

# **THE THORNY DEVIL: A CAPILLARY ACTION HERO?**

## **An Elementary Science Lesson Plan Designed for Group Inquiry Based on the 5E Inquiry Model**

**GRADE LEVEL:** This lesson is intended for a 4<sup>th</sup> grade classroom.

**SCIENCE CONCEPT:** The science concept of this lesson is that for any particular environment, some kinds of plants and animals survive well, some survive less well and some cannot survive at all. This lesson will illustrate this concept by highlighting how the unique skin of a thorny devil lizard helps it survive in its desert environment. This lesson will demonstrate the process of capillary action that helps thorny devils survive. This lesson can also connect to previous knowledge of how plant stems use capillary action to move water from the roots to the rest of the plant.

### **RELATIONSHIP TO THE CALIFORNIA SCIENCE CONTENT STANDARDS**

4<sup>th</sup> grade Life Sciences

3. Living organisms depend on one another and on their environment for survival. As a basis for understanding this concept:
  - b. Students know that in any particular environment, some kinds of plants and animals survive well, some survive less well, and some cannot survive at all.

**LEARNING OBJECTIVE:** Students will demonstrate the process of capillary action that thorny devil lizards use to help survive in their desert environment.

### **EVALUATION IDEAS:**

1. Formative: Observe student demonstrations. Circulate to see how student groups are able to follow the demonstration instructions. Monitor understanding from class discussion.
2. Summative: Review Observation Worksheets and Investigation Journal to assess student observation, questioning, prediction and analysis skills. Review the student response on the Investigation Journal to explain capillary action in their own words.

### **CONCEPTUAL BACKGROUND:**

Thorny devils live in the desert and need to take advantage of all the water they can. They do this by taking advantage of the grooves on their skin which channel water to their mouths through capillary action. After collecting the rain water and dew that falls on their back, they work their jaws to help these grooves move the water into their mouth.

Capillary action is water's ability to move through the small tubes known as capillaries within a porous or spongy material. According to the U.S. Geological Survey,

Capillary action occurs because water is sticky, thanks to the forces of cohesion (water molecules like to stay close together) and adhesion (water molecules are attracted and stick to other substances). Adhesion of water to the walls of a vessel will cause an upward force on the liquid at the edges and result in a meniscus which turns upward. The surface tension acts to hold the surface intact. Capillary action occurs when the adhesion to the walls is stronger than the cohesive forces between the liquid molecules. The height to which capillary action will take water ... is limited by surface tension and, of course, gravity. (Retrieved 24 July 2012 from <http://ga.water.usgs.gov/edu/capillaryaction.html>).

This is also how water is able to travel from the roots to the leaves of a plant.

## LESSON IMPLEMENTATION PLAN

**ENGAGE:** Today I'd like to introduce you to another lizard – the thorny devil. Play the National Geographic Thorny Devil video (see Materials). This video highlights the special features of thorny devils, including how they use the grooves on their skin to channel water to their mouths. How do you think a thorny devil can do that? Today we are going to investigate that question.

**EXPLORE:** Assign students to groups of three. Give each group a paper towel, one empty drinking glass, one drinking glass filled with  $\frac{3}{4}$  cup of colored water, and an Observation Worksheet. Have students follow the demonstration instructions on the Observation Worksheet. The instructions state the following:

1. Twist the paper towel until it is a tight long rope.
2. Place one end of the paper towel in the water and the other end in the empty glass.
3. Observe what happens.
4. Write or draw your observations.
5. Be prepared to share your observations with the class.

Students should see their paper towel starting to get wet, and because the water is colored, they can observe it moving up the paper towel. After a few minutes they will see that some water has started to pool in the glass that was empty.

**EXPLAIN:** Ask students to share their findings. What did you see happen to the paper towel? Why do you think this happens? How could this help answer our question about thorny devils? Explain how this demonstration shows the process of capillary action. Capillary action is the water's ability to move through the small tubes known as capillaries within a porous or spongy material. Capillary action even allows water to climb upwards against the force of gravity.

**ELABORATE:** Can anyone think of another organism that you have studied that also has the ability of capillary action? Guide them to think about organisms that are not animals. This is the same process that can be seen in plants as water moves through the stem. Have students try a similar experiment with carnations. Have students use the Investigation Journal worksheet in Materials and follow the steps below:

1. Fill three cups one-half full with water.
2. Add about 20-30 drops of each food coloring to two of the cups of water. In this case, more food coloring is better! The fourth cup should contain just plain water.
3. Observe and record what happens. It may take up to 24 hours to see the carnations change color.

What happened to the carnation? What can you conclude about the function of a stem?

Another possibility: What would happen if you split the carnation and put one side of it in water and the other side in colored water? Have students make predictions. Would the flower be all one color or would only half of it absorb the color?

#### EVALUATE:

- a. Formative: Observe student demonstrations. Circulate to see how student groups are able to follow the demonstration instructions. Monitor understanding from class discussion.
- b. Summative: Review Observation Worksheets and Investigation Journal to assess student observation, questioning, prediction and analysis skills. Review the student response on the Investigation Journal to explain capillary action in their own words.

#### DIFFERENTIATION PLANS

**Behavioral for Student A:** For the inattentive student, put them in the least distracting location where it will also be possible to have frequent student contact. Provide feedback often. If they become distracting to the class, give them a job in the classroom or send them on an errand.

**Cognitive for Student B:** For a student with lower cognitive skills, check for understanding on the Observation Worksheet and monitor progress. Struggling writers can choose to draw their observations on the Observation Worksheet. Cooperative learning groups can help struggling students follow the demonstration steps.

**Cognitive for Student C:** For students with higher cognitive skills, encourage them to try the demonstration on splitting the carnation stem in two colors. Have them make predictions as to which food coloring will be absorbed the fastest and then graph the results. Ask probing questions on their predictions.

**Affective for Student D:** For a student who needs more emotional support, it may be a good idea to send the data sheet home the day before the assignment so they have a chance to review the questions at their own pace and know what to expect for the classroom work. Use positive reinforcement.

**Language Demands for Students E, F, G:** This lesson is not vocabulary-intensive, but the science concepts are complex. Teachers should speak clearly and slowly when describing the process of capillary action and refer repeatedly to the visual examples. Check for understanding on the vocabulary on the Observation Worksheet before beginning and monitor progress. Cooperative learning groups can help students with limited English language skills follow the demonstration steps. The option to draw their observations on the Observation Worksheet may also be helpful to students learning English.

## MATERIALS

- A sheet of paper towel per group
- 2 clear drinking glasses or plastic cups per group
- Red and blue food coloring
- About two cups of water per group
- Three carnations with freshly cut stems per group
- National Geographic. (2012). Thorny Devil video. Retrieved from [http://video.nationalgeographic.com/video/animals/reptiles-animals/lizards/lizard\\_thornydevil/](http://video.nationalgeographic.com/video/animals/reptiles-animals/lizards/lizard_thornydevil/)

Activity adapted from What is the function of a stem? (Bass, Contant & Carin, 2009, A-143).

## SUGGESTED READINGS

Florian, D. (2001). *Lizards, Frogs and Polliwogs*. San Diego, CA: Harcourt, Inc.

This picture book has some engaging poems and beautiful paintings to help introduce students to some other unique characteristics of selected lizards (as well as other reptiles). The lizards include the skink, gecko, iguana, Komodo Dragon, Gila Monster and chameleon. Some of the poems and paintings are more playful and have some fantasy elements, but many are fact-based and provide a fun way to introduce special characteristics of reptiles.

Marsh, L. (2012). *Lizards*. Washington, DC: National Geographic Society.

This Level 2 book from the National Geographic Kids series provides a good general overview on lizards with stunning photographs of many different kinds of lizards. By providing short fun facts, visually highlighting key terms and including visual key word cards at the back it can be a very accessible resource for students with students learning English and struggling readers.

Ryder, J. (1990). *Lizard in the Sun*. New York, NY: William Morrow & Company, Inc.

This picture book describes a day in the life of an “American Chameleon” (a green anole common to the southeastern United States) with beautiful illustrations. It highlights how this lizard can rapidly change the color of its skin and how males show off their large, brightly colored throat fans when they are courting or defending their territory. The book opens with a young boy waking up and turning into the green anole, but the remainder of the book is the lizard reacting to the outside environment, including predator and prey situations.

Team Members: \_\_\_\_\_

### Observation Worksheet

1. Twist the paper towel until it is a tight long rope.
2. Place one end of the paper towel in the water and the other end in the empty glass.
3. Observe what happens.
4. Write or draw your observations and answer the questions below.
5. Be prepared to share your observations in class.

**Describe or draw your observations:**

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**What questions do you have about these observations?**

**What can you conclude from these observations?**

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Name: \_\_\_\_\_

### My Investigation Journal

1. Key Question \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

2. My Prediction \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

3. What Happened

Day and Time	What I observed on the flower in blue water	What I observed on the flower in red water	What I observed on the flower in regular water

4. What I concluded \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

5. Describe the process of capillary action in your own words  
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\_\_\_\_\_  
\_\_\_\_\_  
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