UNDERSTANDING SEASONALITY IN THE CLOUD FOREST
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Grade Level: 6-8

Introduction: Do the tropical montane cloud forests of Monteverde, Costa Rica experience seasons? Students will use data sets to examine meteorological conditions in the cloud forest over a one year period. Students will graph the data and interpret their results to make a case for (or against) seasons in the cloud forest.

Major Themes: Seasonality

Connections to National Science Education Standards: Structure of the Earth system (D); use appropriate tools and techniques to gather, analyze, and interpret data (A); think critically and logically to make the relationships between evidence and explanations (A); use mathematics in all aspects of scientific inquiry (A).

Time: 60 minutes (5 minutes for opening, 20 minutes for introduction, "Qualitative and Quantitative Data", and "Qualitative Data", 30 minutes for "Quantitative Data", 5 minutes for closing)

Materials: Students will need to view the following *Canopy in the Clouds* videos:
Panorama 1: Ground video 1
Panorama 2: Ground video 1
Panorama 3: Ground video 1, canopy video 1
Panorama 4: Ground video 1
Panorama 5: Ground video 1

Computers with internet access (at least one, preferably enough for one per pair of students)
LCD projector (recommended)
Student handouts (*Seasons in the Cloud Forest?* and *Seasons in the Cloud Forest?: Student Assessment*)
Graph paper
Rulers
Overhead projector, interactive whiteboard, or graphing/illustrating software installed on designated computer (optional)

Objectives: Students will be able to: (1) define "seasonality" and use it in appropriate contexts; (2) identify the seasons that occur in the cloud forest; (3) describe the conditions that are typical of each cloud forest season and (4) understand the difference between "qualitative" and "quantitative" data.

Potential Misconceptions:

1) Spring, summer, winter, and fall are not the only seasons that a region can experience. While these four seasons are typical of Northern and Southern latitudes where energy from the sun varies substantially over the course of the year, regions near the equator (within the Tropics) experience a different sort of seasonal variation. Seasons in the tropics are often identified as the "wet" and "dry" seasons, based on the average amount of precipitation that falls each month. Given their equatorial position, these regions experience far less variation in solar energy than non-tropical areas, thus temperature alone is not a reliable indicator of seasons in the Tropics.

PROCEDURE

Opening: List the words "spring", "summer", "fall," and "winter" on the board. Begin by asking students what these words have in common. (They are all seasons.) Ask students to provide words or phrases that describe each season. Record these ideas in columns under the appropriate term. Next, ask students if they think that all areas of the Earth experience these seasons. Encourage students to extend their thinking by asking about the North and South Pole, tropical forests, deserts, and oceans. Explain that today students will be able to use data from the tropical montane cloud forests of Monteverde, Costa Rica to determine whether or not this unique region experiences seasons.

Development: Distribute *Seasons in the Cloud Forest?* student handout. Solicit volunteers to read the introduction, "Qualitative and Quantitative Data", and the instructions for "Qualitative Data" aloud. If you are using a single computer, work through this section of the handout together as a class, filling in the table as you go. If there are enough computers for students to work in pairs, assign each pair a site (Panorama 1, 2, 3, 4, or 5), and allow each pair to work independently to fill in the appropriate portion of the table. Ask students to watch Panorama 3, Canopy video #1 and to answer the accompanying questions once they are finished with their other panorama video. When all pairs have completed their portion of the table, jigsaw the students into new groupings so that a representative from each panorama is in each group (e.g., a group of five students, each of whom focused on a different site). Allow students to share their observations and fill in the remainder of their tables.

When students are ready to begin the "Quantitative Data" section, bring the class back together and read through the instructions together. Depending on your students' graphing skills, you may want to: (1) distribute data sets, graph paper, and rulers and allow students to begin working on their graphs immediately; (2) review the basic strategies for constructing a graph; or (3) complete one or both graphs together as a class. If you plan to complete the graph(s) together, an overhead projector, interactive

whiteboard, or graphing/illustrating software (installed on the designated computer) will be extremely helpful.

Date will be plotted along the x-axes and temperature/precipitation will be plotted along the y-axes. There are two data sets available for precipitation: low elevation and high elevation. Decide ahead of time whether you would like all students to use the same data set or whether you would like to have some students use one data set and other students use the second set. Be sure to use the same scale for date on each graph. This will make comparison of the two graphs much easier later on. During this graphing instruction, introduce (or review) the concept of outliers and demonstrate how to handle outliers when analyzing graphs for patterns or trends.

If time is of concern, ask half of the class to complete the temperature graph while the other half completes the precipitation graph. Be sure to build in extra time at the close of the lesson for students to share their graphs with one another, as the "Graph Analysis" portion of the handout cannot be completed without knowledge of both graphs.

Closing: Allow students to meet with a partner to preview the "Graph Analysis" questions. This can help jumpstart their thinking and allow time for students to seek clarification before they attempt to complete this portion of the handout as homework.

Suggested Student Assessment: (1) Assign "Graph Analysis" section of the handout as homework. The following day, discuss students' responses to the graph analysis questions. If possible, have images of the two graphs available (e.g., projected via the LCD projector or overhead projector) for reference. Allow time for students to share their explanations with a partner or with the entire class and encourage students to think through their ideas out loud. Supplemental information about how/why seasons differ between the tropics and non-tropical areas is strongly suggested during this time. (2) Have students complete the *Seasons in the Cloud Forest?: Student Assessment* assignment. Once you collect and review student work, pair up students and have them exchange the "data" sets they created. Students should then graph their partner's temperature and precipitation "data" (like they did in the classroom activity), then answer the questions in Part 2 of the handout. Once students have done so, allow time for students to meet with their partners and share their work (Part 3 of handout). This provides students with an opportunity to identify successes as well as mistakes in their work.

Extending the Lesson: Use temperature and precipitation data from your local area to create graphs like the ones students made in this activity. Analyze the graphs to see how temperature and precipitation do or do not correlate with the seasons as students think of them (e.g., based on calendar, annual events, etc.).

Vocabulary: meteorological, qualitative data, quantitative data, precipitation, plot, x-axis, y-axis, pattern, trend, outliers, scale,

WORKSHEETS: Seasons in the Cloud Forest?, Seasons in the Cloud Forest?: Student Assessment