Light

Clear Water

Overview

In this experiment, we'll explore how human activity can affect the quality of water and how different filtration methods can help clean it. This experiment will simulate the impact of pollution on water quality and allow us to assess the effectiveness of filtration techniques. You'll understand how human actions, like dumping waste into water sources, can cause long-lasting environmental damage and how certain methods can help restore water quality. This lab connects water pollution to environmental protection, giving you hands-on experience with monitoring and improving water systems.

Background

Water is essential for all life on Earth, but its quality can be severely impacted by pollution. Pollutants, including plastics, chemicals, and industrial waste, can enter our water sources, affecting both the environment and human health. Over time, contaminants accumulate, making it difficult for aquatic life to thrive and for humans to access clean water.

Water filtration is a crucial process that helps remove harmful substances from water, making it safe to drink, use in agriculture, and release back into the environment. There are many types of filters, including sand, activated charcoal, and even natural materials like cloth. These filters can trap particles, absorb chemicals, and purify water to varying degrees. Understanding how filtration works can help us make informed decisions about preserving and restoring water quality, which is essential for maintaining healthy ecosystems and preventing further damage from pollution.

Grades: Middle School
Time: 45 Minutes
Subject: Earth Water
Topics: Water pollution

What You Will Need/Prep

- databot
- IOS/Android Smart Device
- Transparent glass or plastic cup
- Clean water
- Various pollutants (e.g., soil, oil, soda, food coloring, etc.)
- Different filtration materials
- Funnel, stirring stick or spoon
- Install Vizeey™ on your Smart device.
- Scan the QR code to load the experiment.
- 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.
- Study the background information.

You will simulate water pollution by introducing common contaminants and then use various filtration methods to purify the water. By measuring how light passes through the water at each stage, you will observe the impact of pollution on transparency and evaluate how effectively each filtration method restores the water's clarity. This experiment will provide valuable insights into the science of water purification.

Learning Objectives

In this investigation you will master the following knowledge and skills:

- Measure light transmission through clean and polluted water using databot™.
- Investigate the effect of various pollutants on water clarity.
- Test different filtration methods and measure their effectiveness.
- Record and analyze data to determine the best filtration technique.
- Understand the environmental impact of water pollution and how filtration helps restore water quality.

Important Terms

Light transmission: the amount of light that passes through a substance, which can be used to measure its clarity.

Water pollution: the introduction of harmful substances into water bodies, often as a result of human activity.

Filtration: the process of removing contaminants from water by passing it through a filter.

Contaminants: substances that pollute water, such as sand, oil, or chemicals.

Filter types: materials used to remove contaminants from water, including sand, cloth, activated charcoal, and paper.

Interesting Facts

Around 80% of water pollution comes from land-based activities, including industrial waste, agriculture runoff, and urbanization.

Clean water is a luxury in many parts of the world. According to the UN, 1 in 3 people lack access to safe drinking water.

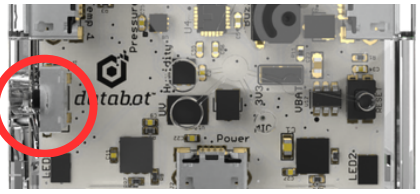
Natural filtration processes, like wetlands and soil filtration, play an essential role in cleaning water before it reaches rivers and lakes.

Some animals, like fish, can adapt to polluted environments, but many species face extinction due to long-term contamination.

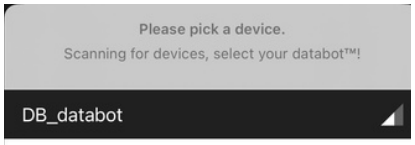
Using Vizeey

To work with the experiment, you need to run the Vizeey application. If you don't have it, you can download it from the Play Store or the App Store.

Turn on databot by pressing this button.



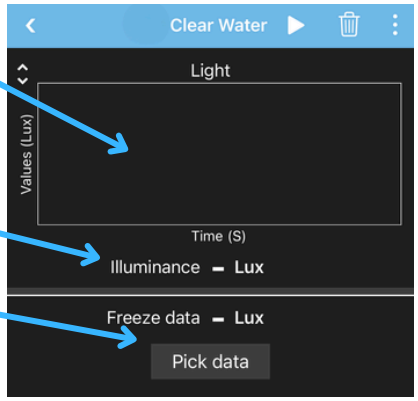
Then in the Vizeey app, select "**Add experiment from QR code**" and scan the QR code prepared for this experiment. Your experiment will appear in the list of experiments. When you start the experiment you will be immediately offered to connect to your databot.



Here you will see a graph that illustrates the changes in Illuminance over time.

Current Illuminance

You can fix the current Illuminance value by pressing this button



Safety Guidelines

Before starting the experiment, review these essential safety guidelines to ensure a safe and successful lab experience.

✅ General Safety Rules:

1. Handle materials carefully – avoid spilling water on electronics (databot™, computer, power outlets).
2. Wear protective gloves when handling contaminants like soil, oil, or activated charcoal.
3. Do not taste the water! Even after filtration, it may still contain invisible impurities.
4. Be cautious when cutting plastic bottles – use safety scissors and ask for adult supervision if needed.
5. Work on a stable surface to prevent cups from tipping over.

Part 1: Initial Observations and Questions

Before beginning the experiment, take a moment to observe and discuss the following:

Look at the clean water in the glass. How would you describe its appearance? What do you think makes it appear clear?

What are some common pollutants that can make water cloudy or dirty? Where do these pollutants come from in nature and human activity?

Have you ever seen water naturally filtered? (For example, rainwater soaking into the ground or passing through sand.) How do natural processes clean water?

What kinds of water filtration systems have you seen at home or in public places? What materials are commonly used for filtering water?

Part 2: Hypothesis

Before you start measuring with databot™, think about what you expect to discover about water pollution and filtration. A hypothesis is your best guess—your prediction—about what will happen, based on what you already know or imagine. Use the questions below to guide you in forming your own hypotheses for the two parts of this experiment. Write them down in the format: "I predict that… because…"

Water Pollution and Light Transmission

How do you think adding contaminants will affect the amount of light passing through the water?

Example: *"I predict that adding oil to the water will block more light than sand because oil spreads out and forms a thick layer on the surface."*

Light

Your turn:

I predict that _____ will block more light than_____because

_____

I predict that _____ will block more light than_____because

_____

Water Filtration

Which filtration method do you think will restore the water's clarity the best?

Example: *"I predict that activated charcoal will remove more contaminants than a paper filter because it can absorb tiny particles and chemicals."*

Your turn:

I predict that _____ will be the most effective at cleaning the water because

_____

I predict that _____ will be the most effective at cleaning the water because

_____

Part 3: Experiment Procedure

In this experiment, you'll use databot™ to simulate and measure water pollution and filtration. First, you'll test how different pollutants affect water clarity by measuring light transmission. Then, you'll experiment with various filtration methods to clean the water. Work in teams to find the most effective filter, record your results, and discover how science helps us protect water resources!

If you have multiple databots, consider dividing students into teams to run experiments simultaneously. Ensure that all teams begin with identical starting conditions, such as the same volume of water in each glass, for accurate comparisons.

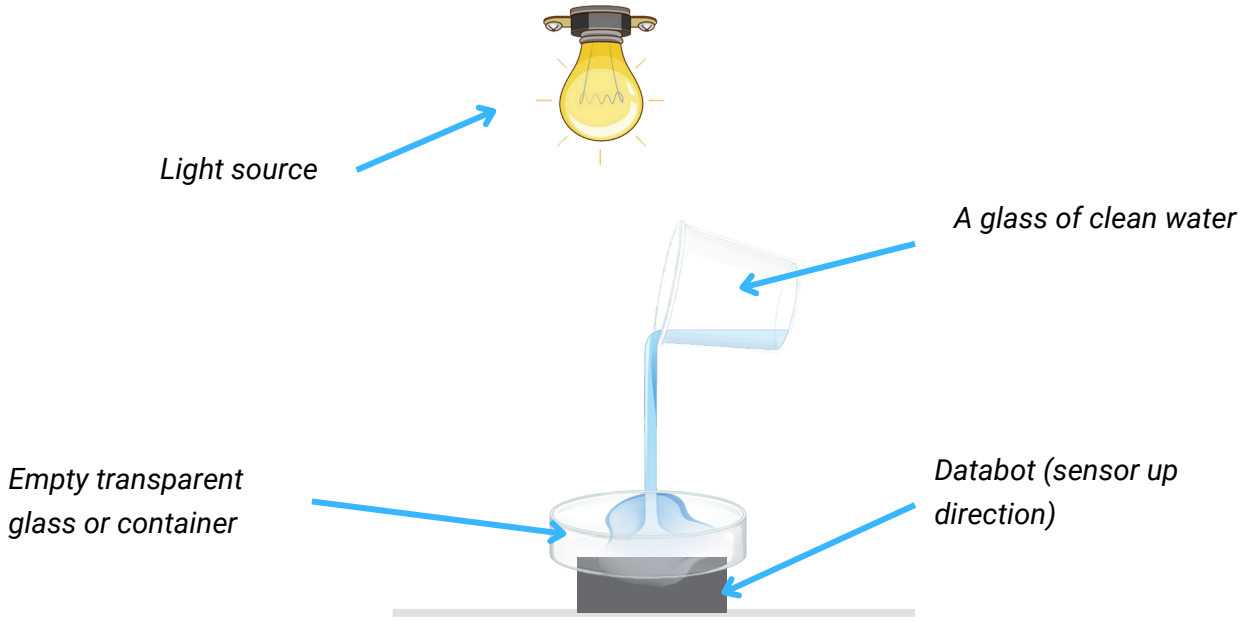
To deepen the investigation, assign each team a different pollutant. This will allow students to analyze how various contaminants affect water quality and filtration effectiveness.

If you're working with just one databot, conduct the experiment one step at a time, testing each pollutant separately. Be sure to keep the starting water volume consistent for reliable results.

Part 1: Measuring Water Pollution

Set Up the Experiment:

- Place databot™ on a stable surface.
- Position a clean, transparent cup on top of databot™ so that its light sensor can measure how much light passes through the water.
- Ensure the sensor is directly under the glass to get consistent readings.

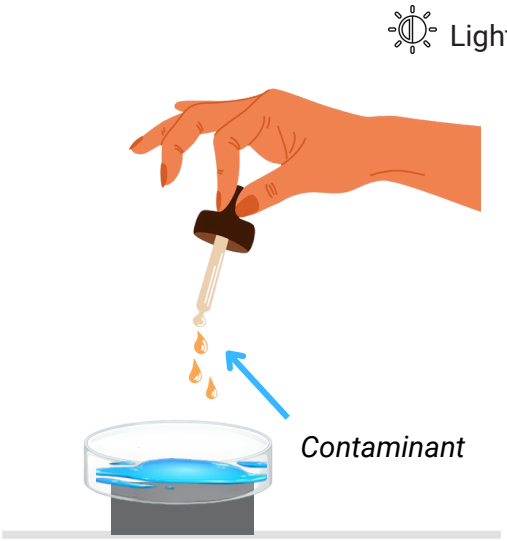


Do not change the position of the light source relative to the location of the databot. The light should fall on the databot equally from the beginning to the end of the experiment. If you suspect that students will move databot, it is better to stick it to the table with duct tape.

- Pour clean water into the glass.
- Tap on "**Clear Water** " 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.
- Record the initial light transmission reading from databot™. This serves as the baseline for comparison.

Initial light transmission for clear water _____ lux.

- Choose a contaminant (e.g., soil, oil, soda, or food coloring) and add a small amount to the water.
- Stir gently to mix.
- Observe how much the value changed compared to clean water.
- Test each pollutant separately, always starting with a fresh cup of clean water.
- Record the readings for each type of pollution in a data table.



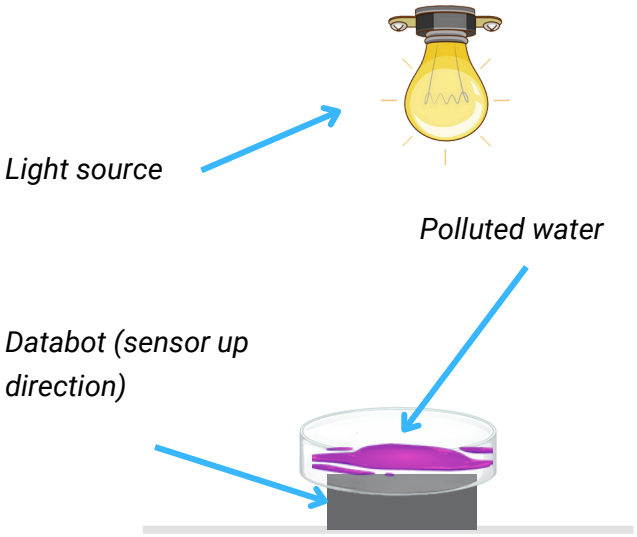
Initial light transmission for clear water_____ lux.

Type of Pollutant Added	Light Transmission After Pollution, Lux	Observations (color, clarity, etc.)

Part 2: Filtering the Polluted Water

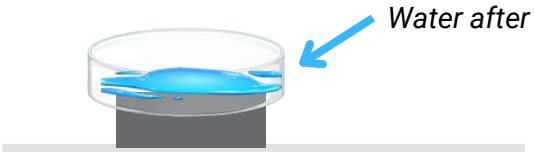
Set Up the Experiment:

- Place databot™ on a stable surface.
- Position a clear cup on top of databot™ so its light sensor can measure how much light passes through the water.
- Fill the cup with clean water and immediately pollute it (e.g., soil, oil, soda, or food coloring), or use the already polluted water from Part 1.



Light

- Tap on "**Clear Water** " 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.
- Record the light transmission of the polluted water using databot™.
- Write these values in the table below.
- Choose a filtering material (e.g., paper towel, coffee filter, sand, activated charcoal, or cotton).
- Place the filter in a funnel or the top half of a cut plastic bottle.
- Position an empty cup underneath to collect the filtered water.
- Slowly pour the polluted water through the filtering material.
- Observe how much contamination is removed.
- After filtration, place the purified water back into the databot™ and measure the light transmittance again.
- Record the data in the table
- Compare the results with the contaminated water and the original clean water.



Set Up the Filtration System

Initial light transmission for clear water_____ lux.

Filtering Material	Light Transmission - Polluted Water, Lux	Light Transmission- Filtered Water, Lux	Observations (Color, Clarity, etc.)

Light

How to Calculate Effectiveness

You should use clean water as your baseline to measure how effectively each filter restores clarity. By comparing the light transmission of the water after filtration to that of the clean water, you can determine the efficiency of different filtration materials. The closer the filtered water's clarity is to the original, the more effective the filter.

$$\text{Filtration Efficiency} = \left(\frac{\text{Filtered Water Transmission} - \text{Clean Water Transmission}}{\text{Clean Water Transmission}} \right) \times 100, \%$$

Field for your calculations

Which filter was the most effective? _____

Part 5: Concept Questions

How does filtration remove contaminants from water, and why is this important for water quality?

_____

_____

What happens to the light transmission as the water becomes more polluted?

_____

_____

Part 6: Reflection

Which filtration method was most effective in restoring clarity to the water? Why do you think this method worked best?

_____

_____

How does this experiment relate to the challenges communities face in maintaining clean water sources?

_____

_____