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WATER AND DECOMPOSITION

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Grade Level: 6-12th

Introduction: Students will use *Canopy In The Clouds* media to examine the effect of water on decomposition. Students will create an original procedure to test a scientific question about decomposition and then build and deploy decomposition bags in their local ecosystem. Mass of material inside the decomposition bag will be weighed over time to determine the rate of decomposition. This lesson can be used in combination with, or as a supplement to, the *Decomposition Experiment* lesson.

Major Themes: Decomposition, Water in ecosystems, Science as inquiry

Connections to the National Science Standards: Science as Inquiry, Matter, energy and organization in living systems

Time: 3+ class periods: 1) one class for introduction, *Canopy In The Clouds* media viewing, and procedure planning, 2) one class for decomposition bag creation and deployment. Data collection may occur over several months, and 3) one class for final data collection, clean up, data analysis and conclusion creation.

Materials: For lesson: one computer with internet access and LCD projector, overhead sheet of soil moisture data and graph, *Canopy In The Clouds* glossary and panoramas #1-5, student handouts. For decomposition experiment: black fiberglass window screen or heavy duty nylon mesh (1 x 2 mm mesh size), glue gun or polyester thread and needle, biodegradable paper (brown grocery bag), additional bags or containers for transportation, heavy duty scissors, stapler, wooden paint-stirrers, sharpie marker, electronic scale, gloves, any additional materials needed as determined by student-created portion of procedure.

Objectives: Students will be able to 1) explain the importance of decomposition in the cloud forest ecosystem 2) evaluate the role of water in decomposition 3) measure the rate of decomposition in the local ecosystem.

Potential Misconceptions: Students may have the following misconceptions:

1) Students may believe that dead organisms (plant or animal) simply rot away, and their material "disappears". Explain that matter can not be created or destroyed, and whenever organic material breaks down it does not disappear, but changes into simpler materials or back into the building blocks (elements) that were used to create it.
2) Students may believe that decomposition is a gradual, inevitable consequence of time. Younger students may not be able to grasp the role of microscopic organisms as decomposers. 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. This may be because the organism, upon death, was trapped in ice or magma that solidified quickly, or other reasons that prevented the penetration of decomposers.

PROCEDURE

Opening: Pass out the *Decomposition Handout* (p.1 of student handouts) and ask students to read the short passage regarding decomposition and answer the questions. They are asked to look up the definition of decomposition using the *Canopy In The Clouds* glossary, as well as answer the following questions:

- Where have you seen decomposition occurring in your everyday life or in the ecosystem around you?
- What factors affect the rate of decomposition?
- Why is decomposition important?
- Who benefits from decomposition?

Discuss the answers as a class and record information on the board. Ask students to review the factors that affect decomposition and explain that they will be studying decomposition within the tropical montane cloud forest of Monteverde, Costa Rica. They will be focusing on the effect of water on decomposition.

Development: Display the following *Canopy In The Clouds* media for students and ask them to make observations regarding water and decomposition. There is a chart on p.2 of the student handouts where students can record information.

- Panorama #1 ~ Hotspot #2 “Soil Sampling Introduction”
- Panorama #1 ~ Hotspot #5 “Dry Leaves and Decomposition”
- Panorama #2 ~ Hotspot #2 “Soil Sampling Introduction”
- Panorama #3 ~ Hotspot #2 “Soil Sampling Introduction”
- Panorama #3 ~ Hotspot #5 “Fallen Debris and Decomposition”
- Panorama #3 ~ Canopy Hotspot #2 “Soil in the Air”
- Panorama #4 ~ Hotspot #2 “Soil Sampling Introduction *(optional)*
- Panorama #5 ~ Hotspot #2 “Soil Sampling Introduction *(optional)*

Hold a discussion with students when they are finished viewing the media and making observations. Base the conversation on the following questions to ensure that students have made a connection between decomposition and moisture levels in soil.

- What did you notice about soils in the cloud forest that were “wetter”?
- What did you notice about soils in the cloud forest that were “drier”?
- How do you think the amount of water in soil changes the decomposition that can occur there?

- What is the connection between water in soil and decomposition?

If necessary, view Panorama #1, Hotspot #5 “Dry Leaves and Decomposition” again as a class. The scientist makes the following statement, “Dry litter in a drier forest means slower decomposition, so that all the nutrients that are locked up in here take longer before they are available for these plants to use again.” This information may help students understand that drier soil will slow down the rate of decomposition and wetter soil will help increase the amount of decomposition occurring at a particular location in an ecosystem.

Once students understand the connection between water and decomposition, explain that they will now be looking at some data collected from soil within the cloud forest ecosystem. This data will let them know the average percentage of water contained within the soil at the high, mid, and low elevation locations of the cloud forest. This data will be used to help strengthen the connections students make between water and decomposition.

Display the soil moisture data set on the overhead projector, found on p.5 of the student handouts (*Soil Moisture Data and Graph*). As a class, in teams, or individually, calculate the average percent of soil moisture at the three locations within the cloud forest. Record the averages on the overhead and then ask students to transfer this data to the right-hand column of their observation chart for future reference. A graph is also provided on p.5 of the student handouts for a visual representation of the data.

Now that students have made some observations, present the scientific question that they will be studying: **What is the effect of water on decomposition?**

Ask students to create a hypothesis, based on the observations they made from the *Canopy In The Clouds* media. Encourage students to utilize the format “I predict….because….” while writing hypotheses to ensure their prediction is based on observations or facts. For example: “I predict that _____ (large/small) amounts of water in the soil will _____ (increase/decrease) decomposition because _____.”

Students will be making decomposition bags filled with biodegradable paper and placing them in the local ecosystem. Explain that they have made their observations and hypothesis based on the cloud forest ecosystem, but will be collecting data based on the surrounding ecosystem. Discuss the differences in the two ecosystems and if this will affect the hypotheses they created. Students will weigh the “organic matter” inside the bags, place them outside, and then collect and weigh the “organic matter” after a specific amount of time to determine the rate of decomposition. Students will be given a general procedure for creating the decomposition bags, but they must create a portion of the procedure on their own to help find an answer to the scientific question.

Ask students to determine the variable that is crucial to answering the scientific question provided (water). Place the students in groups and allow them to create a procedure that will allow them to test the effect of water on decomposition rates. They should write this procedure on their handout.

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Circulate amongst the groups to ensure that they are creating feasible and measurable procedures. Students also need to construct a data table that will allow them to record necessary information throughout their experiment. A sample data table is shown on p.6 of the student handouts *(Sample Student Data Table)*, which may need altering by each group. Determine the length of time your class will be able to leave the decomposition bags outside. A minimum of one month is recommended to allow for decomposition to occur, since it is a slow process. Data may be collected bi-weekly or monthly, depending on the total time available. Warmer climates are also preferable.

Create the decomposition bags using p.6 of the student handouts *(Construction of Decomposition Bags)*. Each student should construct his/her own bag (or more), so that each group has the total number of bags needed to complete their procedure successfully. Weigh the strips of paper placed in each decomposition bag. Students should record this in their data table. When collecting the decomposition bags from the outside, place them inside another container to prevent loss of material in transport. The contents of each decomposition bag should be allowed to dry before being weighed. This will ensure that water weight does not become an uncontrolled variable in the experiment.

Closing: Once data from the decomposition bags is collected, groups should reconvene to organize and analyze the data. Ask students to create graphs that visually represent their findings and determine if their hypotheses were supported or not supported. Students should write a conclusion that explains the process they utilized to answer the scientific question, if their hypotheses were supported or not supported, problems experienced throughout the experiment, and a summary of the results. The conclusion should also include a discussion of the importance of decomposition in the local ecosystem and the cloud forest ecosystem. Differences in these two ecosystems should be covered in relation to how those differences might affect decomposition rates.

Suggested Student Assessment: Ask students to write a formal lab-report, including: observations, scientific question, hypothesis, procedure, data, graphs, and conclusion. Additional background information and research can be included if desired by the teacher.

Extending the Lesson: Study the role of earthworms in decomposition and their ability to turn over soil and organic material, creating “worm castings” that are nutrient-rich and used as fertilizer. Create worm bins, adding compost material and leaf litter. Harvest the rich soil created and examine the decomposition of materials placed inside the bin. Weigh the organic matter placed in the bin and then weigh the castings harvested, comparing the data and discussing the ways in which the decomposition rate could be increased by the earthworms.

Vocabulary: decomposition, heterotroph