Air Sensor Stories Workshop Facilitator Guide

This workshop was developed to help diverse audiences understand the potential of user-friendly air particle sensors to address communities' air quality questions and concerns. It provides a basic introduction to the sources, regulations, and health effects of fine particulate matter (PM 2.5), an overview of the many user-friendly models of air particle sensors on the market, and an interactive "Action Plan" activity to help participants apply what they have learned to a real problem. Optional interactive activities are provided to help participants explore key concepts and how sensors work. The workshop is designed to take between 1 and 3 hours, depending on how many hands-on activities are integrated.

Upon completion of this activity; participants are expected to be able to:

- Define particle pollution, where it comes from, and how it can harm human health.
- Give two examples of how community members have used user-friendly air sensors to address their questions about air quality.
- Explain the potential and limitations of user-friendly air sensors for community use.

Materials Needed

- PowerPoint presentation
- Copies of *Air Monitoring Action Plan* worksheet, one per participant.
- Pen or pencil, one per participant.
- Optional:
    - Copies of *Guide to the Air Quality Index*, one per participant.
    - One or more user-friendly air sensors for demonstration purposes.
    - Materials for any of the optional "Fun with Sensors" activities you plan to incorporate.
    - Access to internet to explore current Air Quality Index information.
    - Copies of participant feedback form, one per participant.

Instructor Preparation

- Prior to conducting this activity assemble required materials (see above); if tables or desks are available, set out Action Plans, handouts, and pens/pencils for participants.
- Familiarize yourself with the PowerPoint. If you need additional information on air quality, health effects, or air sensors, explore the links on the last slide. For information regarding Socioeconomic Status and Air Quality, please see the EPA website using this link: https://www.epa.gov/pmcourse/particle-pollution-exposure#groups
- Review the "Presenter Notes" below each slide. Note that these are not intended to be read verbatim, but rather to guide discussion. Pay particular attention to the "Ask the Audience" prompts and consider which are appropriate to your audience, learning goals, and timeline. You may wish to print the presenter notes for ease of reference during presentation.
- [Optional] Customize the PowerPoint to your state/locale: Insert state-specific information on location of EPA monitoring station into slide 12 and screenshots of current AQI data for your location into slides 14 and 15 – OR – if you will have internet access you can explore these websites in real-time during workshop.
- [Optional] Decide whether or not you will incorporate any of the "Fun with Sensors" activities and assemble needed materials.
- Secure access to a screen and projector.

Instructions

1. Before beginning the PowerPoint presentation, ask participants what are their main interests/questions/ concerns about air pollution.
2. Show the Action Plan and explain that after the presentation, everyone will have an opportunity to complete an Action Plan related to their interest/concern.
3. Present PowerPoint.
4. Pause at "Acknowledgements" slide to ask if there are any questions.
5. Transition to Action Plan activity. Depending on audience and time allowed, options include:
    a. Identify one participant's air quality concern and talk through developing an Action Plan.
    b. Have participants develop individual Action Plans, share in pairs or groups, then share key themes, questions, or challenges with whole group.
    c. If you have one or more sensors available, one group can experiment with the sensor while another works on Action Plans.
    d. Note that the back of the Action Plan includes things to think about when choosing a sensor, which may or may not be relevant for your audience.
6. Debrief the activity by asking participants whether they plan to use a sensor, which type, how, and where to get answers to remaining questions. After completing the workshop, participants may wish to navigate EPA's Air Sensor Toolbox to address remaining questions.
7. Evaluate your session! A template evaluation form, *Air Sensor Stories Workshop Participant Feedback Form*, has been provided. Facilitators may wish to use or modify to solicit participant feedback at the end of the workshop.
8. We welcome feedback on these materials and how they have been used! Please complete the *Air Sensor Stories Workshop Facilitator Feedback Form* and return it to: COEC@URMC.Rochester.edu

Air Sensor Stories Workshop Optional Interactive Activities

Activity 1: Why Particle Size Matters for Health (Sugar Cubes and Crystals) (Slide 7)

Purpose: To demonstrate why smaller particles, like PM 2.5, may be more harmful to health.

Materials: (2) Sugar cubes, a marker, and a sheet of paper.

1. Roll the paper into a cone with a small hole at the tip. Place the sugar cube into the cone and show the audience. The sugar cube is like a large particle of pollution – it can't get very deep into the tip of the paper cone.
2. Crush the sugar cube and pour the grains into the cone. As they spill out through the tip, note that smaller particles – like PM2.5 – can get deep into the small branching passages of the lungs, and the smallest particles can even get into the bloodstream.
3. Take another sugar cube and color its surfaces with a marker. The color represents toxic chemicals in the air stuck to a particle. Crush the sugar cube and note that there are now many grains that have no color on them, representing additional surface area chemicals could stick to. Even though it is the same weight of sugar, the smaller particles have more surface area for carrying toxic particles deeper into the lungs than do larger particle (the sugar cube).

Activity 2: Understanding Units: Particle Concentrations and Counts (Slide 10)

Purpose: To help participants understand what "micrograms per cubic meter" means.

Materials: (12) meter sticks, tape, packet of sugar

1. Build a cube out of 12 meter sticks taped at the corners – this is one cubic meter (note: if this is not practical, draw a meter square on the ground and visualize three dimensions).

2. Open a packet of sugar and divide it into quarters – each quarter is 1 gram (most sugar packets contain 4 grams). A microgram is 1 millionth of a gram. So if you imagine taking a millionth (a thousandth of a thousandth) of one pile of sugar and spreading that through the cubic meter – that is one microgram per cubic meter.
3. Discussion about sensor units:
    a. A cubic meter is usually written like this: m^3
    b. Micrograms may be written like this: mcg or like this: µg, because µ is the Greek letter "mu" which we use to mean 'micro' or 'a millionth.'
    c. So, micrograms per cubic meter is usually written like this: $\mu g/m^3$
    d. Some air particle sensors report results in "particles per liter" (PPL). How are particle counts different from mass concentration? If you have a sensor, what units does your sensor use? If you crushed the sugar into smaller particles, would the particle count go up? Would the mass go up?

Activity 3: Exploring Sensors (Slide 37 or 40)

Purpose: presenters who have access to sensors may want to give participants a chance to explore sensors before developing their action plan. This activity help participants understand how sensors work, how particles get into the air and what happens to them over time, sources of uncertainty, and what questions they could answer using the sensors).

Materials: Review activities below and assemble materials as needed for those you choose. Many sensors have user manuals or web sites explaining how they work and additional activities for learning about them.

1. How it works: turn the sensor on and watch the display. Note how readings go up and down, even if it is in the same place. Why might that occur? Can you figure out where air is taken into the sensor? Where does the air come out?
2. Exploring sources: try moving the sensor near different possible sources or changing activities around the sensor to see how it responds. A few suggestions:
    a. Peel an orange or shake baby powder near the sensor.
    b. Breathe into the sensor intake.
    c. Light a candle and move the sensor slowly toward and away.
    d. Bring the sensor into a moist room (like a bathroom with shower) or spray water from a mister and move the sensor through the mist (note: some sensors could be damaged by soaking – read your instruction manual first!).
    e. Outdoor sources: traffic, heavy equipment, small engines (lawnmowers/leaf blowers, etc.), blowing dust.
3. Changes in particle concentrations over distance and time: Pick a source of particles you discovered in 2…
    a. Move the sensor slowly away from the source. How far away can you detect particles from that source? (for example, write down the sensor readings at different distances from a candle in a closed room – or from a busy street)
    b. Place the sensor near the source, then eliminate the source (for example, blow out the candle and record readings every 30 seconds afterwards). How long does it take for particle counts to go down?
    c. Observe what happens with changes in air flow (using a vent/fan, wind, etc.).
    d. If your sensor measures different particle sizes, compare the sizes of particles from different sources.
4. Interpreting readings: As you noticed, sensor readings go up and down over time.
    a. How can you summarize your findings? (record a reading every minute; take average for an hour; record maximum (peak) readings)
    b. Did any of your observations in 2 surprise you? What might they mean? (for example, why might breathing into a sensor increase readings? (humidity))
    a. Did you see any patterns in higher sensor readings? What was happening during these periods? (for example, did the reading increase every time you peeled more of the orange?)

Supported by National Institute of Environmental Health Sciences grants to: University of Rochester (P30-ES01247), University of North Carolina at Chapel Hill (P30-ES010126); University of Texas Medical Branch (P30-ES006676), Columbia University (P30-ES009089), and WE ACT for Environmental Justice. Last updated 8/2018.