Resource Guide Air Sensor Loan Programs

(Version: July 2022)

Purpose: The purpose of this Resource Guide is to provide supplementary information for your Air Sensor Loan Program(s). This guide includes information about use and operation of air sensors, technical information about air sensors, air quality and air pollution information, educational resources focused on air sensors and air pollution, and other additional resources including topics focused on wildfire smoke, near-roadway pollution, and vegetation.

Disclaimer: Mention of trade names or commercial products does not constitute U.S. EPA endorsement or recommendation for use.

Air Sensors: Using Your Air Sensor

- ♦ Air Sensor Guidebook (U.S. EPA)
 - Guidance on using air sensors to collect measurements
 - https://www.epa.gov/air-sensor-toolbox/how-use-air-sensors-air-sensor-guidebook
- Sensor Educational Toolkit (South Coast Air Quality Monitoring District)
 - Guidance on using air quality sensors. Includes a guidebook on air quality project planning, operating sensors and understanding the data; sensor installation guides; data analysis and visualization tools; and training videos
 - http://www.aqmd.gov/aq-spec/special-projects/star-grant
- Sensor Collocation Guide (U.S. EPA)
 - Guidance on how to collocate air sensors with regulatory monitors
 - https://www.epa.gov/air-research/instruction-guide-and-macro-analysis-toolcommunity-led-air-monitoring
- ♥ Guide to Siting and Installing Air Sensors (U.S. EPA)
 - Information and considerations for locating an air sensor in both outdoor and indoor locations
 - https://www.epa.gov/air-sensor-toolbox/guide-siting-and-installing-air-sensors
- Sensor Siting and Installation Guide (South Coast Air Quality Monitoring District)
 - Guidance on how to locate and install air sensors: http://www.aqmd.gov/aqspec/resources/related-documents
 - English: http://www.aqmd.gov/docs/default-source/aq-spec/resources-page/aq-specsensor-siting-and-installation-guide_v1-0-(english).pdf
 - Spanish: http://www.aqmd.gov/docs/default-source/aq-spec/resources-page/sensorsiting-and-installation-guide_v1-0-(spanish).pdf
- Handbook for Citizen Science Quality Assurance and Documentation (U.S. EPA)

- Summarizes quality assurance and best practices for individual/community projects that include collection and use of environmental data
- https://www.epa.gov/citizen-science/quality-assurance-handbook-and-guidancedocuments-citizen-science-projects
- Scommunity Science Air Monitoring (*New Jersey Department of Environmental Protection*)
 - Guidance on using air sensors for community projects. Includes approaches to using sensors, types of sensors available, interpreting sensor data, four types of sensor projects and data quality assurance plan templates for each, and other helpful links
 - https://www.nj.gov/dep/airmon/community-science.html
- Blueprint for the Development and Implementation of Distributed Sensor Networks (developed as part of the U.S. National Institute of Standards and Technology Global Cities Team Challenge Transportation SuperCluster)
 - Blueprint that summarizes lessons learned, best practices, and research questions for developing and implementing sensor networks
 - https://static1.squarespace.com/static/5967c18bff7c50a0244ff42c/t/5ad7c41c758d4640
 41c7e58a/1524089886422/Distributed_Sensor_Networks_Recommendations.pdf

Air Sensors: About the AirBeam2 Sensor

- Solution Manufacturer's Resource (HabitatMap)
 - AirBeam2 technical specifications, operation, and performance
 - https://www.habitatmap.org/blog/airbeam2-technical-specifications-operationperformance
- Series Performance Evaluation by the South Coast Air Quality Management District, Air Quality Sensor Performance Evaluation Center (*South Coast Air Quality Monitoring District*)
 - AirBeam2 details and performance evaluation
 - http://www.aqmd.gov/aq-spec/sensordetail/habitatmap-airbeam2
- ♣ AirBeam2 Instructional Video (U.S. EPA)
 - Instructional video demonstrating how to use the AirBeam2 to collect particulate matter. Note that this video is based on the AirCasting app Android version 1.5.22 and images may not be the same on more updated versions of the app.
 - https://www.youtube.com/watch?v=JCXVFEsm6o8

Air Sensors: About the PurpleAir Sensor

- ✤ Manufacturer's Resource (PurpleAir)
 - PurpleAir types and technical specifications
 - https://www2.purpleair.com/collections/air-quality-sensors
- Service Air Map (PurpleAir)
 - Displays public PurpleAir sensors and their data from around the world
 - https://map.purpleair.com
- Service Air Community Forum (PurpleAir)
 - Users ask and answer questions about PurpleAir sensors and data
 - https://community.purpleair.com/
- Series Performance Evaluation by the South Coast Air Quality Management District, Air Quality Sensor Performance Evaluation Center (*South Coast Air Quality Monitoring District*)
 - PurpleAir PA-II model details and evaluation in the field and laboratory
 - http://www.aqmd.gov/aq-spec/sensordetail/purpleair-pa-ii

Air Sensors – Your Questions Answered!

- ♦ Air Sensor Toolbox (U.S. EPA)
 - Information and resources for topics related to air sensors
 - https://www.epa.gov/air-sensor-toolbox
- Sensor Performance Evaluation Center (South Coast Air Quality Monitoring District)
 - Field and laboratory evaluations of commercially available air sensors
 - http://www.aqmd.gov/aq-spec
- Videos on Air Sensor Measurements, Data Quality, and Interpretation (U.S. EPA)
 - Educational videos, in both English and Spanish, that can be used to learn how EPA collects and uses air quality data, how air quality health risks are communicated, and how to interpret data collected using air sensors
 - https://www.epa.gov/air-sensor-toolbox/videos-air-sensor-measurements-dataquality-and-interpretation
- South Coast Air Quality Management District, AQ-SPEC Hotline (South Coast Air Quality Monitoring District)
 - Hotline for air sensor-related questions ONLY
 - Phone: 909-396-2713
 - Email: info.aq-spec@aqmd.gov

Air Sensors and Air Pollution for Educators: Single-Lesson Activities

- Build Your Own Particle Sensor (Grades: 5-12) (U.S. EPA)
 - Lesson plan and instructions to build and program a particle sensor
 - https://www.epa.gov/air-research/air-quality-and-energy-choice-stem-activitieseducators
- Season of the search of th
 - Online interactive activity to explore factors affecting air quality index
 - https://www.nationalgeographic.org/activity/measuring-air-quality/
- Is that Smoke Affecting Me? Using Crowdsourced Public Data to Explore Air Quality During Smoke Events (Grades: 6 and up) (U.S. EPA)
 - Lesson plan using the PurpleAir sensor crowdsourced particulate matter measurements to explore air quality during smoke events. Lesson plan includes introductory slides, instructor guide, participant guide, and participant worksheet
 - https://www.epa.gov/air-sensor-toolbox/educational-resources-related-air-sensortechnology
- The Power of Plants! How Vegetation Can Help Protect us from Air Pollution (Grades: 6 and up) (U.S. EPA)
 - Lesson plan using the AirBeam2 sensor to learn about how certain types of vegetation can be used as a barrier against particulate matter. Lesson plan includes introductory slides, instructor guide, participant guide, and participant worksheet
 - https://www.epa.gov/air-sensor-toolbox/educational-resources-related-air-sensortechnology
- What is in the Outdoor Air? Exploring Particulate Matter (PM) Sources and Air Quality Outdoors (Age Levels: All Ages) (U.S. EPA)
 - Lesson plan using the AirBeam2 sensor to learn about outdoor air quality and sources of outdoor air pollution. Lesson plan includes introductory slides, instructor guide, participant guide, and participant worksheet
 - https://www.epa.gov/air-sensor-toolbox/educational-resources-related-air-sensortechnology
- Hidden Particulate Matter Indoors! Explore Your Environment (Age Levels: All ages) (U.S. EPA)
 - Lesson plan using the AirBeam2 sensor to learn about indoor air quality and sources of indoor air pollution. Lesson plan includes introductory slides, instructor guide, participant guide, and participant worksheet
 - https://www.epa.gov/air-sensor-toolbox/educational-resources-related-air-sensortechnology

- ✤ My Pollution Bubble! Exploring My Personal Particulate Matter (PM) Exposure (Age Levels: All ages) (U.S. EPA)
 - Lesson plan using the AirBeam2 sensor to learn about personal exposure to air pollution throughout a daily routine. Lesson plan includes introductory slides, instructor guide, participant guide, and participant worksheet
 - https://www.epa.gov/air-sensor-toolbox/educational-resources-related-air-sensortechnology
- School MIT Edgerton Center Arduino Particle Meter (Grades: Middle School to High School) (*MIT Edgerton Center*)
 - Instructions on building a handheld device to measure particulates in the air
 - https://edgerton.mit.edu/k-12-education/stem-projects

Air Sensors and Air Pollution for Educators: Multi-Lesson Activities

- Air Sensor Stories (Age Levels: All ages)
 (University of Rochester, University of North Carolina at Chapel Hill, University of Texas Medical Branch, Columbia University, & WE ACT for Environmental Justice)
 - Workshop materials including a presentation, facilitator guide, action plan worksheets, and air quality index handout related to air sensors and air quality
 - https://www.urmc.rochester.edu/environmental-health-sciences/communityengagement-core/projects-partnerships/air-sensor-stories-workshop/workshopmaterials.aspx
- StryEngineering Pollution Patrol (Age Levels: 8-18) (IEEE TryEngineering)
 - Full lesson plan and curriculum on building your own outdoor air pollution detector
 - https://tryengineering.org/teacher/pollution-patrol/
- State (Grades: K-12) (University of Colorado Boulder)
 - Database of educational materials on air quality and air pollution monitoring
 - https://www.teachengineering.org/curriculum/browse?q=air+quality+sensor
- Sir Quality InQuiry (AQ-IQ) (Grades: 9-12) (University of Colorado Boulder)
 - Unit for learning about air quality through designing and conducting a research project and presenting the results
 - https://www.teachengineering.org/curricularunits/view/cub_airquality_unit
- Sensing Air Pollution (Grades: 4-6) (University of Colorado Boulder)
 - Activity for learning about electricity and air pollution through building devices that measure indoor air pollutants
 - https://www.teachengineering.org/activities/view/cub_air_lesson09_activity3

- ♥ I Breathe WHAT?? (Grades: 6-7) (University of Colorado Boulder)
 - Build a device that allows students to capture and examine particles to understand how much dust, pollen, and other particles are present in the air
 - https://www.teachengineering.org/activities/view/cub_enveng_lesson07_activity1
- Lesson Plans, Teacher Guides, and Online Environmental Resources for Educators (Grades: K-12) (U.S. EPA)
 - Collection of environmental and science-based lesson plans, activities, and ideas from EPA, other federal agencies and external organizations
 - https://www.epa.gov/students/lesson-plans-teacher-guides-and-onlineenvironmental-resources-educators
- 🏷 Learn About Air (Age Levels: 5-7)

(Scottish Environment Protection Agency & North Lanarkshire Council)

- Contains guides for teachers, history lessons, pollutant activities, monitoring and measurement activities, and information about air quality around the world
- http://www.learnaboutair.com/primary_home.html
- Clean Air Program for Elementary Students (CAPES) (Grades: K-5) (South Coast Air Quality Monitoring District)
 - Program for elementary school teachers in los Angeles, Orange, Riverside, and San Bernardino counties, California, that provides elementary-level curriculum and educational materials about air quality
 - https://www.teachengineering.org/activities/view/cub_enveng_lesson07_activity1
- Why Healthy Air Matters Program (WHAM) (Grades: 6-12) (South Coast Air Quality Monitoring District)
 - Program for middle and high school teachers in los Angeles, Orange, Riverside, and San Bernardino counties, California, that provides age-appropriate hands-on activities and curricula about air quality.
 - http://www.aqmd.gov/home/programs/education/wham
- AirU Teaching Modules (Grades: 3-12)

(AirU, University of Utah College of Engineering)

- Activity-centered teaching modules developed for instructors to use when teaching about air quality. Each module includes a lesson plan, and many include slides and videos.
- https://airu.coe.utah.edu/teaching-modules/
- Section and Outreach (Grades: Pre-K-12) (*Wisconsin Department of Natural Resources*)
 - Educational programs for preschool through high school audiences to learn about air pollution and improving air quality
 - https://dnr.wisconsin.gov/topic/AirQuality/Outreach.html
- Sclean Air, Healthy Children (Grades: Preschool) (Wisconsin Department of Natural Resources)
 - Teacher's guide and activities for young children to learn about respiratory health issues and air pollution
 - https://widnr.widen.net/s/wpb7dx2m55/am603

- ♥ Village Green Project Lesson Plans (Grades: K-8) (U.S. EPA)
 - Community-based air quality monitoring project with lesson plans
 - https://nepis.epa.gov/Exe/ZyPDF.cgi/P100UA3G.PDF?Dockey=P100UA3G.PDF
- Research Education on Air and Cardiovascular Health (REACH) (Grades: 6-12) (University of Montana)
 - Curriculum integrating wearable fine particulate matter (PM_{2.5}) monitors to help students learn about PM_{2.5}, cardiovascular health, and population health
 - http://health.umt.edu/reach/curriculum/default.php

Big Picture – Air Quality in Context

- ↔ AirNow (U.S. Federal, tribal, state, & local agencies)
 - Provides the Air Quality Index (AQI) that tells you how clean or polluted your outdoor air is, along with associated health effects that may be of concern. The AQI converts air pollution data from regulatory monitors into numbers and colors to help the public understand when to take action to protect health
 - https://airnow.gov/
- Scriteria Air Pollutants (U.S. EPA)
 - Information about criteria air pollutants that are regulated by the U.S. Environmental Protection Agency (EPA) under the Clean Air Act
 - https://www.epa.gov/criteria-air-pollutants
- Standards (NAAQS) (U.S. EPA)
 - Information about EPA's NAAQS program for criteria air pollutants
 - https://www.epa.gov/naaqs
- ♦ National Air Quality Trends (U.S. EPA)
 - Information about status and trends of key air pollutants
 - https://www.epa.gov/air-trends
- ♦ Daily Air Quality Tracker (U.S. EPA)
 - Database of outdoor air quality data collected from state, local, and tribal monitoring agencies across the United States
 - https://www.epa.gov/outdoor-air-quality-data
- Solution Overview of EPA's Air Research Program (U.S. EPA)
 - Information about air research conducted at EPA including work on air sensors
 - https://www.epa.gov/air-research
- Indoor Air Quality (U.S. EPA)
 - Information on indoor air pollution, causes, health effects, and environmental justice
 - https://www.epa.gov/indoor-air-quality-iaq/introduction-indoor-air-quality

- Service Pollution and Your Patients' Health (U.S. EPA)
 - Training course on particle pollution for healthcare professionals
 - https://www.epa.gov/pmcourse

Air Quality and Air Sensor Education Programs

- SirNow Air Quality Educational Resources for Teachers (Grades: K-12) (U.S. EPA)
 - Lesson plans and activities related to air pollution and air quality
 - https://www.airnow.gov/education/teachers/
- ✤ AirNow Education Page (Age Levels: All ages) (U.S. EPA)
 - Educational resources for teachers, students, healthcare professionals, and weathercasters
 - https://www.airnow.gov/education/
- Sids Making Sense (Age Levels: Kids) (Sonoma Technology)
 - Kit that includes air sensors, smart phones, a teacher's guide, student workbooks and an in-person teacher training workshop for hands-on science activities
 - https://kidsmakingsense.org/
- Solution AQ Egg (Grades: K-12; Higher education) (Wicked Device LLC)
 - A customizable air quality sensor with accompanying curriculum
 - https://airqualityegg.com/home
- Speck Sensor (Grades: K-12) (AirViz Inc.)
 - An indoor air quality monitor with curriculum and lesson plans
 - https://www.specksensor.com/
- Air Pollution: What's the Solution? (Grades: 6-12) (Center for Innovation in Engineering and Science Education, Stevens Institute of Technology)
 - Educational project with lesson plans for students. Uses online real-time data to study the causes and effects of outdoor air pollution
 - http://ciese.org/curriculum/airproj/
- Sclean Air Make More (Grades: K-12; Educators) (Maricopa County Air Quality Department, AZ)
 - K-2 Lesson plans, online classes, and activity pages. Also offers an air pollution virtual escape room, non-formal education guide and virtual training, and virtual professional development
 - https://cleanairmakemore.com/education/
- Will the Air Be Clean Enough to Breathe? (Grades: 6-12) (The Concord Consortium)
 - An air quality module with six activities
 - https://authoring.concord.org/sequences/389
- Love My Air Denver (Grades: Elementary through high school) (Colorado Department of Public Health & Environment)
 - Curricula and lesson plans related to air quality

- http://www.lovemyairdenver.com
- ✤ AirActions (Grades: 6-12) (AirActions)
 - Curriculum, experimental labs, air sensors, and mapping technologies to empower students to learn, measure, and find solutions to improve local air quality
 - http://airactions.org/

Additional Resources – Books, Curriculum, Programs, Tools, and Other Useful Resources Related to Air Quality

- ♦ Why is Coco Orange? (U.S. EPA)
 - Book for children (ages 4-8) on air quality and how to stay healthy when air quality is bad
 - English: https://www.airnow.gov/publications/why-is-coco-orange/why-is-cocoorange-picture-book/
 - Spanish: https://www.airnow.gov/publications/air-quality-flag-program-enespanol/coco-book-spanish/
- ♦ Why is Coco Red? (U.S. EPA)
 - Book for children (ages 4-8) about wildfire smoke, air quality, and health
 - English: https://www.airnow.gov/publications/why-is-coco-red/why-is-coco-redpicture-book/
 - Spanish: https://www.airnow.gov/publications/why-is-coco-red-en-espanol/why-iscoco-red-picture-book-en-espanol/
- ♦ Air Quality Flag Program (U.S. EPA)
 - Program that uses brightly colored flags based on the EPA's Air Quality Index (AQI) to notify people and their communities about outdoor air quality conditions
 - English: https://www.airnow.gov/air-quality-flag-program/
 - Spanish: https://www.airnow.gov/air-quality-flag-program-in-spanish/
- Section 2017 Secti
 - Lesson plans, activity sheets, coloring page, games, and more related to air pollution and air quality
 - https://www.airnow.gov/air-quality-flag-program-classroom-curriculum-publications/
- ↔ Air Cleaners and Air Filters in the Home (U.S. EPA)
 - Information on portable air cleaners, heating ventilation and air conditioning (HVAC) filters, and furnace filters commonly used in homes
 - https://www.epa.gov/indoor-air-quality-iaq/air-cleaners-and-air-filters-home
- Section 2014 Section 2014 Section 2014 Section 2014 Section 2014 (U.S. EPA)
 - Environmental justice mapping and screening tool that provides demographic and environmental information for that area. Environmental indicators include air toxics, diesel particulate matter, fine particulate matter, ozone, traffic counts at major roads, and others.
 - https://www.epa.gov/ejscreen

- ♦ EnviroAtlas (U.S. EPA)
 - Provides geo-spatial data, easy-to-use tools, and other resources related to ecosystem services. Ecosystem services are the benefits humans receive from nature such as clean air, clean water, and protection from natural hazards. Also includes educational materials associated with EnviroAtlas.
 - https://www.epa.gov/enviroatlas

Wildfire, Wood Burning, and Wood Smoke Resources

- Smoke-Ready Toolbox for Wildfires (U.S. EPA)
 - List of resources to help educate people about the risks of smoke exposure and actions they can take to protect their health
 - https://www.epa.gov/smoke-ready-toolbox-wildfires
- SirNow Fire and Smoke Map (U.S. EPA & U.S. Forest Service)
 - Displays information on ground level air quality monitors recording fine particulate matter (PM_{2.5}) from smoke and other sources, as well as information on fires, smoke plume locations, and special statements about smoke issued by various sources
 - https://fire.airnow.gov/
- Wildfire Smoke: A Guide for Public Health Officials (U.S. EPA & federal, tribal, state, & local partners)
 - Guide designed to help local public health officials prepare for smoke events, to take measures to protect the public when smoke is present, and communicate with the public about wildfire smoke and health
 - https://www.airnow.gov/publications/wildfire-smoke-guide/wildfire-smoke-a-guidefor-public-health-officials/
- ♥ Wildfires and Indoor Air Quality (U.S. EPA)
 - Information on how to reduce your exposure to wildfire smoke inside your home
 - https://www.epa.gov/indoor-air-quality-iaq/wildfires-and-indoor-air-quality-iaq
- Section 2018 Wildfires and Indoor Air Quality in Schools and Commercial Buildings (U.S. EPA)
 - Information for building owners and managers, school facility managers, public health officials, and emergency managers to reduce smoke levels in buildings during wildfires and prescribed burns
 - https://www.epa.gov/indoor-air-quality-iaq/wildfires-and-indoor-air-quality-schoolsand-commercial-buildings
- Smoke Sense Study: A Citizen Science Project Using a Mobile App (U.S. EPA)
 - Crowdsourcing, citizen science research project focused on increasing public awareness and engagement related to wildfire smoke health risks
 - https://www.epa.gov/air-research/smoke-sense-study-citizen-science-project-usingmobile-app

- ⇔ EPA Burn Wise Educational Materials (U.S. EPA)
 - Educational materials related to wood burning and wood smoke
 - https://www.epa.gov/burnwise/forms/order-form-burn-wise-educational-materials
- Separation State S
 - Activity book that teaches children about wood smoke and ways their family can reduce smoke from wood burning (for grades K-3)
 - https://www.epa.gov/burnwise/wood-smoke-activity-book

Near-Road Pollution and Roadside Vegetative Barriers Resources

- Best Practices for Reducing Near-Road Pollution Exposure at Schools (U.S. EPA)
 - Information to help school communities identify strategies for reducing traffic-related pollution exposure at schools
 - https://www.epa.gov/schools/best-practices-reducing-near-road-pollution-exposureschools
- Sear Roadway Air Pollution and Health: Frequently Asked Questions (U.S. EPA)
 - Summary of frequently asked questions about near roadway air pollution and what EPA is doing to address this important health issue
 - https://www.epa.gov/sites/default/files/2015-11/documents/420f14044_0.pdf
- EPA Recommendations for Constructing Roadside Vegetation Barriers to Improve Near-road Air Quality (U.S. EPA)
 - Fact sheet summarizing research findings on the best practices for building roadside vegetative barriers to improve air quality
 - https://www.epa.gov/air-research/recommendations-constructing-roadsidevegetation-barriers-improve-near-road-air-quality
- 🤟 Using Vegetative Barriers to Improve Air Quality Activities and Lessons (Grades: K-5) (U.S. EPA)
 - Vegetative barriers, which include trees and bushes, can help reduce pollution near busy highways and roads. Lesson plans and activities have been developed that focus on air quality, air sensors, air pollution, and the impact of air pollution on human health.
 - https://www.epa.gov/air-sensor-toolbox/educational-resources-related-air-sensortechnology

Vegetation and Gardening Information

🗞 i-Tree

(U.S. Forest Service, Davey Tree Expert Company, The Arbor Day Foundation, Society of Municipal Arborists, International Society of Arboriculture, Casey Trees, & SUNY College of Environmental Science and Forestry)

- Information on the benefits that trees and forests provide in different settings
- https://www.itreetools.org/
- ♥ Native Gardening (U.S. Forest Service)
 - General information about gardening with native plants
 - https://www.fs.fed.us/wildflowers/Native_Plant_Materials/Native_Gardening/index.sht ml
- School Gardening (Purdue University)
 - Information about integrating school gardens into a curriculum
 - https://www.purdue.edu/dffs/farmtoschool/resources/
- Scommunity Gardening (U.S. Department of Agriculture)
 - Information on developing, planning, maintaining, and sustaining community gardens
 - https://www.nal.usda.gov/afsic/community-gardening