°CO2 CO2

Mission: Volcanic Vistas

Grades: 4 & Up
Time: 15 Minutes
Subject: Earth Science, Technology, Drones
Topics: **Volcanic Gases, Volcanic Activity, Seismic Activity, Volcanologist, CO2**

Overview

Recent **seismic activity** shaking the village has given the leadership concern that a new volcano may be waking up and will threaten their families, homes, and businesses. Your team will use a drone carrying a **CO2 sensor** that can detect **volcanic gases**, a tell tale sign of **volcanic activity**, to identify the volcano.

Background

You team, trained **volcanologists** and drone pilots, have been hired by the leadership of a remote village on the Indonesian island of Sumatra to investigate and identify a source of possible **volcanic activity**. Indonesia boasts the largest number of active volcanoes in the world and there have been many fatalities from surprise eruptions. Your mission is to provide the village leadership with solid data to help them determine if there truly is a new, **active volcano** and where it is located.

Volcanic gases are gases associated with **volcanic activity** and include water vapor, **CO2**, sulfur dioxide, hydrogen sulfide, and hydrogen halides. Magma contains these gases in dissolved form and as it rises to the surface and pressure decreases these gases are released and find their way to the surface through volcanic vents, fumaroles, the soil and other pathways to the atmosphere.

Important Terms

CO2 Sensor: Is an instrument for the measurement of carbon dioxide gas.

Seismic Activity: is the frequency and severity of earthquakes in a given region.

Volcanic Activity: An opening in the Earth's crust from which lava, ash, and hot gases flow or are thrown out during an eruption.

Volcanic Gases: Gases associated with volcanic activity and include water vapor, CO2, sulfur dioxide, hydrogen sulfide, and hydrogen halides.

Volcanologist: A geologist who focuses on understanding the formation and eruptive activity of volcanoes.

What You Will Need/Prep

- databot™ 2.0 & Vizeey™
- IOS/Android Smart Device
- Drone (Tello or larger)
- A method to top mount databot™ on the drone.
- Read the Vizeey™ Fast Start Guide and install Vizeey™
- Use Vizeey™ to scan the QR Code
- Baking Soda
- Vinegar
- 5 Large Paper Bags - grocery type
- One gallon jar to mix your chemicals

Volcano Hunter
Find the source of waking...

For Tello Users, download the free 3D printable mount for databot™. Download the zip file here.
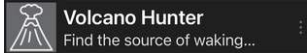
Mission:
Volcanic Vistas

## Mission: Wild Volcanos

Stalking the Wild Volcanos is a team mission. One teammate will be the data scientist, watching and capturing CO2 gas levels for each potential volcanic site. The other teammate, the pilot, is responsible for flying with precision. Flying as quickly as possible to visit each site get close enough to gather data, and move quickly on to the next location. The bags will inflate slightly when you fly close enough to gather CO2 readings.

- Carefully mount databot™ on your drone using 3D printable mounts or adhesive.

- Open the Vizeey™ App on your smart device

- Turn on databot™

- Tap on "Volcano Hunter" in Vizeey™ to load the experiment.

  Volcano Hunter Find the source of waking...

  Please pick a device. Scanning for devices, select your databot™! DB_databot Cancel

- 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.*

- Use these icons ▶ ⏸ at the top of the screen in Vizeey to start and to pause experiments.

- Use the trash can 🗑 icon to clear your dataset after each run.
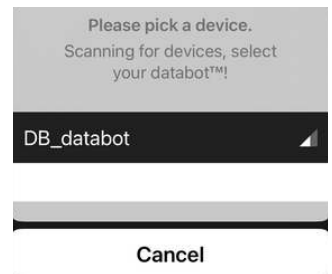
Sample Volcano Hunter
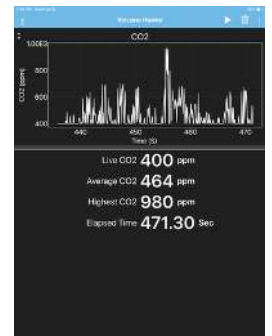
Practice:
  - Pilot: fly the course practicing controlled stops at each volcano and hover long enough for data to be collected. Return to home upon checking your last volcano. Your timed run ends at home.

  - Data Scientist: during practice monitor CO2 levels closely to determine a normal CO2 level. You will be looking for anomalous CO2 levels in your final run so pay close attention to "normal" levels. Practice starting and stopping so timing is accurate.

The Run:
Your facilitator will trigger the "volcano" and tell you to begin your run. Start the Volcano Hunter Experiment in Vizeey™ once the drone run starts. Vizeey™ is timing your run so don't begin the experiment early! Run the course as quickly as possible and identify the active volcano through the presence of CO2. Your timed run concludes upon reaching home. Screen capture your Vizeey™ results and present your final data including your identified volcano, if any, and your total run time. Good luck!

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Facilitator: Set up a staggered course 15-20 feet long with five numbered, paper-bag, "volcanoes" for teams to test. A school hallway is perfect. Don't place the volcanoes too close to the wall as it can make the piloting difficult. Place a book or other weight in the four dormant volcanoes and a gallon sized jar with 2c (500ml) vinegar in the active one. Allow students to conduct trial runs. Emphasize the need to inflate the grocery bag at each stop. For the final run, without the students seeing which volcano is active, you will add 1/2c (125ml) baking soda to generate CO2. For each team run, refresh the vinegar and add new baking soda. Have the students name their teams and put up a score board.

Note: CO2 is more dense than air and will settle to the bottom of the grocery bag. The downdraft from the drone propellors will cause a rush of CO2 to plume upward out of the bag and will be detected by databot™.

Challenge

Compete with other teams to record the highest CO2 data spike over an active volcano. Using a "known" volcano activate it for each team to fly over and capture data. Use the exact same mixture of baking soda and vinegar and clear the bag for each run to make it a consistent, fair challenge. What variables do you think will impact the data reading? Height above the bag? Hover control? Elapsed time from the activation? Good luck pilots and data scientists!

Code Challenge: Use DroneBlocks or other coding environment to program your drone to navigate the volcano field with perfect precision. Human versus machine - which provides superior results?!

Career Connection

Drone Pilot: A drone pilot or operator is responsible for flying a drone, or an unmanned aerial vehicle (UAV). Drone pilot jobs are available for many different professions including Photographer & Filmmaker, Surveyor, 3D Map Modeler, Powerline & Rooftop Inspector, Agriculture applications, and Search & Rescue. In addition, a wide variety of scientific fields are using UAV technology such as Volcanology as shown in this activity.

Volconologist: **Volcanologists** collect data about **volcanic activity** and study the findings. Typically they travel to locations where dormant or active volcanoes reside to collect samples. They examine this data, usually for one of three purposes: to understand why volcanoes behave the way they do, to understand how volcanoes work, and to predict future eruptions for the safety of local populations.

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Standards & Alignment

Science and Engineering Practices

- 2nd Practice: Developing and Using Models
- 3rd Practice: Planning and Carrying Out Investigations
- 4th Practice: Analyzing and Interpreting Data
- 5th Practice: Using Mathematics and Computational Thinking
- 6th Practice: Constructing Explanations and Designing Solutions
- 8th Practice: Obtaining, Evaluating and Communicating Information

ISTE Standards

- 1.1 Empowered Learner (1.1.d)
- 1.3 Knowledge Constructor (1.3.c)
- 1.5 Computational Thinker (1.5.b)
- 1.6 Creative Communicator (1.6.c)
- 1.7 Global Collaborator (1.7.b) (1.7.c) (1.7.d)

Disciplinary Core Ideas

- Chemical Reactions (MS-PS1-2)
- Earth's Systems (MS-ESS2-2)
- Natural Hazards (ESS3.B)

Crosscutting Concepts

- Patterns
- Cause and Effect
- Scale, Proportion, and Quantity
- Systems and System Models
- Energy & Matter
- Structure and Function
- Stability and Change

TEKS -Texas Essential Knowledge and Skills

Elementary Process TEKS
- 3.2D Scientific investigation and Reasoning: Analyze and interpret patterns in data
- 4.2D Scientific investigation and Reasoning: Analyze data and interpret patterns
- 5.2D Scientific investigation and Reasoning: Analyze and Interpret Information
- 5.2F Scientific investigation and Reasoning: Communicate valid conclusions

Elementary Level Content TEKS
- 3.7B Earth and Space: Investigate rapid changes in Earth's surface

Middle School Process TEKS
- 6.2E Scientific investigation and Reasoning: Analyze data to formulate reasonable explanations
- 6.3B Scientific investigation and Reasoning: Use models to represent aspects of the natural world
- 8.2E Scientific investigation and Reasoning: Analyze data to formulate reasonable explanations
- 8.3B Scientific investigation and Reasoning: Use models to represent aspects of the natural world

Middle School Level Content TEKS
- 6.5C Matter and Energy: Identify the formation of a new substance
- 6.10D Plate Tectonics: Describe how plate tectonics causes major geological events
- 8.5E Matter and Energy: Investigate how evidence of chemical reactions indicate new substances
- 8.9B Earth and Space: Relate plate tectonics to the formation of crustal features