

Transcript Welcome to the Herbarium

Brought to you by the Asombro Institute for Science Education.

[Kelly] Hi everybody, this is Kelly with the Asombro Institute. Today I'm at New Mexico State University here in Las Cruces and I'm here to visit the NMSU Herbarium. Let's go!

[Dr. Fuentes-Soriano] So hello, my name is Sara Fuentes-Soriano. I'm currently the herbarium curator here working at NMSU. An herbarium is a collection of dry plants that have been collected by researchers in different areas of the world, in this case our collections come from the Chihuahuan Desert - the area where we live. So herbarium specimens are dried plants but they are preserved in cabinets like the ones you see behind me, and here you see the pictures of the herbarium specimens. Researchers that use herbarium specimens actually go to the field first to recognize what plants live there. As you know all organisms alive on Earth depend on plants, so we need to know what plants organisms eat, survive with, and that's what researchers do.



[Kelly] One plant of particular interest to Dr. Fuentes-Soriano and her team is creosote.

[Dr. Fuentes-Soriano] Creosote is one of those plants that I'm sure you know, because when it rains around us we have a smell, and that smell comes from creosote. Creosote in Spanish in Mexico is called la gobernadora, and also hediondilla. Gobernadora translates to queen, and hediondilla means the smelly one, and you know why. I'm from Mexico, and one of the common uses that my own parents have for these plants is to dry the plant, and if you have smelly feet - once they dry this plant you can macerate it, make a powder, put it into your shoes overnight and then with that take the smell out of the shoes. And that happens because creosote chemicals actually help to kill bacteria and fungi, all those organisms that make the feet smell. So that's one very common use of creosote, but researchers also have found that those chemicals, because the antibacterial properties, antimicrobial properties, can also help to cure some diseases, infections specifically.



So creosote in nature you can find it like I mentioned around you. You can see the plant in what we call the Chihuahuan Desert - the area where we live right now in Cruces. But there are other deserts in North America.

[Kelly] Creosote is common in the Chihuahuan, Mojave, and Sonoran Deserts.

[Dr. Fuentes-Soriano] So it happens that the plants in the Chihuahuan Desert are small. Then if you go to the California area in the Mojave, you will find plants that are tall, and then in the

Sonoran Desert also you will have those forms that are big, bigger than the ones from the Chihuahuan Desert.

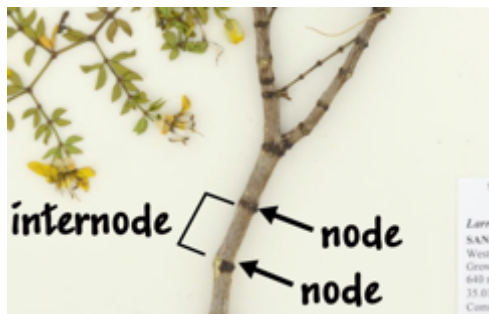
[Kelly] Make a hypothesis. What do you think might cause the difference in the creosote size between the different deserts?

Edpuzzle question: Make a hypothesis. What do you think might cause the differences in the creosote size between different deserts?



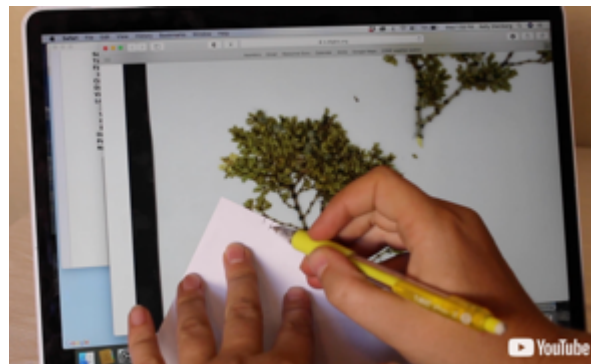
To figure out what causes the difference we see in creosote size between the three deserts, you're going to collect and analyze data from the creosote specimens in herbaria around the southwest. Then you'll conduct an experiment and construct an explanation to explain the differences in creosote appearance. To get started, let's examine some of the creosote bush specimens from the herbarium. Herbaria put pictures of their specimens online so scientists from around the world can access them.

Open the creosote specimen map and select a red marker. The page that opens next has all the information about this specimen - what herbarium holds it, when it was collected, and by who. Click on the picture to get a better look at the specimen itself. We want to know if there really is a size difference between the plants found in each of the three deserts.



Since we don't have the whole plant, we're going to measure something called the internode. Notice the bumps on the branches where the leaves attach. These bumps are called nodes, and the distance between them is called the internode. A bigger plant should have a larger internode, just like a taller person tends to have longer arms and legs than a shorter person. We'll assume that a larger internode means a larger creosote bush. If you have a piece of creosote, look at the internodes now.

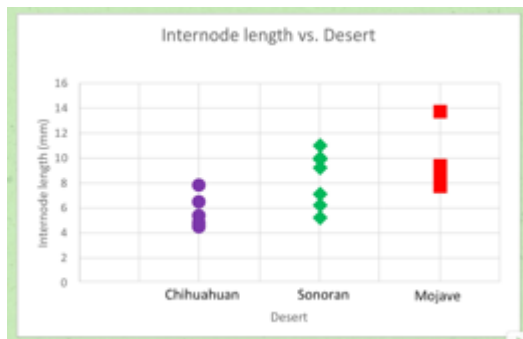
To measure the internode length of the specimens on the computer, you'll need a small piece of paper and a pencil. Zoom in as far as you need to so you can clearly see the nodes. Carefully, without pressing on the computer screen, hold the paper against the screen so the edge of the paper lines up with a branch. Mark the length of an internode at the end of one of the branches on your paper, then scroll to the top or the bottom of the page where the ruler is. Without changing the zoom level, use the ruler



to measure the distance between the marks on your paper in millimeters. Write the internode length down on your paper so you don't forget it.

If you choose a specimen from California or Utah, it's in the Mojave Desert. Specimens in Arizona are in the Sonoran Desert, and specimens in New Mexico are in the Chihuahuan Desert. Use this process to measure one creosote from the Chihuahuan, Sonoran, and Mojave Deserts now. Then, answer the question: which creosote had the longest internode length? Which desert was it in?

Edpuzzle question: Which desert had the creosote bush with the longest internode length?



There's lots of variation in internode length depending on which specimens you chose and where on each plant you measured. Everyone might get a different answer to that question, which is why we use a large sample of creosote bush specimens. We measured the internode length of several creosote from each desert and graphed the results. There's lots of variation between the individual creosote bushes, but do you see any trends or patterns?

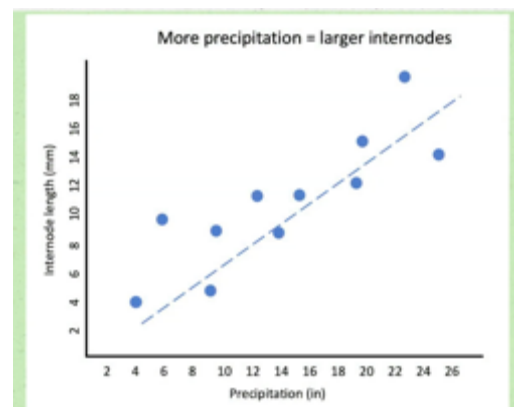
Edpuzzle question: What does this graph tell you about the internode length of creosote from the 3 deserts?

In general, the largest creosote bushes are in the Mojave Desert, and the smallest are in the Chihuahuan Desert. Dr. Fuentes-Soriano has two hypotheses for why this might be.

Hypothesis one: there's some genetic differences or differences in the plant's DNA. Think about dog breeds. There are all sorts of different sizes and shaped dogs, but each breed has some genetic differences which they pass on to their children. Two Chihuahuas have Chihuahua DNA, and so it would be impossible for them to have German Shepherd puppies. They just don't have any German Shepherd DNA. If this hypothesis is true, all the small plants would have similar DNA, and all the big plants would have similar DNA.

Hypothesis two is that the difference in size is caused by the environment the plants grow in. Maybe bigger plants just get more water than smaller plants. If this hypothesis is true, we would see a graph like this when we put rain or precipitation on the x-axis, and internode length on the y-axis.

It's also possible that both of these hypotheses are true. Imagine if you have two German Shepherd puppies, they will probably always be bigger than Chihuahua puppies, but if one of the puppies eats really healthy food and the other puppy gets unhealthy food the puppy who eats



healthy food will probably grow up to be bigger and healthier than the other one. Of course, it's also possible that neither hypotheses is correct, and the differences are based on something else entirely.

Go ahead and make a prediction now. What makes most sense to you? Is the difference in creosote bushes between the three deserts caused by hypothesis 1, hypothesis 2, both, or neither?

Edpuzzle question: Hypothesis: the difference in creosote bushes is caused by:

Hypothesis 1- genetics only

Hypothesis 2- environment only

Hypothesis 3- both genetics and environment

Hypothesis 4- neither genetics nor environment

We're going to investigate these two hypotheses to decide if they explain all some or none of the differences in the creosote bushes of the three deserts. Let's get started. Go back to Canvas and click next to start investigating hypothesis 1.