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IN THE CANOPY: BIODIVERSITY AND CLIMATE

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Grade Level: 9-12th

Introduction: Students will learn about methods that can be used to measure biodiversity, and determine an appropriate method for measuring biodiversity at different elevations within the cloud forest ecosystem. Students will create their own hypotheses, experimental designs, and collect data to answer the scientific question: How does epiphyte biodiversity in the canopy differ across a climate gradient? This lesson can be used as a continuation to the *Canopy In The Clouds* lesson "Measures of Biodiversity."

Major Themes: biodiversity, science as inquiry

Connections to the National Science Standards: Science as inquiry, Populations and ecosystems

Time: 60 minutes (5 minutes for opening, 10 minutes for handout and discussion, 10 minutes for media and methods selection, 20 minutes for data collection, 10 minutes for media review, 5 minutes for closing)

Materials: One computer with internet access per group and *Canopy In The Clouds* canopy panoramas #1-3. If multiple computers are not feasible, each group can work with printed photographs of panoramas #1-3 (preferably color). Overhead sheet of data table (optional), graph paper, and student handouts provided.

Objectives: Students will be able to 1) identify differences in biodiversity at three elevations within the cloud forest 2) create predictions regarding the reasons for differences 3) utilize the scientific method to support or negate predictions.

Potential Misconceptions: Students may have the following misconceptions:

1) Some students may believe that an area with low biodiversity is not important, healthy or worth conserving. Ecosystems with low biodiversity still play a critical role in ecosystem services, such as nutrient and water cycling. They also may preserve rare or endangered species.

2) Many students do not consider human as part of ecosystems and biodiversity. Humans are a very crucial part of the web of life and biodiversity. Humans can have large impacts, positive or negative, on the ecosystems they are a part of, making them very important factors in each and every ecosystem.

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PROCEDURE

Opening: Present students with the following list of terms from the *Measures of Biodiversity* lesson:

- Biodiversity *(number of different organisms or types of organisms in an environment)*
- Species richness *(the number of species in a given area)*
- Functional biodiversity *(the different roles that organisms play in their environment)*
- Species evenness *(the number of individuals of each species in a given area relative to one another)*
- Species density *(the number of each individual species occurring in the area)*

Ask students to access their prior knowledge of these terms, based on the previous lesson. Review the terms as a class to facilitate effective communication through the remainder of the activities. The definitions are provided for teacher reference. If desired, students may also access the *Canopy In The Clouds* glossary to find or check their definitions.

Explain to students that they will be continuing their study of biodiversity within the cloud forest and developing experimental procedures to test hypotheses they generate in response to the scientific question: How does epiphyte biodiversity in the canopy differ across a climate gradient?

Development: Provide students with p.1+2 of the student handouts (*Biodiversity Measurement Methods*) and give students 10 minutes to work through the handout independently, in partners or small groups, as desired by the teacher. Discuss student answers and determine, as a class, the type of biodiversity desired and the method that would be most suitable for the scientific question above. Using a measurement method outside of those discussed in the handout is completely acceptable. However, it is important that the entire class use a consistent method, as data will be shared amongst groups. Use the standardization discussions from the *Measures of Biodiversity* lesson to help guide the class toward a method that will produce replicable and accurate estimates of biodiversity.

The class should also select whether to use natural views of canopy panoramas 1, 2, and 3, or the still photographs of canopy panoramas 1, 2, and 3 provided on p.6 of the student handouts (*Panorama Photographs*).

Once the media and method for determining biodiversity has been chosen, divide students into small groups and assign each group a letter name. Provide students with p.3+4 of the student handouts, *Biodiversity Data*, and ask students to begin developing a hypothesis for the scientific question: How does epiphyte biodiversity in the canopy differ across a climate gradient? Tell students that the gradient is one having to do with seasonality: ranging from no dry season (cloudy and rainy throughout the year) to a strong dry season (no rain or clouds for a portion of the year). Circulate amongst the groups to ensure they are creating hypotheses that follow a “I predict…..because…..” format. It is acceptable, and encouraged, for each group to have a different hypothesis, despite using the same media and measurement procedure.

When all hypotheses have been written, students should make general observations about the panoramas and may then begin collecting data. Copy the data table on p.4 of the student handouts onto the board or an overhead sheet, and alter as necessary to meet the needs of the class. As groups collect data they should contribute it to the class chart. Allow 20 minutes for data collection and recording. Ask a student volunteer to average the data collected for each panorama.

Upon completion of data collection, allow students 10 additional minutes to review *Canopy In The Clouds* media and collect any additional information needed to determine the accuracy of the hypothesis. For example, they may want to review introductory videos (hotspots numbered 1) on the ground of each of the three panoramas.

Closing: Allow each group 1-2 minutes to give a Quick Share. During the Quick Share, the group should share the hypothesis they developed, how the universal class procedure helped them support or negate their hypothesis, and one conclusion that they drew from the activity.

Suggested Student Assessment: Students should finish their biodiversity study by creating an appropriate graph for the class data and writing a conclusion. Page 5 of the student handouts (*Biodiversity Wrap-Up*) includes a description of topics the conclusion should cover and corresponding rubric.

Extending the Lesson: Present students with the challenge of choosing a different function of biodiversity to study and develop a corresponding method for measuring that biodiversity. Utilize the same *Canopy In The Clouds* media, and develop a new set of hypotheses and procedures. Compare the data found using the new method with the data set from this lesson. Discuss the implications of differences seen and challenges that scientists might face in the real world, while collecting biodiversity data.

Vocabulary: biodiversity, replicable