VOC Hunt

Overview

Have you ever noticed how the air feels different in a crowded room compared to being outside in the fresh air? Today, we're going to explore why that matters for our health. The air we breathe has a big impact on how well our lungs work and how we feel overall. Together, we'll investigate air quality, learn what makes air unhealthy, and discover ways to improve the air around us. Let's find out how we can protect our health by keeping the air we breathe clean!

Background

The air we breathe plays a critical role in our health. Clean air supports healthy lung function, while polluted air can harm the respiratory system and lead to health issues. Air quality is often affected by volatile organic compounds (VOCs)—chemical substances that evaporate into the air and are released from everyday items like cleaning products, paints, furniture, and even personal care items. Indoors, where we spend much of our time, VOCs can accumulate, reducing air quality.

Breathing in VOCs and other pollutants can irritate the respiratory system, causing symptoms such as coughing, difficulty breathing, or long-term health effects like asthma. Poor air quality can also impact overall well-being by reducing oxygen delivery throughout the body, which is essential for healthy functioning.

Our bodies naturally filter some airborne particles, but reducing exposure to harmful pollutants is crucial for maintaining respiratory health. This includes monitoring air quality, using natural or low-VOC products, ensuring proper ventilation, and avoiding activities that produce harmful emissions indoors.

Grades: Middle School
Time: 45 Minutes
Subject: Life Science
Topics: Understanding Air Quality, Introduction to VOCs, Data Collection and Analysis

What You Will Need/Prep

- databot with temperature sensor
- IOS/Android Smart Device
- Timer
- 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 and terms and prepare to explore!

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In this lab, you'll explore how air quality varies between environments by measuring VOC levels using the databot's VOC sensor. This experiment will help you understand the impact of air quality on health and how you can take steps to improve the air around you.

Learning Objectives

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

- Visualize, collect and analyze data
- Measure and record VOCs level in ppb
- Understand the Impact of Air Quality on Health
- Identify Common Pollutants: Recognize everyday sources of VOCs and other harmful substances that contribute to poor air quality.
- Propose Solutions for Healthier Air: Discuss practical strategies for improving indoor air quality, such as increasing ventilation, choosing low-VOC products, and minimizing exposure to pollutants.
- Apply Knowledge for Informed Choices: Use air quality data to make decisions that promote respiratory health and support overall well-being.

Important Terms

VOC (Volatile Organic Compounds): Chemical compounds that easily become vapors or gases at room temperature. They are emitted by everyday items like cleaning products, paints, and furniture, and can negatively impact air quality and respiratory health.

Air Quality: A measure of the cleanliness or pollution level of the air in a specific environment. Poor air quality is often caused by pollutants like VOCs, dust, and smoke, and can harm health.

Parts Per Billion (PPB): describes the concentration of something in air, water or soil.

VOC level in Parts Per Billion (ppb) in a room that can have a significant impact on health.

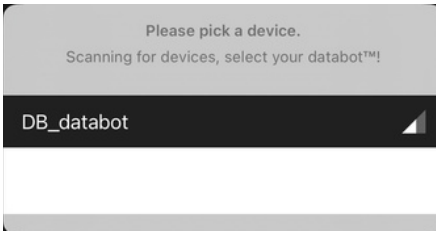
0-50 ppb Safe level. No noticeable effect on health. No action is required.
50-200 ppb Low level. May cause slight discomfort to sensitive people. Ventilate the room if necessary.
200-500 ppb Medium level. Headaches and dizziness may occur. Active ventilation is recommended.
500-1000 ppb High level. May cause nausea, fatigue, eye irritation. Conduct thorough ventilation.
1000-3000 ppb Dangerous level. Strong impact on health: weakness, nausea, irritation. Leave the room and ventilate.
3000+ ppb Very dangerous level. Serious toxic effects may occur. Evacuate and ventilate immediately.

Using Vizeey

In order to work with the experiment you need to launch 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.

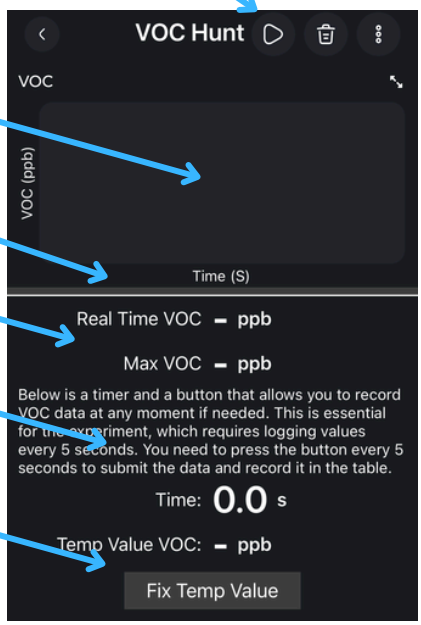
When you start the experiment you will be immediately offered to connect to your databot. Make sure that databot is enabled.



Once in the Experiment

Press this button to start the experiment

- Here you will see a graph of VOC change over time.
- Current VOC values
- Maximum VOC value obtained during the experiment
- Timer from the start of the experiment
- Button with the possibility to fix the intermediate VOC value in any second.
  - *Press it every time you want to fix the value. Previous data will not be saved.*



During the different experiments, you will capture VOC values at different intervals. Capture the VOC value and time by pressing the “Fix Temp Value” button (temp means “temporary”). Once you have captured the values, write them down in your data table and move on to your next data collection point.

Part 1: Initial Observations and Questions

What are some places where you think the air quality might be better or worse? Why? Write your thoughts below.

_____

_____

_____

How do you think poor air quality affects your body, especially your lungs?

_____

_____

Part 2: Hypothesis

Predict how VOC levels will differ in different environments, such as indoors versus outdoors, and explain why you think these differences might occur.

Prediction: _____

_____

_____

Part 3: Experiment Procedure

Work In Teams

Form two-person teams to collect data quickly and efficiently. One team member will carry the databot and place it near areas of suspected VOCs. The other team member will be monitoring the VOC levels on Vizeey and capturing data readings at set intervals. Working together, the team's goal is to successfully identify high levels of VOC concentrations and capture those values at the correct time intervals. There are multiple experiments, team member should swap roles so both can experience the different tasks.

Strategy

Your team objective is to capture the highest VOC value in each experiment. Use your knowledge of VOCs from this activity to hypothesize where you think the highest values will exist and make those areas priority targets in your explorations.

Capturing Data Points

The Vizeey experiment has a temporary "fix value" function that is useful for grabbing a data point at the correct time interval. You can also go back through your data set at the end of your experimental run and pick data points out using Vizeey tools. Do not erase your data set until you have completed filling out your data table and evaluating the data!

Part 3: Experiment Procedure

Baseline Measurement (Test):

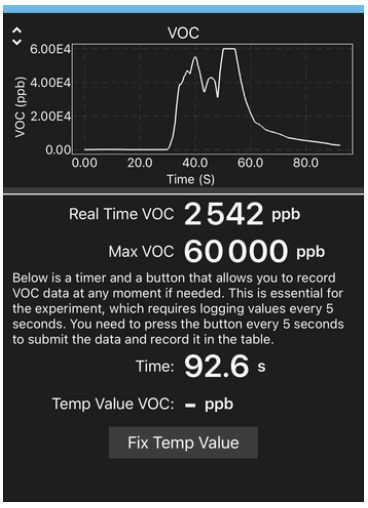
- Open the Vizeey app on your smart device.
- Turn on databot (using the small button on the left side)
- Tap on **"VOC Hunt"** in Vizeey to load the experiment.
- You will be prompted to connect to databot.
  - Hint- if there is more than one databot in use, the one closest to you will be in blue!
  - 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.
  - After testing, clear your data set and prepare for the activities!

Activity 1: Classroom VOC Hunt

Form two person teams, one student will be recording data, the other moving databot from point to point looking for VOC levels. The teacher will start a three minute timer at the beginning of the collection event. During the three minutes teams are challenged to find the highest source of VOCs in the classroom. The team with the highest VOCs level in three minutes wins. *Note: the databot VOC sensor's maximum value is 60,000 ppb.*

Activity 2: School VOC Hunt

In this activity, students explore different areas within the school to measure VOC levels and identify the location with the highest concentration. Working in teams of two, one student will carry databot while the other monitors the readings using Vizeey. Note: Student teams needs to stay close to maintain the Bluetooth connection between databot and the smart device.

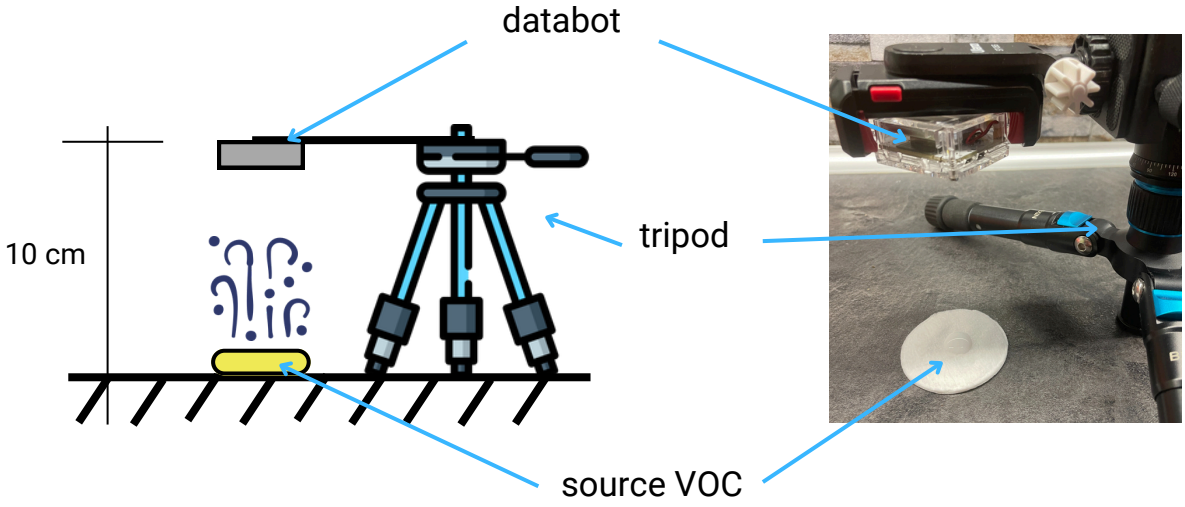


Before beginning, students must restart the experiment. Once the teacher signals the start and begins a 10-minute timer, teams will move around the school, measuring VOC levels and observing how they vary across different environments. The goal is to find the highest VOC concentration and return to the classroom within the time limit. Any data collected after the 10-minute mark will not be counted.

The winning team will be determined based on the highest recorded value displayed in the app's Max VOC field. If multiple teams achieve the databot's maximum reading of 60,000 ppm, the team that returns to the classroom first will win.

Activity 3: VOC Sources

- Continue with two-person teams, one will be managing the apparatus and the other will be recording VOC values and entering them into the data table.
- With your teacher, prepare potential sources of VOCs. These can be as simple as vinegar, acetone (nail polish remover), paint thinner, cleanser etc. Even lemon slices or other plant materials may be a source of VOCs. *Safety Notice! Handle any toxic substances with care and dispose of properly as instructed by your teacher.*
- Devise a mount of some kind to hold databot stable. In a lab setting you may have ring stands or other options. Shown here is a small tripod set up to hold databot in a fixed position. Place databot, battery side up, sensor side down at a height of about 10 cm. Fix the databot in this position on the mount. Beneath databot place a small dish to hold your experimental substances. Clean the dish between trials.



- Start Vizeey and begin recording VOC values. Now drop a material sample (e.g. vinegar) on the dish you prepared for your substances.
- As a team capture VOC values every five seconds for 40 seconds and document these values in your data table.
- When finished, clear your substance dish and aerate around the area to clear the databot sensor of any residual VOC particles in preparation for your next test.

Recommendations

- During the experiment, use the same amount of each substance in your experiments. For example, 1 ml or 1 drop of each substance so your comparisons are equal.
- If the experiment doesn't read any VOC levels, you may need to either increase the concentration of the VOC source or reduce the distance from the VOC source to databot. Or, you may conclude that the substance in question simply does not produce VOCs!

Part 3: Experiment Procedure

Data Collection Tables

Source of VOC_____

Time (s)	VOC (ppm)
0	
5	
10	
15	
20	
25	
30	
35	
40	

Average VOC_____

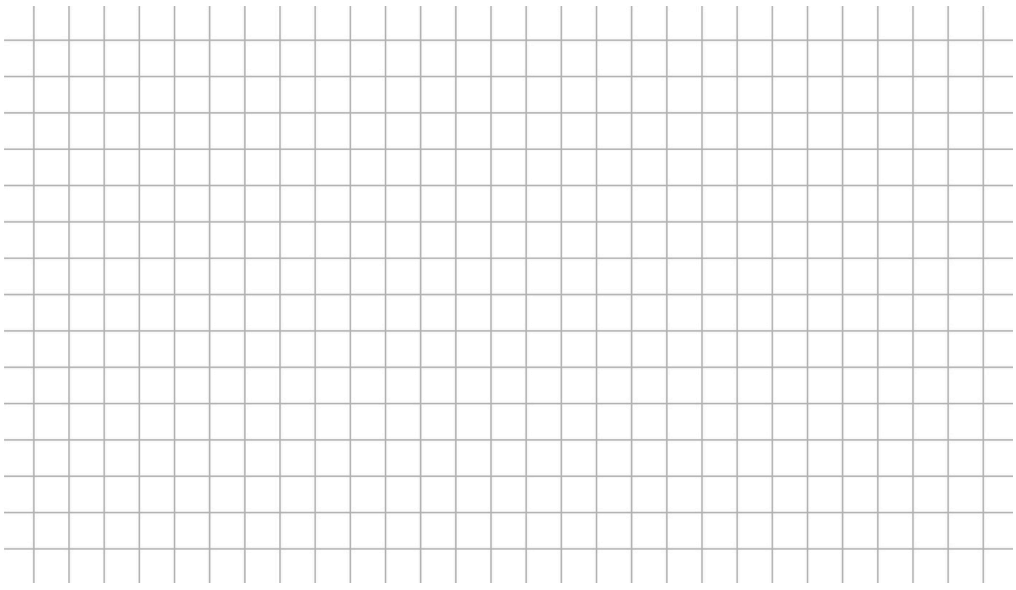
Source of VOC_____

Time (s)	VOC (ppm)
0	
5	
10	
15	
20	
25	
30	
35	
40	

Average VOC_____

Part 4: Data Analysis

1. Calculate the average VOC level of each source:
   - For each VOC source, calculate the average “ppm” level by adding up all readings at that location and dividing by the number of readings.
2. Plot the data :
   - You need to create a bar chart and represent each substance as a separate bar chart showing the average VOC level.
   - Mark different VOC sources in different colors on the same graph.



Part 5: Concept Questions

1. Which location had the highest VOC levels, and why do you think that is?

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2. Which location had the lowest VOC levels, and what might contribute to better air quality there?

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_____

3. How can VOC levels be reduced indoors?

_____

4. What levels of VOCs are considered safe?

_____

5. What substances off-gassed the most VOCs?

_____

Part 6: Reflection

1. What did you learn about how different environments impact air quality?

_____

2. What are some ways to improve indoor air quality?

_____

3. How can being aware of air quality help you make healthier choices in your daily life?

_____

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Part 7: Recommendations

- Ventilate Rooms Regularly: Opening windows helps remove indoor air pollutants and lets fresh air in.
- Avoid Using Strong Chemicals Indoors: Many cleaning products release VOCs; consider using low-VOC or natural cleaning products.
- Add Indoor Plants: Plants can help absorb some pollutants, improving indoor air quality.
- Reduce Dust and Clean Regularly: Dust and particles can affect air quality, so regular cleaning helps keep the air cleaner.