Roots of Desert Plants

Grade Level: Elementary, Middle School, High School
Ecological Concepts: Adaptation, Resource allocation
Arizona Science Standards: Science as Inquiry; Life Science

Materials:
1) Desert and non-desert plants or seeds (use annuals or quick-growing perennials)
2) Plant pots and desert soil
3) Potting soil or compost
4) Writing/drawing materials
5) Magnifying lenses*
6) Weighing scale
7) Trowels*
*May be borrowed from SCENE.

BACKGROUND
Plants have underground tissues called roots that stabilize the plant and hold it in place, and absorb water and nutrients. Plants living in ecosystems with low levels of rain, such as the Sonoran Desert, have evolved adaptations to the dry conditions. One plant structure that has adapted is the root system. (See Plant Adaptations activity for others.) A few plant species have adapted to the climate by growing very long tap roots that reach deep into the ground for underground supplies of water in aquifers. Mesquite trees use this adaptation. Most other plants have evolved large root systems that lie close to the ground surface. Roots are then close to the water when it rains and can absorb the moisture in the soil surface before it evaporates under the desert sun.

GUIDED INQUIRY
Initial Observation/Exploration Period: Observe the plants in the habitat. Carefully dig up some weeds (in the habitat or elsewhere) to look at roots with the naked eye and magnifying lenses. As you dig up the roots, try to notice how the roots are arranged in the soil. The tiniest roots are root hairs. These root hairs do most of the work of absorbing water and nutrients from the soil.

Group Discussion and Question Period: Do desert plants differ from non-desert plants in root structure? Do some species of plants grow more roots than others? How deep do roots grow into the ground?

Important aspects of guided inquiry are encouraging students to generate multiple hypotheses, and letting students make decisions about what data are important and create their own data sheets. Keeping these ideas in mind, the sample in the box below illustrates how ONE OF MANY possible investigations around this topic might develop.

Sample Hypothesis: Let's use the question, "Do desert plants differ from non-desert plants in root structure?" Our hypothesis could be, "Desert plants will have roots adapted to collect as much water as possible, therefore, desert plants will have larger root systems than non-desert plant species." Or it could be stated, "As plants are more drought tolerant, their root systems will become larger, either growing many roots near the soil surface or having very deep roots."

Sample Experiment Design: The independent variable will be the type of plant, desert species versus non-desert species. The dependent variable will be root biomass. Grow five plants each of two different Sonoran Desert species (recommend fast-growing, small plants) and five each of two different, but comparable type and size temperate species. (Note: Desert wildflower seeds such as Mexican poppy, bluebells and globe mallow, to name a few, are available from Native Seed Search. Temperate climate wildflower seeds are available from various nurseries and seed suppliers.)

Each plant is an experimental unit, and by having more than one of each species you will

have **replicates** for statistical purposes. It would be best to grow the plants from seed, or get them when very small so you can control the environment they are grown in. Put plants in 1 gallon pots (one plant/pot). Keep pots in the same area in the habitat, and give them the same amount of water on the same days. The amount of water should be comparable to the natural average rainfall in the Sonoran Desert. An alternative procedure is to grow the plants in the ground and carefully dig them up later. The problem here would be the possibility of cutting off some of the roots and not knowing it. Biomass measurements would then be inaccurate.

Sample Prediction: Desert plants will have larger/heavier root systems than non-desert plants.

Record Results: When plants begin to bloom, remove them from pots, being careful to collect all root material. NOTE: This means that not all plants will be harvested on the same day. Each plant will likely begin blooming on a different day. The important thing is that measurements are taken when the plants are at the same life stage.

Wash the roots carefully to remove all soil. (1) Lay the roots out and draw (or take a photo) of the roots, with a ruler to establish scale. (2) Dry the roots in a safe place. After they are thoroughly dry, weigh them to measure the root biomass. Weight, or biomass, is a measure of the amount of root available to soak up water.

Sample Analysis of Data and Presentation: Compare the root biomass of the two different plant species. Make a **bar graph** of the numbers with plant species on the horizontal axis and root biomass (weight in grams) on the vertical axis. For students who can divide, calculate the **average** of the desert plant root biomass and the non-desert plant root biomass. Graph the average numbers on the vertical axis.

Discussion: Was your hypothesis supported? If yes, go on to test other hypotheses. If not, why not? What did happen? Why? This is a great opportunity to revise your hypothesis and do another test.

MORE:
(1) Elementary:
(a) Grow the plants in rich potting soil or compost instead of desert soil. Compare the root biomass.
(b) Grow desert plants in desert soil and the same species in potting soil. Compare the root biomass.

(2) Middle School:
(a) Find the **mean**, **median**, **mode**, and **range** of the data.
(b) Weigh the root hairs of each plant species. Collect all the root hairs from each plant. Weigh the root hairs of each plant separately, and then average the weights for all plants within a species. Compare the two species.

(3) High School:
(a) Calculate the **variance** and **standard deviation** of the averaged data.
(b) Calculate the surface area of root available for water absorption. Compare the plant species.