



ORGANISM ADAPTATIONS TO WATER AVAILABILITY IN THE CLOUD FOREST Trysta Wall, The New Teacher Project, Philadelphia, PA

Grade Level: 6-8th

Introduction: Students will be given examples of plant species from the tropical montane cloud forest in Monteverde, Costa Rica to examine and two scientific questions based on those plants. Students will then create original hypotheses regarding the habitat of the plant and adaptations the species have evolved in response to water availability. Rainfall data from the forest, as well as information collected from *Canopy In The Clouds* media will allow students to create conclusions to the scientific questions and determine the validity of their hypotheses.

Major Themes: Adaptations, Ecosystems, Data collection and comparison

Connections to the National Science Standards: Populations and Ecosystems, Diversity and Adaptations of Organisms, Scientific Inquiry

Time: 75 minutes – one double period or two single periods (10 min for opening activity, 20 minutes for graph creation, 5 minutes for hypothesis writing, 25 minutes for viewing *Canopy In The Clouds* media, and 15 min for closing conclusion writing)

Materials: One computer with internet access for each student pair and graph paper. Student handouts included.

Objectives: Students will be able to 1) describe the differences in water availability between sites in the cloud forest 2) identify adaptations that organisms have made to water availability 3) draw conclusions regarding the adaptations organisms have made to water availability and their location in the cloud forest.

Potential Misconceptions: Students may have the following misconceptions:

- 1) Some students may believe that organisms develop new traits because they need them to survive. Similarly, they may believe that adaptation is a conscious process used by an individual to fulfill some need or want. It is a common misconception that a single organism may adapt to its environment within its lifetime. A discussion surrounding natural selection is essential to help students understand that species adapt and evolve, not individuals, over long periods of time.

PROCEDURE

Opening: Provide students with a copy of p.1 of the student handouts, *Plant Observations*. Give students 5 minutes to look at the pictures, read the text given, and make scientific observations about



the two specimens. Encourage students to examine similarities and differences between the two plants, as well as note important facts they learned about the plants from reading the given text.

Discuss the students' observations as a class. Encourage students to add to their observations if necessary, during the conversation. Explain that students will be using examples of plants that live in different locations within the tropical montane cloud forest of Monteverde, Costa Rica to answer important questions regarding the plants' habitat and adaptations of the species. They will do this by creating hypotheses, gathering and analyzing scientific data and then drawing conclusions.

Development: Divide the class into groups of two. Provide students with quantitative rainfall data from p.2 of student handouts, *Rainfall Data*. Explain to students that they will be using this data, in combination with the plant observations they just performed to create hypotheses. The data has been divided into two locations from within the cloud forest. A space is provided for students to research each location and determine the elevation.

Partners should work together to decide on the structure of an appropriate graph, and then create a single graph that incorporates rainfall data from both locations. Ask students to discuss the similarities and differences they observe in the data from the two locations within the cloud forest.

While students are working on the graphs, write the following numbered questions on the board:

- 1) Where does each plant species live in the cloud forest?
- 2) What adaptations does each plant species have that allows it to live in its habitat?

If necessary, review the definition of *habitat* (the environment in which an animal or plant normally lives or grows) and *adaptation* (any heritable trait of an organism that increases fitness and ultimately reproduction in its environment).

Using p.3 of the student handouts, *The Scientific Process*, ask each group to create a hypothesis for the first question. Encourage students to utilize the format "I predict....because...." while writing hypotheses to ensure that their predictions are based on the observations made or facts collected. For example: "I predict that the liverwort lives at a high elevation in the cloud forest because it needs wet conditions. Panorama #3 is located at a higher elevation and experiences greater amounts of rainfall with less seasonality, so I predict that the liverwort lives in the high elevation forest." Remind students that they were given two plants to examine, as well as rainfall data, so their hypotheses should incorporate predictions for both.

Once students have written their hypotheses, ask them to determine what additional information they would need to answer the second question regarding plant adaptations. Students should also think about how they would go about gathering that information, if they were in the cloud forest themselves. Partners may discuss and share their ideas together for both of the questions, but each individual is responsible for writing his/her own work.



Allow students to collect additional information on the cloud forest by using the *Canopy In The Clouds* media listed below. Ensure that students adhere to the list provided, as some crucial information may be given away if the hotspots from the opening activity are accessed. Remind students that they are looking for evidence that relates to their hypothesis (supporting or refuting it), as well as information that will help answer the question: What adaptations does each plant species have that allow it to live in its habitat?

Media to access: (teacher may add or subtract from this list as desired)

- Natural Scenes of Panoramas #1-5 (don't forget to visit the canopy natural scenes)
- Panorama #1: Hotspots #1, #2, #5 and Canopy Hotspot #1
- Panorama #2: Hotspots #1, #2
- Panorama #3: Hotspots #1, #2, #3 and Canopy Hotspots #1, #2
- Panorama #4: Hotspots #1, #2, #3
- Panorama #5: Hotspots #1, #2
- Additional Media video "Drip Tips"

Media to avoid:

- Panorama #1 Canopy Hotspot #3 "Succulent Leaves" (species being investigated)
- Panorama #3 Canopy Hotspot #4 "Leafy Liverwort" (species being investigated)
- Panorama #4 Hotspot #4 "Filmy Fern" (species used in assessment)

Before moving on, engage students in a conversation about the evidence they are collecting. Ask for one or two examples of plant adaptations that were observed that help plants live in a habitat receiving more or less rainfall. Remind students that a hypothesis does not always have to be "right" and that discovering errors in predications is very valuable in the scientific process. If the students are not already familiar with terms, review vocabulary words such as *succulence* (full of juice).

Closing: Students should write a conclusion that answers the two questions written on the board, and states whether the hypothesis was supported or unsupported. Some collaboration and exchange of information may be necessary between partners to ensure a complete and thoughtful conclusion to each question. Reassure students that developing a conclusion that is different from the original hypothesis created is acceptable. Encourage them to discuss these differences and important findings in their conclusion and include vocabulary words discussed during class.

Suggested Student Assessment: Students should complete p.6 of the student handouts (*Student Assessment*) for homework. An additional example of a plant is provided and students must use the information they gathered throughout the lesson to predict where this plant species lives within the cloud forest and what adaptations the species has developed. Students should support their answers with qualitative and quantitative data. Ask students to share their thoughts during the following class and provide access to *Canopy In The Clouds* media again to clarify any confusion or support student statements.

Extending the Lesson: Build a device that will collect rain data from the student's local area. Use the tipping bucket rain gauges (student handout p.7, *How Rain Data Is Collected*) as a starting point for



brainstorming about how to create a collection tool. If collecting rain data yourselves is not an option, use the internet to research rainfall data for several different locations in the local area. Ask students to study the plant species present in each area and determine the adaptations each species has developed in response to the water availability. Compare the findings at several different locations and discuss differences in the rainfall data and how this directly relates to the observed plant adaptations.

Vocabulary: habitat, adaptation, succulence