canopy in the clouds
dosel en las nubes

PLANT ROOTING STRATEGIES

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Grade Level: 6-8

Introduction: Roots are critical for plant survival and ecosystem health. Cloud forests are no exception; however, roots come in many forms and in unexpected places. Students will use the *Canopy in the Clouds* panoramas to examine plants on the ground and in the canopy of the cloud forest. They will observe root structures of large and small terrestrial and aerial plants at different sites. Students will also relate rooting strategies to nutrient availability.

Major Themes: Rooting strategies; plant diversity

Connections to National Science Education Standards: Structure and function in living systems (C); regulation and behavior (C); populations and ecosystems (C); diversity and adaptations of organisms (C); structure of the Earth system (D).

Time: 60 minutes (10 minutes for opening, 40 minutes for student handout, 10 minutes for closing)

Materials: Students will use the glossary, as well as the zoom function in a variety of ground and canopy panoramas. Students will need to view the following videos:

Panorama 2: Canopy photo/text 5
Panorama 3: Canopy videos 2 & 3, photo/text 4 & 5

Computers with internet access (at least one, preferably enough for one per pair of students)
LCD projector (recommended)
Student handouts (*Rooting Strategies in the Cloud Forest, Rooting Strategies: Student Assessment, Root Biomass Data Set*)
Overhead projector, interactive whiteboard, or graphing/illustrating software (optional)
Graph paper
Rulers
Colored pencils (optional)

Objectives: Students will be able to: (1) define “bryophyte”, “epiphyte”, “bromeliad”, and “hemi-epiphyte” and use these terms in appropriate contexts; (2) identify and describe the rooting strategies of a variety of plants in the cloud forest, (3) explain how the structure of a plant’s root system relates to its function and life history strategy.

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Potential Misconceptions:

(1) The term "roots" conjures up images of sprawling plant structures that exist deep underground. However, roots may exist partially or fully above ground, and they may extend deep into the soil or remain very close to the surface.

(2) Students may believe that roots are merely the "anchors" of trees, yet in reality, roots generally serve several functions. Among these are: stabilization of the plant, procurement of water and essential nutrients, and energy storage.

(3) Students may believe that all plants have roots. However, some epiphytic plants have only very reduced root-like structures that are not actually roots.

PROCEDURE

Opening: Ask students to make a quick sketch of an *entire* plant, allowing a few minutes for completion. When students are finished, ask students to trade sketches. After students have had a few seconds to view the sketch, ask them to trade again. When students have viewed several sketches, ask them to describe the sketches. Listen carefully to hear whether any student included roots in the sketch. If so, collect that drawing and share it with the class. If no student included the roots, ask students again if they're sure they drew the *entire* plant. Once students catch on, you can reveal that you are talking about the root system. This is a fun exercise to complete with a small nursery plant such as tomato, as you can remove the plant from the pot to show students the root system while keep the plant intact.

Development: Distribute *Rooting Strategies in the Cloud Forest* student handout and solicit volunteers to read the introduction aloud. Address any student questions or comments. If students have completed the *Tropical Montane Soils* lesson, ask them to share what they remember about the properties of these soils. Otherwise, move on to the "Background" section. If there are enough computers for students to work alone or in pairs, allow them to begin working on their own. If you are using a single computer, work through the handout together as a class up until it is time to review and graph the root biomass data.

When students are ready to make their graphs, you may want to: (1) distribute 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 the graph 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.

Allow 15 minutes for students to complete the graph analysis. Students who are unfamiliar with reading graphs will need additional support here.

Closing: Have students meet in pairs or groups of 3-4 students to discuss their responses to the graph analysis questions. Students may revise their answers at this time if they wish.

Suggested Student Assessment: Ask students to complete *Rooting Strategies in the Cloud Forest: Student Assessment*. If students have access to computers with internet connection at home, this can be assigned as a homework project. If students do not have access to the internet at home, it works best as an in-class activity. Allow students several days to complete the assignment. Completed projects can be shared with other students in the school, so that others have an opportunity to explore the cloud forest.

Extending the Lesson: Buy small nursery plants and compare the root structure. To do so, have students carefully remove the plants from their pots and wash off the soil in buckets of water (messy!). Then use scissors to separate the roots from the shoots, leaves and flowers (i.e. above- and below-ground biomass). Place above and below ground biomass in separate bags for each plant and dry. Then weigh the contents of the bags and compare between species. Do different species have different ratios of above- to below-ground biomass? Is it possible to relate aboveground biomass (i.e. plant size) to root mass, even across species?

Vocabulary: biomass, photosynthesize, defecation, bryophyte, bromeliad, epiphyte, hemi-epiphyte, terrestrial, soil column

WORKSHEETS: *Rooting Strategies in the Cloud Forest, Rooting Strategies in the Cloud Forest: Student Assessment*