ADEQ Arizona Department of Environmental Quality
Clean Air, Safe Water, Healthy Land for Everyone

Air Quality Monitoring PocketLab Lesson
Lesson Plan

Objective:

To study and record air quality readings by gaining an understanding of the significance of the readings along with the use of the correct vocabulary.

Standards:

- HS.E1.U1.14: Engage in argument from evidence about the availability of natural resources, occurrence of natural hazards, changes in climate, and human activity and how they influence each other.
- HS. L2.U1.19: Develop and use models that show how changes in the transfer of matter and energy within an ecosystem and interactions between species may affect organisms and their environment.

Vocabulary:

- Air Quality Index (AQI): A daily measure of the level of air pollution that goes from 0-500. With a value of 50 or less is good air quality, and a value above 100 exceeds the standard.
- Barometric Pressure: The weight of the atmosphere pressing down on the Earth at a specific elevation
- CO2: Carbon Dioxide.
- Dew Point: The temperature where water vapor condenses into liquid water.
- Heat Index: What the temperature feels like to the human body when relative humidity is combined with the air temperature.
- Light Intensity: The measurement of the light emitted or reflected by a source.
- Ozone (O3): A highly reactive, invisible, odorless gas composed of three oxygen atoms. It is both naturally occurring and a human-created product that occurs in Earth's upper atmosphere.
- Particulate Matter (PM): Tiny particles of solids or liquids that are in the air including dust, dirt, soot, smoke, etc.

Materials:

- Day 1: Index card, tape, vaseline or double-sided tape, map of campus, phone/computer for photographs.
- Day 2: Air Study: PocketLab Field Form, PocketLab/group, map of campus, phone/computer for photographs, magnifying glass, data collection Google form.

Phenomenon:

What is in the air? Students will test chosen locations around campus to determine what is in the air.

Day 1 Procedure:

1. Groups of 4 students will receive an index card with a 1-inch square drawn on it, along with a map of campus.
    a. Roles should be assigned to your students to help with equal participation.
        i. Student A: Photographer
        ii. Student B: Recorder
        iii. Student C: Observer
        iv. Student D: Index Card Placer

2. As a team, they will choose a specific area of their campus where they believe there will be evidence of particles/debris in the air and will record the location name on their card.
    - Examples include: parking lot, playground, field, near the doors, bus bay, parking lot, etc.

3. Before leaving the classroom, they will use either vaseline, or a square of double-sided tape to make this square "sticky." Add a written note to the index card that identifies that this is part of an air quality lab.

4. When at the chosen location, teams will place their index card at a height of 1 meter from the ground and tape it in place for 24 hours.
    a. Using the field form, record:

        Date
        Time
        Temperature
        Names Present
        Weather
        General Observations

    b. A photo should be taken when it is first hung up.

5. Students may choose to "stir up the air in the area" by doing a foot dragging motion to "kick up" particles/debris but this should be with a set number of "kicks" determined by the class. A photo should be taken after the area has been stirred up.

6. Students should then return to the classroom to investigate the different key vocabulary terms of this topic.

7. Download the app on the phone or the computer. Allow students to have time to make recordings in the classroom environment to become familiar with the field guide, the *PocketLab* and the app (see notes).

Day 2 Procedure:

1. After 24 hours, the students will return to their chosen locations to complete a PocketLab Data collection as well as to retrieve their index cards to then analyze their sample of particulates.

2. While at their locations, students will use the PocketLab to collect information on their Data Collection Sheet on the following categories that will include a column for data collection both before and after "stirring up the land." This will then be compared with the Purple Air monitors upon return to the classroom:

Date	*Dew Point*
Time	*Heat Index*
Temperature	*Light Intensity*
Names Present	*Ozone*
Air Quality Index	*Particulate Matter*
Barometric Pressure CO2	*General observations*

3. Photos will be taken of their index card, as well as their PocketLab for number verification.

4. Once returned to class, record, and compare the numbers to those across campus of both their index card sample using magnifying glasses, and of their PocketLab data collection sheet.
    - ***Teacher Note:*** *If you have more than one class, take an average for the area as your data point.*

5. Data should be shared using the ArcGIS survey123 (coming soon) that aligns to the field data sheet. This enables your data to be shared with other STEM classes within the state. The data can show broad trends and differences from different geographic regions. A Google Form is available until the survey123 is completed.

6. The numbers can be compared to a local PurpleAir device as well as ADEQ's website to help check for accuracy.

Data Analysis Questions & Follow Up Studies:

1. Collect data on indoor and outdoor air quality using PocketLab sensors. Analyze and compare the levels of pollutants such as carbon dioxide, particulate matter, and volatile organic compounds. Discuss factors that may contribute to differences in indoor and outdoor air quality.

2. Investigate the effects of human activities on air quality by conducting experiments in different environments (e.g., near a busy road, in a park). Measure pollutants such as nitrogen dioxide and carbon monoxide and analyze how human activities like traffic or industrial processes affect air quality.

3. Explore the relationship between weather conditions and air quality. Collect data on temperature, humidity, wind speed, and air pollution levels. Analyze the correlation between these variables and discuss how weather patterns influence air quality.
    a. ***Note:*** *Correlation does not necessarily mean causation.* For example, ozone needs sunlight to form. So, often, elevated ozone levels will correlate with higher temperatures. But, this is not always the case. For instance, if it's hot and windy, ozone could be lower. Also, if temperatures are taken near a concrete building or over asphalt, they will likely be locally higher, compared to temperatures over a grassy area. The idea is to have students review the data, make a hypothesis, and look at high level trends.

4. Examine the potential health effects of air pollution by researching common pollutants and their impact on public health. Use PocketLab data to measure pollutant levels in different environments and discuss how exposure to pollutants can affect respiratory health and overall well-being.

Extension Activities:

Brainstorm and implement strategies to reduce air pollution in a simulated environment. Measure baseline air quality using PocketLab sensors, then implement interventions such as reducing vehicle emissions or increasing green spaces. Monitor changes in air quality over time and evaluate the effectiveness of mitigation efforts.

Engage students in a community-based project to raise awareness about air quality issues and advocate for clean air policies. Use PocketLab to collect data on local air quality and collaborate with local organizations or government agencies to address pollution sources and promote sustainable practices.

Teacher Notes:

Day 1:

- **Quick Reference Guide – Air Quality Monitoring PocketLab Lesson**
- If you have students that are unable to travel around campus without guidance, you can move as a class to different locations around campus all together. You can still have teams choose the different locations, and still assign roles to the students.
- You may need to inform your maintenance/custodial team about the index cards and provide the correct types of tape to ensure that they stay up, don't damage paint, and are left undisturbed.
- The app can be downloaded onto a phone or computer, each group will need to have a device paired to the individual PocketLab.
    - **PocketLab**
    - **Trials | Notebook**
    - **Data collection corresponding Google form**

Day 2:

- Classroom Data Sheet
- The app can be downloaded onto a phone or computer and each group will need to have a device paired to the individual PocketLab.
- To compare your data to the closest Purple Air monitor please go to:
    - **PurpleAir Map**
- Check to see if any ADEQ or county air quality data is available near you:
    - **airdata.azdeq.gov/airvision**