cynodon dactylon)** uses quite a bit of water and does not attract much wildlife, except students. Other plants that will survive low light levels, keep the teacher happy, and attract wildlife include **sago palms (Cycas revoluta)**, **golden columbine (Aquilegia crysantha)**, and **Salvia clevelandii**. **Sago palms** look like ferns when young and grow to look like 10' palms. This primitive, dark green, cone-bearing plant is neither palm nor fern, but rather is related to pine trees and other conifers. The large tubular flowers of the **golden columbine** attract hummingbirds and have a fairylike, woodland quality. **Salvia clevelandii**, a fragrant purple-blooming shrub, also attracts a variety of wildlife.

#### AREA DESCRIPTION - PROBLEM #2

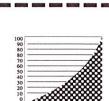


**AREA 6**: This area has lots of interesting smells, different colors, and wildlife. Two birds, verdins and gnatcatchers line their nests with dried fragrant purple flowers of **desert lavender (Hyptis emoryi).** The bright red tubular flowers of **pineapple sage (Salvia elegans)** attract hummingbirds. Yellow, white, pink, purple, red, and orange **lantanas** and **verbenas** are preferred nectar plants for some adult long-wing butterflies, but the vine **Maypops (Passiflora incarnata)** must be nearby to feed the butterfly larvae.

# PROBLEM #2: WILDLIFE ON CAMPUS?

## STAFF PLACE CARDS

cut pictures along dotted line



MS. GRIJALVA MATH



MS. SCHMIDT SCIENCE



MR. JOHNSON HISTORY



**OFFICE & STUDENT** 

**HELPERS** 

### PROBLEN #2: WILDLIFE ON CAMPUS?

# SCHOOL MAP

