Red Rock Relationships

Grades: 6-12

Estimated Time: 30 minutes

Standards Met:
- 6-8 grade:
  - *Science L.8.C* Students understand how living and non-living components of ecosystems interact.
- 9-12 grade:
  - *Science L.12.C* Students understand that ecosystems display patterns of organization, change, and stability as a result of the interactions and interdependencies among the living and non-living components of the Earth.

Materials Needed:
- One set of Animal/Plant cards per twenty students (attached)
- Plant and Animal Relationships (attached)

Sources:
Adapted from Project Wild activity *Good Buddies*. Council for Environmental Education, 2008.

Adapted from *Exploring Symbiosis.* Josh Lord, accessed from http://pages.uoregon.edu/oimb/Academics/GK12/Documents/Josh%20Symbiosis.pdf

Coyote, desert woodrat, western tent caterpillar, and cactus wren photographs by Bureau of Land Management, Red Rock Canyon NCA.

Yucca moth photograph by Dr. Olle Pellymyr.

Remaining photographs by Stacy Dahl.

Submitted by Stacy Dahl

Objective:
Learn about relationships between plants and animals at Red Rock Canyon NCA

Procedure:
Start activity by leading a discussion on ecological relationships. Have students relate to their own personal relationships as appropriate. Discuss symbiotic, commensalism, mutualism, and parasitism (see attached).

Discuss how all things in nature are connected and dependent on each other in a web of life. Can the students come up with relationships that they know about? Give them some examples, such as a spider eating a bug, or a tortoise eating a wildflower.

Divide the class into two groups, mutualism and commensalism. Explain to each group what kind of symbolism they are. Tell those in the mutualism group that that they will each be a Red Rock Canyon NCA organism that will benefit in a mutual way from their relationship. In this group there will also be a parasite which will harm another organism and is tied together in a sort of triangle with two other mutualistic organisms. Tell those in the commensalism group that in their relationships, one organism will benefit while the other is unaffected.

Pass out the cards, making sure that each organism has a symbiot as follows:

Mutualism group:
Joshua tree/yucca moth
Desert mistletoe/Phainopepla
Mexican manzanita/coyote
Banana yucca/desert woodrat
Desert mistletoe/honey mesquite (parasitic)

Commensalism group:
Creosote bush/white bursage
Desert almond/western tent caterpillar
Desert trumpet/wasp
Turbinella oak/Andricus gallfly
Cactus wren/buckhorn cholla

Tell the class that each organism (student) in their group has someone else in their group that they have a special relationship with (their symbiot). Their goal is to find that organism by questioning the other members of their group until they think they have the answer. Some hints are provided on each organism card. Once they think they have the answer, have them check with you. If they are correct, give them the Plant and Animal Relationships and have them sit down to discuss it while waiting for the rest of the class. When they have all finished, have each pair share their relationship with the class.

Suggested Locations: Open area where students can sit.	
Pine Creek Trail: 3,6,7, or 8	**Red Spring Boardwalk:** 1 or 4
Fire Ecology Loop: 3 or 4	**Moenkopi Loop:** 3,6,7,8, or 9

- Eats animals and plants
- Has strong acid in stomach

- Seeds have hard coating that cannot germinate without fire

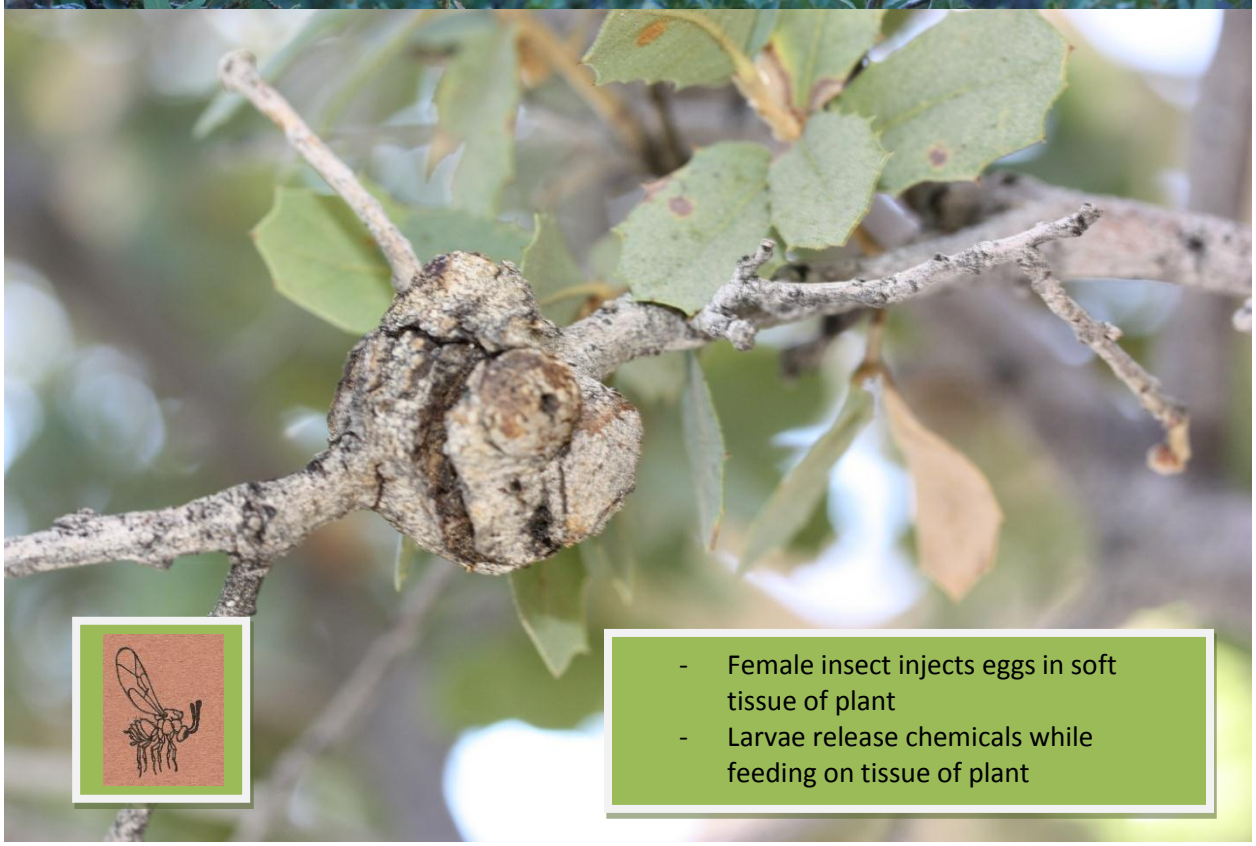
- Has tough skinned fruit that cannot release seeds unless eaten by an animal
- Has sharp, rigid leaves

- Eats seeds, fruit and pads or leaves of cactus and other plants
- Builds nests in rock crevices or at bases of sharp desert plants

- Lives in colony on intricate branches of particular shrub
- Forages leaves from host plant for several weeks before spinning individual cocoon

- Preferred host plant for larvae of a certain moth

- Tissue of this oak swells when irritated by chemicals

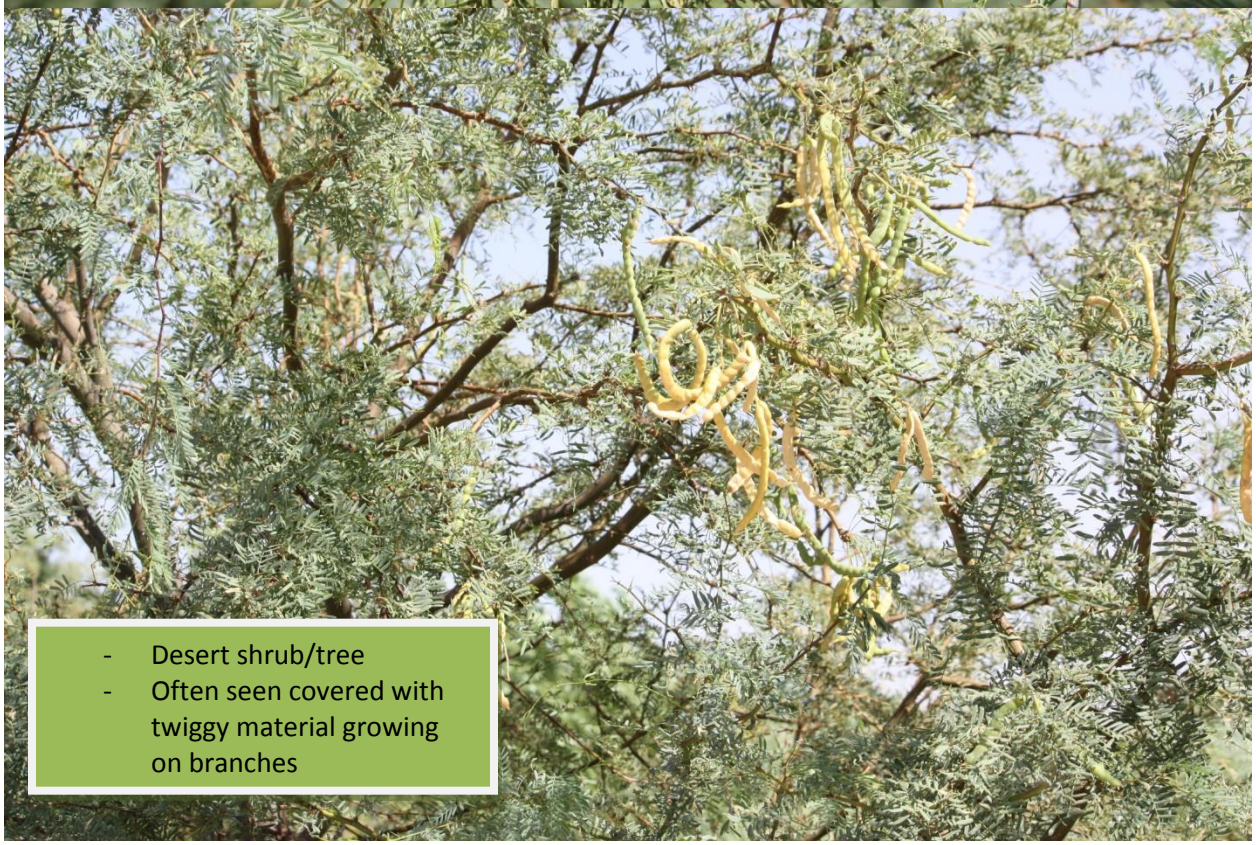


- Female insect injects eggs in soft tissue of plant
- Larvae release chemicals while feeding on tissue of plant

- One of this birds favorite foods is berries
- Flies from desert tree to desert tree looking for food

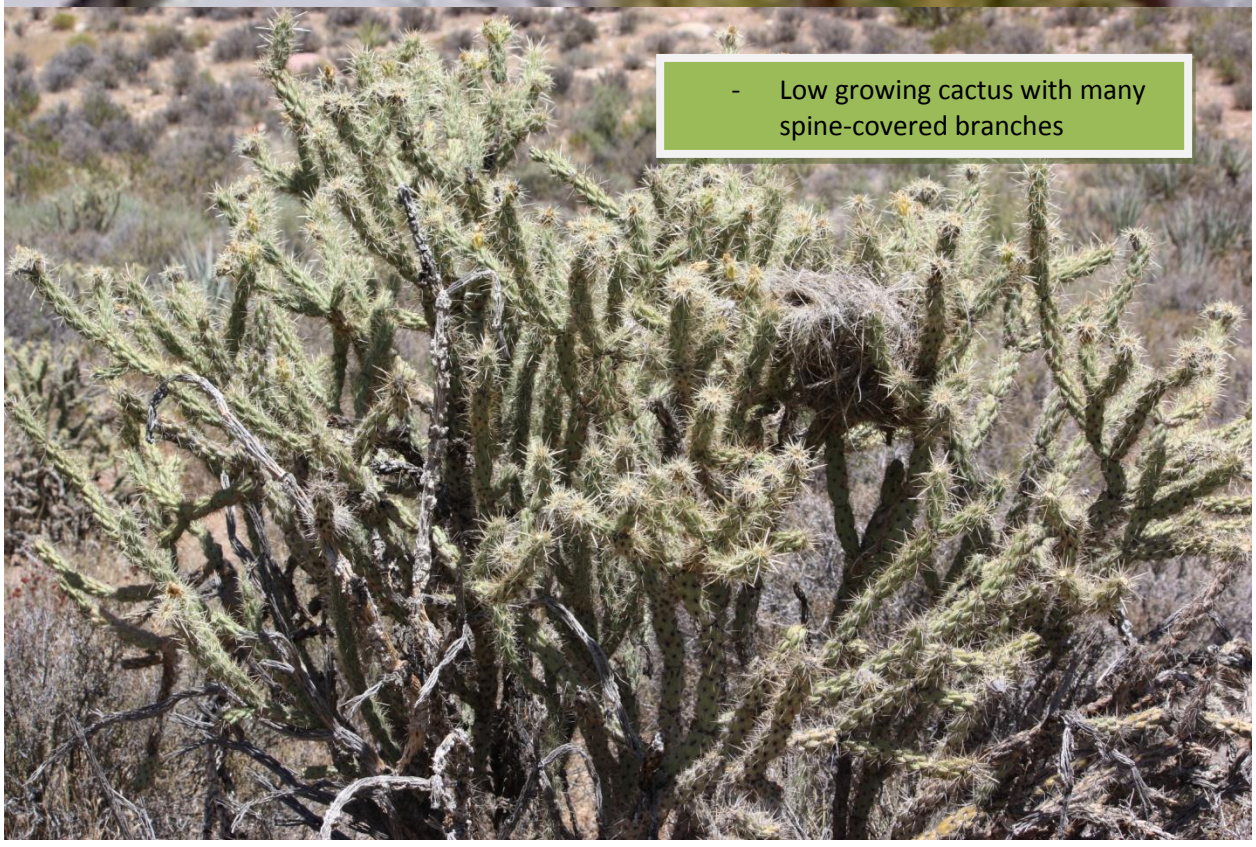
- Seeds cannot disperse without help of animals
- Has very, sticky berries

- Takes water and nutrients from other plants
- Does not grow on the ground

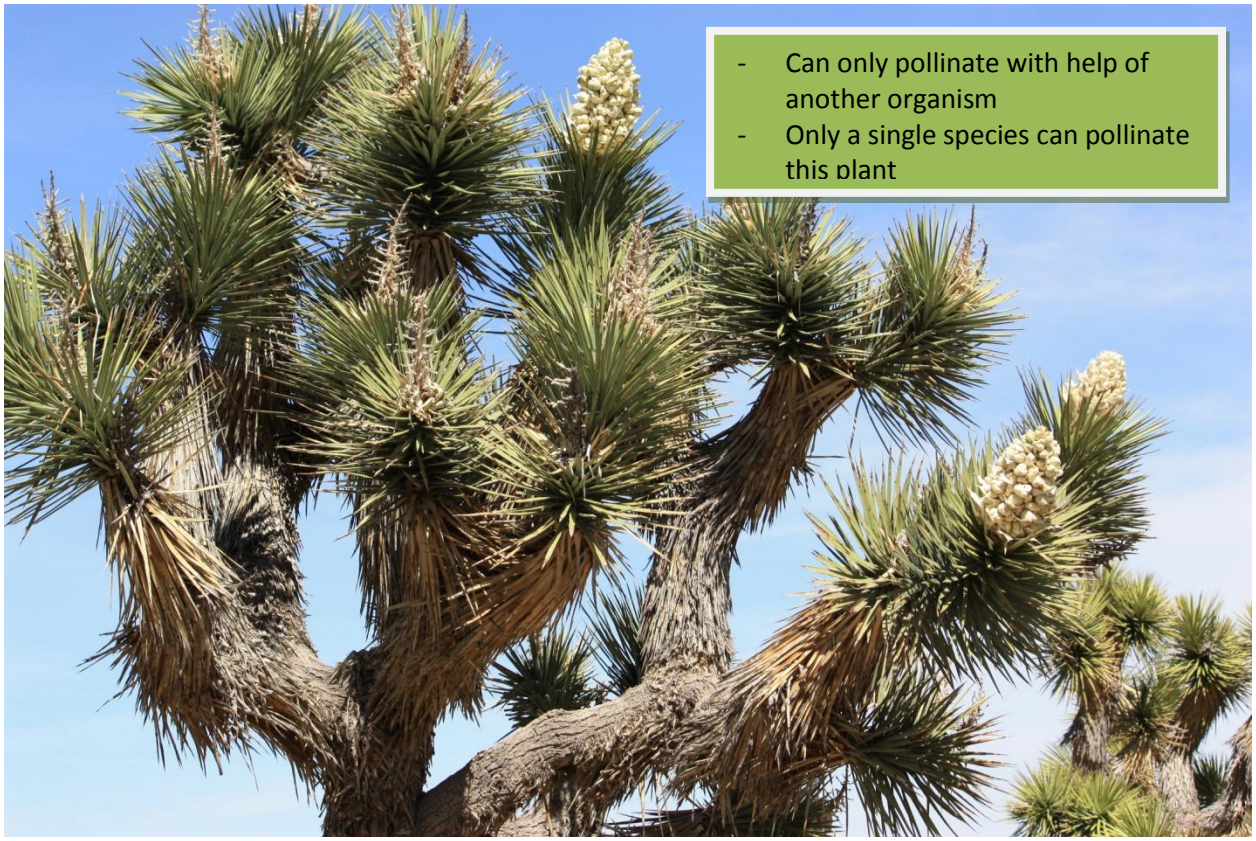


- Desert shrub/tree
- Often seen covered with twiggy material growing on branches

- Builds multiple nests in low growing desert plants
- Nests need protection from predators



- Low growing cactus with many spine-covered branches


- Can only pollinate with help of another organism
- Only a single species can pollinate this plant


- Female moth gathers ball of pollen and carries it to another plant
- Developing larvae only eats seeds from one kind of plant

- Seedlings need protection from harsh, desert conditions in order to germinate

- This dense-stemmed desert plant provides shade, collected water, and nutrients to other desert organisms

- Female wasp needs safe place to lay eggs
- Larvae feed upon store of insect parts that female has deposited

- Has inflated, hollow bulge in stem

Plant and Animal Relationships

Relationship types:

- Symbiotic: when two species of organisms live in close association with each other and at least one of the organisms benefits from that association.
- Commensalism: a relationship in which one species derives food or shelter from another species without seriously harming that organism or providing any benefits in return.
- Mutualism: a reciprocal relationship in which the two different species benefit and are dependent upon the relationship.
- Parasitism: a relationship between two species in which one species (the parasite) nourishes itself to the detriment of the other species (the host).

Relationships:

Joshua tree (*Yucca brevifolia*) and Yucca Moth (*Tegeticula synthetica*)
Relationship – obligate mutualism

Joshua trees begin blooming by mid March, depending on moisture and temperature. Yucca moths mate within the safety of the Joshua tree flower. After mating, the female moth gathers pollen from the flower's anthers and forms a ball which she then tucks under her head. She flies to another yucca flower and injects one to several eggs into the flower's ovary. She then climbs to the stigma and packs her load of pollen into the groove at the tip of the stigma, thereby pollinating the flower. When the moth's eggs develop into larvae within about a week, they then spend about four to five weeks within the flower, feeding upon the developing seeds. They will not eat all of the seeds, however, which ensures the development of future Joshua trees. After dropping back to the ground, the larvae will burrow under the soil of their tree and may remain dormant for as long as 17 years before pupating and emerging as a moth. While there are several species of yucca moth, only *Tegeticula synthetica* has a relationship with *Yucca brevifolia.*

Desert Mistletoe (*Phoradendron* spp) and Phainopepla (*Phainopepla nitens*)
Relationship – mutualism

Phainopepla feed mostly on the berries of plants, although they also eat insects when there are no berries to be found. Mistletoe berries are a particular favorite when they are present (fall and early winter). The bird eats the berries, which contain a seed encased in a very sticky pulp. Those seeds that are not digested by the bird are then deposited, in the bird droppings, upon the branches of the desert mesquite or juniper tree. This partial digestion of the seed is necessary for it to germinate. Because of the stickiness of the seed it will adhere to the branch and begin to germinate. Mistletoe plants are parasitic and will remove water and nutrients from its host plant.

Desert Trumpet (*Eriogonum inflatum*) and wasp (*Onyerus* spp)
Relationship – commensalism

Desert trumpet is a 12-14 inch tall plant often found in disturbed areas alongside roads or trails. It is an unusual looking plant with an inflated stem in which the plant stores carbon dioxide to use in photosynthesis at night. This inflated stem is also useful for the female *Onyerus* wasp which bores a small hole in the plant and utilizes it as a larder, packing it full of dead or

paralyzed insect larvae. She then deposits her eggs within the plant and the hatched larvae utilize the food store until they are ready to emerge from the plant.

Creosote Bush (Larrea *tridentata*) and White Bursage (*Ambrosia dumosa*)
Relationship - commensalism

Creosote and bursage shrubs are the dominant plants of the Lower Sonoran life zone of the Mojave Desert, but it is easy to overlook the bursage plants among the larger, showier creosote. This is ironic, because if it weren't for the bursage plant, creosote would not be as successful. White bursage is one of the most highly adapted plants in the Mojave Desert, able to succeed in the most arid and brutally hot conditions. Its small, light green leaves will wither and drop when soil conditions become too dry to support photosynthesis. Because of its dense stems, this abundant shrub acts as a nurse plant for creosote seedlings, which are unable to colonize on open ground. As a nurse plant, the bursage provides protection from hungry animals, shade from the relentless sun and additional nutrients and water that collect under the plant. This allows the creosote seedling to establish itself and it will soon outgrow the bursage.

Banana Yucca (*Yucca baccata*) and Packrat or Desert Woodrat (*Neotoma lepida*)
Relationship - mutualism

Banana yucca, one of three yuccas at Red Rock, in addition to the Joshua tree and Mojave yucca, does not fruit every year. Because of the tremendous amount of energy required to grow a fruit, the plant only does so once every several years. In addition, the fruits or pods never split open, even after falling to the ground and so the seeds cannot fall out on their own. Instead the plant relies upon animals to eat the fruit and disperse the seeds. One animal that does this is the desert woodrat. In turn the banana yucca provides a place for the woodrat to build its home. Woodrats choose the base of sharp or spiny plants such as Banana yucca and cholla to build its nest, often fortifying it with additional spines or spiny leaves. While the woodrat may be adept at moving in and out of its spiny nest, any predator will be deterred.

Desert Almond (*Prunus fasciculata*) and Western Tent Caterpillar (*Malacosoma californicum fragile*)
Relationship – commensalism

The desert almond is the primary host plant for the western tent caterpillar in the Mojave Desert. Female moths deposit their eggs around a small twig of the desert almond. When the larvae hatches, which usually coincides with the emergence of leaves on the plant, the caterpillar will undergo several stages of metamorphoses, all while remaining on the same plant. The caterpillars cluster in a colony and will build a very distinctive tent out of silk which they spin from a spinneret on the underside of their heads. Periodically, a group of the caterpillars will emerge from their tent and go on foraging trips in their host plant. They will remain on their plant, consuming more and more leaves as they evolve over six to eight weeks. In the last two stages of their development, they will leave the plant, searching for additional food and a place to spin their cocoon. For the most part, tent caterpillars will not harm the desert almond. The plant may become defoliated; however it will be able to recover. In other parts of the country, some species in the *Malacasoma* genus have killed off wide swaths of trees due to significant defoliation.

Mexican Manzanita (Arctostaphylos *pungens*) and Coyote (*Canis latrans*)
Relationship – mutualism

Manzanita plants have very hard coated seeds which will not germinate unless they undergo a process called scarification. This requires that the seed either be subjected to fire or the acidic juices of an animal's digestive tract. Coyotes, being omnivores, will often eat the berries of the manzanita and will pass the seeds through, into their scat. This disperses the scarified seeds. During late summer, when the fruit is most abundant, it is not uncommon to see coyote scat that predominantly consists of manzanita seeds.

Turbinella Oak (*Quercus turbinella*) and Andricus gallflies (*Andricus spp*)
Relationship - commensalism

This oak tree, often referred to as shrub live oak or scrub oak, commonly grows in the slope areas of Red Rock where there is a little more water, such as Pine Creek and Willow Springs. It is a small oak with leaves that are no more than 1 ½" long. In the spring the female Andricus wasp inserts her eggs into the new growth tissue of a twig. In response to a chemical irritation from the insects, the tissue begins to swell and a tough, tumorous looking gall forms. This provides not only a safe place for the larvae of the gallflies to develop but also a source of nutrition until the fully grown adults emerge many months later. Ordinarily the presence of galls does not harm the host tree.

Honey Mesquite (Prosopis glandulosa) and Desert Mistletoe (Phoradendron californicum)
Relationship – parasitism

Honey mesquite is a common desert tree that grows at Red Rock. It is not unusual to see what look like large, twiggy bird's nests on the branches of the tree or even engulfing an entire tree. These are not nests, however, but a parasitic plant growing on the mesquite. Mistletoe seeds are dispersed most commonly by the activity of birds such as Phainopepla, onto the branches of host trees. Once the seed begins to germinate, its root develops into a structure called a haustorium, which penetrates the bark of the tree and into the tissue. The mistletoe utilizes this structure to absorb water, sugar and amino acids from the mesquite. Individually, mistletoe will not significantly harm its host, although it can have an impact on the tree's growth and reproductive success over time. However, if the tree becomes covered with mistletoe and experiences other environmental stress such as drought, the host plant can die.

Cactus Wren (*Campylorhynchus brunneicapillus*) and Buckhorn Cholla (*Cylindropuntia acanthocarpa*)
Relationship - commensalism

The cactus wren is a large, very conspicuous wren, noted for its dark, streaked coloration on its back, a long white "eyebrow" and black spotting on its breast. This bird builds its dome shaped nest in the branches of the buckhorn cholla. A mating pair will build several nests, both for clutching the eggs and also for roosting at other times of the year. Cacti are chosen for protection from predators such as fox and coyote, which are unwilling to brave the sharp points of the cactus spines.