STi | Sonoma Technology

Turnkey Air Sensor Kits for Education & Community Engagement

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Outline

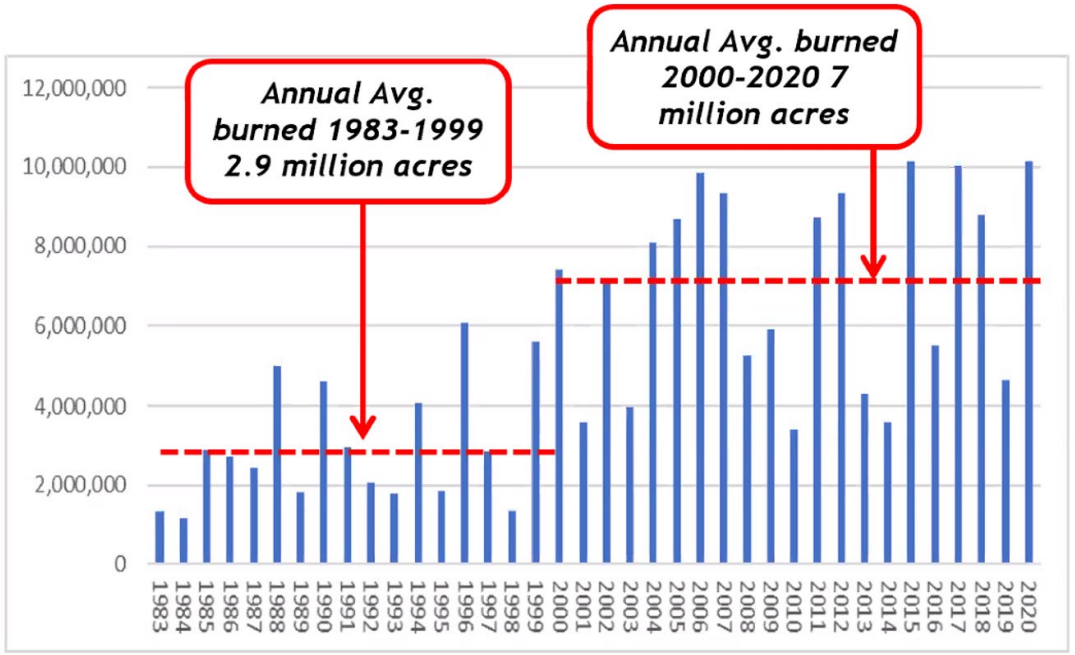
1. What barriers do educators and community groups face regarding implementing air quality and climate education?
2. How do turnkey kits provide a possible solution?
    1. Kids Making Sense Air Quality Kit
    2. Build a Sensor Kit
3. Lessons learned

Why is Air Quality Education Needed?

In 2019, 99% of the world's population lived in areas where air pollution exceeds safe standards [WHO].

There is increased national and international interest in understanding more about local air pollution.

This is especially true in the U.S. due to increased prevalence of wildfires.



- EPA Tools & Resources Webinar: How to evaluate Air Sensors for Smoke Monitoring Applications
- https://www.nifc.gov/fire-information/statistics/wildfires

What are the Barriers to Implementing Air Quality and Climate Education?

- Schools, colleges, community groups, and the general public are interested in air quality education.
- What key technical & logistical hurdles might these groups face?

May have little or no background on air quality

Where to begin?

May not have access to local data

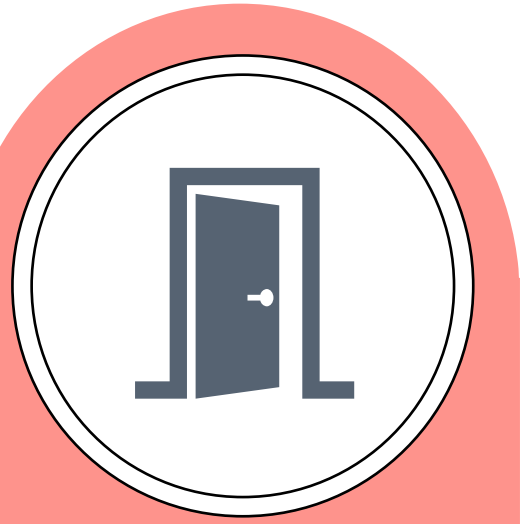
May need guidance on how to interpret data

May not have access to air sensor technology

May need knowledge on how to use air sensors

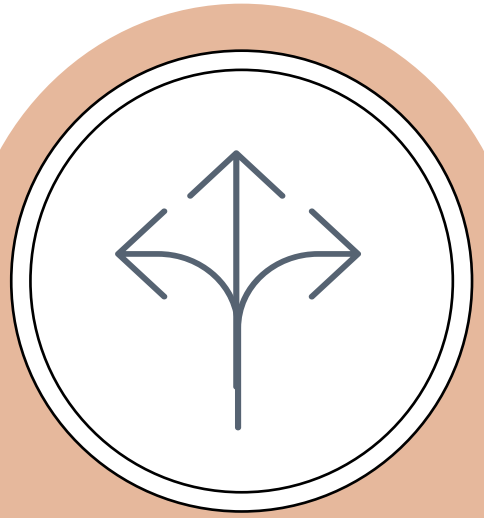
Turnkey Sensor Kits

➡ Turnkey sensor kits provide one possible solution to help bridge the gap for educators and community groups.



Access

Help fill the gap in both access to technology and information surrounding air quality.



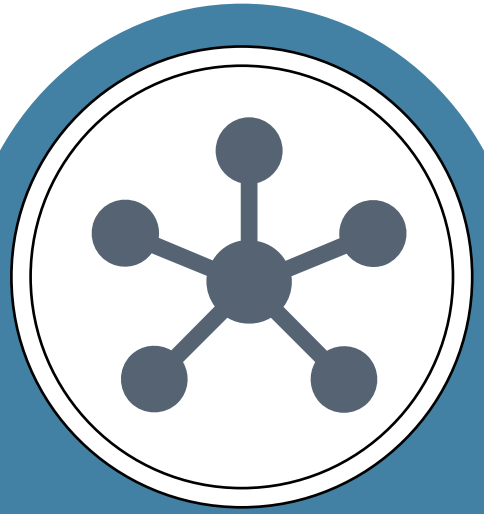
Flexible

Can be used in **school or community settings** to equip students and the public with **tools and knowledge** to measure their own air quality and take action.

Comprehensive

Includes **all components, curriculum, and parts** needed for lesson modules and activities to lower the barrier to implementation.

User friendly.



Versatile

Turnkey kits can be used as standalone tools, implemented into existing programs, or used as a component of developing programs.

Air Sensor Education & Community Programs

Two examples of turnkey kits that have been developed for this purpose:

Kids Making Sense

Audience

- 6-12 grade +
- 400 classrooms worldwide

Focus

- Air quality education
- Indoor and outdoor particulate matter (PM) measurements using handheld air sensors

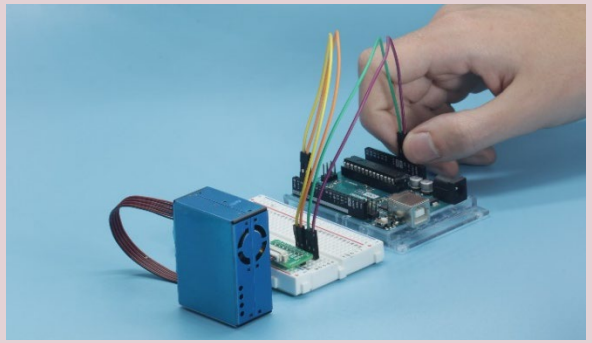
Build A Sensor Kit

Audience

- Blue Lake Rancheria/ 6-12 grade students

Focus

- Indoor PM air sensor build
- Electronics, coding, engineering



For each:

- Brief overview
- Implementation examples
- Significant outcomes from case studies
- Lessons learned for future turnkey kits

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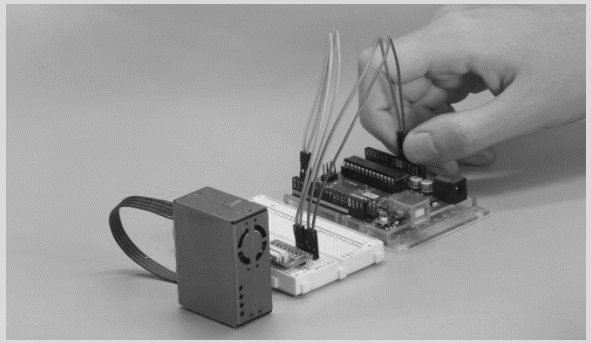

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Kids Making Sense ®

A **turnkey educational program** that teaches students how to measure air pollution using low-cost air quality sensors, interpret the data they collect, and take action to reduce emissions and exposure to air pollution.

History

- The program and its tools were developed and refined over 10+ years.
- The program has received support and collaboration from EPA's Office of Environmental Education, air districts, teachers, and community groups.
- To date, the program has been used in over 400 classrooms in the U.S. and abroad.

Benefits

- Increases awareness and empowers students to measure air pollution within their communities.
- Provides students with opportunities to interact with air quality scientists.
- Includes information on recommended actions to reduce exposure.

Program Components

kids making sense

Supplemental Curriculum

- Student Workbook (Grades 6-12)
- Teacher's Guide
- Labs and experiments
- Aligned with NGSS* & CC**

Small Sensors & Activity Kits

- Teaches about particulate matter
- Involves interactive data collection
- Turnkey and reusable

Data Visualization

- Data map for sharing and visualization
- Online resources

Zoom with a Scientist

- Classroom sessions with air quality scientists

Train the Trainer

- Training sessions with air quality experts available to help educators understand the topics, experiments, and support integration into existing lessons

Optional

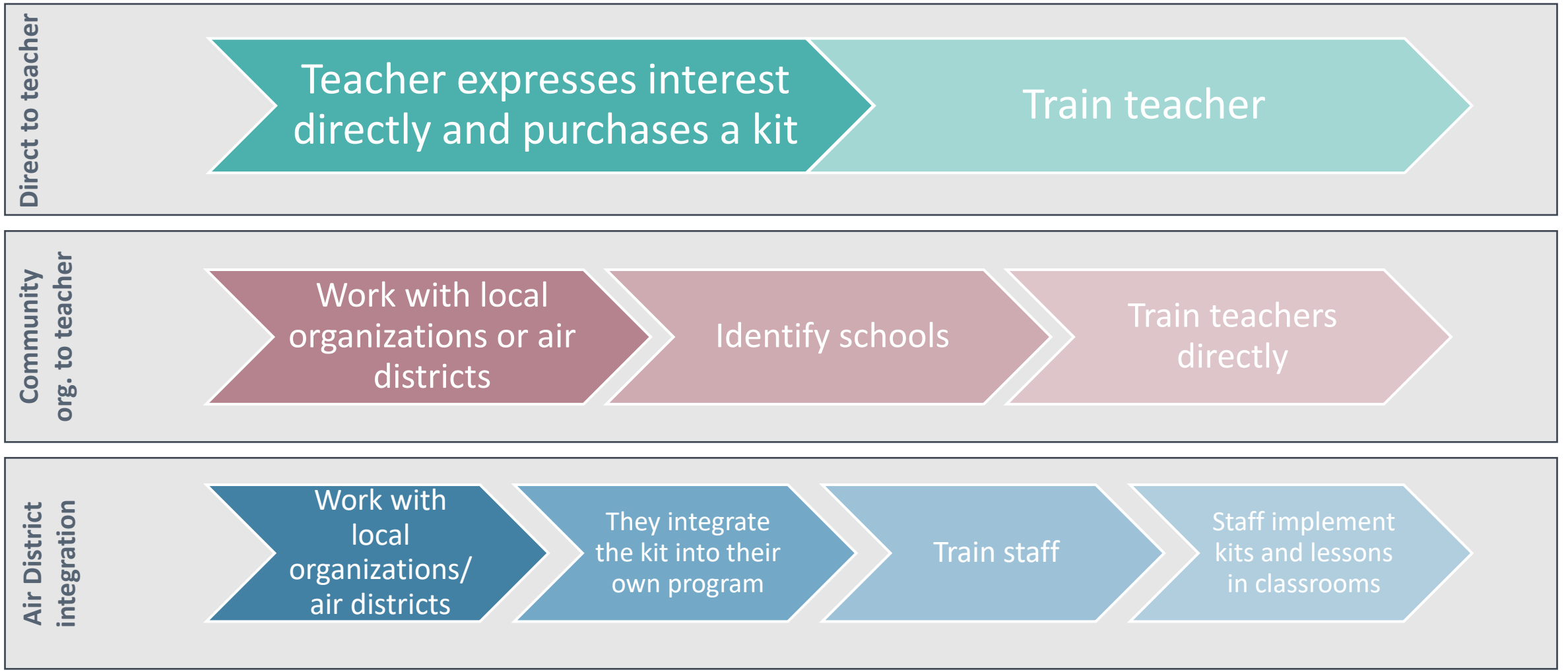
*NGSS= Next Generation Science Standards
**CC = Common Core

Standard Curriculum Overview

Eight Learning Activities

1. Our Air and Pollution
2. Particle Pollution
3. Particle Sources
4. Health Effects of Particles
5. Measuring Particles
6. Field Measurements (Sensor Experiment)
7. Data Analysis and Interpretation
8. Be Part of the Solution – Community Engagement

Bringing Kids Making Sense to Classrooms

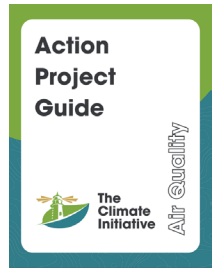


Flexible Implementation

kids making sense

Allows for a variety of implementation methods for schools and educational groups. Some examples:

- The Climate Initiative
  - Grassroots climate movement built on hands-on education and action
  - Learning lab created around Kids Making Sense
  - Ask from teachers: Action Project and reporting



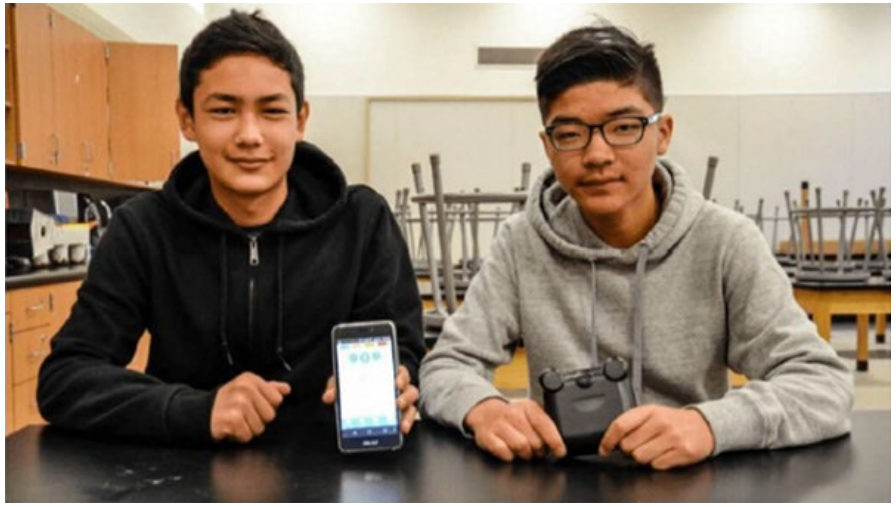
- Kids Action Through Science (Newcastle University)
  - Water security & sustainable development hub
  - Designed to engage children in climate change and youth action
  - Incorporated a module on air quality and climate via Kids Making Sense sensors and materials

Flexible kits and materials lower the barrier to including complex air quality and climate topics into existing programs.

Turnkey Programs Can Have Real World Impacts

- Classroom in Rosemead, CA, as part of the CLEAR program via Coalition for Clean Air.
- The teacher led students to measure freeway pollution on an overpass.
- Afterwards, some students stopped to get a drink at a fast-food restaurant next to the freeway.
- They were shocked to see red dots when they went into the restaurant indicating PM levels higher than over the freeway.
- The students presented their findings to a South Coast AQMD board member, school district superintendent, and school board member.

The board agreed to prioritize reconsideration of existing charbroiler emissions regulations.



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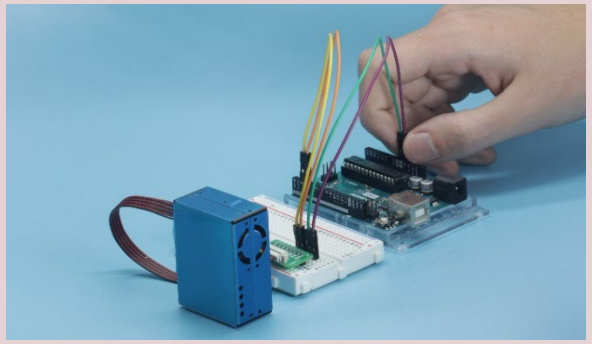

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Development of the "Build a Sensor" Kit

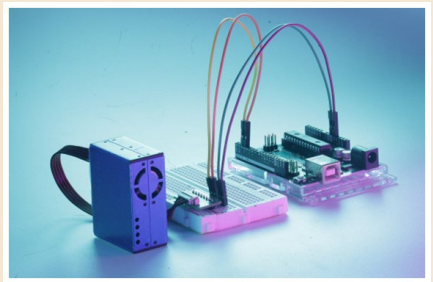
BLUE LAKE RANCHERIA
A Federally Recognized Tribe

- CARB funding source (via AB 617 CAPP)
- Blue Lake Rancheria; Launched in 2021
- The kit was developed to allow students to learn more about how air sensors operate by creating a working indoor air sensor
- Each kit comes with the necessary components and easy-to-follow instructions
    - Students are asked to test the sensor, code and critically think about the design
- Training was provided to participating educators

Program Components

Supplemental Curriculum

- Student Workbook (Grades 6-12)
- Teacher's Guide
- Build instructions and "design an experiment" module
- Aligned with NGSS* & CC**



Kit Components

- All components needed to build an indoor air sensor
- Plantower sensor, Arduino controller, breadboard, wires, USB cable
- Turnkey and reusable

Coding

- Downloadable code files
- Student version "missing" code with instructions for how to edit read-in data
- Teacher version of code included for reference

Teacher Support

- FAQ and troubleshooting guide for teachers who are less familiar with electronics
- Technical support via phone and email

Train the Trainer

- Training sessions with air quality experts available

Optional

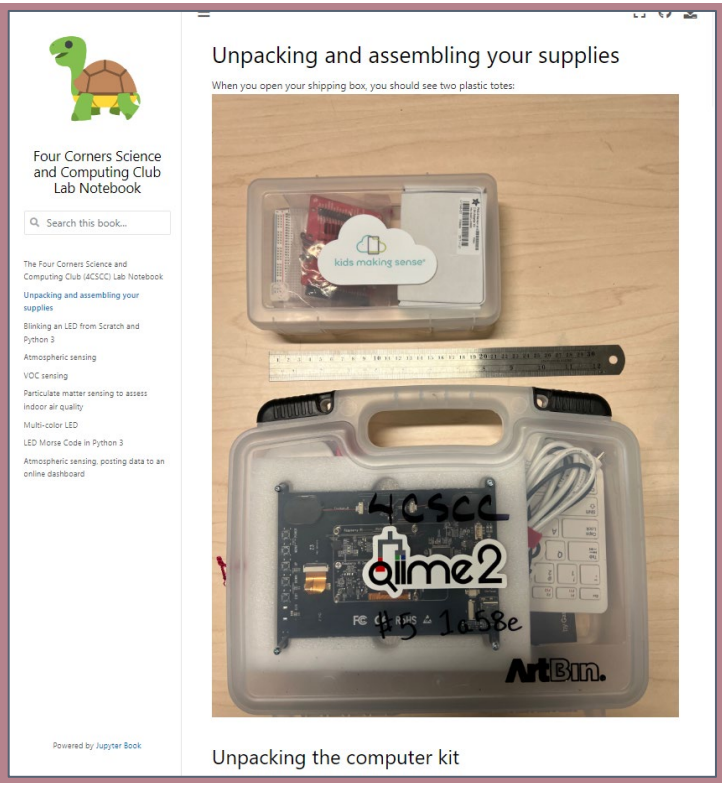
*NGSS= Next Generation Science Standards
**CC = Common Core

Flexible Implementation

ITEP and Northern Arizona University (NAU)

- Build a Sensor kits were combined with a separate Volatile Organic Compound (VOC) sensor kit developed by researchers at NAU to create a “DIY air sensor kit”
- Used as part of a summer school program with high school students during July 2022
- Plan to continue to integrate this material into environmental education outreach programs and disseminate to tribal schools

Image courtesy of Mansel Nelson, Mansel.Nelson@nau.edu



“I love this whole program.“

-BLR educator

“Relevant and easy to adjust curriculum.“

-BLR educator

Lessons Learned

Programs that engage participants with air sensor technology and practical knowledge of how to interpret data empower individuals to investigate their own environments.

- Hands-on training for educators is valuable.
- Providing access to continued technical support is key!

- The “train the trainer” approach can build capacity and provide sustainability.

- Kits with a modular curriculum:
  - makes integration into existing programs and structure simpler.
  - Lowers barrier to implementation.

- Turnkey kits that include all components needed for the activities covered make learning more equitable.
- User-friendly technology and data displays are a must for engagement.

Thank You!

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Resources

Kids Making Sense: www.kidsmakingsense.org

Acknowledgements

BLUE LAKE RANCHERIA
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Mansel Nelson
(NAU, ITEP)

The Climate Initiative

WATER SECURITY & SUSTAINABLE DEVELOPMENT HUB

(Kids Action Thru Science)