Animal Adaptations to the Desert - Reptiles

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

Materials:
1) Binoculars
2) Stopwatches
3) Writing/drawing materials

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, in leaf litter, 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? Which animals drink lots of water and which don't need to? How do animals survive desert heat? Does an animal behave differently in the morning compared to the afternoon?

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 fence lizards (*Urosaurus*) behave differently in the morning than in the afternoon?" The hypothesis could be, "If fence lizards need heat to be active and we watch lizards during the morning and afternoon, then we will observe more activity in the afternoon when the temperature is hotter."

Sample Experiment Design: Split into groups of two or three. Each group watches a different fence lizard. Use eyes and perhaps binoculars to observe lizards. Watch the lizards in the morning and afternoon for a set period of time, such as twenty minutes. The **independent variable** is time of day, morning versus afternoon. The **dependent variable** is the length of time or number of times the chosen behavior is observed during the set time period.

Before starting, you will need to carefully define "behavior" and what behaviors are to be recorded. Your initial observations will give you some ideas of what to expect and which behaviors will be easiest to accurately record. Some ideas: In the sun, in the shade, on the ground, on a rock, in the grass, on a fence, on a tree, under litter; sitting still, running, doing push-ups (fence lizards, usually males, do push-ups to warn off other males and impress females).

To limit this experiment to testing only one factor, observe the lizards on only one day. If you choose to observe on different days, each day should be considered a new experiment. Do not combine the data from different days, unless you are proficient in higher-level statistics. By collecting and analyzing data on one day you are **controlling** for other factors such as temperature, day length and cloud cover. In order to have **replicates** observe at least three lizards in the habitat, at the same time. Each lizard will be a replicate.

Sample Prediction: Lizards will be more active in the afternoon than the morning.

Record Results: Record the length of time for each behavior, or record the number of times the behavior occurred.

Sample Analysis of Data and Presentation: Make a **bar graph** with the time of day (morning versus night) on the x-axis and the **raw number** of times for the behavior (or total length of time per behavior) on the vertical axis. For students who can divide, calculate the **average** number of times for each behavior or length of time. 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) Observe other commonly found animals in the habitat, such as grackles, pigeons, Inca doves (small

species of dove), ants, crickets, spiders (jumping spiders are great!), or butterflies.

(2) Middle School:
(a) Find the **mean**, **median**, **mode**, and **range** of the data.
(b) Use sweep nets to collect aerial insects. Sweep net the same places in the early morning and then the afternoon. Use forceps to gently sort the insects and then categorize them. Compare morning and afternoon insect types and numbers.

(3) High School:
(a) Calculate the **standard deviation** of the averaged data.
(b) Do a **T-test** on behavior numbers or length of time, comparing morning and afternoon. (T-test is a standard statistics test comparing **means** of two samples).