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INDEPENDENT STUDY OF WATER IN THE LOCAL ENVIRONMENT

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Grade Level: 6-12th

Introduction: Students will use questions they develop regarding water and the local ecosystem to design and perform an original ecohydrology experiment. The results of their independent study and background research will be communicated in a written paper which encompasses all the steps of the scientific method. This lesson can be used as an alternative assessment following the completion of any or all of the *Canopy In The Clouds* ecohydrology lessons: "Water Cycle in the Cloud Forest", "Organism Adaptations to Water Availability in the Cloud Forest", "Water and Decomposition", and "Transpiration and Water in the Cloud Forest".

Major Themes: Science as inquiry, water and ecosystems

Connections to the National Science Standards: Science as Inquiry, Structure of the earth system, Populations and ecosystems, Matter, energy, and organization in living systems.

Time: 60 minutes (10 minutes for opening, 5 minutes for ecohydrology discussion, 25 minutes for brainstorming and collaboration, 15 minutes for assigning topics and reviewing project directions, 5 minutes for 3-2-1 closing activity). If the teacher desires, additional class periods may be used for student research, performing experiments, and presenting final work.

Materials: One computer with internet access and LCD projector, *Canopy In The Clouds* media. Student handouts provided. Additional materials may be needed as determined by individual student experiments.

Objectives: Students will be able to 1) explain the importance of water within the cloud forest ecosystem 2) collect data from the local ecosystem 3) compare and contrast ecohydrology of the two ecosystems.

Potential Misconceptions: Students may have the following misconceptions:

1) Many students believe that water disappears when it evaporates. Remind students that water is the only substance that can exist as all three phases of matter: solid, liquid, and gas. Evaporation is a change of state, not a change in the water molecule. Use an example of steam to help students understand that water still remains water when it is in the gas state, and may only be visible in certain situations.
2) Students may believe that decomposition is a gradual, inevitable consequence of time. Show students evidence of organisms that have been preserved, without decomposition, over millions of years due to the inability of decomposers to reach that organism.
3) Students may believe that plants only give off oxygen. Explain that even though water is a reactant in photosynthesis, some water is lost as plants exchange oxygen and carbon dioxide through leaf surfaces. A similar process happens in humans – water is lost through our breath as we inhale and exhale.

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PROCEDURE

Opening: Provide students with p.1 of the student handouts, *Water and the Cloud Forest*. Give students five minutes to write down the facts they have learned about water within the cloud forest ecosystem from studying *Canopy In The Clouds* and the tropical montane cloud forest ecosystem. Review the topics of lessons covered to refresh students' memories, if necessary. Students should also answer the question: Why is water important in the cloud forest ecosystem?

As a class, discuss the information recorded by students and their thoughts regarding the question. Display one piece of *Canopy In The Clouds* media from each of the ecohydrology topics that has been covered as a class to reinforce the facts and ideas they have remembered. Explain to students that they will be using the tropical montane cloud forest ecosystem and the lessons on water as a basis for learning more about water within the local ecosystem.

Development: Write the word ECOHYDROLOGY on the board. Ask students to think about what this word means and then share their ideas. It may help to break the word down into its parts using different colored markers or chalk (eco – ecological prefix, hydro – water, logy – a body of knowledge). Explain to students that ecohydrology is a new and developing branch of science that has a very broad definition. Etymology of the word can help to construct a basic understanding of the discipline's focus: interactions between ecosystems and the hydrologic cycle. Scientists who study ecohydrology are interested in how hydrology, the distribution, movement and quality of water, interacts with ecosystems.

Explain to students that all of the lessons and activities they have been completing that involve water and the cloud forest ecosystem have been studies of ecohydrology. Ask students to think about the local ecosystem they are a part of and the role of water within that ecosystem. Give students five minutes to brain storm a list of questions they have about water and their local ecosystem. There is a place on p.2 of the student handouts for students to record their thoughts (*Ecohydrology Brainstorming*). Students will be using these questions to design an experiment to be performed that includes ecohydrology of the local ecosystem.

Potential topics for projects may include, but are not limited to:

- Decomposition
- Transpiration
- Soil moisture
- Annual rainfall
- Water stress

The teacher should decide how the class should complete their ecohydrology work- independently, in partners, or small groups, and then divide the class accordingly. If students are placed in groups, allow 20 minutes for collaboration. Each group should prepare a proposal which includes the experimental design for at least two questions, and their preference for which project they would like to complete. If students are working independently, each one should write a proposal that includes at least two of the questions that were developed during the brain storming.

Collect the proposals and determine, based on the measurability and feasibility of the experimental designs, which scientific question each group/individual will be addressing. While the teacher reads proposals, students can read over the expectations for the project (p. 3 of student handouts, *Ecohydrology Independent Study Introduction*). Hold independent meetings with groups or individuals during this time if more clarification or direction is needed in the ideas and experimental designs.

Hand back the proposals with the desired projects assigned to each group/individual. Review the expectations for the project completion and due dates. A handout on constructing abstracts is included on p.5 of the student handouts (*Abstract Help*), if students are unfamiliar with writing abstracts. An additional class period may be used for students to complete research in the library or media center, if desired by the teacher. The teacher should also decide if students will be required to conduct experiments in class or at home.

Closing: On a piece of paper, ask each student to complete a 3-2-1 activity:

- 3 things you are excited about this project
- 2 questions you still have regarding the project
- 1 challenge that you foresee in completing the project

Collect the 3-2-1 sheets and use the information provided by students to guide discussions about the project during the following class session. Make sure remaining questions are answered before students progress in their work.

Suggested Student Assessment: The finalized project can be used as an assessment of students written work, scientific inquiry, and experimental design and execution. Page 6 of the student handouts (*Ecohydrology Independent Study Rubric*) includes a rubric for grading the final product.

Extending the Lesson: Ask students to make a presentation board that showcases their work. Individual presentations may be delivered to the entire class, or boards can be displayed around the classroom and students can participate in a “gallery walk” to explore the experiments.

Vocabulary: ecohydrology