Desert Water Adaptations

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Time:
(2) 45 minute sessions in the classroom

Level:
Secondary Science

Goals:
Students will participate in a hands-on exploration activity to increase their understanding of how various plants and animals adapt to survive in desert habitats.

Objectives:
Students will be able to

1. Use a model situation to represent and make inferences about real desert organisms.
2. Use a scale to measure weights of 2 sponges soaked in water with 100% accuracy.
3. Describe and communicate observations relating to specialized organisms and interaction with a dry environment in a short presentation for another small group.

Materials listed with each individual activity.

A materials kit is available for this lesson plan on www.utahnatureexplorers.org

Correlations to Core Curriculum:

Secondary Education

- Standard 1: Students will understand that living organisms interact with one another and their environment.
  - Objective 3: Describe how interactions among organisms and their environment help shape ecosystems.
    - Indicator b: Formulate and test a hypothesis specific to the effect of changing one variable upon another in a small ecosystem.

Background Information:

Deserts

A desert is defined as an area that is dry (less than 10" of precipitation per year) and has a high rate of evaporation. Deserts can be hot (precipitation falls mostly as brief rains in summer) or cold (precipitation falls mostly as snow in winter). This specific lesson plan focus on how animals survive within these ecosystems. A few interesting desert animals and their adaptations are listed below.

Kangaroo Rats

This small vertebrate is probably the quintessential desert animal. The kangaroo rat can metabolize water from the food it eats. It also has extremely efficient kidneys allowing it to retain much of the moisture many animals lose in urination and defecation. Its nasal passages are extremely long to cool and recapture moisture that would be lost during respiration. In order to avoid the harsh daytime temperatures, this rodent feeds only at night. It has adapted to be very sensitive to low frequency sounds due to a large inner ear canal allowing it to avoid long-eared owls (its major predator) more often than not. Usually found close to sand substrates as it requires frequent sand baths or its oily fur becomes matted. After collecting seeds, the kangaroo rat will seal up its burrow, which results in the moisture from respiration softening and hydrating the seeds collected.

Reptile Adaptations

Did you know?

Some desert animals are able to burrow deep into moist soil, where they are able to absorb water through their skin!

http://www.livingdesert.org

Materials available in a kit are italicized in the list below.

Materials:

Supplies --

- Water
- Chart paper or Whiteboard
- *Scientific Plan sheet (attached at the end of the lesson plan)*
- *Materials that will mimic adaptations*
    - *Wax paper*
    - *Ziploc bags*
    - *Elastic bands*
    - *Toothpicks*
    - *Pipe cleaners*
    - *Coffee stirrers*

Equipment:

- *2 small sponges per group/pair, differently colored for differentiation*
- Bucket
- Scale
- Heat lamp (optional)
- Desert Adaptations PowerPoint

These ectothermic vertebrates will emerge in late spring to sun themselves on the warm rocks. If the temperature becomes too intense during the summer, many reptiles will go in to a state of aestivation (dormancy or inactivity) in underground burrows. Scientists believe this has more to do with a lack of food source than inability to cope with the conditions.

Spadefoot Toad

Before the heat of summer comes on, this amphibian will bury itself under the mud, coating itself with a gel-like substance to retain the moisture in its skin. It will not emerge until it feels the vibration of an intense rainstorm. At that point, it will emerge to mate and release eggs or sperm to continue the cycle of life.

Activities:

Day 1 --

Engage (7-8 minutes) – Using the Desert Adaptations PowerPoint, show students a variety of desert plants and animals. Introduce some interesting facts about the survival of desert animals, which can be found in the 'Background Information' or 'Did You Know?' sections. Ask students what other adaptations they think desert animals have made in order to live in the desert, and record their answers on the whiteboard or chart paper.

Tell the students that today, they will have a chance to explore what types of adaptations may help desert animals survive. Divide the class into pairs or small groups (2-4 people) to work on this project. Explain that they will be using small sponges to simulate desert animals. Each group will need to determine one variable to change that they feel will help their sponge retain the moisture longer. One of their sponges will be the test sponge, in which the variable is changed, and the other sponge will be the control sponge.

Explore (20-25 minutes) -- In pairs or small groups, do the following activities:

1. Give each pair or small group 2 dry sponges. Allow each group to weigh each dry sponge on the scale and record their measurements on their Scientific Plan Sheet, on the 'data' section (attached at the end of the lesson plan).
2. Explain to students that these sponges represent desert plants and animals with a limited amount of available water.

(download free at www.utahnatureexplorers.org)

Did you know?

Some desert animals have specialized kidneys that extract water from their urine!

http://www.livingdesert.org

Their job is to help conserve that water. Over the next 2 class periods, they are to take care of their 'organisms' in a manner that they believe will best achieve this goal using various materials. They can only test one variable in their experiment. Their 'organism' must be in the open for at least four hours during that time to 'feed,' and will be in direct sunlight for these four hours unless an adaptation for crepuscular activity is made.

3. Demonstrate some of the options for adaptations that are available as you show students the wax paper, Ziploc bags, elastic bands, toothpicks, pipe cleaners, coffee stirrers, and any other supplies you have chosen to use. Explain that, although an obvious use for the material may be available, students are welcome to creatively design an adaptation with these materials that may not be obvious at first. Also mention that many desert animals have adapted to the heat by avoiding the hottest parts of the day, and only moving at morning and night time. If they should choose this adaptation, they can choose to request that their sponge be placed in cool shade instead of hot, direct sunlight.
4. At this point, students should be given 5-10 minutes to determine which variable they want to test. This should be written down and drawn on the 'Scientific Plan' sheet (attached at the end of the document). Once their plan has been approved by the teacher (all plans should generally be approved, unless there is an obvious problem which could cause harm or damage), the students can begin their setup. The scientific plan sheet should also include their prediction of what will happen when this variable is tested (i.e. 'The water will be held in longer,' or 'Our sponge will weigh____ amount after 2 class periods). They should get all needed materials for their test and put them on their table so that they are ready to go once the sponges are wet. When this is completed, students can move onto the next step.
5. One sponge will function as the control, and the other sponge will be the 'test' sponge. Each sponge at this point will be soaked in a bucket of room temperature tap water. Students will be responsible to time the soaking of their sponges. Both sponges will be weighed immediately upon being pulled out of the bucket, and the 'wet weights' will be recorded on their data sheets. It is important to make sure that the sponges are wet, but not dripping. Students should ensure that the two wet weights of the sponges are similar to one another, so that they can accurately compare the sponges when collecting results.
6. The rest of the 'explore time' should be spent by students starting their experiment and recording scientific

observations and drawings on their 'Scientific Plan' sheet.

Explain (7-8 minutes) – After students have started their experiments and have finished filling out their 'Scientific Plan' and 'Data' sheets, each small group should be partnered with another small group. In this setting, each group should have 3-4 minutes to explain which variable they are testing, the structure of their test, and their predictions. The other group may ask clarifying questions. Both groups should have an opportunity to present their ideas to the other small group they are partnered with.

Elaborate (6-8 minutes) – Discuss with the students the similarities and differences between their 'organisms' and real desert plants and animals. Ask if any of the students used a variable that represents an adaptation of one of the desert animals/plants discussed earlier. Remind students that their 'creature' will be set out for 4 hours to represent feeding. This will happen after school, before they come to class the next day.*

**Note to the teacher – You can choose when you want to set the sponges out to 'dry out.' In the tests run by the Utah Nature Explorers Team, we found that placing the sponges in direct sunlight on a hot day showed the most drastic results. When sponges were left at room temperature, the control and test sponge didn't show many differences in weight or appearance. If a hot, sunny day is not available, using a heat lamp may be a good substation for these conditions.*

You will want to think of how to organize the sponges so that you keep each sponge in the correct groups. This could be done by placing the sponges on the groups' tables, or you could have Ziploc bags with their names on them to set the sponges on. This is up to you. You could set the sponges out after school, but be cautious to leave them out for the correct amount of time. You may want to set them out right as the class leaves, with a timer to remind you when to put them away. This makes it so that you don't have to stay after school to check on the sponges. Again, these are just ideas. The actual execution of these ideas is up to you!

Materials:

Supplies:

- Science journals and pencils for each student
- Sponge experiments
- Scientific Plan sheet

Day Two –

Engage (5 minutes) – Remind students of their experiment that they set up the day before. Tell the students that today, they will have the chance to look at their sponges and see how they have changed over the 24 hour period. Ask them to collect results, and record it on their 'My Results' page within their Scientific Plan Worksheet.

(attached at the end of the lesson plan)
- Presentation materials – poster paper, markers, note cards, etc.

Equipment:
- Student computers (if PowerPoints are being created)

Explain that you will be giving them time to create a short (3-5 minute) presentation to give to the class. In this presentation, they will need to talk about their 1. Setup and procedures of the experiment, 2. Their prediction, 3. Their results, and 4. How their experiment relates to desert animals and their survival in their ecosystem. They can get 5 bonus points for relating their experiment to a specific desert animal or plant. They can name their creature for 1 bonus point. Remind them to compare their 'test' sponge and 'control' sponge to see what their variable affected.

Explore (30 minutes) -- In the pre-determined pairs or small groups, do the following activities:

1. Allow each group to collect their sponges. Give them about 5-7 minutes to observe and compare the sponges, and fill out their results page. The group should again weigh their sponges, record weights, compare with previous weights and make inferences about the results in relation to real organisms.
2. The group should discuss *why* they think the similarities and differences are present. In addition, they should discuss how their experiment relates to adaptations that desert animals could make in order to retain or acquire water.
3. The group should work together to create a presentation for the class about their experiment. They can create this presentation in a variety of ways. Some options may be creating a poster, making a short PowerPoint presentation, or writing down their experiment on note cards for a verbal presentation. The groups will have about 20-25 minutes to do this.

Explain (8-10 minutes) – During the 'explain' portion of the lesson, students will give their presentation to another small group (a different group than the one they worked with yesterday). A timer will be set for 5 minutes for each group presentation. If a group finishes presenting before the 5 minutes are over, the other group should ask clarifying questions, or a group discussion may be held on the differences and similarities between their experiment and desert animals/plants. At the end of the 5 minutes, the timer will be reset, and the other group will have a chance to give their presentation. The teacher should spend this time walking around, taking anecdotal notes and performing informal assessment. On occasion, the teacher may choose to sit with a group and listen to a presentation if a group is off task, nervous, or confused about what they are doing.

Did you know?

Desert plants may have to go for years at a time without fresh water.

Elaborate (3-5 minutes) – Conduct a class discussion of methods, results and how this experiment relates to adaptations for desert survival in real organisms. Each group should turn their presentation in for assessment purposes.

Assessment:
Informal assessment opportunities are plentiful in this lesson plan. Formal assessment should be completed by grading group presentations according to the rubric at the end of this document. Students should be informed of the grading requirements before they create their presentation. Remind them of the bonus point opportunities as well.

Extensions:

- Research project – This extension encourages deeper understanding about desert animals and their adaptations for survival. Each student can choose a desert animal to research. This could be extended into a literacy project if desired. A great list with photos of neat desert animals can be found at http://environment.nationalgeographic.com/environment/photos/desert-wildlife/
- Do the Math -- A fun math activity in which students use the Pythagorean theorem in a desert adventure is found at http://www.mathsisfun.com/activity/walk-in-desert.html

Resources:

Books

- *Utah Master Naturalist Deserts Textbook* *http://extension.usu.edu/utahmasternaturalist/files/uploads/UMNP_Deserts_Text.pdf*
- *The Deserts of the Southwest* by Lane Larson
- *A Field Guide to Desert Holes* by Pinau Merlin
- *Scats and Tracks of the Desert Southwest* by James C. Halfpenny, PhD
- *Secret Knowledge of Water* by Craig Childs

Websites

- Arizona-Sonora Desert Museum -- https://www.desertmuseum.org/books/nhsd_adaptations_amph.php
- The Living Desert -- http://www.livingdesert.org/desert_animals.html

- Utah: Land of Natural Diversity (Information on Utah Deserts) – http://wildlife.utah.gov/education/magazine/diversity_i.pdf
- Desert USA: Desert Life (Answers to Questions About Desert Life) -- http://www.desertusa.com/life.html

Name_____
Period_____

My Scientific Plan

Question:

Variable I will test:

My prediction:

Setup and Procedures:

My observations:

Data Sheet

Sponge #1 (Color_____)	**Sponge #2 (Color_____)**
Dry Weight=	Dry Weight=
Wet Weight=	Wet Weight=

My Results:

My Conclusion:

Water Adaptations Presentation

Setup and Procedure is clearly determined and appropriate for the experiment *(10 points)*	Setup and Procedure is somewhat determined and appropriate for the experiment *(7 points)*	Setup and Procedure is not clearly determined and not appropriate for the experiment *(3 points)*	No setup or procedure is given *(0 points)*
A reasonable prediction is given in a complete sentence *(10 points)*	A reasonable prediction is given, but not in a complete sentence *(7 points)*	An unreasonable prediction is given *(3 points)*	No prediction is given *(0 points)*
A reasonable conclusion is given in a complete sentence *(10 points)*	A reasonable conclusion is given, but not in a complete sentence *(7 points)*	An unreasonable conclusion is given *(3 points)*	No conclusion is given *(0 points)*
The experiment has a clearly stated connection with desert animals and their survival adaptations *(20 points)*	The experiment has a loosely stated connection with desert animals and their survival adaptations *(14 points)*	There has been somewhat of an effort to relate their experiment to desert ecosystems *(6 points)*	There are no desert connections listed or described *(0 points)*

Group Members:

Bonus Points for a name: /1

Bonus Points for a specific desert connection: /5

Total Points: /50