Ecology

Introductory Material: Ecology

- Overview: An Introduction to Ecology & Life Zones

Activity 1: Take A Hike! A Card Game Using Life Zone Cards & Use Cards for Discussion Around Life Zones

Activity 2: Identify Plants Around Your School, Schoolyard Biodiversity Inventories Program & iNaturalist

Activity 3: Make a 3-D Model from a Topographic map

Activity 4: Draw it! Identifying plants around your school, Schoolyard Biodiversity Inventories Program & iNaturalist Continued

Activity 5: Gilded Nature Print Activity

Field Trip 1: University of Arizona Mt Lemmon Sky School & Observatory

Field Trip 2: Reid Park Zoo

Arizona Science Standards

3rd-5th grade (4th)

1.1PO 1-2: Observe, ask questions, and make predictions

1.2.PO 1- 5: Participate in planning and conducting investigations, and recording data.

1.3. PO 4: Organize and analyze data; compare to predictions

1.4.PO 1, 1.4.PO 3: Communicate results of investigations.

6.2.PO1-6: Understand the processes acting on Earth and their interaction with the Earth systems (e.g. erosion, weathering, forest fires). (Grade 4)

6.3.PO6: Compare weather conditions in various locations (e.g., regions in Arizona)

6th-8th grade (7th)

1.1.PO 1: Formulate predictions, questions, or hypotheses based on observations. Locate appropriate resources.

1.2.PO3, 1.2.PO 4. 1.2.PO 5: Design and conduct controlled investigations.

1.3.PO 3, 1.3.PO 5: Analyze and interpret data to explain correlations and results: formulate new questions.

1.4. PO 5: Communicate results and conclusion of the investigation

Overview: An Introduction to Ecology & Life Zones

C. Hart Merriam and the Life Zones Concept

Merriam's study area, the San Francisco Peaks in Arizona, rise nearly 6000 feet above the pine forests of Flagstaff. Photograph courtesy of USGS.

C. Hart Merriam was an American zoologist and naturalist. He also studied and documented birds, bugs, and other wildlife. Later in life, Merriam's focus shifted to studying and working with Native American tribes in the western United States.

In 1889, Merriam was authorized to conduct a biological survey of a high mountain region where different climates and zones of animal and plant life follow each other from base to summit. He decided that the San Francisco Mountains (near Flagstaff, AZ) would be an appropriate study area because of its southern position, isolation, high altitude, and nearness to an arid desert.

Merriam and his expedition members arrived in Flagstaff on July 26, 1889 and for the next two months the scientists completed extensive field work in the high forests of the peaks, out in the Painted Desert to the east, and at the Grand Canyon.

Although his findings influenced early biological ideas about the American west, further study has shown that there are many other factors that affect the distribution of plants and animals, including aspect (i.e., which direction the slope is facing), wildfire history and frequency, and soil type. Modern ecologists still consider Merriam's life zones the major biomes of North America.

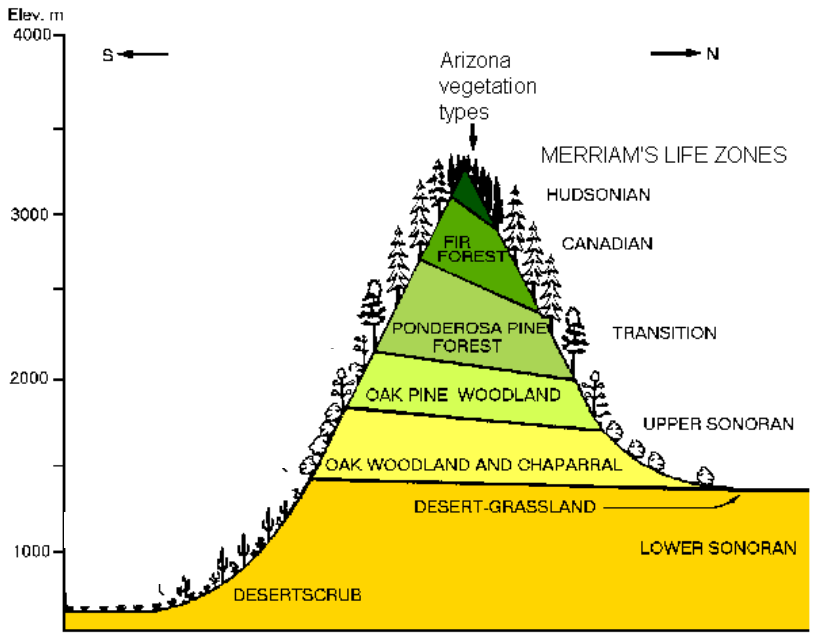
Merriam's Life Zones 1891	***Modern Vegetation Zones***	***Elevation Range (feet)***	***Annual Precipitation***
Arctic-Alpine	***Alpine Tundra***	***11,500-12,700***	***35"-40"***
Hudsonian	***Spruce-Fir or Subalpine Conifer Forest***	***9,500-11,500***	***30"-40"***
Canadian	***Mixed Conifer Forest***	***8,000-9500***	***25"-30"***
Transition	***Ponderosa Pine Forest***	***6000-8500***	***18"-26"***
Upper Sonoran	***Pinyon-Juniper Woodland, Semi-Arid Grasslands, Semi-Arid Scrub***	***3500-6500***	***10"-20"***
Lower Sonoran	***Mojave, Sonoran, or Chihuahuan Desert***	***100-3500***	***3"-12"***

Reference: Merriam, C. H. and Steineger, L. 1890. *Results of a biological survey of the San Francisco mountain region and the desert of the Little Colorado, Arizona.* North American Fauna Report 3. U.S. Department of Agriculture, Division of Ornithology and Mammalia, Washington, D.C., 136 pp.

LIFE ZONE CARDS: Playing "Go Take a Hike!"

Go Take a Hike! is a version of Go Fish that uses the Life Zones of Arizona cards.

The Life Zone concept was developed by the ecologist, C. Hart Merriam in 1889. It is a way of describing areas with similar plant and animal communities.



There is actually one more life zone, that can't be found in Arizona that is the tropical life zone. But since there are no tropical zones in Arizona, we have not included it in this game. The other six zones can be found in Arizona. And five of the life zones can be found within 40 miles of Tucson! When traveling from Tucson up the Santa Catalina Mountains to Mt Lemmon, you go through 5 distinct Life Zone. The sixth life zone (Tundra) can be found on in the San Francisco Peaks, near Flagstaff in northern Arizona.

Activity 1: Take A Hike! A Card Game using Live Zone Cards

Take a Hike can be played with 2-4 players.

Goal of the Game: *To collect the most number of complete sets of Life Zones. Each Life Zone is described on 7 different cards. So, one set consists of 7 cards, which describe the features of the particular zone.*

Here are 6 Life Zones included in the deck of cards

Lower Sonoran,Upper Sonoran, Transition, Canadian, Hudsonian, and Tundra

Setting Up the Game

Shuffle the cards thoroughly. Deal 7 cards face down to each player. Place the remaining cards in a stack face down between the players.

Playing the Game

The player to the left of the dealer starts by asking another player for a specific card. For example, they would ask another player,

"Do you have a blue card (or a Hudsonian)?" The player asking must already hold at least one card of the requested zone, in this case a blue-Hudsonian zone card. If the player who was asked has card(s), they must give all of them to the person who asked for them. That player then gets another turn. They may now ask any player for another (or the same) color/zone card, as long as they hold at least one card of that rank. If the person asked does not have any of the cards asked for, they will say "Go Take a Hike!" The person who asked then draws a card from the top of the deck. Then the play moves to the next person.

Rules

Once you have 4 of one zone (color), lay them down face up in front of you. You may continue to add to your own sets with each turn until you have the complete set (7 cards). The play continues until all of the draw pile is gone. Even if you have no cards in your hand, you can ask for a card that belongs to one of the zones you have placed out in front of you **or** you can draw a card from the pile.

The 7 cards of each set (Zone) include:

1) Name of the zone	4) Precipitation of the zone (snow and rain)	7) typical plant life
2) Altitude of the zone (how high above sea level)	5) Vegetation zone	
3) Average July temperature of the zone	6) Animals that you can find in the zone (there are many more)	

Winning

When the last card is drawn from the draw pile, whoever has the most complete zones (7 cards for each zone/color) is the winner.

Note:

The Life Zone cards can be used as a reference to inform and explain the topics in the Mt Lemmon 3D Model Project. Each Life Zone is described on 7 different cards. So, one set consists of 7 cards, which describe the features of the particular zone.

There are 6 Life Zones included in the deck of cards

Lower Sonoran, Upper Sonoran, Transition, Canadian, Hudsonian, and Tundra

Activity 2: Make a 3-D Clay or Foam Cone Model from a Topographic Map

Here is our topographic map of Mt Lemmon.

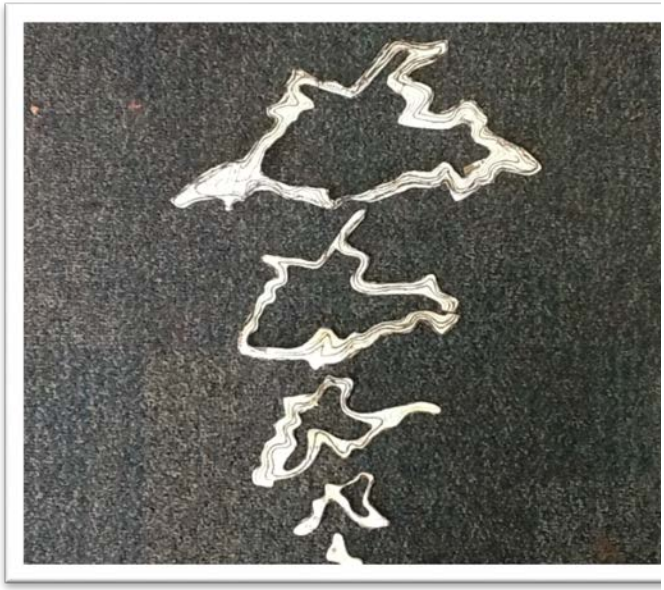
A topographic map shows the shapes and features of the Earth's surface using contour lines. Contour lines show places on the map that have the same elevation. Using contour lines as a guide, you can build a three dimensional model of a landform. In our project we will be constructing a three dimensional model of Mt. Lemmon.

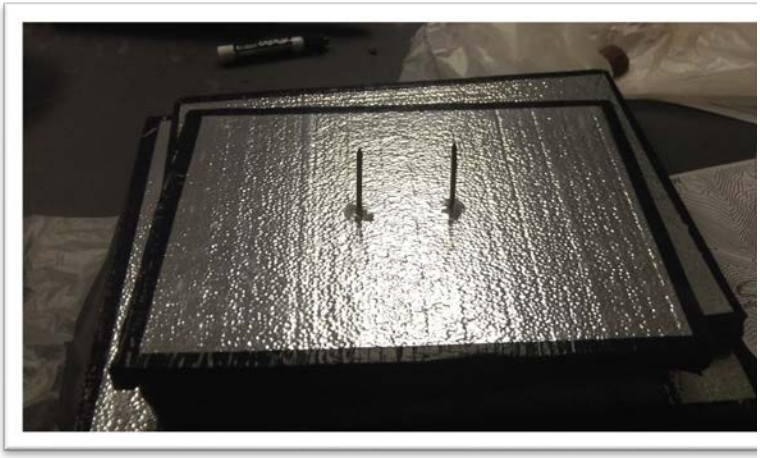
What you need

1) 2 Copies of a topographic map (Mt Lemmon)
2) 3 pieces of foam core to build on
3) Clay carving tools
4) **Modeling Clay**/ or **Foam Cone**
5) Nails (to secure your core boards together)

Question:

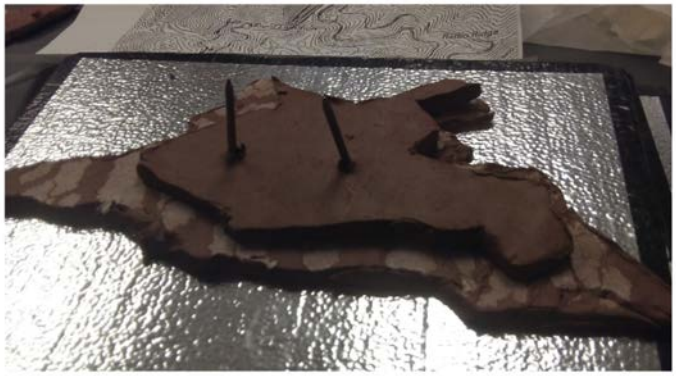
How many feet does each contour line on the topographic map represent?

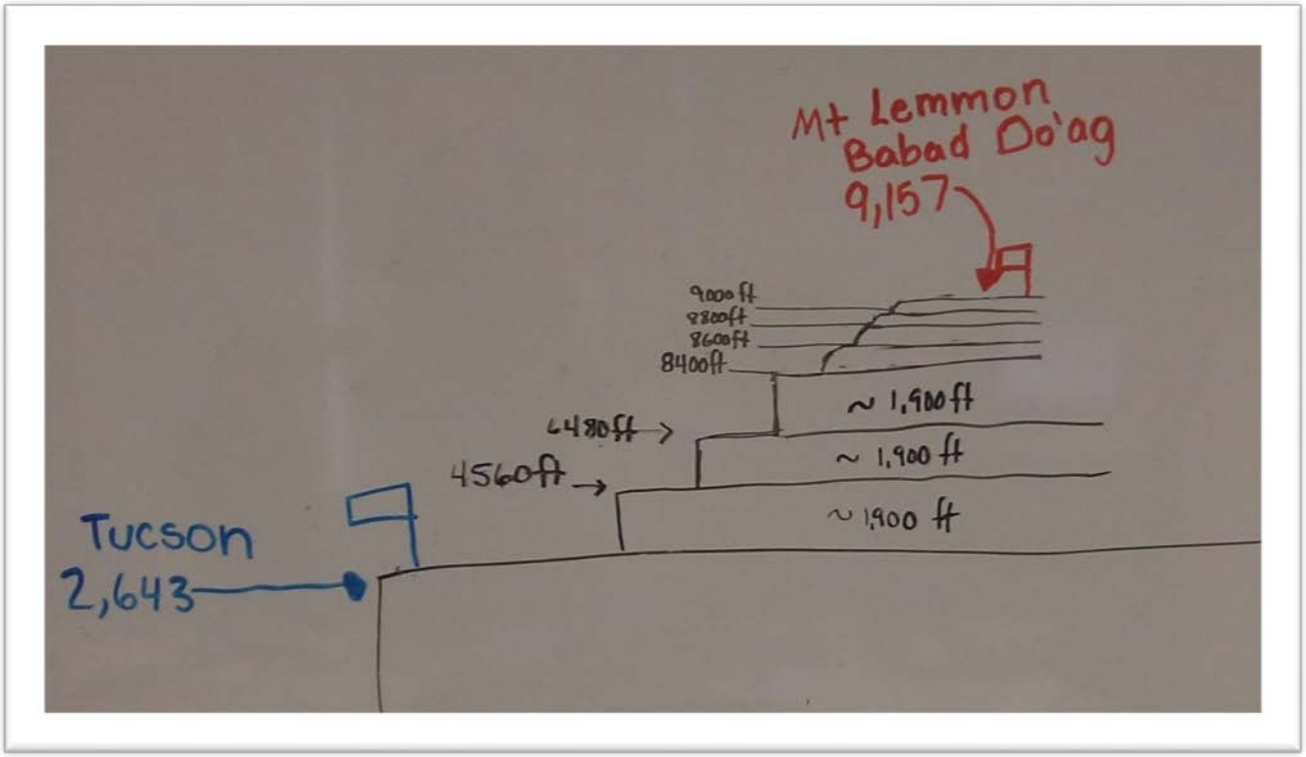




1. Secure your top two pallets with one or two nails

2. Start with the largest stencil and trace around the edges.





Use toothpick flags & objects to label:

1) Elevations
2) Tucson
3) Life Zones
4) Vegetation found at each elevation: Trees, cactus
5) Precipitation and/or temperature
6) Animals you would find at each level

Question:

What is the difference in elevation from Tucson to the peak of Mt. Lemmon?
OR, to say it another way: How many feet will we go up when we travel from Tucson to the top of Mt. Lemmon??

Activity 3: Identifying Plants Around Your School, Schoolyard Biodiversity Inventories Program & iNaturalist

Background

Plants are important components of any ecosystem. They are the base of the food chain taking energy from the sun and converting it into food for all other organisms. Ecologists study patterns of plant distribution and factors affecting plant growth. Plants grow in certain places because environmental factors are suitable for the germination of seeds and continued growth of developing plants. Environmental factors can include abiotic factors such as temperature, light, moisture, soil nutrients; or biotic factors like competition from other plants or grazing by animals. People can also influence distribution patterns.

Schoolyard Biodiversity Inventories Program/iNaturalist

The Schoolyard Biodiversity Inventories Program is a collaboration between the University of Arizona's Women in Science and Engineering Program, the Arizona-Sonora Desert Museum, the National Park Service, and schools throughout the Tucson Unified School District. This program aims to increase student knowledge and interest in issues of environmental science and biodiversity conservation, while fostering a sense of environmental responsibility among participants.

iNaturalist allows students to upload photographs of living things to a global database where they are mapped and identified. In this way, participants in this program contribute to a global community of those committed to better understanding and fostering biodiversity.

Objectives:

1. Identify patterns in plant distribution and diversity in an ecosystem. They will be encouraged to develop ideas about why these patterns exist.
2. Photograph plants
3. Identify the plants you photographed /ask for help identifying them

Safety Precautions:
Bring Water
Ideally, students should wear closed-toed shoes
Make students aware of potentially dangerous plants, i.e. don't touch the cactus!! Ouch!

Vocabulary
Dominants: dominant plants cover more space (they may also be larger but not necessarily) and may influence other organisms.
Plant Distribution: refers to the arrangement of plants in the area
Limiting Factors: factors that limit the distribution of plants (or animals). Ecologists do research to find limiting factors. Quite often limiting factors are things like the amount of sunlight, nutrients, and water. Plants and animals can also adapt to very harsh environments, especially desert plants!
Diversity: sometimes called species richness, this is the number of different species living in the same area
Community: in ecology, a community refers to all the plants and animals in a particular area. This study looks specifically at the plant community.

What You Need

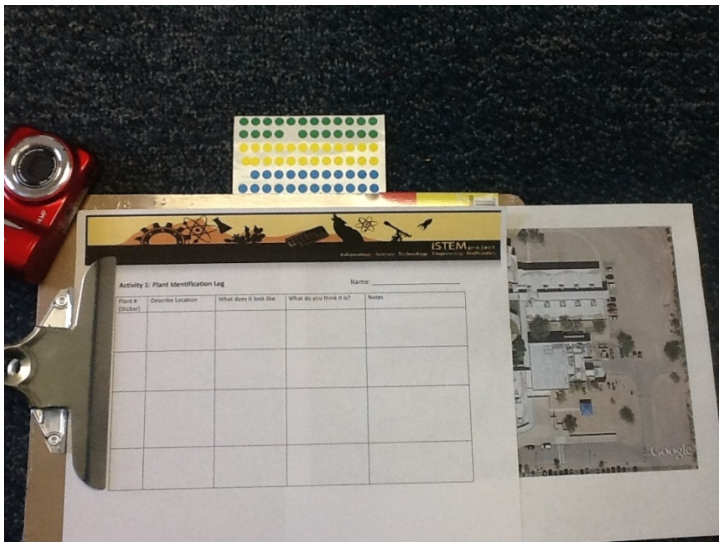
Bring these things on your walk around school to look for plants & trees.

- *Bring a clip board for your notebook, identification log & map*
- Camera (Digital) Bring on Walk
- Your Science Journal or Notebook, Bring on walk
- Small round stickers (for marking locations on map)
- Plant identification log
- Map of area to be sampled (Google Map of School)

Back at the iSTEM Room

- Glue
- Colored Pencils/crayons
- Plant identification book and/or internet sites for reference
- Printer (inside office)

What to: Do Take a Walk around the Courtyard or around the School grounds



1) Find an area around your school that contains a moderate amount of vegetation on the ground. Inspect the site. What kind of variation (diversity) do you see?

2) See if you can identity at least 5-10 different types of trees, scrubs or flowers.

3) Take a picture of 5-7 different plants or trees. Make a note on your identification sheet of the location of each plant/tree and the number of the picture (that you take). Then mark the plant with one of the round stickers on the school map. Make sure that you right a number on the sticker that corresponds to the picture you took with your camera.

4) Return to SBP room and download your photos into your folder on the computer. If you have time, print out 2 copies of each photo, no larger than 4x6. If you don't get to this step, iSTEM staff will print them out for you and have them ready for you next time.

Part II: Making a School Plant Guide

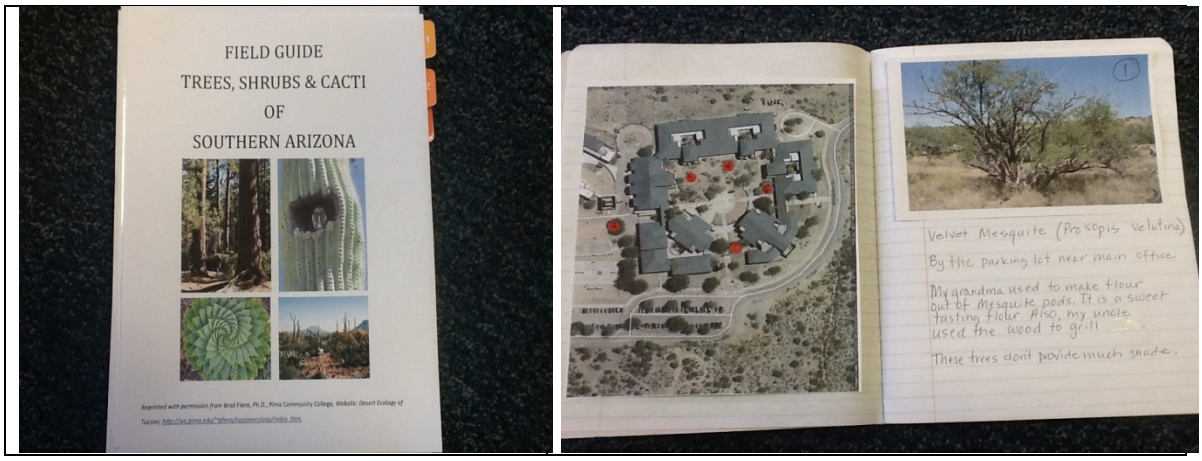
1) Download and print out (4x6) the pictures of the plants/trees from the camera.

2) Glue your map onto the first page of your plant guide section (science journal)

3) Place a sticker on the map that corresponds with each tree/plant that you photographed.

4) In your science journal, glue each picture on a separate page, note the number of the plant (as shown on your map). Glue the picture on the top half of the page and leave room to write below it.

5) Use the Field Guide to identify each of the trees or plants you photographed. Write the number that corresponds to your map and write the common name and the scientific name. You can also sketch out a picture of the plant, add a background, animals, write down ways your family or elders use the plant or other names that the tree is referred to in Spanish or Yaqui or . . . . . anything you want! Be creative!



Online Resources for Identifying Plants

Desert Plants of Southern Arizona: http://wc.pima.edu/~bfiero/tucsonecology/plants/plants_home.htm

Field Guide to Flora and Fauna of Southern Arizona (Includes plants and animals): http://www.arizonensis.org/sonoran/fieldguide/

Activity 4: Draw it!

Identifying plants around your school, Schoolyard Biodiversity Inventories Program & iNaturalist Continued

History

Historically scientists used a combination of dried plants, photographs, and drawings (known as scientific illustrations) to record plant species that currently exist in nature and those that are extinct. These records allow for future generations to have the ability to continue to study these species.

(Above) The Smithsonian's herbarium, one of the largest in the world, contains nearly 5 million dried plant specimens. The collection began with the acquisition of specimens collected in the around-the-world United States Exploring Expedition, 1838–42 (http://www.smithsonianeducation.org/educators/lesson_plans/botany/smithsonian_siyc_spring2011.pdf).

What You Will Need

1 photo (from Schoolyard Biodiversity Inventories Project Activity)
1 sheet of paper
Colored pencils
Markers

What to Do:

- Select one of the pictures you took of plants in the schoolyard and try drawing it.
- Examples are on the next 2 pages

YELLOW LADY'S SLIPPER

(Cypripedium parviflorum)

According to a 1920s guide to botanical medicine, the root of this orchid was used to treat disorders ranging from "muscular twitching" to "gloom." Valued today for the beauty of its shoe-shaped flower, the plant is protected against "orchid poachers" by several state governments. For reasons not yet known, its numbers are declining drastically even in protected areas.

Illustration © 2008 Kathleen Carness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Activity 5: Gilded Nature Print Activity

Background/History:

Sun prints are also known as cyanotypes. Sun prints were used in the 1800s to capture images. Before cameras were widely used people used sun prints or blue prints to copy images.

Process: Objects are put on a light sensitive paper and then the paper is placed outside in the sun.

The term "blueprints" came about because architects used to use sun prints to make duplicates of their drawings. They would draw their sketches on paper in a dark ink, place a sheet of the light sensitive paper underneath, and a copy of their sketch on top. The sun light would travel through the paper creating a blue background, and leave white marks where the ink was.

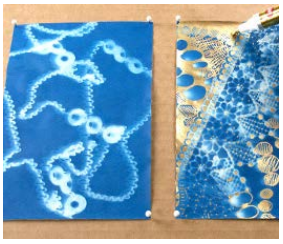
Examples of sun prints:


Materials:

Nature print paper
Found objects- plants, rocks, feathers, etc.
Metallic sharpies

Instructions:

1. Gather your items (flat items with an interesting shape/silhouette work best)
2. Arrange them on a sheet of nature print paper
3. Expose the paper to sunlight for 2 minutes until it turns pale blue
4. Remove the items
5. Soak the paper in water for one minute
6. Lay flat until dry.



Decorate it!

Using metallic sharpies draw on the nature print paper accentuate shapes, add patterns or accents.

Ecology Field Trip 1: University of Arizona Mt Lemmon Sky School & Observatory

uaskyschool@gmail.com

https://skyschool.arizona.edu/

Programs:

UA Science Sky School provides year-round residential science programs (1-5 days) to Arizona K-12 students at their 25-acre Mt. Lemmon campus.

Philosophy: to provide place-based, inquiry-based, and outdoor science education.

Programs focus on core UA science areas such as sky island ecology, biology, geology and astronomy and have been developed in collaboration with local school districts to meet Arizona State and Next Generation Science Standards. Programs include:

- Daytime field instruction in small groups on Mt. Lemmon with UA graduate student scientists serving as instructors and mentors
- Student developed and led research projects
- Nighttime astronomy experiences with University telescopes
- Post-trip relationships with UA scientists built via exploration of long-term datasets and web resources for classrooms
- Dormitory lodging and all meals on-site

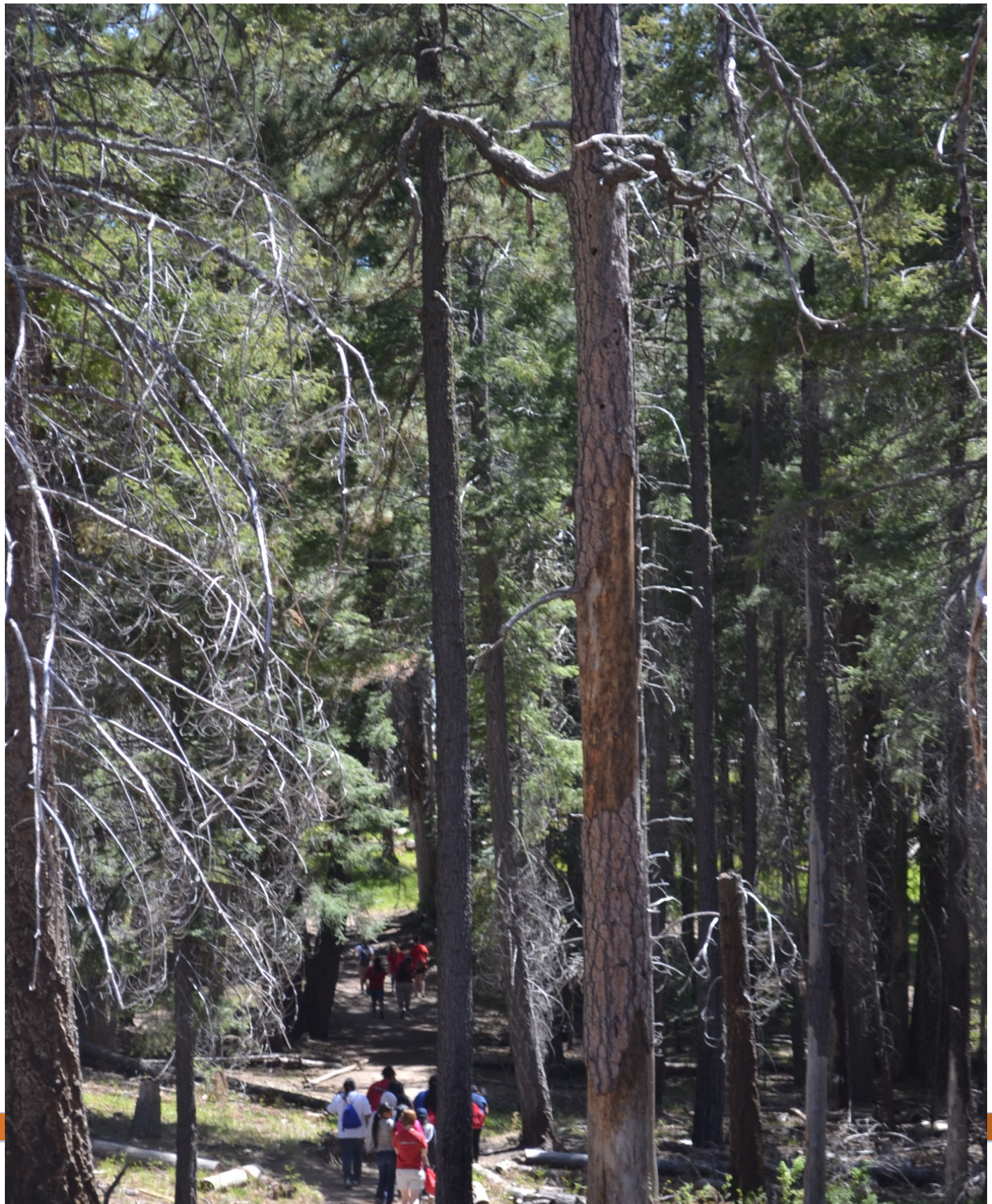
UA Science Sky School offers several options for programs led by university scientists and graduate fellows. These offerings are all aligned to the Next Generation Science Standards and can be mixed and matched as is appropriate for the visiting group. They are designed to offer a variety of topics that build and connect to each other year after year in order to allow students to keep learning and growing as scientists each consecutive year they attend the Sky School.

During this one-day trip, we explored the ecology and geology of the Arizona Sky Islands. We learned more about how our natural environment changes from the low desert near Tucson to the forests near the summit of Mt Lemmon. We made multiple stops on our way up the mountain for a hands-on outdoors experience guided by young and enthusiastic scientists from the University of Arizona.

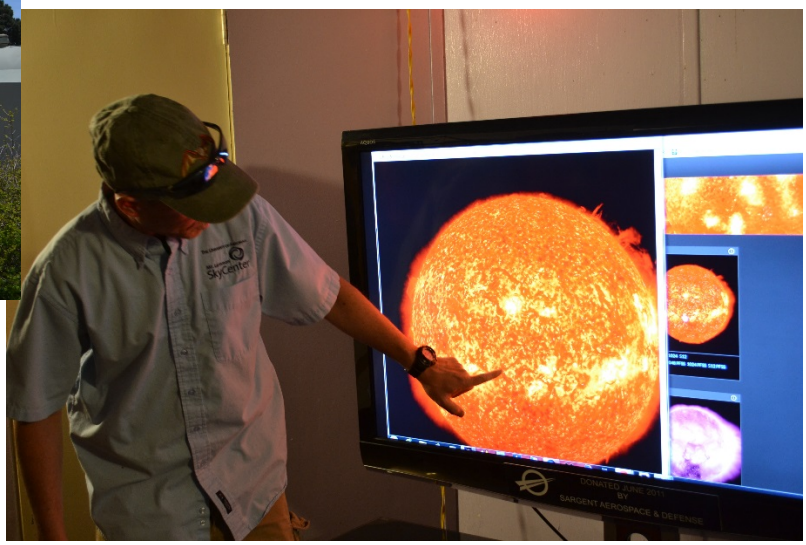
Activities:

- Sky island discussion
- Tucson basin geology & hoodoos
- Sense of **Place** activity
- predator-prey game
- Tour of the Observatory
- lesson at the spring and discussion of water resources
- stop at the fire lookout
- Discussion of the Aspen fire and fire ecology.


ARIZONA



UA Mt Lemmon Observatory



Mt Lemmon, AZ Windy Point

Ecology Field Trip 2: Reid Park Zoo

UA iSTEM Field Trip to the REID PARK ZOO

Agenda: **Saturday, March 12th 9:00am- 1:30pm**

9:00am—Meet the bus at Lawrence school: 4850 W. Jeffrey Rd 85757

9:20am— Depart

10:00am— **Arrive at REID PARK ZOO:**

3400 Zoo Court
Tucson, Arizona 85716
520 791-3204

10:00am- 12:00pm— Zoo Tour and Giraffe Encounter

12:15pm— LUNCH at the **Taste of the Wild Café**

12:45pm— **Head back to the bus.**

12:55pm— **Depart for Lawrence School**

1:30pm— **Arrive at Lawrence / Parents / Family Pick up youth**