

STEM Utilizing Cactus Areoles and Spines

Developing and Utilizing Science, Technology, Engineering and Math Knowledge and Skills

Tucson Cactus and Succulent Society

www.TucsonCactus.org - Education@TucsonCactus.org



Table of Contents

I.	INTRODUCTION TO STEM UTILIZING CACTUS AREOLES AND SPINES.....	2
II.	AREOLES	2
III.	SPINES.	4
IV.	SUGGESTED MATERIALS FOR EXERCISES.....	6

Note: You can click on a page number on the right side to go directly to that section.

This material has been developed for K -12 Educational purposes by the Tucson Cactus and Succulent Society (TCSS) and may be freely copied and used for Educational purposes. If the document is altered or amended in any way, all references to the Tucson Cactus and Succulent Society (TCSS) must be removed including our logo. Joe Frannea 6/21/15 rev3

I. INTRODUCTION TO STEM UTILIZING CACTUS AREOLES AND SPINES



Science - Technology - Engineering - Math

Cactus Areoles and Spines can be utilized to provide many hands on and interesting activities to develop and utilize Science, Technology, Engineering and Math knowledge and skills. Cholla cactus have unusual spines that make for some interesting investigations. Prickly Pear have interesting Areoles to study. They both are always plentiful but care needs to be taken when handling, metal tongs are required for safety.

Each of the sections below can be very simple using math and others skills as appropriate for various grade levels. There is lots of opportunity to do observations, sketches and analysis work. Students can work in small groups (2-4) with each group needing one cactus piece. If the opportunity exists, the students can observe stems, segments, pads, new buds, flowers and fruits growing on nearby cactus or pieces brought into the classroom.

This material is organized so many of the sections can be used individually without following the entire document. Improve, improvise, amend and have fun. Share your suggestions and improvements with TCSS so we can share with others via our web site.

II. AREOLES

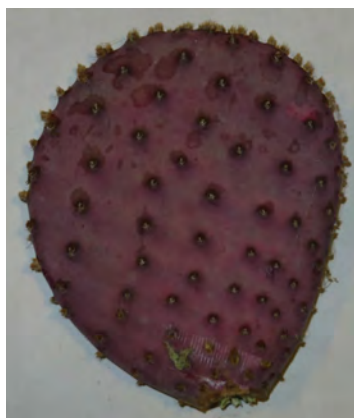


Areoles are small, usually fuzzy, bumps all over the cactus surface. If a Succulent has areoles, then it is called a Cactus. A Succulent is a plant that stores water somewhere in the plant, normally the stems, so it can sustain life for many months without rain or supplemental water. So, all Cactus are Succulents, but not all Succulents are Cactus. Spines, flowers, branches (stems, segments, pads, etc.) and roots can grow out of the areoles. Can more than one of these grow out of the same areole? How does the cactus determine what the areole should do?

Referring to the TCSS Cactus postcard that shows eleven common cactus and other succulents in the Tucson area, which of the succulents shown are cactus? (Answer: all but 4, 5 and 10). These postcards are available from TCSS for classroom and field activities.

A. Prickly Pear - Flat Surfaces

Prickly Pear are great cacti (or cactuses) to observe and analyze areoles, especially the flat surfaces. Be very careful when handling pads as most have glochids, very small reddish spines or stickers that are hard to remove because there are so many of them and they are very hard to find on your skin. Always use metal tongs or other metal tools to handle the pads. Here are some thoughts and possible items to investigate. We will be using two different size pads from the same species for our work.



1. With a pad on a piece of paper on your work desk (or observing a pad on the cactus) notice the areole arrangement. Can you sketch it? A magnifying glass may be helpful. Notice the symmetry. Is the back or other side similar? Be sure to carefully fold up the paper when done, capturing any glochids or spines inside and place in the trash. Do not recycle due to possible spines inside the paper.
2. Count the areoles on the flat surface of one side, write it down. Now do the other side. Are they the same, if not how much do they differ?
3. Using another pad that is quite a bit larger or smaller, repeat the two steps above and write down these answers. Be sure the new pad is from the same cactus or the same species.
4. Calculate the density of areoles for each of the pad surfaces (areoles per square inch or use others units of your choice). Do the larger or smaller pads have a higher density?
5. From the data you collected and your calculations, do you think the cactus grows more areoles as the pads get bigger?

B. Prickly Pear - Edges

The edges of a Prickly Pear cacti pads are normally full of spines and glochids. Here are some thoughts and possible items to investigate.



1. Count the areoles that start from the bottom of the edge and go all the way around the pad to the other side on the bottom. Do the same for the other pad. What is the difference in the count?
2. Do you observe anything different about the areoles on the edge of the cactus versus the flat surfaces? You may need to look at a few pads to see differences, best if you look at pads on a whole cactus, not just one pad. Remember that areoles may have stems/pads, flowers/fruit, spines or roots.
3. How do the pads connect together? Are they all the same or do some grow out of a different part of a pad?
4. Where do the flowers grow? Where do the fruits grow? How many can there be on one pad? Will flowers grow from the same areole each year?

III. SPINES

Spines have several purposes including shade, protection and collection of water droplets. The spine clusters appear to be different for each species. On a given species, each spine cluster growing out of an areole is almost exactly the same. This is often a big clue for cactus identification purposes for even baby or juvenile cacti.

A. Chain Fruit Cholla Spines



The most common cholla in the desert is the chain fruit or jumping cactus. The spines are long and sharp and make an interesting study. Cholla stems must be handled with care and only use metal tongs and other instruments. Here are some thoughts and possible items to investigate.

1. Observe the spine clusters growing on the areoles. Can you sketch a cluster accurately paying attention to orientation of the spines, quantity and spine length of each spine. A good Botanical Art artist will pay very close attention to these details and document them carefully.
2. The chain fruit cholla has a couple of special spine attributes. Observation should be able to find one. Use needle nose pliers and pull gently from near the base to the tip of the needle. What happens? I call this a spine scabbard. Why does it have these sheaths?
3. The needles are very sharp and have a unique trait when they stick into a soft object like your skin. A microscope is necessary to observe the tip of the spine. To see how sharp it is, compare it to a pin point or sewing needle, which is more pointed? Anyone who has encountered a cholla spine knows that they like to hold on and your skin is pulled away when pulling the spine out. Why does this happen with cholla and not other cactus? The needle has barbs that open up when the needle is pulled out so that is how it grabs so much and hurts so much. I have not found a material, like a gummy bear, that will cause the barbs to expand when pulling the needle out. It needs to be something that will grab around the needle tip.



Cholla spine sheath laying on cactus, the thin spine sticking straight up does not have a sheath.

B. Barrel Cactus Spines

Our common barrel cactus in the Tucson area is called a Fishhook Barrel (botanical name is *Ferocactus wislizeni*). The spine cluster is very distinct, even on baby Barrel fishhooks. Here are some thoughts and possible items to investigate.



1. Make a drawing of the spine cluster. Pay special attention to the length, orientation, thickness and shape of each spine.
2. The various spine shapes within a cluster perform different functions like protection, shade and water droplet capture. Can you identify which of the spines would perform these functions the best?
3. Test the strength of the fishhook spine. Use two needle nose pliers to flex and bend or break. How does it compare to other types of cactus spines?

C. Saguaro Cactus Spines

Our most majestic and largest cactus, the Saguaro, has a unique spine cluster. The Saguaro spines are very strong and sharp and can penetrate deeply if you get jabbed, care must be taken to avoid injury.



Very unusual for Saguaro spines to be this long

1. Look at several different spine clusters and make a sketch to show what is distinctive about the Saguaro.
2. Measure several of the longest spines to see the max and average lengths. Are the spines longer near the top of the cactus?
3. How strong are these spines compared to the fishhook?
4. Can Saguaro spines be used to help predict the age of a Saguaro?

IV. SUGGESTED MATERIALS FOR EXERCISES

Special Items for activities above, need one each per student group:

- 1) Metal tongs to handle cactus stems, pads, fruits, etc.
- 2) Gloves, optional, to help protect hands but not for handling cactus directly. Glochids will stick to them and then the gloves must be thrown away.
- 3) Needle nose pliers

Other items needed that are commonly available:

- 1) Paper, graph paper, clipboard, pencil, ruler (cm and inches)
- 2) Magnifying glass, one per group or share
- 3) Digital Camera, can use a cell phone camera that takes close-ups
- 4) Calculator if allowed for some of the calculations, one per group

For other educational materials and STEM activities, see our [Education Materials section](#) or go to our web and click on Education on the left side navigation links.