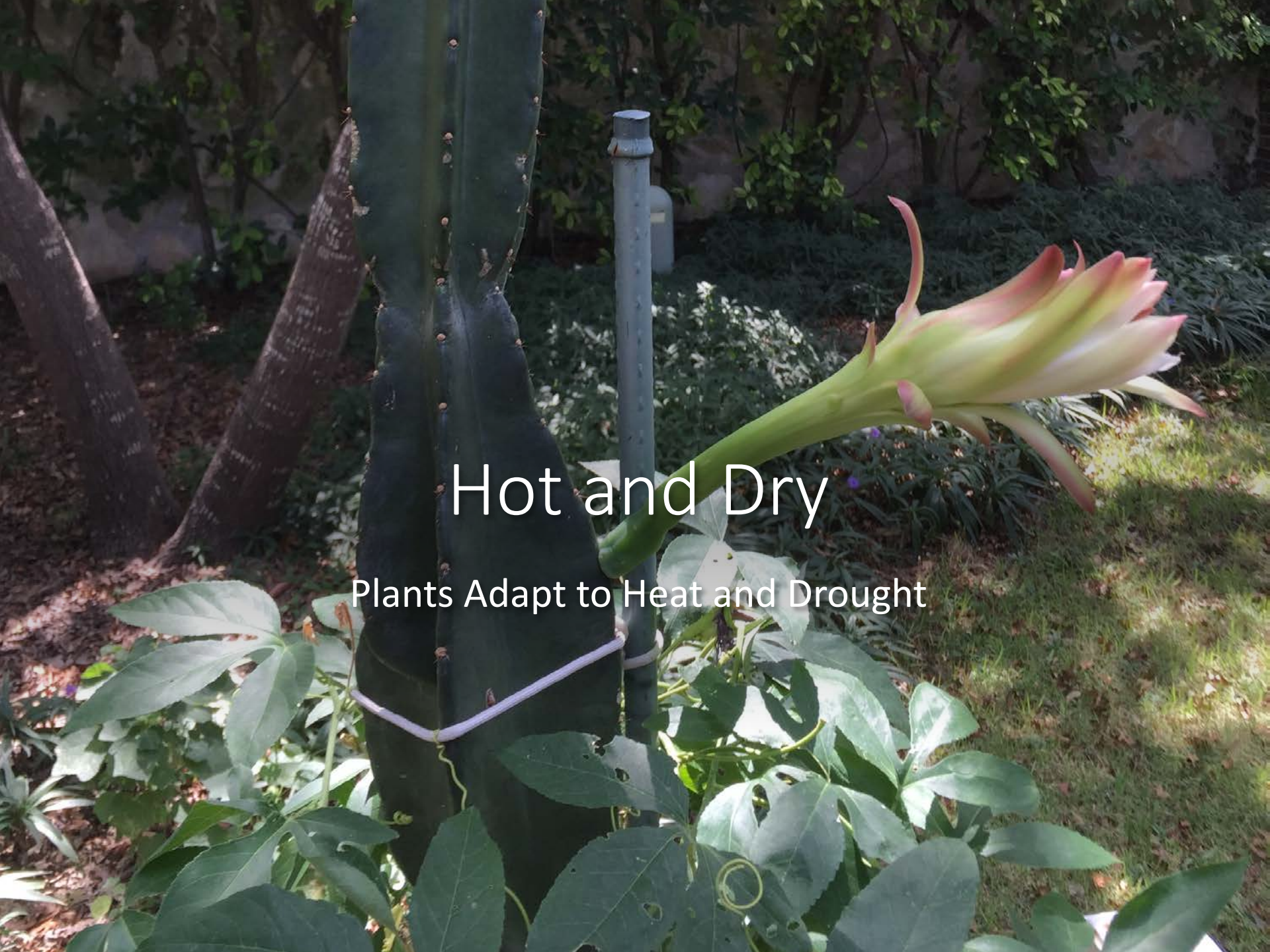


Hot and Dry

Plants Adapt to Heat and Drought

Xeric adaptations

Plant adaptations to xeric conditions may include coloration to reflect light, thick waxy covering or hairy leaves to reduce transpiration (water loss), high water storage capacity (succulent leaves and stems), and different photosynthetic pathways with high water use efficiencies.

Color

Plant adaptations to xeric conditions may include silver or blue coloration to reflect light.

Other structural changes

- Xeric adapted plants have special cells which hold water for photosynthesis when soil moisture is low or nonexistent. The cells of xeric adapted plants can lose up to 95% of their water content. Succulents, and many xeric adapted plants, have mucilaginous interior tissues (specialized cells) which store water. Cacti store water in their stems as do most succulent euphorbias. Others, like aloes and Haworthia, store water in their leaves, and a few store water in their roots as either tubers or other swollen membranes.

- By reducing the number of leaves, or breaking the leaf area into tiny parts, the leaf surface area is decreased, so the plants lose less water. Leaves are reduced to spines (cacti) or very fine leaflets (legumes). In other cases, for example, Red Buckeye, Retama, Mesquite, and Creosote Bush drop leave during the summer in response to drought.

- The main site of photosynthesis is moved to the stems (chloroplasts in the stems). Prickly Pear pads, which are actually stems, are an example of this adaptation.

- Stomata, the sites where water vapor during transpiration is released, become fewer, in sunken pits below the surface, or located on the leaf underside. Some grasses with broad leaves like Indian Grass have cells on the leaf surface which cause the leaves to fold, in response to drought protecting the stomata. Many grasses found in arid conditions like *Aristida*, *Sporobolus*, and *Muhlenbergia* have very narrow leaves, which are not only folded, but also in-rolled, enclosing the stomata more completely, often accompanied by very dense basal growth which further contributes to conserving moisture.

Additional adaptations

- Growth is compact, often spherical or cylindrical, reducing surface area, saving water. Plants may have a ribbed structure enabling rapid increase in plant volume and decreasing surface area, minimizing exposure to the sun and directing water directly to the roots. A rosette arrangement of the leaves, as in agaves, yucca, and aloes, also directs water to the roots. Some authors suggest the pads of Prickly Pear orient E/W to escape the direct rays of the sun.

- Waxy, hairy, spiny outer surfaces trap air insulating the plant from heat and cold. Artemisia hair shades the plant. Hair and spines can also scatter light reducing the sun's effect. Waxy impervious covering holds water, for instance in Live Oak leaves. Downward pointing spines directs water from fog and dew to the plant roots.

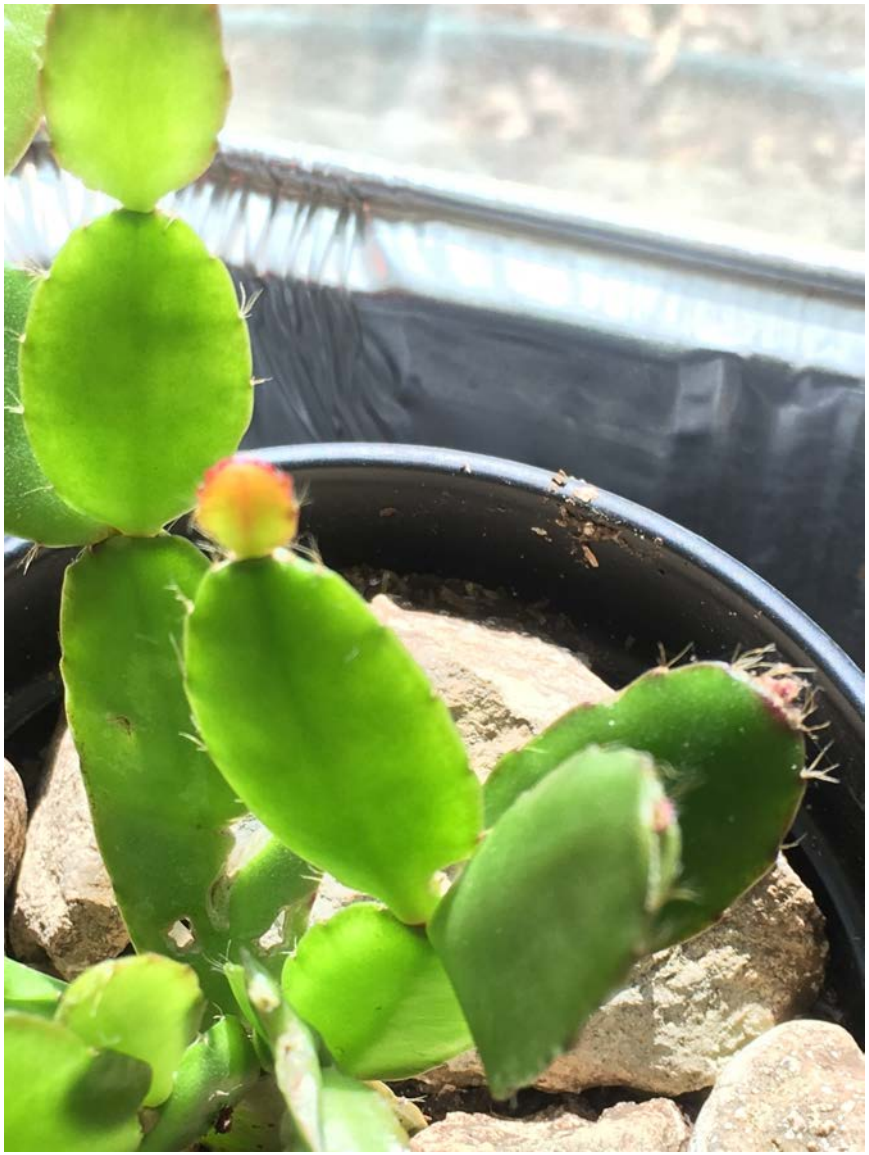
Metabolism

Plant adaptations to xeric conditions may also include different photosynthetic pathways with high water use efficiencies.

Water storage

Thick waxy covering or hairy leaves reduce transpiration (water loss) and improve water storage capacity (succulent leaves and stems).

Roots near the surface absorb water quickly and can regenerate quickly after a rain.



Activity

Crassulacean acid metabolism (CAM metabolism) works as the plant gets its CO_2 at night and stores malic acid to use during the day. This allows photosynthesis to take place so water loss during the day, when it is hottest, is minimized by having the stomata closed.

Restricting germination to optimal times, as in the case of bluebonnets, allows plants to germinate and bloom in the cool part of the year. Many xeric species have a short six to eight-week life cycle delaying germination to optimal conditions, while others, such as rain lilies bloom after a rain.

Native cacti examples

- Opuntia—Prickly pear
- Tasajillo—Pencil cactus



A cactus is a xeric plant—xeric means it does well in a dry hot climate.

- The pad is the stem.
- The spines are the leaves.
- The fruit are called ‘tunas’ possibly after the Spanish word for olive—aceituna, or a word from Taino.

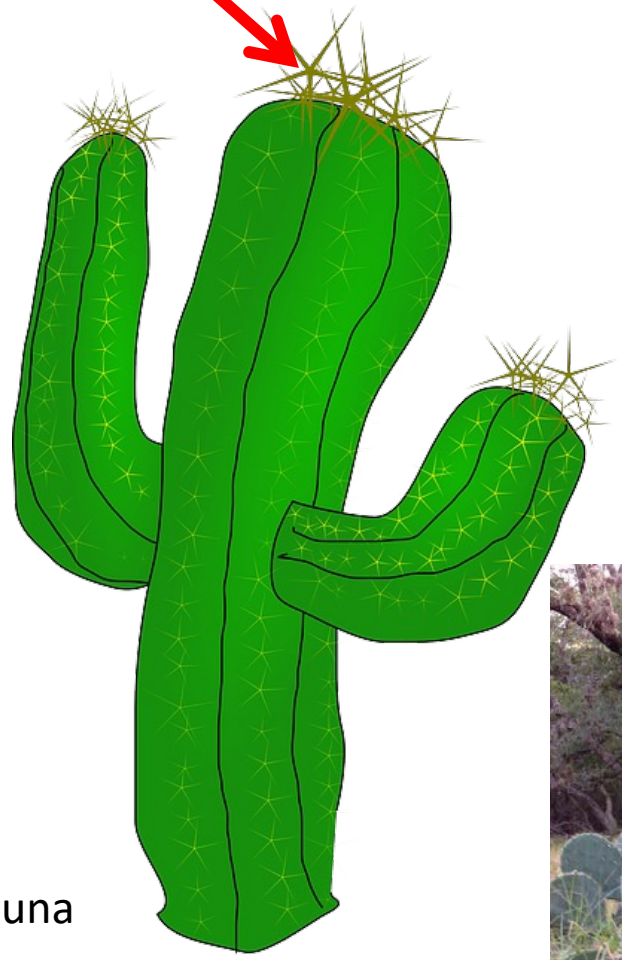
The white is a scale insect called cochineal—we make natural red dye, as in Pom juice, from it. During the Revolutionary war, the Redcoats' coats were colored red with carmine or red dye from the cochineal.

The cactus has tiny spines called glochids that get stuck on your hands and clothes.

We can eat the tunas and pads.

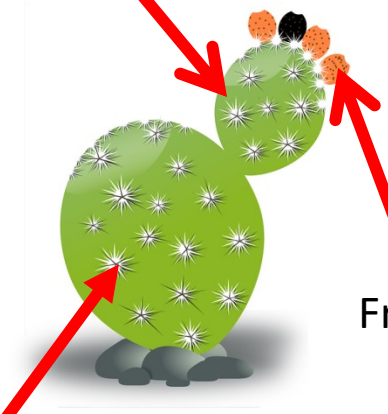
The little bumps on the cactus are the areoles. The pads and flowers and fruits grow from the areoles.

Spines=leaves



Flower

Pads=stem



Fruit=tuna

Areoles=bumps

Xeric adaptations—plants adapt to a dry environment and hot climate in many ways.

- Escape—annuals begin to grow again (germinate) and bloom in the cool part of the year and re-seed strongly—an example is the Texas bluebonnet.

- Evade—perennials have bulbs (parts of stems) like rain lilies, or tubers (parts of roots) like potatoes, to store water when it's wet and replace the water with the new rains. The underground part stays alive when water is scarce.

Endure--Xeric adaptation

- Reduce leaf surface—tiny leaves broken into little leaflets, or deeply toothed—an example is the acacia.
- Dropping leaves like the mesquite.
- Shading leaves with hairs like the Artemisia.

Other adaptations

Rosette spiral structure to direct water to the root, as in agaves, yuccas, and aloes.

Leathery/stiff leaves with a waxy (cuticle) layer as in the live oak.

Delayed growth and bloom as in the penstemmons

Cactus, agave, and yucca plants endure. They have ways to change their structure, and how they function, to minimize heat and water loss.

They make their energy (big word alert—photosynthesis) in their stems.

Compact, round stems reduce the surface. Ribs direct water to the roots.

Waxy, hairy, spiny surfaces trap air, shade the surface, and downward leaves direct water to the roots

Roots near the surface absorb water quickly

They germinate, or make new growth, in cool months.

More adaptations for heat and dry weather (draught).

Succulence means they store water in sticky tissues.

They reduce leaf area with thin small leaves or leaves with irregular edges.

Stomata, or breathing holes are sunken.

They make their energy and give off water at night when it’s cool.

Illustrating adaptations

Xeric plant shapes—plants adopt lots of different structural adaptations to direct water to the roots and minimize water loss.

More shapes—ribs, rosettes, hairs….




Fruits—animals eat the fruit and disperse the seeds.

Spines and glochids are modified leaves which reduce water loss, shade the plant and are a hardy defense strategy. Areoles are the little bumps from which various cactus tissues grow.

!

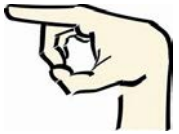
Spines and glochids shade and defend the plants. Glochids detach easily and are barbed, hard to remove.

Cactus in a tree—
cactus grows in
lots of places!

You can sing the song to *Clementine.*

Oh, the cactus, oh the cactus(two flat hands)

Feel the sharp and pointy spine. (1 finger)



The cactus fruit are called tunas (fist)

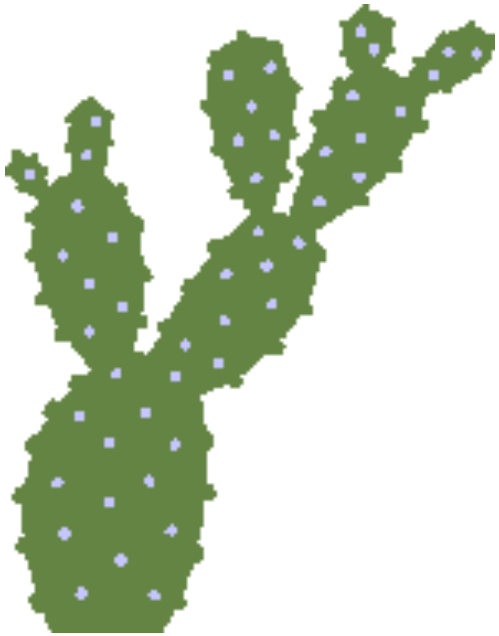
And the green pads look just fine. (clap)

Casey Cactus

Parts of a cactus

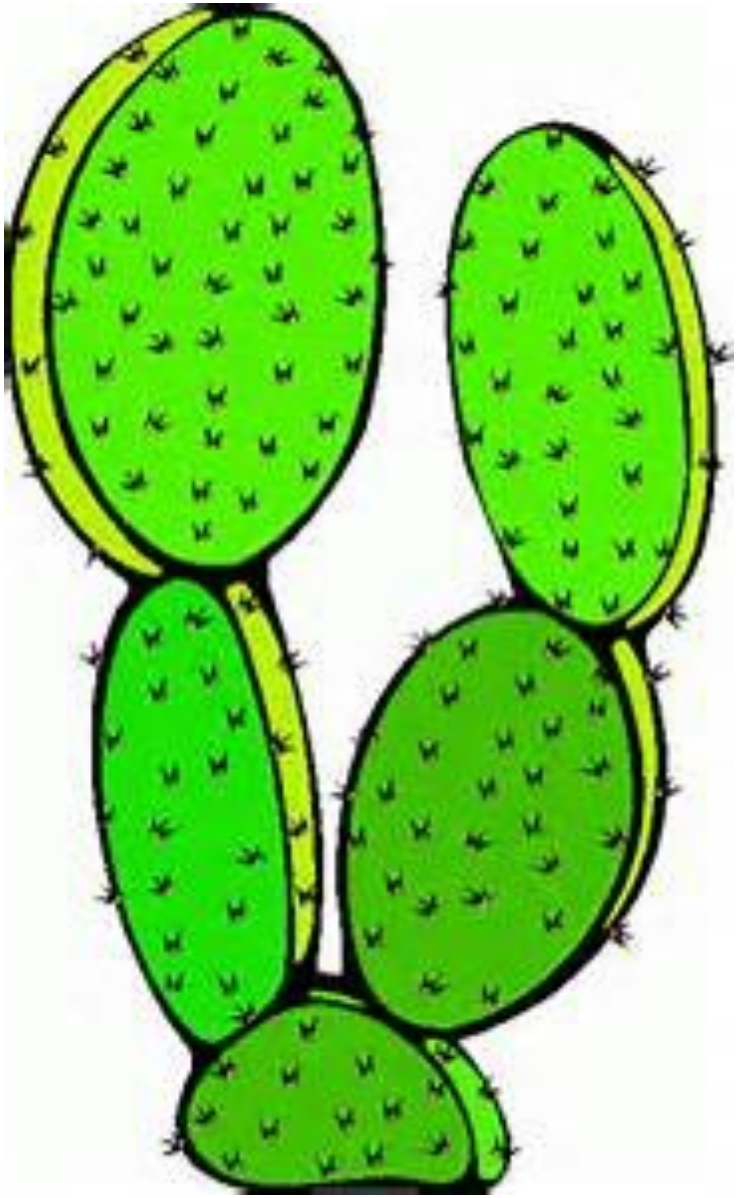
Casey Cactus

I’m a little cactus –pads green and flat.



You can sing this song to the tune of *I’m a Little Teapot or* read the story.

My pads are my stems, just think of that!



My spines are my leaves—I think they’re cute.

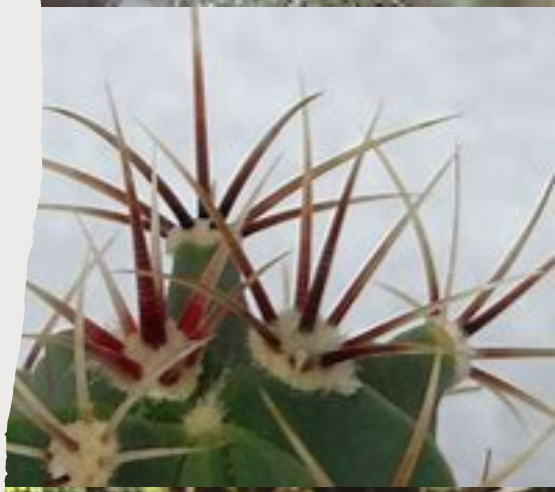
My flowers are yellow, and my tunas are the fruit!

I spy plants hot and dry!

Take a XERIC—that means plants adapting to dry hot conditions—walk around your house.

Can you find:

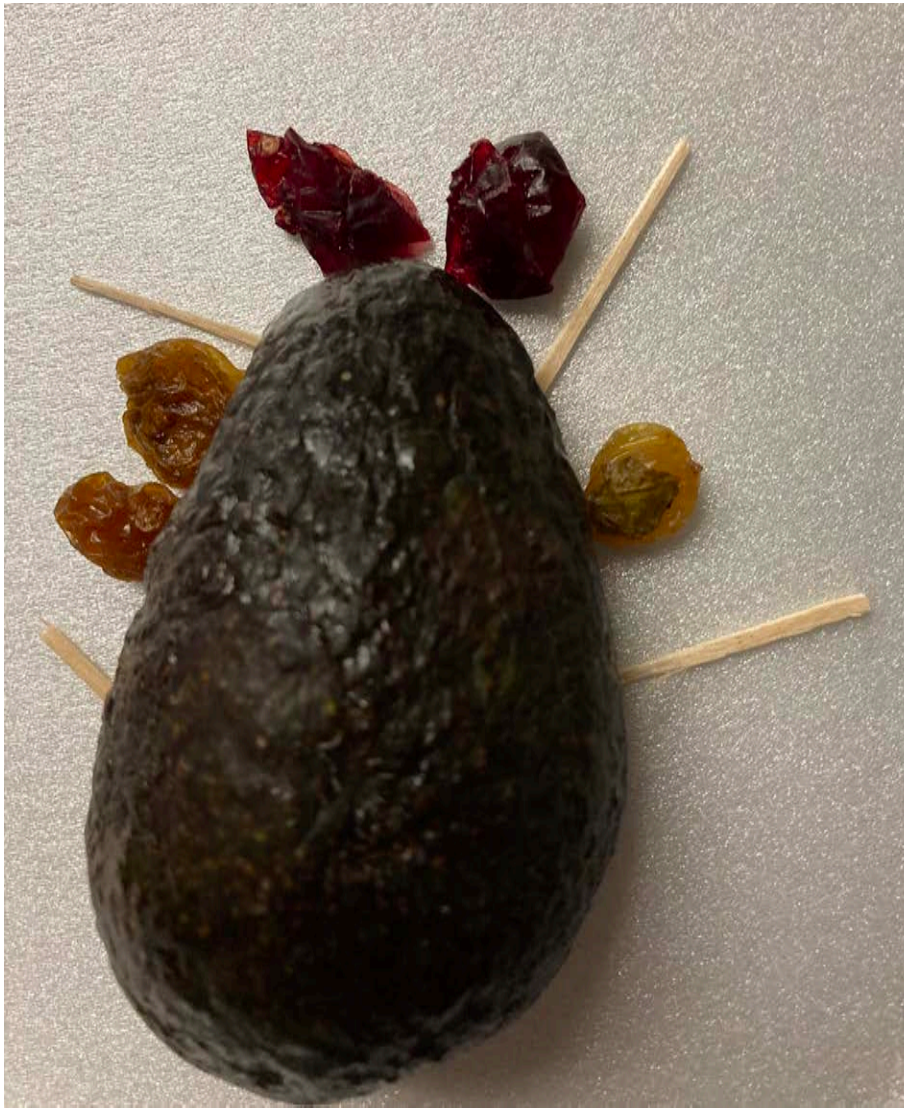
- Plants with spines for leaves?
- Plants with waxy leaves or stems?
- Leaves with broken up edges?
- Leaves with tiny leaflets?
- Plants with hairs?
- Plants with rosettes?
- Plants that come out when it rains?



Big thinking—make an edible cactus!

- Let’s make a cactus snack!
- What can you use for the pads?
- What can you use for the spines?
- What can you use for the fruits—tunas?
- What can you use for the flowers?

Yummy cactus--avocado for the pad, cranberries for the tunas and golden raisins for the flowers!



Or cucumber with a cactus flower and pear with a fruit!

Cactus cookies!

Cactus snacks—yum yum!

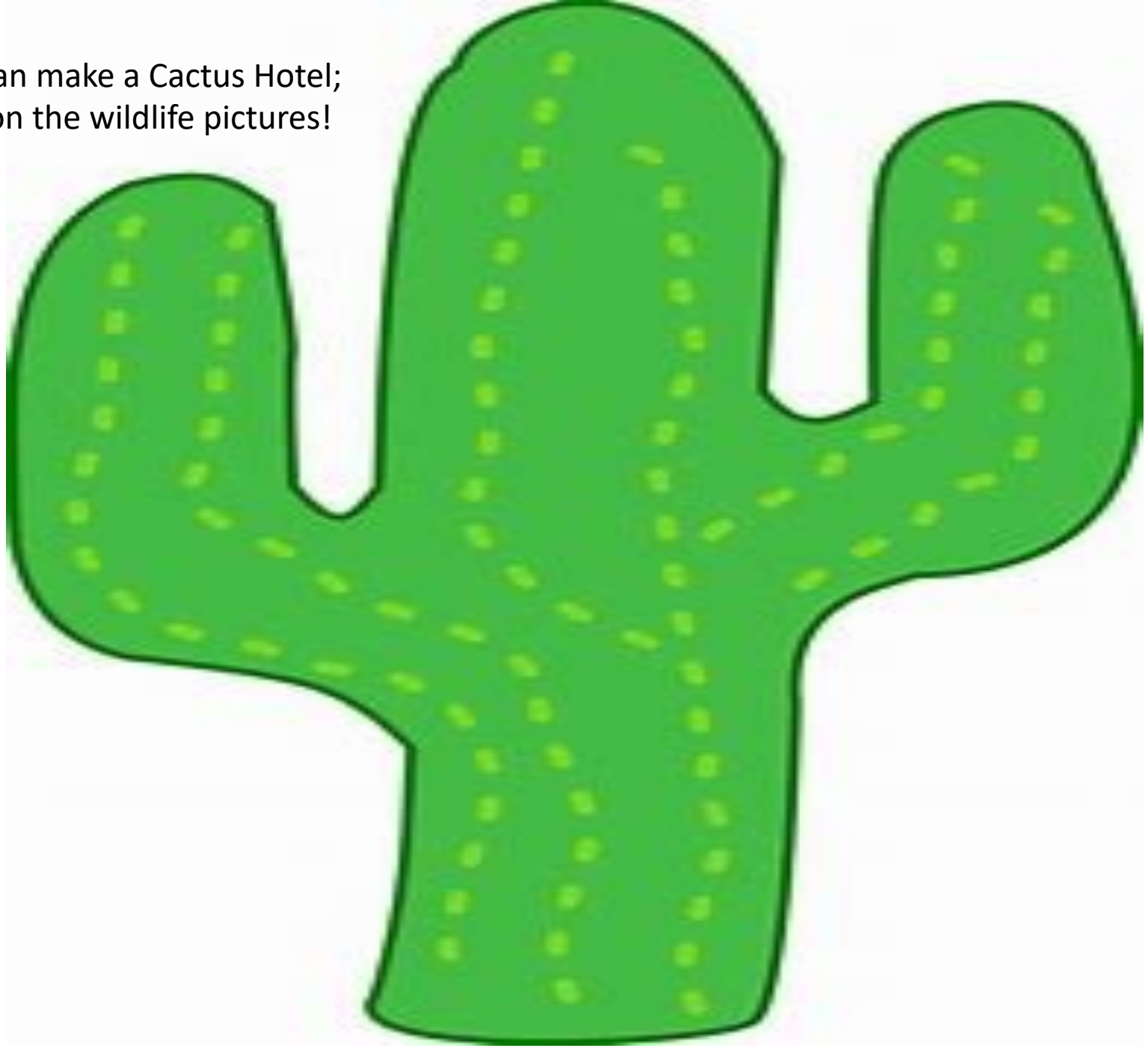
You can use cream cheese, candy melts or frosting—raisins, cranberries, minichips, Skittles or M&Ms!

Be an engineer and design a cactus!
You can add flowers and tunas!

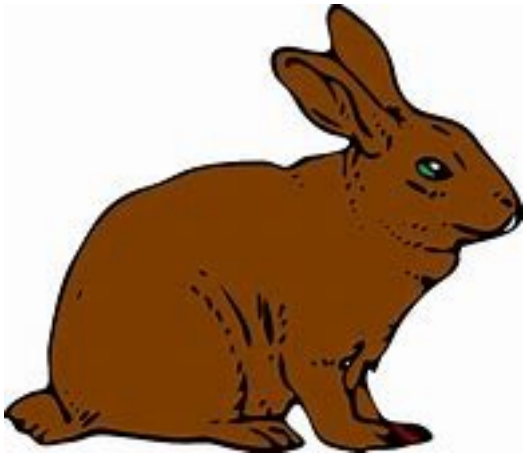
Did you know that a cactus can be a cactus hotel!

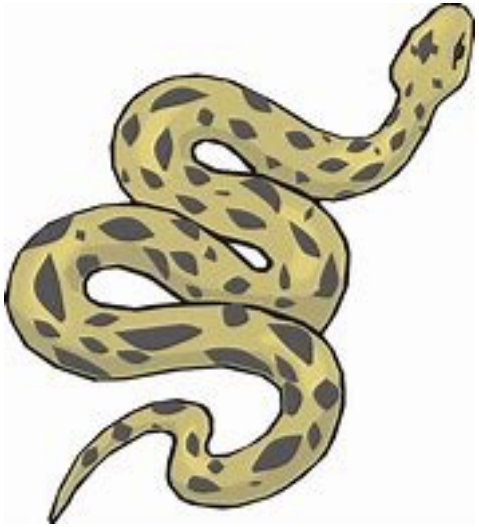
Critters get food and shelter and places to live and lay eggs on cacti. Birds and insects get seeds pollen and nectar. We can eat cactus fruit and nopales (pads) too!

You can make a Cactus Hotel;
glue on the wildlife pictures!

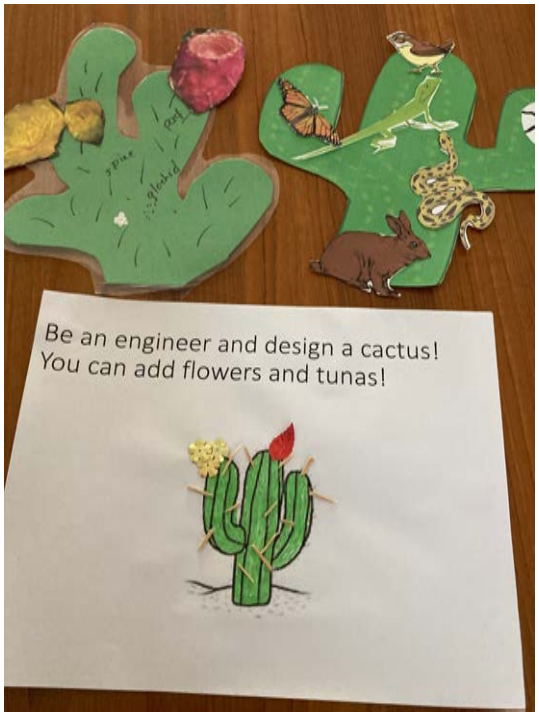


Wildlife for Cactus Hotel





Cactus crafts



You can be a cactus sculptor--playdough for the pads and flowers, toothpicks for the spines, and beads for the tunas!

Cactus books