

TEACHER INFORMATION PACKET

Activities for Pre and Post-Workshop
about
**The Sonoran Desert Region, The Special Pollinators that Dwell
There and How Pollination Occurs**

Elementary Level
Grades 1-5



Prickly Pear Cactus with blooms



Bumblebee, primary consumer that feeds on plant nectar.

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Pollination

Pollination is a process by which plants reproduce by transferring pollen from flower to flower between different plants or in the same plant. The process is vital pre condition for fertilization and reproduction for offspring. There are two types of pollination - cross pollination and self pollination. In cross pollination plants need to rely on other animals and insects, called pollinators, to transfer their pollen to other plants where in self pollination, the process can take place to the same flower or to other flowers in the same plant. There is another way plant can be pollinated which is called wind pollination. In this type of pollination wind can blow up pollens from one plant and land them onto other plants. Flowers produced from plants grow by wind pollination are unscented and are not brightly colored, whereas flowers produced from cross pollination are brightly colored and scented and easily attract birds and other flies and insects. About 80% of the pollination requires insects or other pollinators to pollinate their flowers.

Why Pollinators Are Important?

Pollinators are very important to our survival as humans and to plant eating animals. They are important to many ecosystems and play a key role in maintaining wild plant communities as well as agriculture productivity (Potts, et al., 2010).

There are a lot of implications to continuing the diversity and abundance of wild flowers and plants which humans use a great amount of these products for cultural symbolism, food plants, medicinal plants, and plant-based dyes ("Celebrating wildflowers"). Fruits, vegetables, and nuts are all insects pollinated. There are many self-pollinated or wind-pollinated vegetables which are barley, corn, oats, rice, rye, sorghums and wheat, grass hay crops, sugar beets, sugar cane, potatoes, sweet potatoes, and tobacco.

With this evidence it is clear that we need pollinators and will continue to need the process of pollination for present and past human livelihood. And in a

desert such as the Sonoran Desert where water is not abundant it is still ever more important to have pollinators around to help keep the biodiversity alive.

Plant and pollinators have a symbiotic relationship – plant provides nectar and pollen to the pollinators and accidentally pollinators provide pollination to the plants as it moves from plant to plant and flower to flower (<http://www.suite101.com/content/how-desert-plants-get-pollinated-a13618>). When pollen, left by other pollinators, sticks on stigma, it grows into a long tube, called pollen tubes (Fig.1). Pollen tubes grow through the style and meet the eggs, called ovules, Ovules resides inside the ovary. After the fertilization takes place, ovules turn into seeds and ovary forms the fruits.

Pollination and pollinators are important natural process for the reproduction of plants regardless of their birth of origin whether plants grow in land or in desert. To find out the diversity of pollinators and its plant kingdom in Sonoran Desert, we will familiarize ourselves with this unique desert.

The Sonoran Desert

The Sonoran Desert is the largest desert in the Southwestern part of North America. One of the main key facts about Sonoran Desert is that it has average more rainfall – about 10 inches rain in a year - than any other desert. The desert is located in two different states: Arizona and California and in different countries: USA and Mexico. The desert contains a variety of unique plants and animals. The most common plants include: Bittlebush, Ocotillo, Prickly Pear, Fishhook Barrelcactus, Buckhorn Cholla, Desert Marigold, Foothills Palo Verde, Globe Mallow, Saguaro Cactus, Summer Poppy etc. The most common animals include: bob cat, coyote, scorpion, Javelina, tarantula, Gila monster, Jackrabbit etc. (<http://www.desertmuseum.org/kids/oz/long-fact-sheets/>)

Pollination and Pollinators in Sonoran Desert

All those plants, mentioned above, found in Sonoran desert rely on different types of pollinators for their



reproductions. The most common pollinators in Sonoran desert are: hummingbirds, bats, butterflies, moths, bees, wasps, flies, and beetles. Sonoran deserts also observe the visit of migratory pollinators such as Monarch Butterflies, White Winged doves, Rufous Hummingbirds, Long-Nosed Bats. These pollinators use different migratory corridor or “nectar corridor” to pay visit in the Sonoran desert during their 2000 – 6000 km flyways. As they pass through the area, these migratory pollinators pollinate the desert plants.

Glossary:

Scientific Method – observing, describing, predicting, testing, and drawing conclusions

Life Cycle – different stages of life among living organisms

Organisms and their Basic Needs – water, nutrients, sunlight

Classification of organisms – viewing of avian species, mammals, and insects

Ecosystem and its components – living and nonliving organisms

Pollination – is the transfer of pollen from an anther onto the stigma of a flower.

Adaptation –Mutualism–mutually beneficial interactions (In this case, between plant and animal)–Pollinators and Plants. Interaction among organisms and their environments –plant to animal, animal to plant.

carnivore

Any of an order of flesh-eating mammals.

Context:

Lions and sharks, which eat meat, are carnivores.

herbivore

A plant-eating animal.

Context:

Pandas and zebras, which only eat plants, are herbivores.

metamorphosis

A marked and more or less abrupt developmental change in the form or structure of an animal occurring subsequent to birth or hatching.

Context:

A butterfly undergoes metamorphosis at different life stages, changing its physical form.

nectar

A sweet liquid that is secreted by the nectaries of a plant and is the chief raw material of honey.

Context:

Nectar gives many flowers their smell.

pollination

The transfer of pollen from an anther to the stigma in angiosperms or from the microsporangium to the micropyle in gymnosperms.

Context:

Bees help with the pollination of plants by moving pollen from one plant to another, helping the plants to reproduce.

Staging the Learning Environment:**Ideas for Teacher/Classroom Preparation: Planning ahead**

- A. Gather various books (*see suggested resources for specific titles), along with articles, pamphlets and photographs of the Sonoran Desert. Collect a variety of common objects that are found in the desert (example: fresh flowers, seed pods from trees, yuccas, other types of plant samples, cactus fruits, insect models, displays, kits, or a habitat for a classroom safe desert creature such as insects, tortoises, toads, snakes, or other species you have access to.

(Tip: fresh clippings sealed in a ziplock plastic bag make an easy way for students to view the samples without handling possible poisonous or harmful plant clippings, as well as storing them in a refrigerator or cool place overnight helps preserve some of the plant material)

If you are not sure where to find these display items, check with the local Universities, such as the University of Arizona Science Department, Museums, like the Arizona Sonoran Desert Museum, or School Districts Science Department/Center, for example, Tucson Unified School District's Regional Science Resource Center. They often have samples and displays you can reserve or borrow to keep in your classroom during the pre and post workshop activities. Your own backyard or school yard can often serve as a great resource for classroom materials during the study of the Sonoran Desert.

- B. Display books around the classroom, or create a display table. Designate an area of your classroom to become your discovery or exploration center where students can go to explore the types of desert materials you have brought in. This supports the enthusiasm of the young learners, captures their interest and brings real life into their learning environment. Later in the activities, teachers will be encouraged to take students outside to experience real life outside "in the Sonoran Desert."

A **Bulletin Board Idea** for the classroom teacher to use when preparing for the Pre-workshop activities. Having visual aids in the classroom for children to look at and think about during a discussion can help trigger the enthusiasm in the learning environment, as the teacher sets the stage for their students. Some teachers may ask a volunteer or assistant to take over the Bulletin Board Display, or they may allow students a chance to work in small groups creating a theme for the classroom board.

Sonoran Desert/Tucson Basin Visual Display Board

1. Cover board with a Background color: Blue for daytime Sky, or black for night.
2. On the bottom half of the board, cut and attach mountain shapes out of colored tissue paper, slightly crinkle it to create a textured appearance of the mountain range, and gently staple it to the board. (examples: dark purple to represent the purplish hue of the local mountain ranges at certain times of the day). This is not limited to a specific color. Let your visual accuracy mixed with your own creativity guide you with the color selection, however, the intent is to connect this bulletin board to the students' personal lives and region for which they live to make this a meaningful learning experience.
3. Use brownish shades of tissue paper to line the portion under the mountain ranges to represent the valley or basin below the mountains.
4. Decorate sky with stars and moon for a night time scene, or sun and clouds for a daytime scene. Label the highest peak of the mountain as the Sky Island, and the lowest portion of the brown desert floor, the "Basin".
5. Add your own personal touch by selecting pictures or cut outs of native plants and animals from the local region (examples: Prickly Pear Cactus, Saguaro Cactus, Ocotillo, wild flowers, Sonoran Desert Pollinators-bats, hummingbirds, bees, moths, butterflies, white-winged doves, wasps such as "Tarantula Hawks" are a really awesome species to excite students interest and increase their understanding of the diversity of animals in the desert).

Note: If you are unsure about pictures or species, search the internet for plants and animals in the Sonoran Desert. The internet is a limitless tool for this entire learning experience.

6. As new vocabulary is introduced during the enclosed lessons, feel free to add them to your Mountainous display board. The students will love helping you make labels to add to the board!

Note: If time is limited, this board can serve a number of purposes throughout the lessons and over the course of the school year. Use it to support lessons on Ecosystems, Biomes, Water Cycle, etc.

7. Add color or different plants and flowers to represent the changing seasons through the year, or to represent the beautiful sunsets the desert displays for us so generously. Leave it up all year, or use it as your classroom theme, as many teachers and students tend to enjoy having a classroom theme that represents their interests.

Focus on building on prior knowledge about the Sonoran Desert by allowing the students to look at photographs, digital images, or books, maps, or other media sources on the topic of the Sonoran Desert.

Objectives

Students will:

- Practice map reading skills such as direction, distance, and use of legends.
- Locate and identify towns, countries, bodies of water, and mountain ranges on a map of the Sonoran Desert.
- In reference to their personal location, visualize where other creatures of the desert live.
- Observe and describe pollination.
- Compare different types of pollinators.
- Identify basic requirements for pollination to occur.
- Understand the basic structures and parts of a flower and how pollination takes place.
- Explore wildlife of the Sonoran Desert, make predictions about the future of the Sonoran Desert and our local community if the pollinators were to disappear.
- Gain empathy toward the value of pollinators in the Sonoran Desert and ways of conservation.

Academic Standards

Grade Level:

K-2, 3-5, 6-8

Subject Area:

science

Standard:

Understands how species depend on one another and on the environment for survival.

Benchmarks:

Knows that living things are found almost everywhere in the world and that distinct environments support the life of different types of plants and animals.

Knows that all organisms (including humans) cause changes in their environments and that these changes can be beneficial or detrimental. Knows ways in which species interact and depend on one another in an ecosystem (e.g., producer/consumer, predator/prey, parasite/host, relationships that are mutually beneficial or competitive).

Grade Level:

3-5

Subject Area:

science

Standard:

Knows about the diversity and unity that characterize life.

Benchmarks:

Knows that plants and animals progress through life cycles of birth, growth and development, reproduction, and death and that the details of these life cycles are different for different organisms.

Grade Level:

6-8

Subject Area:

science

Standard:

Understands the genetic basis for the transfer of biological characteristics from one generation to the next.

Benchmarks:

Knows that reproduction is a characteristic of all living things and is essential to the continuation of a species.

The understanding of the Sonoran Desert, Pollination and Pollinators in the learning environment will encompass many areas of the curriculum, including science, language arts, social studies, mathematics, technology, and art.

Science

Basic needs of an organism

Life cycle of an organism

Characteristics of living things

Plant and animal adaptation

Plant structures and their functions

Living components of an ecosystem

Behavioral and structural adaptation

Examine interrelationships between plants and animals

Research and present findings through technology, art, or graphs/tables

Language Arts

Comprehension of informational text

Note taking

Journaling

Summarizing

Social Studies

Roles of citizenship

Community contribution and cooperation

Respect, trustworthiness, and responsibility important to the preservation of the environment

Recognize ways of protecting natural environment

Viewing of the world in special terms

Map construction and utilization

Importance of vegetation to human survival

Mathematics

Data collection

Research and present findings through technology, art, or graphs/tables

Technology

Use of internet and reputable sites for research

Develop data bases/spreadsheet application for gathered data

Idea exchange with students from other schools

Research and present findings through technology, art, or graphs/tables

Art

Create projects inspired by natural areas

Research and present finding through technology, art, or graphs/tables

ACTIVITY #1: WHERE ON EARTH IS THE SONORAN DESERT?

Activity Summary

Using a copy of a map of the Sonoran Desert Bioregion - Tucson Basin Area, students will locate and color rivers, mountain ranges, countries and towns. Intermediate students will also conduct exercises and answer questions using a legend as their guide. They will measure the mileage of distance between

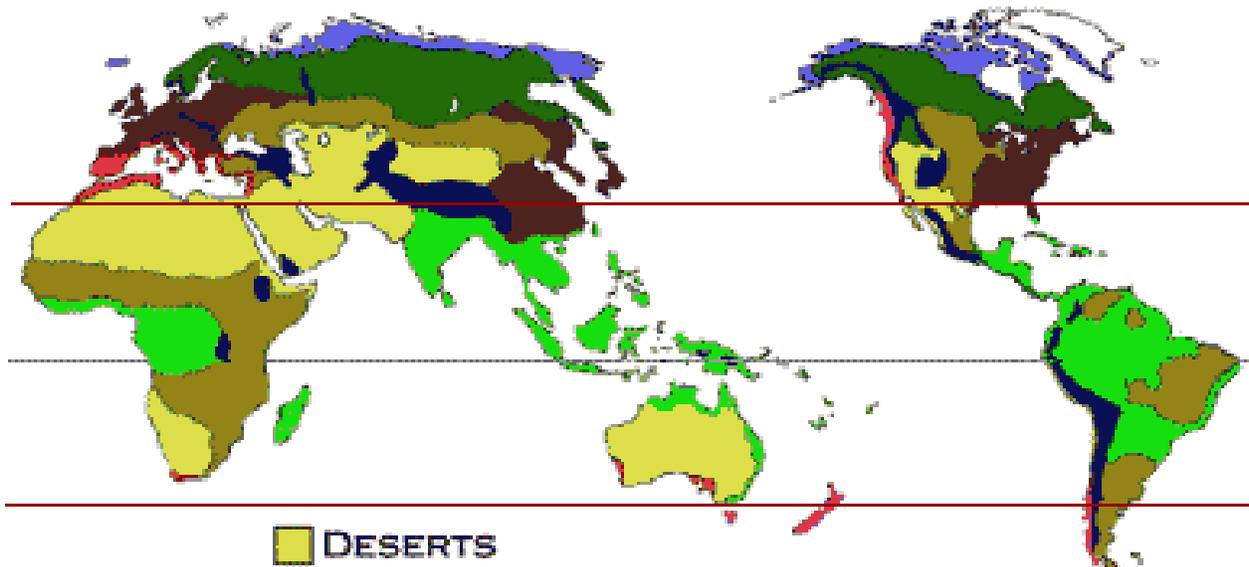
particular locations on the map. Students will use cardinal directions to describe where places are in relation to one another.

Materials

Teacher's Master Map of the Sonoran Desert Bioregion - Tucson Basin Area
Student Journals (notebook, or other specified journal used by the classroom teacher)
Crayons or colored pencils

Deserts around the World

Many deserts are found in bands along 30 degrees latitude north and 30 degrees latitude south (between the red lines on the map).



Mid-latitude deserts occur between 30° and 50° North and South pole-ward of the subtropical high pressure zones. These deserts are in interior drainage basins far from oceans and have a wide range of annual temperatures. The Sonoran Desert of southwestern North America is a typical mid-latitude desert.



A great portion of the Sonoran Desert, shown here in yellow, is considered to be a Mid-latitude Desert. It spans across two countries: Portions of California, USA and Arizona, USA, and some regions of Mexico, extending into the Baja California Peninsula.

What is the Sonoran Desert like and why is it so special/unique?

Reflecting seasonal shifts in prevailing winds, the rains usually arrive primarily during the late summer and in the winter in the eastern Sonoran Desert, or the Arizona Upland; in the winter in the western Sonoran Desert, or the Lower Colorado Valley.

Remind students that there are deserts all around the world. Refer them to a world map by displaying one on the wall, on the Interactive White Board or use an overhead projector to show the image on the screen.

Facts about the Sonoran Desert of North America

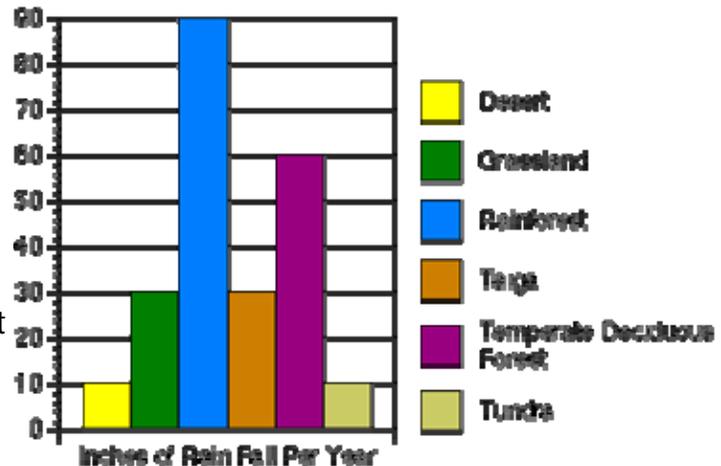
Name <i>Location</i>	Size	Physical Features	Some Plants & Animals	Special Facts
Sonoran <i>Southwestern United States (Arizona, California) and parts of Mexico (Baja Peninsula, Sonora)</i>	120,000 mi ² 312,000 km ²	Covered by sand, soil, and gravelly pavement. Gets more rain than any other North American desert.	agave, coulter's globemallow, creosote bush, desert mariposa lily, mesquite, ocotillo, paloverde, saguaro coati, elf owl, gila monster, kangaroo rat, pack rat, roadrunner, sidewinder, tarantula, white-winged dove, bats, butterflies, and over 1000 species of bees	Most complex animal-plant community of any desert.

Aridity in the Desert: Dryness

The hot desert is a land of extremes: extreme heat and extreme dryness; sudden flash floods and cold nights.

Deserts are usually very, very dry. Even the wettest deserts get less than ten inches of precipitation a year.

In most places, rain falls steadily throughout the year. But in the desert, there may be only a few periods of rains per year with a lot of time between rains. When it does rain, there may be quite a downpour! After the rain, desert flowers bloom.



Temperature: Hot During the Day, Cool at Night

During the day many deserts are hot, very hot. Temperatures in excess of 100 degrees Fahrenheit are not uncommon. Yet at night, the same deserts can have temperatures fall into the 40s or 50s? Why?

Other biomes are insulated by their humidity (water vapor in the air). Temperate deciduous forests, for example, may have 80 percent humidity or more during the day. This water reflects and absorbs sunlight and the energy it brings. At night the water acts like a blanket, trapping heat inside the forest.

Since deserts usually have only between 10 and 20 percent humidity to trap temperatures and have so few trees and other vegetation to retain heat, they cool down rapidly when the sun sets, and heat up quickly after the sun rises.

How do plants and animals survive in such a hot and dry climate?

The desert can be a hard place to live, but for animals and plants that know how to live here, it is not so challenging. These animals and plants have adaptations. **Adaptations** are special things about their bodies or the way they behave that help them survive the heat or dryness of the desert.

Discuss with students, some examples of adaptations of people and animals. (People have large brains to help them create things. Eagles have talons to help them grab their prey.)

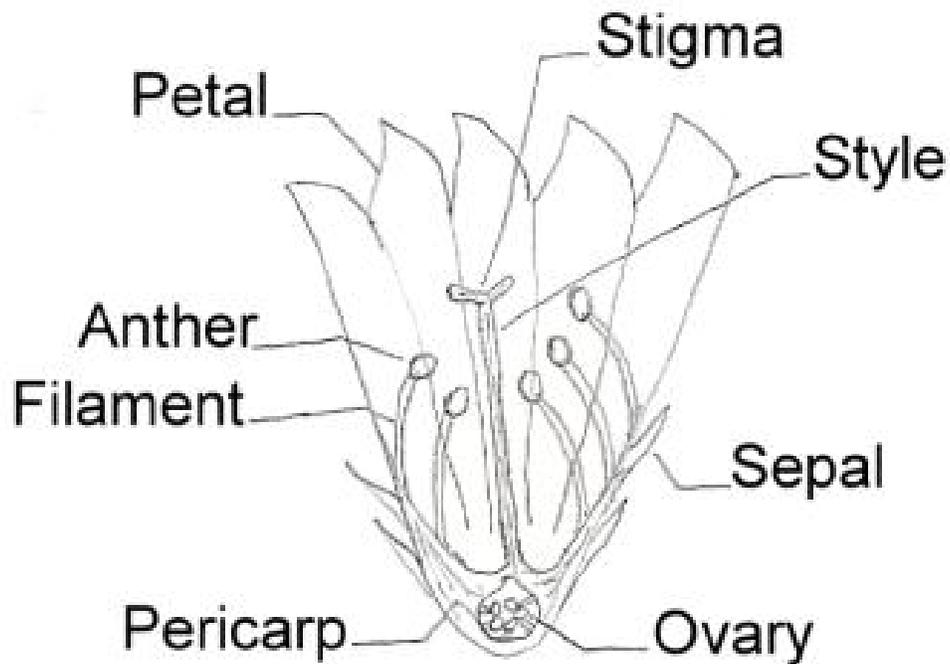
Pollination: What is pollination ?

Pollination is the transfer of pollen from the anthers to the stigma. The pollen may be transferred from the anthers to the stigma of the same, or different flowers.

Why is pollination necessary ?

The pollen contains the male gametes (sperm) of plant. The pollen is transferred from the anthers where it is produced to the stigma where it germinates forming a pollen tube. The pollen tube then transfers the male gametes to the female gamete (egg cell) which is contained inside the ovules. Once the sperm reaches the egg cell it fuses with it to form a zygote and fertilization takes place.

Activity #2: Anatomy of a cactus flower:



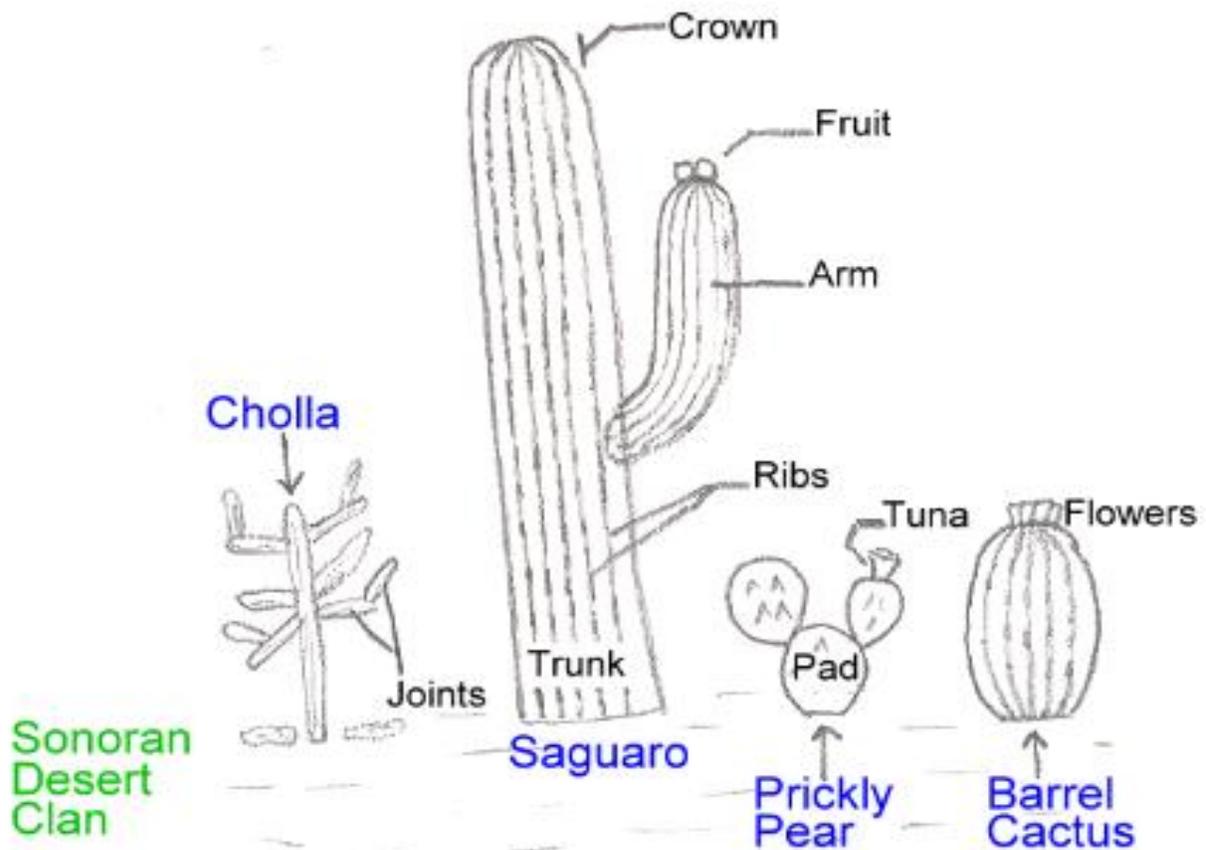
Cactus Flower Parts

Pistil = Stigma + Style + Ovary

Stamen = Anther + Filament

Perianth = Petals + Sepals

Cactus flowers are distinguished by the presence of an inferior ovary - that is, the ovary is located beneath the other parts of the cactus flower.



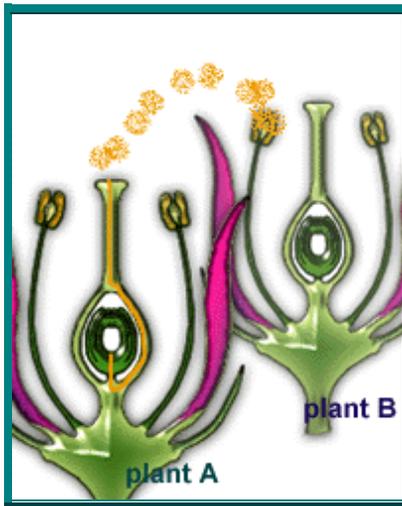
Drawing shows four common cacti of the Sonoran desert: Cholla, Saguaro, Prickly Pear, Barrel Cactus. Even though their growth habits are different, the cholla and prickly pear are both members of the *Opuntia* genus. The Saguaro, whose scientific name was named for Andrew Carnegie, is the typical monarch of the desert. Barrel cacti of the desert are predominately *Ferocactus* and *Echinocactus* species.

Types of pollination

Numerous aspects of flower structure are related to a plant's avoidance of self pollination. Flowers which contain all four whorls (androecium, gynoecium, corolla and calyx) are called **perfect flowers**. Perfect flowers may or may not be self compatible. Other plants have imperfect flowers. Their flower lack stamens, and only have carpels (**carpelate**). Sometimes these flowers are referred to as female

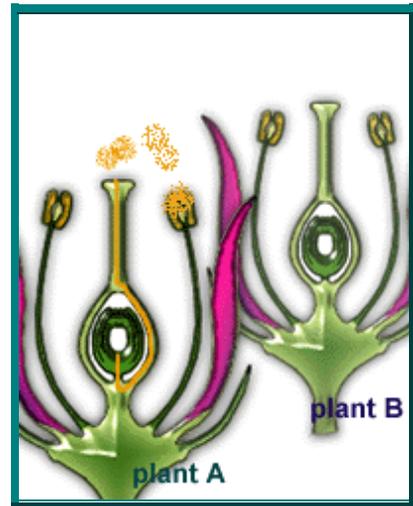
flowers but this is not strictly correct. Other plants have flowers which lack carpels and only have stamens (**staminate**) and are sometimes incorrectly called male flowers. If the staminate and the carpelate flowers occur on the same plant, self pollination is still possible and the plant is **monoecious**. If they occur on different plants the plant is **dioecious**.

Cross pollination is believed to be advantageous for the plant because the seeds produced by the flower will contain another source of genetic material which may contain genes which are advantageous to the survival of the seedlings. Plants that self pollinate are said to be **inbreeding** whereas plants which only cross pollinate are said to be **out-crossing**. However, most plant species are not strictly inbreeding or out-crossing but a combination of the two.



Cross pollination

When pollen is transferred from an anther to a stigma, it may be transferred within one flower (**shown in the diagram on the right**) or between two flowers (**as shown in the diagram on the left**). If the flowers are on two different individual plants, the flower has been **cross pollinated** whereas if the flowers are on the same individual, or if the anther and stigma are in the same flower, the flower has been **self pollinated**. Flowers that are self pollinated and can produce viable seeds are **self compatible**. Flowers that are self pollinated but the pollen does not function properly on the carpels of the same plant are termed **self incompatible**.



Self pollination

Post-Workshop Activity # 1: Play the Pollination Game:

If students have access to a computer at school, allow them to take turns playing the pollination game. Use it on the interactive white board to include the entire class.

Link: (control and click to access site)

<http://www.botany.uwc.ac.za/ecotree/flowers/pollingamwin.htm>

Two Types of Pollinators, and their importance and place in the desert:

Bees

Bees hold a special place in the desert food chains. Largely dependent on flowers, bees visit blooms like connoisseurs attending wine tastings. According to the Earth-Life Web Production Internet site, some bees deign to visit only a single species of flower. Others visit but a few species. Some bees prefer flowers of one color over another, perhaps like some people prefer red wine over white. Some bees mark flowers with a short-lived repellent, a reminder not to try that particular bloom again. Still others, presumably the bee lowbrows, visit many species indiscriminately.

Buchmann said, "By moving pollen around from flower to flower and plant to plant, bees perform vital and often unappreciated roles as the most important group of pollinating animals on earth..."

For example, "Of the approximately 640 flowering plant taxa growing in the Tucson Mountains near the Desert Museum, approximately 80 percent of these species have flowers adapted for and pollinated by bees..."

"Without the pollination services bees provide, many plants would not produce seed-laden fruits from which the next generation of plants would grow. Without bees, there would be few or no fleshy berries or fruits to sustain birds, mammals, and other wildlife. The tunneling activity of bees aerates the soil and allows water from infrequent rains to quickly penetrate and reach plant roots; and bees' nitrogen-rich feces fertilize the soil. The bees themselves often provide food for lizards, mammals, birds, insects, spiders, and other arachnids."

Thousands of species of bees populate our deserts of the Southwest, with the area around Tucson having perhaps the most diverse community of these insects in the world.



Butterflies and Moths

You can usually differentiate between a butterfly and a moth because a resting butterfly holds its wings vertically and a resting moth holds its wings horizontally. Compared with many other insects, the butterfly poses little threat to economically important plants.

The distinctive color of a species of butterfly identifies it as something unsuitable to be eaten by a bird or other predators. Often the insect takes its poison from the plant it feeds on as a caterpillar.

One spectacular butterfly in the Sonoran Desert is the yellow and brown Giant Swallowtail, which has a wingspan of approximately four inches.

The adult butterfly serves as an important pollinator as it flies from bloom to bloom, seeking nectar.



Activity # 2: Questions for the Student Journals:

1. *Write the name of your desert pollinator and the plant it's known for pollinating.*
2. *What does your desert pollinator eat? (where does it get its energy)?*
3. *What does your desert pollinator do when it gets real hot?*
4. *What does your desert pollinator do when it gets cold?*
5. *Name two other desert pollinators.*
6. *Do those pollinators have some sort of inter-relationship with the same kinds of plants as mentioned? If not, what plants do they pollinate?*
7. *Write down anything else unique about your desert pollinator.*
8. *In your own words write three sentences about your desert pollinator.*

Activity Procedure

1) Begin this activity with a review of plants and pollinators in the Sonoran Desert.

- the other children of the desert. Who remembers who they are and where they live? Explain that in this exercise, the class will look at our other neighbors in the desert. Who might they be? -- The *plants and animals* with whom we share this desert home!

2) As a class, generate a list on the board of as many plants and animals "native" to the Sonoran Desert as students can name. If students include things like chicken or burro, list those but come back to them and explain that native means that the animal or plant originated in the desert and was not brought here by humans. Creatures such as chickens, burros, and mulberry

trees were introduced into this area by humans and are thus called "exotic" or "introduced". Explain that this activity focuses on native plants and animals.

3) Choose a native animal or plant from the list and ask if anyone knows anything about it. Use some of the following questions to guide a discussion

on the life history of several of the plants or animals from the list. The purpose of this discussion is to get students to focus not just on naming

animals or plants but on how they live and what they do.

How does it get its food?

Where does it grow?

Where does it make its nest or home?

What does it do when it gets hot?

What other plants or animals might it depend on for food, shelter, or other things?

Does anything eat it?

<http://www.desertmuseum.org/kids/oz/long-fact-sheets/white-winged%20dove.php>

<http://www.desertmuseum.org/kids/oz/long-fact-sheets/Pepsis%20Wasp.php>

<http://www.desertmuseum.org/kids/oz/long-fact-sheets/Anna%27s%20Hummer.php>

<http://www.desertmuseum.org/kids/oz/long-fact-sheets/Flowers%20and%20Fruit.php>

Video Links:

Videos provided by Desertusa.com

Prickly Pear http://www.desertusa.com/video_pages/pp_movie.html

Saguaro Cactus http://www.desertusa.com/video_pages/saguaro_movie.html

Desert Food Chain http://www.desertusa.com/video_pages/food_movie.html

Suggested Readings:

A Desert Scrapbook: Dawn to Dusk in the Sonoran Desert

by Virginia Wright-Frierson

Magazine

Article from: National Parks

Article date: January 1, 2004

Author: Updike, Bill

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Article:

http://www.eoearth.org/article/Pollination_ecology_of_desert_plants

Recommended Websites:

If the weblinks do not work by clicking on them, then highlight, click copy, and paste it into the address bar of your browser window, then enter.

http://www.desertusa.com/du_sonoran.html

<http://www.desertmuseum.org/desert/sonora.php>

<http://www.mbgnet.net/sets/desert/index.htm>

http://www.eoearth.org/article/Pollination_ecology_of_desert_plants

<http://www.ucmp.berkeley.edu/glossary/gloss5/biome/deserts.html>

<http://www.botany.uwc.ac.za/ecotree/flowers/pollination.htm>

Additional Weblinks:

All About Butterflies

This Enchanted Learning site is a colorful combination of textual information and clearly labeled diagrams and pictures providing data on topics such as anatomy, species, senses, differences between butterflies and moths, and more. Especially useful is the illustrated dictionary of butterfly terms.

<http://www.enchantedlearning.com/subjects/butterfly/allabout/>

Pollination Parties!

The U.S. Geological Survey's Children's Butterfly Site provides photo galleries organizing butterfly species by the continent they inhabit, coloring pages, frequently asked questions and answers, a place to ask questions, a listing of books and videos, and links to other sites.

<http://www.mesc.usgs.gov/butterfly/Butterfly.html>

Nature: Alien Empire

This PBS Online site shows a terrific diagram of a worker bee that allows you to click on various body parts, both inside and out, to learn about their functions.

<http://www.wnet.org/nature/alienempire/multimedia/bee.html>

DISCUSSION QUESTIONS:

1. Worker bees have stingers that are bent at the tip. When a worker bee stings something, its stinger gets stuck in its victim. When the worker pulls away, it loses its stinger—then dies! Queen bees, on the other hand, have straight stingers that can be used over and over again. Why should the queen have a better stinger?

2. Bees are terrific fliers. They can fly forward, backward, and sideways, and they can even hover! If scientists built an airplane that could fly like a bee, what would it look like? Would it have wings? Propellers? What shape would it be?

EVALUATION:

Allow your students time to share their findings from their research. You can assess their work using a simple three-point rubric:

- **Three points:**complete facts, detailed drawing, well-written responses complete with many supporting details
- **Two points:**some facts, adequate details in drawing, satisfactory responses with some supporting details
- **One point:**few facts, vague or inaccurate drawing, limited responses with little or no supporting details

EXTENSION:

There's More to Bees Than Stingers!

Bees are useful to the plants they feed on. Yet bees often get a bad reputation because of their stingers. Have students design posters that will change the negative image of bees so that people appreciate them more. Drawings could show bees as helpful farmhands. Ask them to include a catchy slogan.

Did an Insect Help Make This?

Have students make a list of all the fruits and vegetables in their homes and at school and then conduct research to find out whether the farmers who raise these crops rely on bee pollination.

Butterfly and Bee Buzz Words

Have students create an illustrated dictionary of butterfly and bee vocabulary. For each word, students should provide the definition and a small illustration. Compile the images into a class reference book or scan them for publication on your school's Web site.

More SUGGESTED READINGS:

The Magic School Bus: Inside a Beehive

Joanna Cole. Scholastic Press, 1998.

Join Mrs. Frizzle and her class as they visit the inside of a beehive! Watch her students become

busy worker bees who participate in all the hive activities: gathering and storing honey, caring for the larva bees, and following a swarm of bees as they establish a new hive.

An Extraordinary Life: The Story of a Monarch Butterfly

Laurence Pringle. Orchard Books, 1997.

Experience in exquisite detail the life of a monarch butterfly, starting with her late summer birth in a Massachusetts field and her transformation from caterpillar to butterfly. Continue as she travels on an amazing journey to Mexico for the winter months, mates in the spring, and then migrates back to Arkansas to lay her eggs, completing her life cycle.

Resources and Citations:

http://desertmuseum.org/center/edu/pollinator_kit/Teacher_Manual_Complete.pdf

http://www.blueplanetbiomes.org/sonoran_desert.htm

All Family Resources "To enrich the lives of families": Flower Anatomy

http://www.familymanagement.com/holidays/flowers/flower_anatomy.html. Retrieved October 07, Dec. 15, 2010.

Arizona Sonoran Museum: Center for Sonoran Desert Studies:

<http://www.desertmuseum.org/pollination/>. Retrieved October 07, 2010.

ASDM - Sonoran Desert Fact Sheets: <http://www.desertmuseum.org/kids/oz/long-fact-sheets/>.

Retrieved October 07, Dec. 15, 2010.

Fleming, T. H. (January 01, 2000). Articles - Pollination of Cacti in the Sonoran Desert - Unusual evolutionary inventions allow species to vie for scarce resources. *American Scientist*, 88, 5, 432.

Images for different parts of a flower: Google:

<http://www.google.com/search?q=different+parts+of+a+flower&ie=utf-8&oe=utf-8&aq=t&rls=org.mozilla:en-US:official&client=firefox-a>. Retrieved October 07, Dec. 15, 2010.

Migratory Pollinators Program: <http://www.desertmuseum.org/pollination/>. Retrieved September 27, Dec. 15, 2010.

North American PollinatorProtection Campaign NAPPCC: <http://pollinator.org/nappc/index.html>.

Retrieved October 08, Dec. 15, 2010.

Pollinators Habitat Kit for the Sonoran Desert Region:

http://desertmuseum.org/center/edu/pollinator_kit/Teacher_Manual_Complete.pdf

Potts, S.G., et al. (2010). Global pollinators declines: trends, impacts, and drivers. *Cell Press*, 25(5), 345-353.

Sonoran Desert: http://www.blueplanetbiomes.org/sonoran_desert.htm. Retrieved October 07, Dec. 15, 2010.

<http://www.braaschphotography.com/pages/246.htm>. Retrieved October 08, Dec. 15, 2010.

Suite 101.com - How Desert Plants Get Pollinated: <http://www.suite101.com/content/how-desert-plants-get-pollinated-a13618>. Retrieved October 08, Dec. 15, 2010.