Animal Adaptations to the Desert - Insects

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

Materials:
(1) Magnifying lens, loupes*
(2) Sweep nets
(3) Sorting trays*
(4) Forceps*
(5) Insect field guide*
(6) Writing/drawing materials
* May be borrowed from SCENE.

BACKGROUND
Many animals, including mammals, birds, reptiles, fish, insects and other invertebrates, have adapted to the stresses of the Sonoran Desert. Desert adaptations can be manifested in behavior, size, shape, or physiology. The highest priorities for any desert dweller are to survive the heat and lack of water. Most animals accomplish this by a combination of behavior, anatomy, and physiology. For example, small desert rodents are usually only active at night (behavior), have eyes capable of seeing in the dark (anatomy), and have a metabolism that retains almost all water ingested through food (physiology).

Other animals are active during the day. A jackrabbit has large ears with a high density of blood vessels to release body heat. This keeps the animal from overheating. Reptiles, which are ectotherms, need heat to become active and to digest food, but even they have limits as to how much heat they can withstand. When it's too hot, lizards seek shade. Larger animals tend to be active during the day because a large body can dissipate heat faster. A large animal has a larger volume to surface body ratio than a small animal, keeping the body from absorbing heat quickly.

Early morning, late evening, and night are the active times for many desert dwelling animals. There are trade-offs, however. Some animals have to be active during the day to find food and mates, and are thus adapted for daytime conditions, such as jackrabbits, lizards, and snakes. In the hottest parts of the summer, rattlesnakes do more hunting at dawn and dusk.

The closer an urban area is to relatively undisturbed desert, the more animals will spend at least some time in the urban area. But almost all areas are habitat for fence lizards (*Urosaurus*), hummingbirds, most insects, scorpions, spiders, and some rodents. The lizards, hummingbirds, and many insects and spiders are active during the day. As summer progresses and the heat rises, the active times become more concentrated in the morning and evening. Rodents and scorpions tend to be most active at night, as do most moths. Areas nearer to undisturbed desert will have jackrabbits, javelina, coyotes, pocket mice, kangaroo rats, a wider variety of insects, and many more reptiles. Reptiles include rattlesnakes of various species, chuckwalla lizards, horned toads, Gila monsters, whiptail lizards, and desert tortoises. NOTE: Be extremely cautious around wild animals. All wild vertebrate animals are legally protected and cannot be captured without permits from Arizona Game and Fish.

Fish live in the water, of course, and it might be thought they are not affected by the desert conditions, but they are. Over the ages, desert dwelling fish have adapted to seasonal low water periods, high water temperature, sudden monsoon-caused floods, and higher salinity levels. Fish adaptations are also behavioral, anatomical and physiological. Pupfish can tolerate very high salinity levels because of their physiology. Small fish such as spikedace (*Meda fulgida*) and longfin dace (*Agosia chrsogaster*) can withstand sudden floods that wash away and kill non-desert fish species.

GUIDED INQUIRY
Observation/Exploration Period: Observe animals in your habitat. Observe at different times of the day,

and in the early morning and late evening, if possible. Observe places such as burrows, and other **microhabitats** used that may protect the animal from the heat. Behaviors to look for are those such as birds sleeking their feathers to insulate their bodies from the sun's rays, and panting, a form of evaporative cooling. Notice which animals are active when, where they are (in a tree, in the sun, on the ground, in the shade), how long they perform a behavior, what color the body is, and body size and shape.

Group Discussion and Question Period: Some possible questions are "How do body shape and body size affect an animal's ability to survive desert heat?" "Are large insects more active during the day than small ones?" "Is it true that moths are more active at night?" "Which animals drink lots of water and which don't need to?" "How do animals survive desert heat?"

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, "Is it true that moths are more active at night?" The hypothesis could be, "If moths are more active at night and we collect moths during the day and night, then we will collect more moths at night." Investigating this question my help open up for students the rich world of nocturnal animals. It could be done on a class overnight or as homework.

Sample Experiment Design: The **independent variable** is time of day, night versus day. The **dependent variable** is number of moths found. Use **sweep nets**to collect insects. Sweep the nets through pre-determined areas of the habitat. To limit this experiment to testing only one factor, sweep net the same area of the habitat only at the same time of day or night. For example, sweep net only the air at head height, but not trees and bushes. Or sweep net only bushes, but not elsewhere. By doing this, you are **controlling** for other factors. In order to have **replicates**, collect from at least three places in the habitat, at the same time. Each sweep net collection will be a replicate.

Sample Prediction: More moths will be found at night than during the day.

Record Results: Sort and count the number of moths collected during the day and night. Be gentle and use forceps to handle the moths, if necessary. Release them once counted.

Sample Analysis of Data and Presentation: Make a **bar graph** with the time of day (night versus day) on the x-axis and the **raw number** of moths on the vertical axis. For students who can divide, calculate the **average** number of moths for each time period from the replicates. Graph the average number 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) Choose a common animal in the habitat that can be watched. Split into groups. Each group watches a different animal of the same species. Watch the animals for a set period of time such as ten minutes. Record where the animals go, whether they are in the sun, shade, under litter, in a hole, etc., and for how long. Watch the animals again at a different time of day, comparing morning and afternoon.

(2) Middle School:
(a) Find the **mean**, **median**, **mode** and **range** of the data.
(b) Sweep net at different times of day and compare collections.

(c) Sweep net in different parts of the habitat at the same time of day and compare collections.

(3) High School:
(a) Calculate the **standard deviation** of the averaged data.
(b) Calculate **species richness** in the habitat.
(c) Test for a correlation between two variables, e.g., active times of day and body color. Draw a **scatter plot** and calculate the sample **correlation coefficient**.
(d) Sort the collected moths into sizes or species and compare activity times.