Humidity

Plant Microclimate

Overview

Plants play a vital role in maintaining environmental balance by cycling water through their systems. They absorb water through their roots and release it into the atmosphere as water vapor through the process of transpiration. This lesson uses the databot's humidity sensor to investigate how plants create localized microclimates by affecting humidity levels in their immediate surroundings.

Background

Water is essential for all living organisms, and plants are a crucial part of Earth's water cycle. Here's how the process works:

- Absorption: Roots take up water from the soil. This water carries nutrients that plants need for growth.
- Transportation: Water travels through the plant's vascular system, known as xylem, to reach the leaves. This movement is driven by capillary action and transpiration pull.
- Transpiration: Water is released from stomata, tiny openings mostly found on the underside of leaves. This process cools the plant and creates a flow of water and nutrients from roots to leaves.

Trees, as large plants, have an especially significant role in the global water cycle. They release vast amounts of water vapor into the atmosphere daily, contributing to local and global rainfall patterns. Forests, like the Amazon, are often referred to as "natural water towers" because they release water vapor that forms clouds and eventually returns as rain, maintaining ecosystems and water sources.

Additionally, plants influence the climate by regulating humidity and temperature around them.

Grades: Middle School
Time: 45 Minutes
Subject: Life Science
Topics: Humidity, Plant Microclimate

What You Will Need/Prep

- databot
- IOS/Android Smart Device
- Install Vizeey™ on your Smart device.
- A potted plant with large leaves.

- Test your databot™ connection.
- You will be prompted to select and connect to databot™ each time you launch an experiment.
- If there are two or more databot™'s listed, the one closest to your device will be highlighted in blue.
- Study the background information and terms and prepare to explore!

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The cooling effect of transpiration not only benefits the plant but also helps moderate the temperature in the surrounding area, creating a comfortable microclimate for other organisms.

This hands-on experiment demonstrates the water cycle and the importance of plants in regulating environmental conditions.

Learning Objectives

By completing this lab, students will:

- Use databot to measure humidity in different microenvironments.
- Observe and analyze how plants influence local humidity levels.
- Understand the importance of water movement in plants and its connection to the water cycle.

Important Terms

- **Humidity:** The amount of water vapor in the air. Relative humidity is the % water vapor in the air compared to the total it will hold.
- **Transpiration:** The release of water vapor from plants into the atmosphere.
- **Stomata:** Small pores on the underside of leaves that regulate gas exchange and water release.
- **Microclimate:** A small, localized environment with distinct atmospheric conditions.
- **Xylem:** The plant tissue responsible for transporting water and nutrients from roots to leaves.

Interesting Facts

Trees are water champions: A single mature oak tree can transpire over 150 gallons of water into the atmosphere in a single day during the growing season.

Rainforests and rainfall: The Amazon rainforest generates about 20% of the world's oxygen and acts as a massive water pump, cycling moisture across continents.

Desert adaptations: Plants like cacti have evolved to minimize water loss by reducing or eliminating leaves and using their stems for photosynthesis.

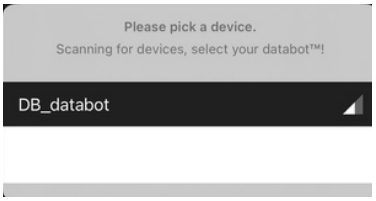
Stomata “breathing”: Stomata not only release water but also control the intake of carbon dioxide, crucial for photosynthesis. They can open and close depending on environmental conditions.

Using Vizeey

In order to work with the experiment you need to launch the Vizeey application and click on + in the upper right corner.

Then select “Add experiment from QR code” and scan the QR code prepared for this experiment. Your experiment will appear in the list.

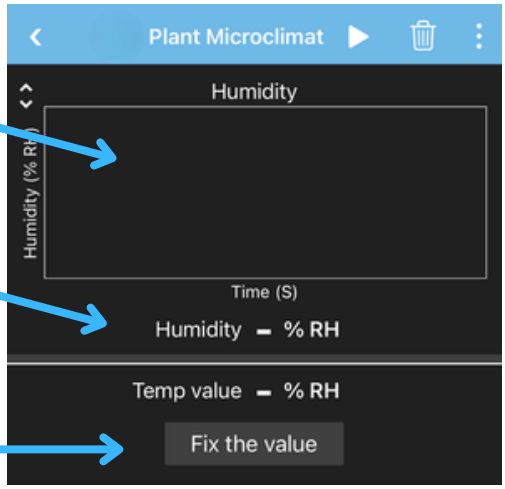
Once in the Experiment



When you start the experiment you will be immediately offered to connect to your databot. Make sure that databot is turned on and in Vizeey mode with a blue blinking light.

This lab work investigates the humidity sensor

- Graph showing the humidity
- Humidity value in real-time.
- The humidity value you can fix at the current moment by pressing the button.



During the experiment, you need to record the humidity values every 30 seconds.

Press the "Fix the value" button every 30 seconds to capture the next values for your data table.

Once you have captured the values, write them down in the table to avoid losing any information and prepare to capture the values at the next 30 second mark. Be fast and accurate!

Humidity

Part 1: Initial Observations and Discussion Questions

Why do you think plants release water vapor through their leaves?

_____

How do you think the plant's surroundings (e.g., light, temperature) influence transpiration?

_____

_____

How might the size, shape, or texture of a leaf affect the amount of water vapor released? _____

_____

Do you expect the air under the leaf to be more humid than the air above? Why?

_____

_____

Part 2: Hypothesis

Before conducting the experiment, think about what might happen when you measure the humidity under and above a leaf.

"I think the humidity under the leaf will be _____ compared to the air above it because _____

_____

Part 3: Experiment Procedure

Microclimate Beneath Leaves

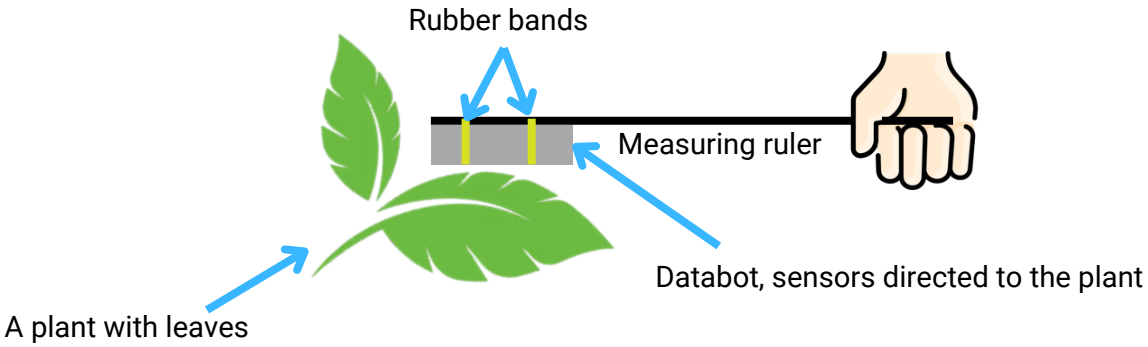
You will investigate the difference in humidity under and above plant leaves.

Materials Needed:

- databot with humidity sensor.
- A potted plant with large leaves.

Part 3: Experiment Procedure

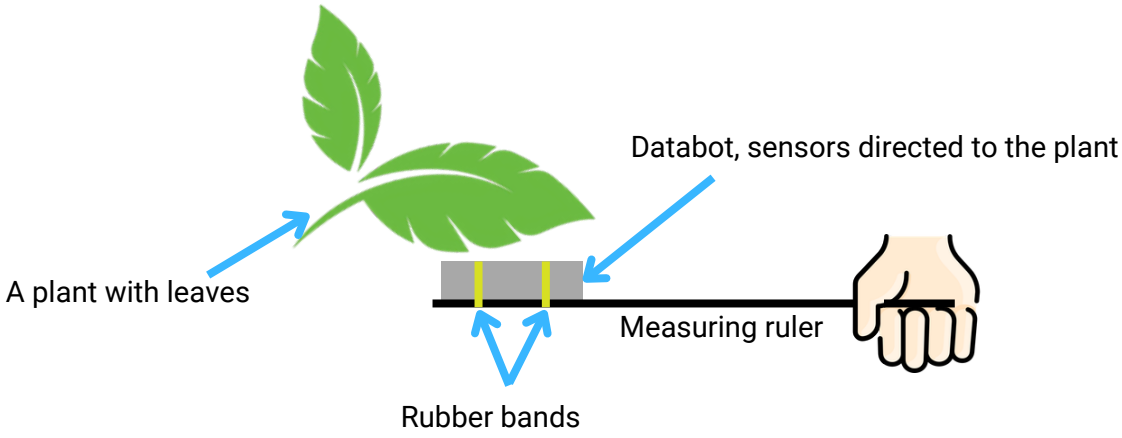
- Select a healthy plant with large leaves.
- Take a ruler and fix databot with rubber bands to the tape so that the ruler does not cover the sensors.
- Turn on databot (using the small button on the left side)
- Tap on " **Plant Microclimate**" in Vizeey to load the experiment.
- You will be prompted to connect to databot.
  - Hint- if there is more than one databot in use, the one closest to you will be in blue!
  - A solid blue light on databot means you are connected.
- Start your experiment using:
  - Use these icons at the top of the screen in Vizeey to start and to pause the experiment.
- Leave databot on for a few minutes so that the humidity can stabilize.
- Place databot with the humidity sensor under a leaf and record data every 30 seconds for 5 minutes.



The humidity sensor is very sensitive and reacts to even the slightest changes. To get reliable data, do not bring your hand to the sensor during the experiment, this can greatly affect the values.
Also, do not keep a water source nearby.

Microclimate Above Leaves

- Move databot over the same leaf and record data every 30 seconds for 5 minutes.



- Record all observations in a table, noting the time and humidity levels for each location.

Write the name of the plant

_____

Databot location: above or below the leaf

_____

Time	Humidity
0	
30	
60	
90	
120	
150	
180	
210	
240	
270	
300	

Write the name of the plant

_____

Databot location: above or below the leaf

_____

Time	Humidity
0	
30	
60	
90	
120	
150	
180	
210	
240	
270	
300	

Part 3: Experiment Procedure

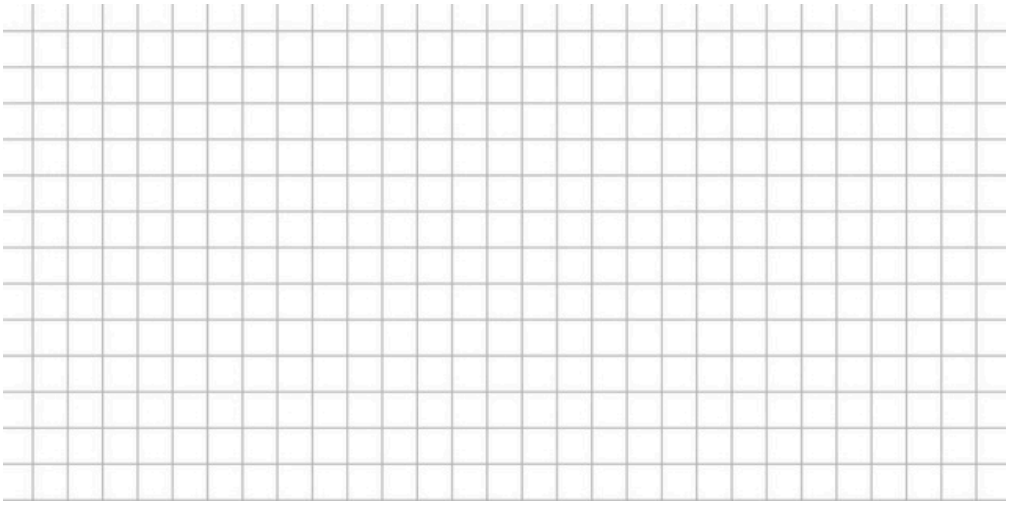
Average Humidity

You can calculate the average humidity for different measurement points:

$$\text{Average Humidity} = \frac{\text{Sum of All Measurements}}{\text{Number of Measurements}}$$

Do your calculations here

Make graphs of the results (top of the leaf, under the leaf, and average values.)



Extend the Experiment: Investigating the Plant Stem

Repeat the experiment, but this time focus on the plant's stem. Observe and measure the humidity levels near the stem to compare with your previous findings under the leaves.

Additional Task

If the weather is suitable, move the plant into direct sunlight. Leave it there for 5 to 10 minutes, then repeat the experiment.

You may observe that the plant releases moisture more intensively under the sunlight due to increased evaporation.

Humidity

Create a labeled diagram showing how water moves from the soil, through the roots and stem, and exits through the stomata in the leaves.

Part 5: Concept Questions

Data Interpretation:

Why is it important to take multiple measurements during the experiment?

How might different plants or environments impact the results of this experiment?

Do you expect the air under the leaf to be more humid than the air above? Why?

Why do you think plants release water vapor through their leaves?

Part 6: Reflection

1. How do your findings help you understand the role of plants in regulating humidity and supporting the water cycle?

2. Consider any environmental factors or measurement errors that may have affected your results.