Sponge Salamanders:
Using Science to Protect Sacramento Mountain Salamanders

Overview: In this two-part lesson, students work in teams to plan, design, and build a habitat that will help a "sponge Sacramento Mountain Salamander" retain water for 1 to 3 days. Students calculate the water loss over the course of the experiment and compare their habitat to a control and to other students' habitat designs. Students discuss strengths and weaknesses of various designs before determining what changes they would make if they repeated the experiment.

Grade Level: 3rd - 5th

Phenomenon: The Sacramento Mountain Salamander is a "Species of Greatest Conservation Need" in New Mexico. What is the best habitat design for helping a "sponge Sacramento Mountain Salamander" lose the least amount of water over several days?

Next Generation Science Standards
3-5-ETS1-1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

3-5-ETS1-2: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

3-5-ETS1-3: Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking questions and defining problems Planning and carrying cut investigations Constructing explanations and designing solutions Analyzing and interpreting data	ETS1.A Defining and delimiting engineering problems ETS1.B Developing possible solutions	Systems and system models Structure and function Influence of science, engineering, and technology on society and the natural world

Common Core State Standards
ELA-LITERACY.L.3.1, 4.1, 5.1: Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
ELA-LITERACY.RL.4.1: Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.

Time
Part 1 – (45 minutes) Introduction, habitat creation, and starting the experiment
Part 2 – (45 minutes, 2-3 days after Part 1) Collecting data, data analysis, and salamander conservation

Materials
- Slide show
- Worksheets
- 1 sponge per team of 2 students (12 in kit)
- 1 foam plate per team of 2 students (12 in kit)
- 1 sponge to use as a control
- 1 gallon plastic bag
- 3 scales
- 3 plastic containers for holding water
- 3 washcloths
- 1 index card per team
- Recycled materials that students bring from home or find at school
- Water

Background
This lesson features the Sacramento Mountain Salamander, a Species of Greatest Conservation Need in New Mexico. Only found in the Sacramento Mountain range in New Mexico, these salamanders are small, only growing to 2-3 inches long. They live in the forest under fallen trees, rotting logs, and leaf litter. They are lungless, meaning they take in oxygen through their skin, and their skin must be moist in order for them to breathe. It is important and may be challenging to conserve their habitats because temperature and drought trends show New Mexico getting warmer and drier. The letter from a "sponge salamander" provides constraints for students to consider when engineering a habitat with the goal of reducing water loss over the two-to-three-day experiment.

Preparation:
Part 1:
- Prepare the slide presentation to show.
- Gather craft supplies.
- Put water in the three containers.
- Set out scales on level surfaces at gathering points students can reach.

Part 2:
- Prepare the slide presentation to show.
- Set out scales on level surfaces at gathering points students can reach.

PART 1 PROCEDURES
1. **Sponge Salamander Introduction (10 minutes)**
    A. Slide 1: Pass out worksheets.

B. Slide 2: The Sacramento Mountain Salamander is only found in the Sacramento Mountains in New Mexico. They are small, only growing to 2-3 inches, including their tail. They live in the forest under fallen trees, rotting logs, and leaf litter. They are a Species of Greatest Conservation Need in New Mexico, meaning they are at risk of extinction!
C. Slide 3: The Sacramento Mountain Salamander is like a sponge because it doesn't have lungs like other animals. They breathe through their skin, which must stay moist; if they dry out, they cannot breathe. It is therefore important for their habitat to be moist.
D. Slide 4: Read the letter from the sponge salamander on the worksheet with your students or ask for a volunteer reader.
E. Slide 5: As shown on this graph, deserts get less rain than other habitats, so learning how other Chihuahuan Desert dwellers live with little water might help us prepare to keep our sponge salamander moist.
F. Slide 6: How do you think the Spadefoot Toad lives with little water? **[Click forward]** Spadefoot Toads avoid the sun by coming out at night, using specialized hard structures on their hind feet to make and hide in burrows underground until rainfall.
G. Slide 7: How do you think the Rattlesnake lives with little water? **[Click forward]** Rattlesnakes take advantage of cooler temperatures by hiding in abandoned burrows. Their tough, scaly skin locks moisture in their body.
H. Slide 8: How do you think Creosote Bush lives with little water? **[Click forward]** Creosote Bush is a shrub with small, waxy leaves and long, spreading roots that can reach deep water.
I. Slide 9: How do you think the Fishhook Barrel Cactus lives with little water? **[Click forward]** A Fishhook Barrel Cactus has a waxy coating. It has accordion folds that expand to store water.

2. Habitat Building (20 minutes)

A. Slide 10: Have students work with a partner to create a plan for a habitat that will keep their sponge salamander from drying out. Write the plan on question 1 on the worksheet. Review and initial students' worksheets once you approve their habitat design; ensure they follow the requests:
   - Nothing can be placed or spread directly on the sponge salamander's body. For example, they cannot put Vaseline all over the sponge.
   - The sponge salamander must be exposed to the air for at least 10 minutes each day. If there are habitats that are completely sealed, you will need to make sure students open them for 10 or more minutes each day.
   - After the sponge salamander is in its habitat, students can not add more water to the sponge or habitat.
   - **Leave this slide up** as you give students time to build their approved habitats. Give students at least 20 minutes (or however much time you can) to gather their supplies and construct the habitat.

3. Experiment Setup (20 minutes)

A. Slide 11: Once all student habitats are constructed, show students how to set up the experiment by demonstrating how to set up the control.
   - Place the sponge in the container of water for 10 seconds. The goal is to completely saturate the sponge with water.
   - Remove the sponge and turn the sponge above the container a few times to get rid of any water not completely held by the sponge.
   - Place the sponge on the foam plate. This allows any extra water on the sponge to fall off without making a mess in the classroom.
   - Next, make sure the scale reads zero. Place the sponge directly on the scale and write the starting weight in the "My Results Table" on the worksheet. Everyone should write the starting weight of the control.
   - After weighing, dry the top of the scale to prepare for the next group. Note that the scales are delicate, so students should not press down on the scale as they dry it off.
   - After the control sponge salamander is weighed, place it on top of the closed flat plastic bag and leave it in an exposed area in the classroom for the duration of the experiment. We will compare the water loss of this control to the water loss of the sponges in students' habitats.
   - Tell students they will put their sponges directly into their habitats after weighing.

B. Slide 12: **Leave this slide up** as you supervise student groups setting up. Have students carefully place their sponge in the habitat they created and leave it there for the duration of the experiment.

C. Slide 13: Now we wait. We will give our salamanders 10 minutes of air every day. We will not add water. The experiment can run for one to three days. If your classroom is very hot and dry, you may want to run the experiment for one day only to make sure there is at least some water left in the sponges. **Stop** on this slide and pick up on the next slide when your experiment is over.

PART 2 PROCEDURES

1. Collecting Data (20 minutes)

A. Slide 14: At the end of the experiment, remind students of the goal of the experiment and how many days the experiment lasted.

B. Slide 15: Demonstrate with the control sponge how to carefully remove the sponge salamander from its habitat and weigh it again. Students should make sure the scale says zero, place the sponge directly on the scale, and write the final weight in the "My Results Table" on the worksheet. Calculate the total water lost for the control sponge. Make sure the entire class copies the final weight and water lost for the control.
   - Have students repeat the steps with their sponge salamanders.
   - Have students calculate the total water loss.
   - Pass out one index card per habitat. Have students write the total water lost on the index card and place it in front of their habitat.

2. Data Analysis and Habitat Design Strengths and Weaknesses (15 minutes)

A. Slide 16: As a class, arrange all the habitats in order from most water lost to least water lost using the index cards (keep them in front of their habitats).

- After the habitats are arranged in the classroom from most water lost to least water lost, facilitate a gallery walk so students can view each other's habitat designs. Ask them to think about why some habitats lost more water than others.

B. Slide 17: Have students use the results table to compare the total water loss in their habitat to the control total water loss. Which had the lowest water loss? Have students circle an answer on question 2.
C. Slide 18: What was the difference in water loss between your habitat and the control? Have students calculate the difference and answer question 3.
D. Slide 19: The salamander in the best habitat lost how many grams? Have students answer question 4. What was the difference in water loss between your sponge and the sponge in the best habitat? Have students calculate the answer to question 5.
E. Slide 20: Have a class discussion about what made a habitat good at reducing water loss. Discuss strengths and weaknesses of the designs for the best habitat(s), the control, and their own. Have students write one strength and one weakness of their habitat on question 6. Have students write one strength and one weakness for the best habitat(s) on question 7.

3. Sacramento Mountain Salamander Conservation (10 minutes)

A. Slide 21: As we learned, it's tricky to stay moist. Amphibians need moist habitats because of their delicate skin and jelly-like eggs.
B. Slide 22: Amphibians especially have challenges because a lot of New Mexico is getting hotter and drier.
    - The graph on the top shows a map of current drought levels in New Mexico; this map comes from the New Mexico Drought Monitor, which is updated weekly. You can access last week's drought monitor here: https://droughtmonitor.unl.edu/CurrentMap/StateDroughtMonitor.aspx?NM
    - Drought is when an area receives less rain than normal for a period of time. Both counties (Otero and Lincoln) where the Sacramento Mountain Salamander is located often experience extreme drought, indicated by the red coloration on the legend.
    - The graph on the bottom shows the average annual temperature across New Mexico over many years. It is increasing, meaning it is getting hotter.
C. Slide 23: The Sacramento Mountain Salamander must find cool, moist habitats in an environment that is getting hotter and drier. Humans can help protect these habitats to protect these salamanders. As a class discuss changes students would make to their habitat design if they were doing this experiment again. Have students write their answer on question 8.
D. Slide 24: Thank you for helping your sponge salamander during its visit.