



## PLANT TRANSPIRATION IN THE CLOUD FOREST Trysta Wall, The New Teacher Project, Philadelphia, PA

**Grade Level:** 6-8<sup>th</sup>

**Introduction:** Students will learn about the process of transpiration and the environmental factors that can change transpiration rates in plants. Students will examine data sets gathered from the tropical montane cloud forest of Monteverde, Costa Rica and media from *Canopy In The Clouds* to deepen their understanding of how water in an ecosystem can affect transpiration.

**Major Themes:** Transpiration, Science as inquiry, Water usage in cloud forest

**Connections to the National Science Standards:** Structure and function in living systems, Science as inquiry

**Time:** 50 minutes (5 minutes for opening activity, 10 minutes for transpiration introduction, 30 minutes for station directions and rotation, 5 minutes for closing)

**Materials:** One computer with internet access for station #4, print outs of data and graphs for stations #1-3, plant leaves, hand microscope or light microscope, and student handouts provided. The following *Canopy In The Clouds* media: Panorama #1 Canopy Hotspot #1 “Wind in the Trees”, Panorama #4 Hotspot #3 “The Canopy’s Close!”, Panorama #5 Hotspot #3 “The Science of Wood”, Additional Media Video “Drip Tips”, and any additional *Canopy In The Clouds* media as needed by student groups.

**Objectives:** Students will be able to 1) define transpiration 2) analyze data from the cloud forest that may affect transpiration.

**Potential Misconceptions:** Students may have the following misconceptions:

- 1) 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.

### PROCEDURE

**Opening:** Have several leaves of plants (Wandering Jew or Boston fern are recommended) and hand microscopes at each student desk. If light microscopes are available, prepare slides of plant leaves ahead of time for students to observe (make sure they stay wet). Ask students to examine the plant leaves, draw pictures of what they see, and explain what they think might be occurring within the leaf. Ask students to search for structures within the plant leaf that are not visible to the naked eye.



Discuss student answers as a class. Explain that there are many different processes occurring within plant leaves, even if the leaf appears to be static. Write the word “transpiration” on the board so students may see and hear it, if they are unfamiliar with the term. Let students know that transpiration is one of the processes occurring at leaf surfaces, and they will be using information and data from the tropical montane cloud forest of Monteverde, Costa Rica to develop and answer questions about water and transpiration within the cloud forest ecosystem.

**Development:** Provide students with p.1 of the student handouts (*Transpiration Introduction*) and read together as a class or in partners. Ask students to answer the questions provided and then discuss the answers to ensure that they have a basic understanding of the process of transpiration, and the factors that can change the rate of transpiration in plants. Next, divide students into small groups. They will be rotating through the following for stations:

- Station #1 → Plant Water Stress
- Station #2 → Soil Moisture
- Station #3 → Annual Rainfall
- Station #4 → Transpiration & Cloud Forest

Look at p.2-4 of the handouts, *Station Worksheet*, with students. Explain that they will find a data table and graph at stations #1-3 and a computer at station #4. They are to examine the information at each station and answer the questions that match the name of the station on the worksheet. Let students know that it may be helpful to have the *Transpiration Introduction* available for reference as they work. Give students six minutes to work at each station.

The data tables and graphs for each station can be found on p.5-7 of the student handouts, *Station Data & Graphs*. Station 4 does not have a data set or graph, but needs a computer with internet access.

After groups have visited each station, briefly discuss their findings as a class. Have students share summary statements from their worksheets and clarify any confusion regarding the data sets.

**Closing:** Now that students have examined data, graphs, and information about water and the cloud forest, ask each student to draw a conclusion that incorporates at least three of the stations visited. The statement should focus on the predicted rate of transpiration at a particular location. For example: *I know that plants at the low elevation site are experiencing greater amounts of water stress. I believe this is due to the fact that the low elevation site receives less annual rainfall and therefore has a lower percentage of soil moisture. I predict that plants at the low elevation site transpire less because the lower percentage of moisture in the soil means that they are absorbing less water through their roots and therefore losing less water through their leaves.* Each student should write his/her own statement and then share it with the class.

**Suggested Student Assessment:** Students can complete p. 8 of the student handouts (*Transpiration and Water Student Assessment*) as an assessment. Students should complete the assessment without the aide of the *Transpiration Introduction* worksheet, to accurately determine their mastery of the topic.



The assessment requires students to discuss their understanding of transpiration, as well as use *Canopy In The Clouds* media to identify environmental factors that may influence transpiration.

**Extending the Lesson:** Expand students understanding of transpiration by using bean or mustard seedlings and a potometer to measure the amount of water used, and hence the amount of water lost through transpiration, by the plants. Set up several potometers to measure different variables. Humidity can be created by misting the leaves and then covering them with a plastic bag, wind can be generated with a fan, and light intensity can be changed by placing plants under ambient light or in the dark. Track changes in water levels over time and then create graphs of the data with time on the x-axis and water loss on the y-axis.

**Vocabulary:** transpiration, stomates