Light

Reflect and Grow

Grades: Middle School
Time: 45 Minutes
Subject: Life Science
Topics: Light, Light Intensity, Light Reflection, Light Absorption

Overview

Have you ever wondered how soil moisture and leaf cleanliness impact plant growth? In this lesson, you will explore how water absorption affects light reflection and how dust on leaves influences the amount of light plants receive.

Background

Light is one of the most important factors in plant growth. Through photosynthesis, plants convert light energy into chemical energy, producing the nutrients they need to survive. The amount of light a plant receives depends on various factors, including light intensity, reflection, and absorption by surrounding surfaces.

Soil moisture plays a crucial role in light reflection. Dry soil reflects more light, while wet soil absorbs more, affecting the light available to nearby plants. This can influence soil temperature, evaporation rates, and overall plant health.

Leaf cleanliness also impacts light absorption. Dust and dirt on leaves can block incoming light, reducing the efficiency of photosynthesis. In natural and urban environments, air pollution and dust accumulation can limit plant growth by decreasing the amount of usable light.

Understanding how light interacts with soil and leaves helps scientists and farmers optimize growing conditions for plants. By studying these factors, we can improve agricultural efficiency, greenhouse design, and environmental sustainability.

Using databot™, you will measure light intensity, analyze reflection patterns, and discover the connection between soil moisture, leaf cleanliness, and plant health.

What You Will Need/Prep

- databot
- IOS/Android Smart Device
- Install Vizeey™ on your Smart device.
- A potted plant with large leaves.
- Paper box, light source
- Small container for soil + different types of soil + water
- Fine powders for dust simulation + damp cleaning cloth
- Tripod
- 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!

Learning Objectives

By completing this lab, students will:

- Understand how soil moisture affects light reflection and absorption.
- Investigate how dust accumulation on leaves impacts light availability for photosynthesis.
- Measure and analyze light intensity using databot™ under different soil and leaf conditions.
- Develop critical thinking and data analysis skills by comparing experimental results.
- Explore the relationship between light reflection, plant health, and environmental conditions.

Important Terms

Photosynthesis – The process by which plants use light, carbon dioxide, and water to produce energy (glucose) and release oxygen.

Light Reflection – The process of light bouncing off a surface instead of being absorbed.

Light Absorption – The process of light being taken in by a surface, such as soil or plant leaves.

Soil Moisture – The amount of water present in the soil, affecting its ability to reflect or absorb light.

Leaf Cleanliness – The presence or absence of dust and debris on leaves, which can impact the amount of light they receive.

Light Intensity – The amount of light energy reaching a surface, measured in lux.

Evaporation – The process by which water turns into vapor, influenced by soil moisture and temperature.

Plant Health – The overall condition of a plant, influenced by its ability to absorb light, water, and nutrients efficiently.

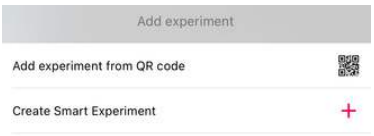
Interesting Facts

NASA studies light reflection for plant growth in space: scientists analyze how different materials and moisture levels affect light absorption to develop efficient plant growth systems for future space missions.

Greenhouses optimize light absorption: in controlled environments, greenhouses use reflective surfaces and clean glass panels to ensure plants receive the right amount of light for growth.

Using Vizeey

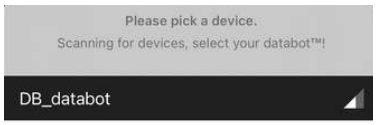
In order to work with the experiment you need to launch the Vizeey application and click on + in the upper right corner.



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

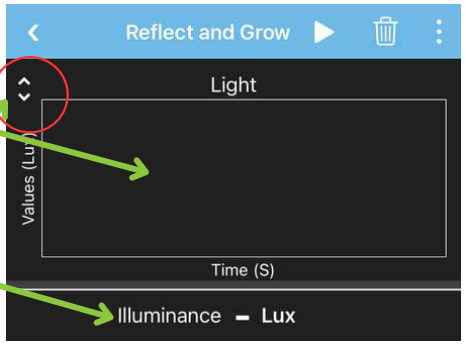
When you start the experiment you will be immediately offered to connect to your databot. Make sure that databot is turned on and in Vizeey mode with a blue blinking light.



This lab work investigates the Illuminance sensor

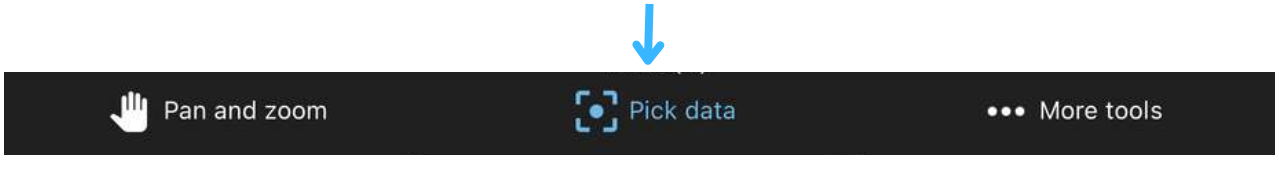
Graph showing the Illuminance

Illuminance value in real-time.



To explore the chart, you can use the extended version.

- By default you will be in Pan and zoom mode which allows you to move the data side from side to side with your finger or pinch to zoom in or out.
- To see the values at any point of the graph, you first need to press the “Pick data” button.



- Click on any point on the chart to see the values.

Light

Part 1: Initial Observations and Discussion Questions

Why might farmers care about how much light is reflected or absorbed by the soil?

_____

In what environments do you think plants are more likely to collect dust on their leaves?

_____

_____

How do plants naturally keep their leaves clean in the wild?

_____

_____

How could cleaning plant leaves improve their health and growth?

_____

_____

Part 2: Hypothesis

Before conducting the experiment, think about what results you expect. Consider the following questions to help you form your hypothesis:

1. How do you think soil moisture affects light reflection?

"I think that dry soil will reflect _____

because _____

_____

2. What do you expect to happen when dust covers the leaves?

"I predict that dusty leaves will receive _____

because _____

_____

Part 3: Experiment Procedure

Experiment Purpose and Goal

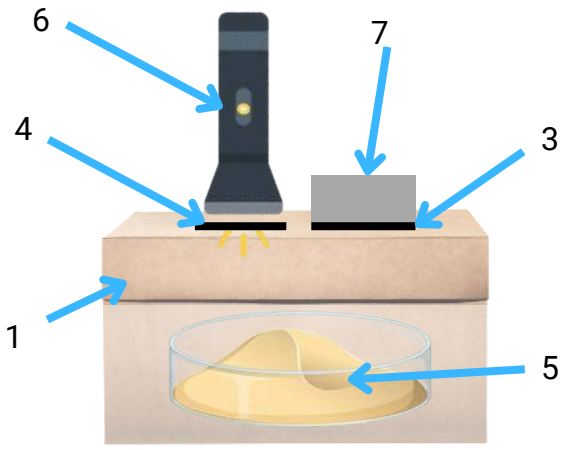
The aim of this experiment is to explore how the moisture content in soil affects the reflection of light. By measuring the change in reflected light (lux) as the soil becomes wetter, you can observe the impact of water content on light reflection. The experiment also compares how different soil types, such as sand and clay, influence light reflection.

Required Components

- Paper box (with a lid that closes securely)
- Databot with light sensor
- Light source
- Small container for soil
- Water
- Different types of soil

Preparation Before the Experiment:

1. Use a paper box that can be securely closed to prevent any light from entering.
2. Make two holes in the top of the box.
3. One hole should be large enough to fit databot.
4. The other hole should fit the light source (e.g., flashlight or lamp).
5. Place a small container inside the box and fill it with sand.
6. Fix the light source so that it stands still and shines into the box.
7. Position and fix databot so that its sensors point into the box.



Databot has several operating modes, so make sure that when you turn it on, the sensors are facing up, and only then turn it over.

Experiment:

- Tap on **"Reflect and Grow"** 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.

Part 3: Experiment Procedure

- Start your experiment using: ▶
  - Use these icons ▶ ⏸ at the top of the screen in Vizeey to start and to pause the experiment.
- Turn on the light and shine it on the sand.
- Record the level of reflected light (lux) that the databot light sensor detected.
- Pour a small amount of water onto the sand. Use one of the following ways:
  - You can open the box, pour water and close the box again. Then measure the value of the reflected light. The key point is that the amount of light remains constant and databot stays in its position.
  - Make an extra hole in the lid and pour water with a tube, in this case it is better to use an opaque tube so that the light does not get inside the box.

- Measure and record the change in the level of reflected light.
- Add more water to fully saturate the soil.
- Measure and record the reflected light one final time.

Soil type	Dry soil	Wet soil	Completely wet soil
Sand			

- Remove the sand from the container and replace it with a different type of soil (such as black soil or clay).
- Follow the same steps as before, measuring the reflected light with the new soil.
- Compare the results with those from the sand experiment to observe how different types of soil reflect light differently.

Part 3: Experiment Procedure

How Does Dust on Leaves Affect Light Absorption

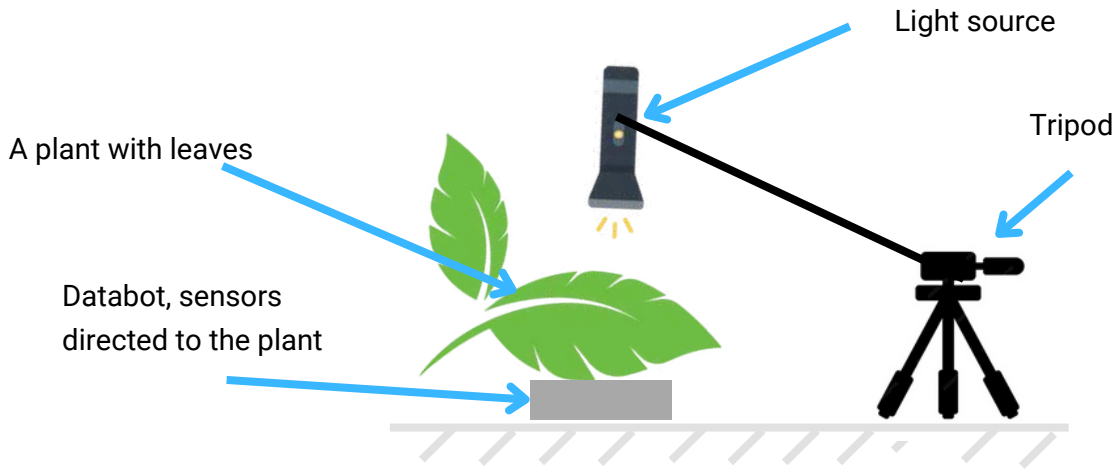
Since plants rely on light for photosynthesis, any obstruction can reduce their ability to produce energy. By testing different types of dust, we will analyze how much light is blocked and whether cleaning the leaves restores their ability to absorb light effectively. Understanding this process is important for plant care, especially in urban environments where dust and pollution are common.

Required Components

- Databot™
- Light source
- Plant with broad leaves
- Stand or clamp
- Fine powders for dust simulation
- Soft brush or sponge (to distribute the dust evenly)
- Damp cleaning cloth

Preparation Before the Experiment:

- Choose a plant with large, smooth leaves to ensure uniform dust coverage.
- Secure databot™ on a stand or clamp as close as possible to the underside of the leaf.
- Position the light source so that it shines directly onto the top of the leaf.
- Ensure that all equipment is stable and does not move during the experiment.



Experiment:

- Turn on databot™ and launch the Vizeey™ app.
- Tap on "**Reflect and Grow**" 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.
- Direct the light onto the leaf and measure the light intensity.
- Record the data in a table as the baseline measurement.

Leaf Condition	Light Intensity (lux)
Clean Leaf (Baseline)	
Leaf with Flour	
Leaf after Cleaning (Flour)	
Leaf with Talc	
Leaf after Cleaning (Talc)	

- Sprinkle a small amount of flour, talc, or chalk dust evenly across the leaf surface.
- Repeat the light measurement with databot™ and record the results.
- Observe how the amount of light reaching databot™ changes.

Cleaning the Leaf and Retesting:

- Use a damp cloth to carefully wipe the dust off the leaf.
- Measure the light intensity again and record the results.
- Compare the data before and after cleaning.

Repeating with Different Dust Types:

- Repeat the experiment with different powders (flour, talc, chalk dust).
- Record how each type of dust affects light absorption.

Create a histogram of the obtained values

Part 5: Concept Questions

Data Interpretation:

- Which type of dust blocked the most light? Why do you think that happened?

- What would happen if plants could not remove dust from their leaves?

- How does soil moisture affect the amount of light received by the plants?

- How could this experiment be expanded to study the effects of other soil properties, such as color or texture, on light reflection?

Part 6: Reflection

1. Were your initial predictions about dust and light absorption correct? Why or why not? What surprised you the most about the experiment results?

2. Were your predictions about soil moisture and light reflection correct? Why or why not? What surprised you the most about the results?