Grand Canyon National Park

Natural History
Lesson Plans

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United States Department of the Interior
NATIONAL PARK SERVICE
Grand Canyon National Park
PO Box 129
Grand Canyon, Arizona 86023-0129

Glossary of Natural History Terms

Abiotic factor: a non-living component of an ecosystem, such as air, water, or temperature.

Adaptation: something an organism has or does that allows it to survive in its environment.

Biodiversity: the variety and variability of living organisms in an environment.

Biology: the study of life**.**

Biotic factor: a living component of an ecosystem.

Birding: the popular hobby of observing birds in the wild.

Botany: the study of plants.

Carnivore: an animal that eats other animals.

Classification: the grouping or ordering of objects or organisms into categories based on shared or common characteristics.

Colorado Plateau: a large geologic area uplifted thousands of feet in elevation covering parts of Arizona, Colorado, New Mexico and Utah.

Colorado River: a major river of the southwestern United States, flowing 1450 miles from its headwaters in the Rocky Mountains of Colorado, through the Grand Canyon, and ending in the Gulf of California.

Commensalism: a symbiotic relationship in which one partner benefits without significantly affecting the other.

Community: an interacting population of plants or animals living in the same habitat.

Decomposers: an organism, usually a bacterium or fungus, that breaks down the cells of dead plants and animals into simpler substances.

Desert: a region with a mean annual precipitation of 10 inches or less; thus capable of supporting only a limited population of plants and animals.

Detritivore: an organism that derives its energy from dead organic wastes and dead organisms.

Diurnal: animals that are active during the day.

Ecology: the study of relationships between living things and their environment.

Ecosystem: a community of living things together with their nonliving environment.

Endemic: a plant or animal (can refer to humans) found specifically in one location and nowhere else

Environment: the total of all of the surroundings – air, water, vegetation, human element, wildlife, climate, location – that has influence on something's existence.

Habitat: the arrangement of food, water, shelter or cover and space suitable to an animal's needs.

Herbivore: an animal that eats only plants.

Inner Gorge: the steep-walled gorge at the bottom of the Grand Canyon where the Colorado River flows.

Life Zones: bands of vegetation resulting from particular topography and climatic conditions; also called biotic zones.

Mutualism: a symbiotic relationship in which both partners benefit.

Natural History: the story of nature's past; the conditions in nature's past that have led to its current state.

Naturalist: one who studies nature and the relationships in nature.

Niche: a population's role in its community; the sum total of a population's use of the biotic and abiotic resources of its habitat.

Nocturnal: animals that are active at night.

North Rim: the top of the north side of Grand Canyon, a less visited part of the park that is closed from mid-October through mid-May due to snow. The North Rim is approximately 8000 feet in elevation, which is 1000 feet higher than the South Rim.

Organism: an individual living thing, such as bacterium, fungus, protist, plant, or animal.

Omnivore: an animal that eats plants and animals.

Parasitism: a symbiotic relationship in which the parasite lives within or on the surface of a host, from which it derives its food.

Producer: an organism that makes organic food molecules from CO2, H2O, other inorganic raw materials and sunlight.

Scavenger: an animal that eats dead, decaying animal remains.

South Rim: the top of Grand Canyon on the south side where most people visit; open year-round. The elevation at the South Rim averages 7000 feet.

Symbiosis: a close association between organisms of two or more species.

Wildlife: all animals that are not domesticated.

Zoology: the study of animals.

Create a Journal Cover

School Subjects Science; Art
Grade Level 3rd – 5th
AZ Standards Addressed

SC03-S1C4-01: Communicate investigations and explanations using evidence and appropriate terminology.
SC03-S1C4-03: Communicate with other groups to describe the results of an investigation.
SC04-S1C1-04: Locate information (e.g., book, article, website) related to an investigation.
SC04-S1C4-01: Communicate verbally or in writing the results of an inquiry.
SC04-S1C4-03: Communicate with other groups to describe the results of an investigation.
SC05–S1C1-03: Locate information (e.g., book, article, website) related to an investigation.
SC05-S1C4-03: Communicate with other groups to describe the results of an investigation.
VA-S1C2-202: Demonstrate purposeful use of materials, tools, and techniques in his or her own artwork
VA-S1C4-302: Create artwork that communicate substantive meanings or achieve intended purposes

Lesson Overview
Students create a cover for their field trip program journal. The cover can include a collage of photos and/or drawings of plants and animals that live at Grand Canyon, or that live in Arizona.

Lesson Objectives
Students will be able to identify several animals and plants that live in different ecosystems and gain an understanding of the diversity of plants and animals that survive in different environments. They will understand how a creative and personal approach to their journal will increase their memory and understanding of the natural world.

Materials

- Construction paper (various colors may be used; size can be 8 ½ x 11 or 9 x 12)
- Journal insert for activity of your choosing (make enough copies so each student will have one)
- Magazines, brochures, or other media with photos of wildlife and plants from near your hometown and/or from Grand Canyon. *Suggested references:* "Who Am I" cards, found at: http://www.nps.gov/grca/forteachers/lessonplansandteacherguides.htm and "Web of Life" cards (this smaller set includes plant information) found at: http://www.nps.gov/grca/forteachers/lessonplansandteacherguides.htm
- Scissors
- Glue and tape
- Colored pencils, crayons, or markers
- Staples and stapler
- Optional: reference books on animals, encyclopedias, field guides, etc.

Background Information
Arizona has a wide diversity of ecosystems ranging from hot deserts to alpine tundra. Therefore, there is also an amazing diversity of plants and animals that call Arizona home. If you are not familiar with the variety that Arizona has to offer, local natural history museums and botanical gardens offer an abundance of information. Some may have free information that can be sent or they may have websites available so you can gather information from the classroom.

In addition, numerous magazines specific to Arizona (ie. Arizona Highways) offer many photos and information about state-wide flora and fauna. Each National Park Service site in Arizona (there are 20!) will have information on flora and fauna found in the park area.

Procedure
1. Prior to conducting the activity, begin collecting magazines, brochures and other printed media with photos of animals and plants that both live in your area and at Grand Canyon (for Grand Canyon animal and plant photos, see the "Who Am I" or "Web of Life" cards; details are above in material list. These can be printed

out on a black-and-white or color printer if available.). You can also have students start bringing some of these items in from home, too.

2. Tell the students that they will be making the front and back covers of a journal for an activity of your choosing. Discuss the value of journals; in addition to recording observations, feelings and impressions, they are places to record important data to refer to later. Both words and artwork can be important ways to record all these things. Students will fill in page two of their "Life on the Edge" or "Eco Explorers" journal, if you are scheduled for an in-park program with the Environmental Education Office.
3. Using the collected materials, "Who Am I," and/or "Web of Life" cards, have the students identify two animals and one plant that live at Grand Canyon AND near you. Then have the students identify one plant and animal that live ONLY at Grand Canyon (here the term "endemic" can be introduced.) Talk about similarities and differences of the animals and plants to cover the terms: *carnivore, herbivore, omnivore, scavenger,* and *adaptation.*
4. As a review, or in conjunction with your discussion, have the students fill in page two of their journal. Also, on the front page of the journal, have the students fill in the parts of the food chain using the plants/animals on that page. (juniper tree/bush→deer→mountain lion→condor. Stress with the students that the mountain lion would need to die before the condor would scavenge from it for a meal.)
5. Hand out the construction paper – if you have a variety of colors, they can come up and choose which color they want. Have students fold the construction paper in half. Get out colored pencils, crayons, marking pens, or the like. Also get out the scissors, glue, tape and stapler.
6. If you have collected a lot of animal and plant photos, have the students cut out at least one of each that live at Grand Canyon*. Have them glue the photos to what will be the front cover of their journal. They can label each if they want. Make sure they leave room to put their own name on the cover, too.
   *if you don't have enough photos, they can also draw the plant(s) and animal(s).
7. Now have students cut out one of each plant and animal that they think they would find in the area they (the students) live in. Have them glue these on what will be the back cover and label them if they want.
8. Take the journal insert and have the students staple it into their journal cover such that their artwork forms the outside front and back covers of their journal.
9. Discuss why they think that different animals, or possibly the same animals, live at Grand Canyon as opposed to where the students live. Is one area hotter? Wetter? Higher elevation? Etc.

Extension Activity

On the inside of the front and back covers, have them write something down about the plants and animals they chose. This could include an adaptation each has to living where it lives, or perhaps some information on the range of each species – is it specific to one area or is it found over a larger area. The students could even write a poem, haiku or other such creative writing about their plant or animal.

One option is the following type of poem, called a "cinquain", which uses this format:

	EXAMPLE
Line 1: one word to name the subject (noun)	canyon
Line 2: two words to describe it (adjective)	huge, colorful
Line 3: three action words about it (verbs)	eroding, growing, changing
Line 4: four-word phrase about it	making me feel small
Line 5: one new word that renames the subject (noun)	chasm

Resources

The following organizations have websites with information that may be useful:

Arizona Game and Fish Department- www.gf.state.az.us/i_e/environmental_education.html www.azgfd.com

National Park Service and US Fish and Wildlife Service- www.nps.gov/grca/pphtml/nature.html (Grand Canyon specific) www.nps.gov (will enable you to see an alphabetical listing of parks) www.fws.gov

Do You See What I See?

School Subjects Science, Art
Grade Level K – 6th
AZ Standards Addressed

SC00-S1C1-01: Observe common objects using multiple senses
SC01-S1C1-01: Observe common objects using multiple senses
SC03 -S1C3-01: Organize data using the following methods with appropriate labels: bar graphs, pictographs, tally charts
SC03 -S4C3-01: Identify the living and nonliving components of an ecosystem.
SC03 -S4C3-02: Examine an ecosystem to identify microscopic and macroscopic organisms.
SC06 -S1C2-05: Keep a record of observations, notes, sketches, questions, and ideas using tools such as written and/or computer logs.
VA-S1C4- 101: Select and use subject matter and/or symbols in his or her own artwork
VA-S1C4- 202: Create an artwork that serves a function

Lesson Overview

Students will practice observing their surroundings and recording what they see through words and/or drawings. They will list what they remember seeing in an environment (ie. On part of a wall in the classroom that has been covered; what is on the playground outside; etc), then check their accuracy and discuss the results. They will then apply these skills in another setting.

Lesson Objectives

Students will be able to describe in detail the differences between their memories of a scene and their observations of the same scene. They will also be able to describe why it is important to carefully observe something, and to record the information if they are to accurately remember it or pass the information on to others.

Materials

- A cloth sheet or large piece of paper
- Journal, note pad or sheet of paper for each student

Procedure

1. Before students arrive at class cover a section of a wall, chalk board or a desk with the cloth sheet or large pieces of paper. Use a surface that the students likely see on a regular basis and therefore have some familiarity with. When the students arrive have them write down or draw what they remember being on the surface that has been covered. After they have done this, remove the covering and have them see what they included and what they missed. Some questions to consider:
   - Are there any patterns overall of what was remembered or not remembered?
   - Did all students remember certain items? Did all miss certain items? Was it more random?
   - Why did they remember or not remember certain items?
     - Camouflaged? A bright or dull color?
     - Not of interest to them?
     - Something they like or dislike?
2. Now have them write down or draw as many details as possible about an outdoor area around the school (ie. Playground, playing field, etc). This can include not only physical items like play equipment, trees, fences, etc., but you can also have them include any sounds they may recall hearing on a regular basis (ie. A nearby highway or railroad, the school bell, birds, etc), or any smells that are common (ie. Fresh cut grass, lunch being cooked in the cafeteria, etc.) After they do this, take the class outdoors to the area and again have them compare what they remembered relative to what is actually there.
3. Have the students pick a spot to sit outdoors. Each student should have space from the others by sitting at least 10 feet apart, and they should be quiet (no talking or excessive shuffling of feet, legs, etc.). Have them

record in as much detail all that they see, hear, feel and smell. They can choose to focus on a small area (ie. One tree or rock) or on the whole scene. Give them a minimum of five minutes to complete the exercise. *Ideas to enhance the students' senses: Cupping their hands around their ears simulates the large ears of deer, elk and other animals, and increases their ability to hear subtle sounds. Moistening the undersurface of the nose and the entire upper lip increases the sense of smell (many animals can do this to help them smell for predators or prey).*

4. Discuss the joy and importance of closely observing the world around them. Through this process, they learn to appreciate, respect and understand more about the world in which we live. It is through this process of observing and recording that we understand the role of all the plants and animals that live in the deserts, mountains and other regions of the world. In addition, they begin to appreciate and understand the fundamental life support systems we all rely on – air, water, soil, plants and animals.
5. If your class will be participating in one of our natural history programs, Life on the Edge, Eco Explorers, or Discovery Pack, you may want to discuss with them that their powers of observation will be used extensively while exploring the forested rim of Grand Canyon. In addition, like any scientist doing field work, they will be recording their observations in a journal.

Extension Activities

1. If you have access to a park or wild area near your school, they can be excellent locations for this activity.
2. Find and observe an insect or small animal if available. Pretend you are making a report to a scientist because what you are observing has never been seen before. Provide a detailed description. If you were reporting your find to the general public, would you change what you say about the creature regarding details?

Oh, Deer!

School Subjects Science, Math
Grade Level 4th – 8th
AZ Standards Addressed

SC03-S1C3-01: Organize data using the following methods with appropriate labels: bar graphs, pictographs, tally charts
SC04/05- S1C4-02: Choose an appropriate graphic representation for collected data: bar graph, line graph, Venn diagram, model
SC06/07-S1C4-01: Choose an appropriate graphic representation for collected data: line graph, double bar graph, etc
SC07-S4C3-03: Analyze the interactions of living organisms with their ecosystems: limiting factors, carrying capacity
SC08-S1C4-02: Choose an appropriate graphic representation for collected data: line graph, double bar graph, etc
M03/04/05-S2C1-02: Construct an appropriate graph with labels and title from organized data.
M08-S2C1-03: Determine the appropriate type of graphical display for a given data set.

Lesson Overview
Students will discuss basic needs for animal survival and how resources are limited in an environment (there are only so many plants and a limited amount of water). They will experience how limited resources have a limited carrying capacity and can track the cyclical population growth and decline.

Lesson Objectives
Students will be able to identify and describe food, water and shelter as three essential components of habitat and define "limiting factors" and give examples. They will also recognize that some fluctuations in wildlife populations are natural as ecological systems under constant change.

Materials
- Area, inside or out, where students can run around
- Chalkboard and writing materials

Background Information
A variety of factors affects the ability of wildlife to successfully reproduce and to maintain their populations over time. Disease, predator/prey relationships, varying impacts of weather conditions from season to season, accidents, environmental pollution and habitat destruction and degradation are among these factors.

Some naturally-caused as well as cultural-induced limiting factors serve to prevent wildlife populations from reproducing in numbers greater than their habitat can support. An excess of such limiting factors, however, leads to threatening, endangering, and eliminating whole species of animals.

The most fundamental of life's necessities for any animal are food, water, shelter, and space in a suitable arrangement. Without these essential components, animals cannot survive.

Wildlife populations are not static. They continuously fluctuate in response to a variety of stimulating and limiting factors. We tend to speak of limiting factors as applying to a single species, although one factor may affect many species. Natural limiting factors, or those modeled after factors in natural systems, ten to maintain populations of species at levels within predictable ranges. This kind of "balance in nature" is not static, but is more like a teeter-totter. Habitat components are the most fundamental and thereby the most critical of limiting factors in most natural settings.

Procedure
1. Begin by reviewing the essential components of habitat with the students: food, water, and shelter (space is also a factor, but this activity does not focus on this). Animals must have a balance of all of their needs to survive and support a healthy population.

2. On the playing field you will need to mark two parallel lines on the ground about 20 yards apart. Divide students by counting off, 1-4. The ones will go to one line; all of the other students go to the other line.
3. The ones become "deer," while the rest of the students will be the essential components of habitat. The deer need to find food, water, and shelter in order to survive. When a deer is looking for **food**, it puts both hands on its stomach. When a deer is looking for **water**, it puts its hands over its mouth. When a deer is looking for **shelter**, it should place its hands over its head like a roof. Each deer will choose what it wants to look for each round. It is important that deer cannot change what it is looking for during the round (when it sees what is available). There are no extra prizes for playing the deer for every round.
4. At the beginning of each round, students face away from the other team and everyone decides which symbol to display. The deer and habitat components will display the symbols for food, water, and shelter in the same way. Give everyone a few moments to decide and show their symbol- hands on their stomachs, mouths, or overhead. There should naturally be a balance of symbols each round.
5. When everyone has decided which symbol to use, have both lines turn toward each other. The deer will then run to the habitat line to find someone in the habitat with the same symbol. If the deer is looking for water, it must tag water; two deer cannot share one habitat (person), so only the first deer to tag their corresponding habitat symbol will survive. Deer that are successful take their habitat partner back with them to the deer end of the field. Deer that fail to find their food, water, or shelter will die and stay on the habitat side of the field. (If you find that students are changing symbols mid-round, consider having three different tokes for each student to choose from before each round.)
6. Habitat that has been brought to the deer side of the field become deer for the next round. Keep track of the deer population at the beginning of each round. Continue playing for about 15 rounds.
   (A variation: consider introducing a predator such as a mountain lion or wolf. The predator must start outside the playing field. Hopping or skipping onto the field to catch deer running TOWARD the habitat. Once the predator tags a deer, it must escort its prey back to its den to represent the time it would take to eat, before returning to the field to hunt again. Prey will become an additional predator for the following round, while unsuccessful predators die and join the habitat line for the next round. The predator population will fluctuate much in the same way the deer population does. If you wish, record the predator population at the beginning of each round as well.)
7. At the end of the activity, gather the students together to talk about what they experienced and saw. (For example: seeing a small population grow over many rounds and crashing when the habitat could no longer support the large population.)
8. Guide students to graph the population fluctuations over time on the board, each round represents a year. The graph will serve as a visual reminder of what the students experienced during the activity.
   (If predators were introduced into the game, graph their population fluctuations as well to see how the deer and mountain lion populations relate to one another.)
9. During the discussion, ask the students to summarize some of the things they have learned from this activity. What do animals need to survive? What are some of the "limiting factors" that affect their survival? Are wildlife populations static, or do they tend to fluctuate, as part of an overall "balance of nature"? Is nature really in "balance" or are ecological systems involved in a process of constant change?

*Adapted from *Project WILD, K-12 Activity Guide,* from the Council for Environmental Education, 1992.

Dichotomous Key

School Subjects Science
Grade Level $4^{th} – 8^{th}$
AZ Standards Addressed
W04/05/06/07/08-S3C3-01: Write a variety of functional text (directions, recipes, procedures, graphs/tables, etc)

Lesson Overview
Students will discuss how plants and animals can be identified by using a dichotomous key. They will learn how to use a dichotomous key and create their own. Groups visiting Grand Canyon may use a dichotomous key to identify plants on the South Rim.

Lesson Objectives
Students will be able to use a dichotomous key to identify arbitrary nuts & bolts. They will be able to group objects by their visible characteristics to create their own dichotomous key.

Materials
- A variety of nuts and bolts (suggested selection shown *on page 10)*
- Copies of ***EITHER*** the Nut and Bolt Key *(page 11)* ***OR*** the Jelly Belly Key *(page 12)*- one for each student or group of students
- Copies of the "_____'s Creatures!" (page 13) one for each student

Background Information
To identify plants and animals, people must often reference field guides to identify what they have seen in order to learn more about it. Sometimes by focusing on categories we put organisms into (including mammals, reptiles, amphibians, birds, fish, insects, and arachnids) we can narrow down the field of search. After narrowing a search down to birds, for example, identifying the bird would rely on its physical characteristics of color, size, etc.

Using a dichotomous key is a method for identifying a subject in question by going through a series of choices of opposites that lead to a correct identification. Dichotomous means "divided in two parts"; thus at each step of the key, the group of possibilities is divided into two distinct smaller groups, and keeps dividing those groups in two until only one individual is left at the end. Typically, the division at each step of the identification process is that of opposites: one "is" and the other "is not." To use a dichotomous key, the user must be familiar with the terminology used. When creating a new dichotomous key and focusing on the size of the individuals, it is important to use measurements rather than "big" and "small." This type of identification system is valuable when identifying common plants or birds found in an area or region.

Procedure
1. Explain that naturalists sometimes make keys for classifying different things and describe how a dichotomous key works: breaking a group of object into two distinct groups continuously until individuals are singled out for identification.
2. Pass out the dichotomous key for Nuts & Bolts (page 11) or Jelly Belly Jelly Beans (page 12), at least one copy for every two or three children. Then pass at least one nut or bolt to each group or one jelly bean to each student and instruct the students to work through the key to identify their object. If identifying jelly beans, once they determine what flavor the bean should be, they can then eat the bean to find out if they were correct.

Note: *If you use the Jelly Belly Key, you may need to address the following issues:*
- ✓ *You can address opaque versus translucent this way if it is necessary to explain the difference. The best way to test whether the bean is opaque or translucent is to hold the bean between you and a bright light source.*
- ✓ *Some of the beans have distinctive centers. To identify the bean properly, it may be necessary to dissect it. We've found that plastic spoons work; a plastic knife may also do the trick.*

- ✓ *The way Jelly Belly produces their cinnamon and cherry beans, it is very difficult to distinguish between the two. This is another opportunity to explain how difficult it may be to identify some plants. You may not be able to identify them unless they are side by side and even then, you may need an expert to really know what flavor you have before tasting it.*

3. Now that the students have had the chance to try using a dichotomous key, they will have the chance to create their own key. Have the students gather their chairs to sit in a circle and ask about ten students take off one of their shoes to place in the center of the group (try to get a variety of shoes).
4. Looking at the shoes in the circle, brainstorm similarities and differences in the individuals. Try to get the children as much involved as possible in suggesting the features used in classifying. The more active they are in the process, the more likely they are to understand it. Help the students choose one characteristic by which to split the shoes into two groups, roughly the same size. Make sure the distinction between the groups is something like "has laces" vs. "does not have laces" rather than "tennis shoes" vs. "sandals." Keep track of the keying-out process on the board.
5. Once the shoes have been split into two groups, set one group aside, which the group will worry about later. Lead the students through splitting group one into successively smaller groups until each is identified individually. Then return to the second half of the shoes and follow the same steps of splitting the shoes into smaller groups until each is individually identified.
6. Check the accuracy of the dichotomous key by choosing one of the shoes to key out and see if works.
7. Now that the students have used a key and constructed a successful key as a group, pass out the "_____'s Creatures!" worksheet. Tell the students to make names for the creatures they will use to create a dichotomous key on their own.

Extension

Find a dichotomous key that can be used to identify native/common plants in your area. Take the students outside to identify some of the plants with the dichotomous key.

Nuts/bolts used in key on following page:

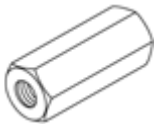
Split lock washer

Flat washer

In tooth lock washer

Wing nut

Finished hex nut


Hex coupling nut

Square nut

Tee nut 3 prong

Serrated hex locknut

Phillips self-drilling screw

Slotted flathead screw

Slotted hex screw

Slotted round screw

Square flat screw

Unslotted hex screw

Nut and Bolt Dichotomous Key

1a. Post. . . . . go to 2
1b. No Post . . . . . .go to 7

2a. Round head . . . . . go to 3
2b. Not Round head (hexagonal). . . . . go to 6

3a. Phillips slot . . . . . Phillips Screw
3b. Does not have Phillips slot . . . . . go to 4

4a. Flathead slot . . . . . go to 5
4b. No flathead slot (square hole) . . . . Square flat screw

5a. Rounded head . . . . . .Slotted round screw
5b. Flattened head . . . . . .Slotted flathead screw

6a. Has flathead slot . . . . . Slotted hex screw
6b. Does not have flathead slot. . . . Unslotted hex screw

7a. Has threads . . . . . go to 8
7b. No threads . . . . . .go to 13

8a. Square. . . . . Square nut
8b. Not Square. . . . . .go to 9

9a. Hexagonal. . . . . go to 10
9b. Not Hexagonal. . . . . .go to 12

10a. Hexagonal with round base. . .Serrated hex lock nut
10b. Only Hexagonal . . . . . .go to 11

11a. Taller than wide . . . . . Hex coupling nut
11b. Wider than tall . . . . . .Finished hex nut

12a. Has 2 wings. . . . . Wing nut
12b. Has 3 prongs. . . . . Tee nut 3 prong

13a. Has teeth . . . . . .In tooth lock washer
13b. No teeth . . . . . go to 14

14a. Continuous circle. . . . . .Flat washer
14b. Broken ring. . . . . .Split lock washer

Flattened head	**Rounded head**	**Slot for Phillips Screwdriver**	**Slot for Flathead Screwdriver**

Jelly Belly Jelly Bean Dichotomous Key

1a. Bean is blue	go to 2
1b. Bean is NOT blue	go to 3
2a. Bean is blue	Blueberry
2b. Bean is blue with spots	Plum
3a. Bean is pink	go to 4
3b. Bean is NOT pink	go to 7
4a. Bean is opaque pink with spots	go to 5
4b. Bean is pink WITHOUT spots	go to 6
5a. Bean is opaque pink with red spots	Strawberry Cheesecake
5b. Bean is opaque pink with multi-colored spots	Tutti-Fruitti
6a. Bean is whitish-pink	Bubble Gum
6b. Bean is plain pink	Cotton Candy
7a. Bean is green	go to 8
7b. Bean is NOT green	go to 11
8a. Bean is dark green with red center	Watermelon
8b Bean is NOT dark green	go to 9
9a. Bean is green with spots	Juicy Pear
9b. Bean is green WITHOUT spots	go to 10
10a. Bean is lime green	Lemon Lime
10b. Bean is grass green	Green Apple
11a. Bean is yellow	go to 12
11b. Bean is NOT yellow	go to 14
12a. Bean is yellow with brown spots	Top Banana
12b. Bean is yellow WITHOUT spots	go to 13
13a. Bean is opaque yellow	Piña Colada
13b. Bean is translucent yellow	Lemon
14a. Bean is white	go to 15
14b. Bean is NOT white	go to 18
15a. Bean is white with spots	go to 16
15b. Bean is white WITHOUT spots	go to 17
16a. Bean is white with yellow spots	Buttered Popcorn
16b. Bean is white with black dots	French Vanilla
17a. Bean is translucent white	Cream Soda
17b. Bean is opaque white	Coconut
18a. Bean is cream-colored with light orange spots	Carmel Corn
18b. Bean is NOT creamy with spots	go to 19
19a. Bean is dark orange brown with red spots	Peach
19b. Bean is NOT dark orange brown with spots	go to 20
20a. Bean is orange	go to 21
20b. Bean is NOT orange	go to 22
21a. Bean is opaque orange; has a white center	Orange Sherbet
21b. Bean is translucent orange	Tangerine
22a. Bean is red	go to 23
22b. Bean is NOT red	go to 25
23a. Bean is opaque red; has a white center	Red Apple
23b. Bean is NOT solid red	go to 24
24a. Bean is fire-engine red	Very Cherry
24b. Bean is darker than fire-engine red; may have yellow spots	Cinnamon
25a. Bean is off-white with brown spots	Toasted Marshmallow
25b. Bean is NOT off-white with brown spots	go to 26
26a. Bean is light brown with green center	Carmel Apple
26b. Bean is dark brown	go to 27
27a. Bean is translucent dark brown	Root Beer
27b. Bean is opaque dark brown	go to 28
28a. Bean is opaque dark brown with spots	Cappuccino
28b. Bean is opaque dark brown has NO spots	Chocolate Pudding

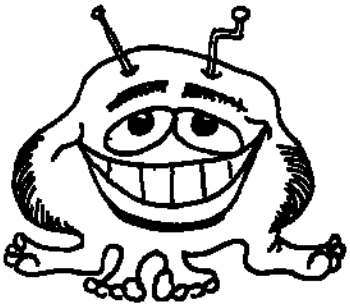
** Note: Watch out for new species!! **

_____’s Creatures!

(name)

Give your creatures names before you start making a dichotomous key for them.

1. _____ **2.** _____ **3.** _____



4. _____ **5.** _____ **6.** _____ **7.** _____

8. _____ **9.** _____ **10.** _____

Who Am I?

School Subject Science
Grade Level 4th
AZ Standards Addressed

SC04-S4C1-02: Classify animals by identifiable group characteristics: vertebrates (mammals, birds, fish, reptiles, amphibians) and invertebrates (insects, arachnids)

Lesson Overview

Students will discuss how animals can be categorized according to size, animal class, number of legs, warm or cold blooded, diet, predator or prey, etc. They will then use knowledge of various animals to identify animals without seeing them by asking questions of others to narrow down their options.

Lesson Objectives

Students will be able to list some of the animal classifications and give examples of individuals in each classification. They will be able to define herbivore, omnivore, carnivore, and scavengers and be able to give specific examples as well.

Materials

- Who Am I cards, printed two-sided, laminated (optional) with string or a safety pin for each card
  Found at: http://www.nps.gov/grca/forteachers/lessonplansandteacherguides.htm

Background Information

Grand Canyon is home to an astonishing array of wildlife. Over 450 types of mammals, reptiles, amphibians, birds, and fish live within the 1.2 million acres of the park. The reason for this vast diversity of life stems from the fact that Grand Canyon topography is quite varied—from over 8000 feet elevation on the North Rim to around 2000 feet at the bottom of the canyon. These changes in elevation result in drastic climatic differences, creating environments that range from alpine forests on the rim to Sonoran desert at the bottom (as you go up in elevation temperatures go down about 4°F every 1,000 feet). In addition, riparian areas—environments next to water sources—provide habitats for a great number of plants and animals that would otherwise be unable to survive in a dry landscape (The Colorado River, and numerous springs and small side streams provide this habitat in the canyon). These riparian areas comprise a very small percentage of the Grand Canyon landscape, but provide critical habitat for many different organisms.

This diversity of life within Grand Canyon National Park contributes to the park's uniqueness and importance. National Park status ensures that these plants and animals, some of which only live at Grand Canyon, are protected from human interference.

Biodiversity is important in every ecosystem. The earth has a variety of organisms including mammals, reptiles, amphibians, birds, fish, insects, and arachnids. Every species has evolved and adapted to their environment and fills a specific niche.

- ⇒ *Mammals* are vertebrates that have hair, and the females have mammary glands that produce milk for their young.
- ⇒ *Reptiles* are cold-blooded vertebrates that breathe with lungs and have skin covered in scales.
- ⇒ *Amphibians* are vertebrates, including toads, frogs, newts and salamanders. Amphibians generally spend part of their lives in water and part on dry land.
- ⇒ *Birds* are warm-blooded egg layers and are unique in their covering of feathers.
- ⇒ Most *fish* are cold-blooded, entirely aquatic vertebrates that have paired fins, torpedo-like bodies, and lay eggs.
- ⇒ *Insects* have exoskeletons, six legs that occur in pairs, and most have wings.
- ⇒ *Arachnids* are insect-like arthropods with bodies comprised of two parts, the abdomen and the cephalothorax, which contains the head and thorax; examples include scorpions, spiders, ticks and mites.

Another important classification of animals depends on their food source: herbivore, carnivore, omnivore, and scavenger. *Herbivores*, like deer or rabbits, get all of their energy solely from eating plant material. Their teeth are mostly flat, designed to grind through copious amounts of plant material. *Carnivores*, like mountain lions or red-tail hawks, sometimes considered top predators, get all of their energy from eating other animals. The teeth of carnivores are sharp, designed to shred the meat of their prey before ingesting it completely. Of course, birds and reptiles have other adaptations that specialize on eating meat. *Omnivores*, like coyotes, many lizards, or humans, are adapted to eating both plant and animal material. Having such an adaption allows animals to be more flexible about their food sources as they fluctuate over time. And finally, *scavengers*, like the California condor, eat dead animal material; scavengers serve as nature's cleaning service, helping to complete the cycle of nutrients returning to the soil.

Procedure

1. Introduce the idea of classifying animals and ask for ideas how animals can be described. Make sure to introduce or touch upon animal classifications (mammal, reptile, amphibian, bird, fish, insects, arachnids), animal relationships of predator and prey, and classification according to food source. Perhaps choose an animal that all students are familiar with and talk about its characteristics.
2. Discuss strategies of how students could determine what animal they have been given by asking ONLY yes or no questions, starting with broader questions and getting more specific as the student has more information about their animal. Give examples if necessary: Am I an herbivore? Am I active at night? Do I have 4 legs? Am I a predator? Am I smaller than [*insert specific object here*]?
3. Each student will receive a Who Am I card, pinned to their back or draped around their neck with the card on their back. Students should ask their classmates one yes or no question at a time, moving around the room to talk with a variety of people. Make sure the students know that if they don't know the answer to the question, they can check the information on the card. It is important that if they don't know and can't find the answer to a question for their classmate, they know they can say "I don't know," rather than providing misdirection. Some students will take longer to identify their animal than others and may need a few hints to help them along.
4. Once the students have identified their animal, allow them time to read all of the information provided on their card. If time permits, allow some or all of the students to share something they learned about their animal. To show how animals are connected, use the cards to create a food chain, starting with an herbivore. For example: Tarantula Hawk Wasp, Tarantula, Grand Canyon Pink Rattlesnake, Red-Tailed Hawk

Extension Activities

See the activity: *Web of Life*, found on page 19.

OR

One of the most important facets of ecology is learning how all organisms are connected within their environments. An ecosystem includes carnivores (meat eaters), herbivores (plant eaters), omnivores (meat and plant eaters), scavengers (clean-up crew), decomposers, plants, fungi, water, air, soil, and sunlight.

When students have finished learning about their animals, see if they can create a food web by drawing connections between their animals. Challenge students to find who they are connected to within the class. Does every animal have some sort of connection? If not, what is missing? What would happen if one of the animals was taken away? Why is it important for a balance of different organisms to be present in an ecosystem?

*Activity inspired by *What Animal Am I?* from Sharing Nature with Children by Joseph Cornell

Ecosystem Match-Up

School Subject Science
Grade Level 3rd – 7th
AZ Standards Addressed

SC03-S4C3-03: Explain the interrelationships among plants and animals in different environments: producers-plants, consumers- animals, decomposers- fungi, insects, bacteria
SC04-S4C3-01: Describe ways various resources (e.g. air, water, plants, animals, soil) are utilized to meet the needs of a population
SC07-S4C3-02: Explain how organisms obtain and use resources to develop and thrive in: niches, predator/prey relationships

Lesson Overview
Students will discuss how animals and plants are found in different ecosystems based on their adaptations to various conditions. During this activity students will be introduced to the five ecosystems and learn what makes them different based on the different biotic (living) and abiotic (non-living) components. This activity can be used as an introduction to ecosystems, adaptations, or be a creative way to put students in groups for further research.

Lesson Objectives
Students will be able to discuss how different components of an ecosystem are interdependent. They will also be able to list some scenarios that can affect the health of an ecosystem and explain why biodiversity is important.

Materials
The following materials can be found at: http://www.nps.gov/grca/forteachers/lessonplansandteacherguides.htm

- *Web of Life* cards, printed two-sided, laminated (optional)
- *Ecosystem signs*

Background Information
Grand Canyon National Park has five distinct ecosystems: boreal forest, ponderosa pine, pinyon-juniper, desert scrub, and riparian. Due to water availability and temperatures influenced by elevation different animals thrive in each environment.

Procedure

1. In the *Web of Life* cards, you will find seven additional cards on pages 20-23 of abiotic (non-living) components at the end that are not needed for this activity, but can be included if creating a web of life.
2. Display the *Ecosystem* signs around five different parts of the classroom where each student can see and gather around. Discuss that they will be learning about the five diverse ecosystems found at Grand Canyon National Park.
3. Give each student a *Web of Life* card that belongs to one of the five ecosystems: boreal forest, ponderosa pine, pinyon-juniper woodland, desert scrub and riparian. Try to ensure that there is equal distribution of cards for each ecosystem if you have less than 35 students in the class.
4. Tell the students to read their card carefully and stand under the ecosystem to which they think their plant or animal belongs.
5. Confirm that each student is in the correct ecosystem by asking them to look at their *Web of Life* cards and match the symbol on their *Web of Life* card to the symbol on the *Ecosystem* sign. Students who may be in the incorrect ecosystem can move to their correct ecosystem.
6. You may want to discuss how the plants and animals were grouped to each ecosystem. Refer to the paragraph below that discusses the *Web of Life* cards and their meaning.

***Web of Life* cards and their meaning**

Each card has a distinct symbol that represents the ecosystem in which the plant or animal belongs. The following is a list of each symbol and the plants and animals that are primarily found within each ecosystem. It is important to discuss with the class that many of these plants and animals can be found in more than one ecosystem. This can be a confusing concept to understand. Provide the following hint: Plants are the defining characteristics of every ecosystem. A plant community can not move, however, many animals are capable of adapting and traveling between one or more ecosystems. The plants and animals we have selected to represent each ecosystem are predominantly found there, not restricted to it, meaning many can naturally live in a wide range. During the winter when food may become scarce, some animals are forced to travel to where food is available. At the Grand Canyon, this is often to lower elevations where there isn't snow cover.

Boreal forest

1. Engelmann spruce
2. Red-tailed hawk
3. Quaking aspen
4. Long-tailed vole
5. Kaibab swallowtail
6. Mountain lion
7. Mule deer

Ponderosa pine forest

1. Northern goshawk
2. Ponderosa pine
3. Rocky mountain elk
4. California condor
5. Hill lupine
6. Coyote
7. Kaibab squirrel

Pinyon-juniper woodland

1. Utah juniper
2. Pinyon pine
3. Pinyon jay
4. Striped Skunk
5. Common porcupine
6. Desert cottontail
7. Bobcat

Desert scrub

1. Collared lizard
2. Beavertail cactus
3. Desert tarantula
4. Grand Canyon pink rattlesnake
5. Desert bighorn sheep
6. Mormon tea
7. Tarantula hawk

Riparian

1. Humpback chub
2. Canyon tree frog
3. Beaver
4. Cardinal monkey flower
5. Cottonwood
6. Ringtail
7. Great Blue Heron

Extension

Facilitate research of your local ecosystem to compare/contrast animals in your hometown to the animals at Grand Canyon. Assign an animal found within your hometown to each student or group of students. The animals you assign your students should be based upon interest and available local resources.

Web of Life

School Subject Science
Grade Level 3rd – 7th
AZ Standards Addressed

SC03-S4C3-01: Identify the living and nonliving components of an ecosystem
SC03-S4C3-03: Explain the interrelationships among plants and animals in different environments: producers-plants, consumers- animals, decomposers- fungi, insects, bacteria
SC04-S4C3-01: Describe ways various resources (e.g. air, water, plants, animals, soil) are utilized to meet the needs of a population
SC06-S4C3-01: Explain that sunlight is the major source of energy for most ecosystems
SC07-S4C3-01: Compare food chains in a specified ecosystem and their corresponding food web
SC07-S4C3-02: Explain how organisms obtain and use resources to develop and thrive in: niches, predator/prey relationships

Lesson Overview
Students will discuss how animals and plants play necessary roles in their ecosystem. They will then use knowledge of various animals to create a food web to illustrate connections between various animals, plants and non-living components of the ecosystem.

Lesson Objectives
Students will be able to discuss how different components of an ecosystem are interdependent. They will also be able to list some scenarios that can affect the health of an ecosystem and explain why biodiversity is important.

Materials
- Who Am I cards, printed two-sided, laminated (optional)
  Found at: http://www.nps.gov/grca/forteachers/lessonplansandteacherguides.htm
- String, about 100 yards long (optional, extension activity)

Background Information
The concept of an ecosystem is important because it conveys one of the key insights that we have gained from the science of ecology, that everything is related to everything else. Everyday perception tells us that we live in a world composed of distinct units: trees, rocks, animals, buildings, and so on. Yet all of these seemingly unconnected fragments are in fact part of one system; they are interrelated, and this interrelation is essential for life. Since no piece exists independently of another, none can be modified without affecting the others. It is this idea that is behind the term "ecosystem".

In the study of Ecology, we identify the species and community to which an organism belongs and how it interacts with the ecosystem and other organisms in the ecosystem. Scientists have also studied the interaction between different organisms and classified their interactions into different types. All of these interactions form a "web of life". Strong ecosystems have a high biodiversity, a broad diversity of species working together and interacting. When organisms are removed, the interactions and connections are broken and the web is weakened. Humans are a part of every ecosystem, so everything we do affects the parts of an ecosystem.

Procedure
1. (This is a good extension activity for *Who Am I?*, found on page 15 or *Ecosystem Match-up*, found on page 17). Define "ecosystem" with the students and identify all of the different components. Discuss how food chains are a simplified representation of how plants and animals interact in an ecosystem. Deer eat more than just grass; mountain lions prey on more than just deer. Plants and animals also rely on non-living (abiotic) components like: soil, water, air, and sunlight.
2. Hand out a variety of plant, animal, and non-living cards to the students. Arrange the students to stand in a circle, facing center. Ask where all energy comes from in an ecosystem. The sun is the source of all

energy; ask the student with the sun card to stand in the center of the circle and grab one end of the long string.

3. Next, the string is passed from student to student, each grabbing hold of it in the process, to show the connection of plants to herbivores, carnivores, and omnivores, successively. This activity can be general, connecting students by the category they fit in or can be specific, connecting the sun to cottonwood to beaver to water, etc. until all students are included.
4. After each student is holding onto the string, emphasize connections and introduce certain situations that commonly occur in nature, such as forest fires, predation, drought, and urban development. As you introduce different scenarios, discuss who will be affected. (For example: plants can not relocate or move during a forest fire, they will die and thus students should drop their string. In turn, animals who are dependant on the plants for survival may die due to a lack of food, and should also drop their string.) Emphasize that if one species goes extinct in an ecosystem, the web probably will not fall apart. Other animals might start to fill the niche of the newly extinct animal. Soon, students will see how everything is connected and affected by natural and unnatural factors in the environment.