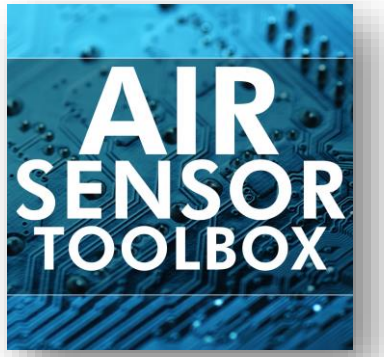
SENSOR STORIES

Developing materials to support community use of low-cost air quality sensors

PEPH Webinar, September 24, 2018

Context

- Community Engagement Cores and community partners using air quality sensors
- Wide variety of air sensors available
- Gaps in understanding → user frustration
- Ongoing efforts to promote appropriate use of sensors by USEPA and others



https://www.epa.gov/air-sensor-toolbox

Collaborators

Environmental Health Sciences Core Centers

- **University of Rochester** Environmental Health Sciences Center
- **University of North Carolina-Chapel Hill** Center for Environmental Health and Susceptibility
- **University of Texas Medical Branch** Center for Environmental Toxicology
- **Columbia University** Center for Environmental Health in Northern Manhattan

Community Partners

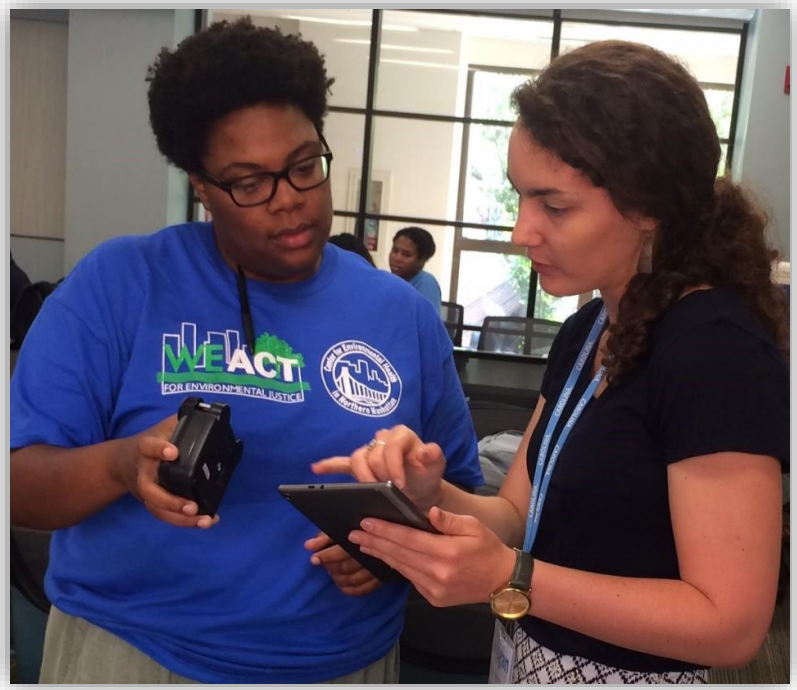
- Environmental Services **City of Rochester**
- **Smoking and Health Action** Coalition of Monroe County, NY
- **Explore More Initiative** of the **Chapel Hill Public Library**, Chapel Hill, NC
- Residents of **port-adjacent neighborhoods** in Galveston, TX
- **Community In-Power & Development Association**, Galveston, TX
- **WE ACT for Environmental Justice**, New York City, NY

Supported as collaborative administrative supplement (2017-18)

Project Goals

1. **Enhance understanding** of air pollution and available sensor technologies

2. **Enable people to effectively choose, use and interpret** sensor data to address community public health concerns



Approach

- **Reviewed existing materials** and **sought input** from key players (CBOs, agency staff)
- Drafted **presentation** and **supporting documents**
- **Pilot tested materials** with 56 residents of communities in NC, NY, and TX
- Revised and **uploaded materials** to University of Rochester web site and PEPH Resource Center
- **Seeking feedback from users** through **February 2019**

Overview of materials

- Presentation and facilitator guide **designed for diverse community audiences**
  - **Interactive, featuring real-world applications** of particle sensors
  - Emphasis on use of sensors to understand **patterns of local air pollution**
  - **User stories highlighted** to inform community action

Let’s look at some slides from the presentation…

What we will do today

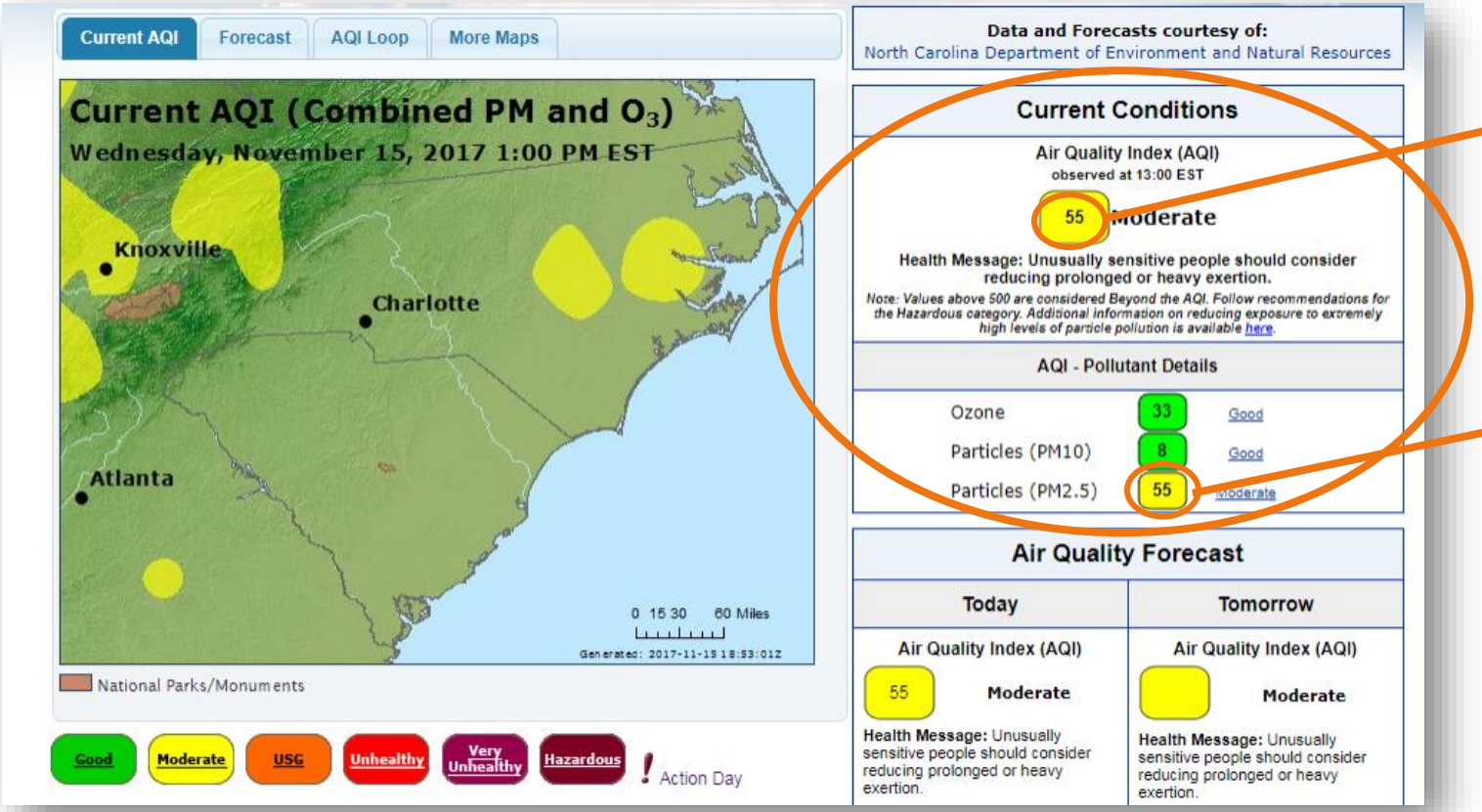
1) Learn about **particle pollution**
2) Explore **how sensors are used** by individuals & community groups
3) Develop an ***Action Plan*** for using an air sensor in <u>your</u> community

Why are we talking about particle pollution?

Particle pollution…

- is **all around us**
- can be **invisible**
- is linked to **negative health effects**
- can be **measured** and **reduced**

How can I find out about PM2.5 in my area?



Today's AQI

Details for $PM_{2.5}$

https://www.airnow.gov/

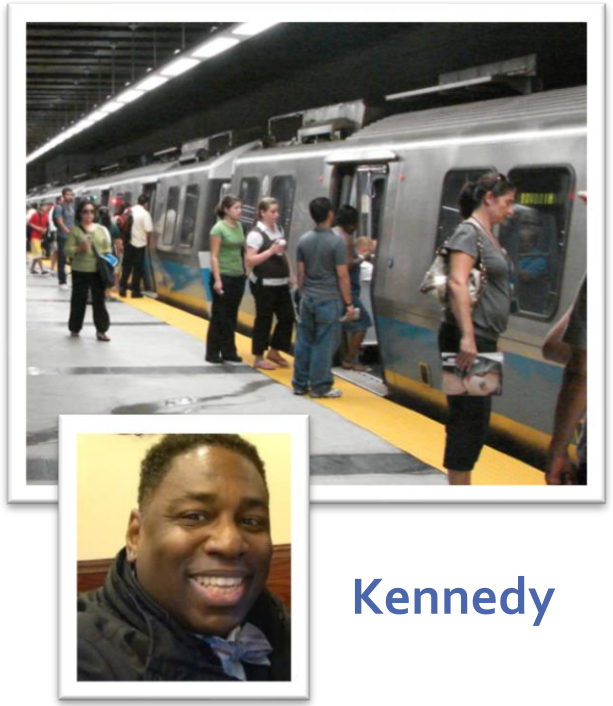
If we can access AQI, why use a PM sensor?

AQI **may not reflect local conditions** and **does not address indoor air quality**

Sensors can help:

- **Educate others** about air quality
- Monitor **personal exposure** indoors and outdoors
- Identify **local sources** of air pollution
- Facilitate **community action** to reduce exposure

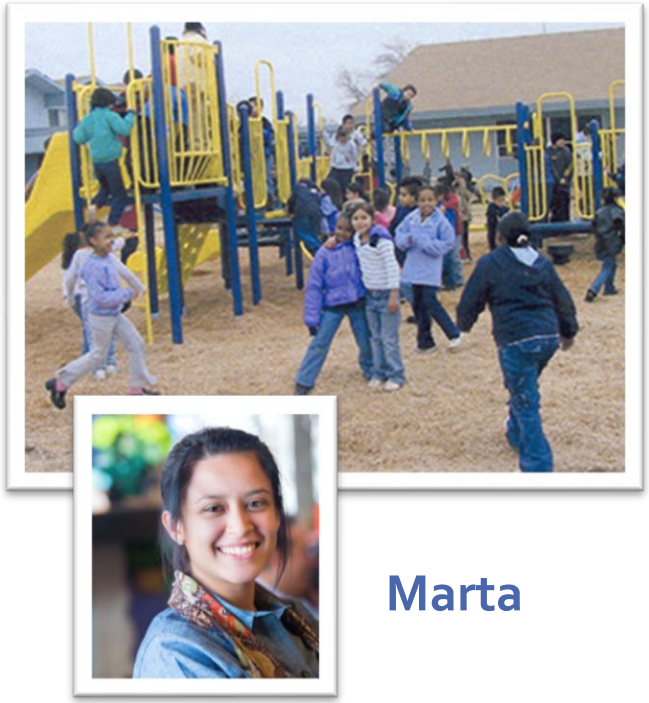
Sensors can **reveal patterns** of exposure



Kennedy

Lisa

Donna



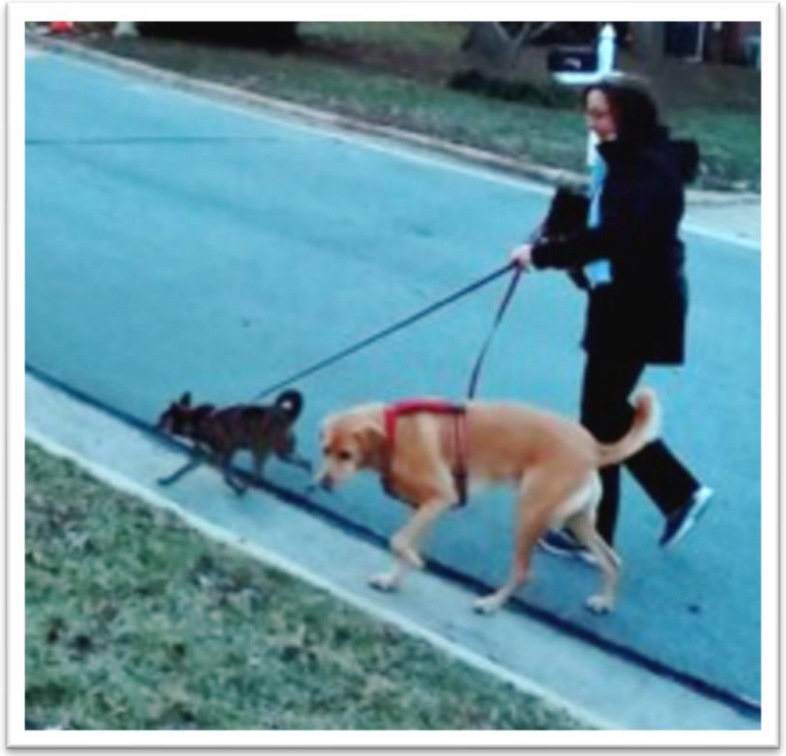
Marta

& **inform actions** to reduce exposure

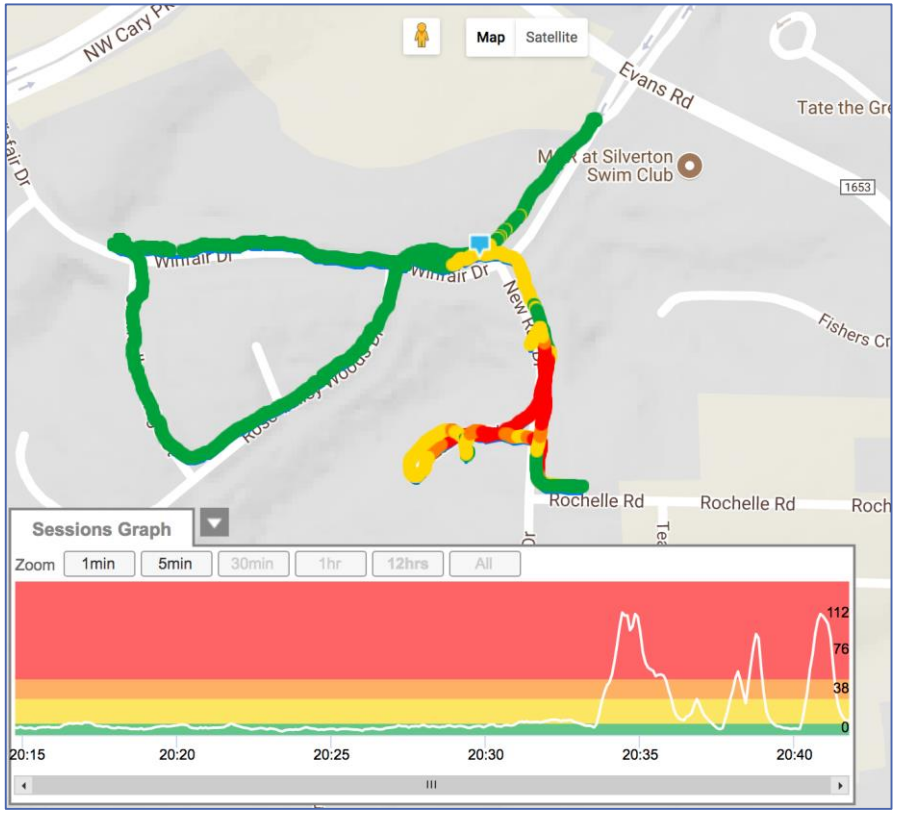
Sensors inform **personal choices**

Lisa wondered whether PM exposure **worsened her family's health**

- Husband and daughter had **health problems potentially affected by PM exposure**
- Wanted to monitor air quality in **varied locations**, outdoors and indoors



What might explain this area of high PM2.5?



Air Beam Data

Peak PM: 112 µg/m³

Friday, Jan 26, 2018

AQI: Good

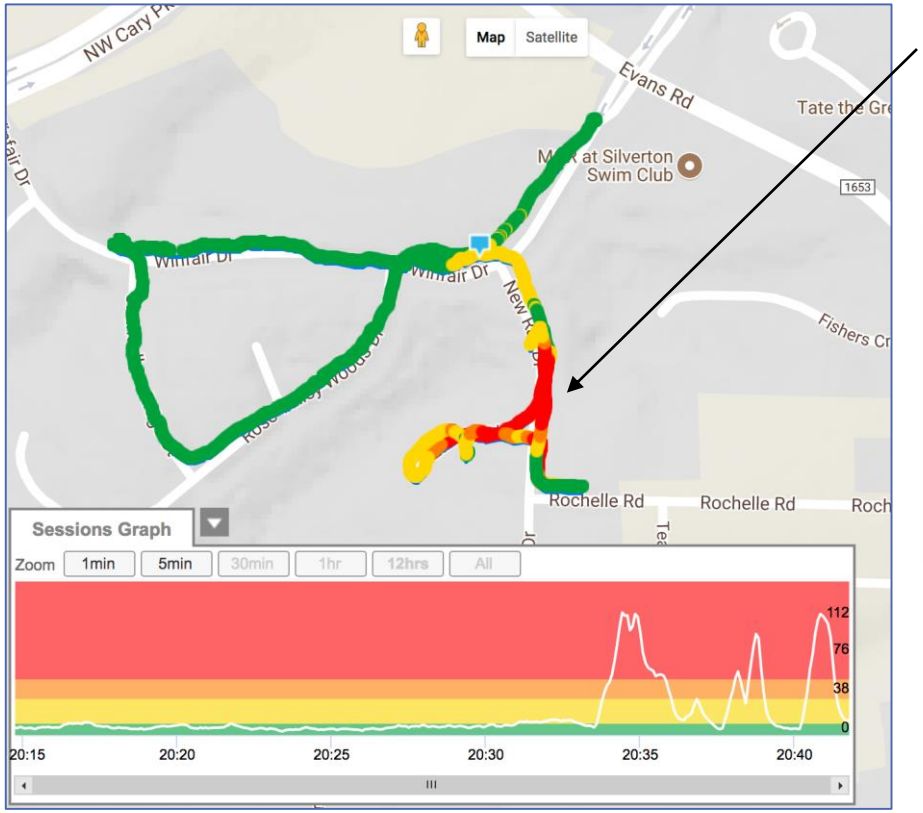
Evening: 25 minute walk

Temp: 53°F

Relative humidity: 35%

Sky: after dark, not windy

Wood smoke can impact PM2.5 levels

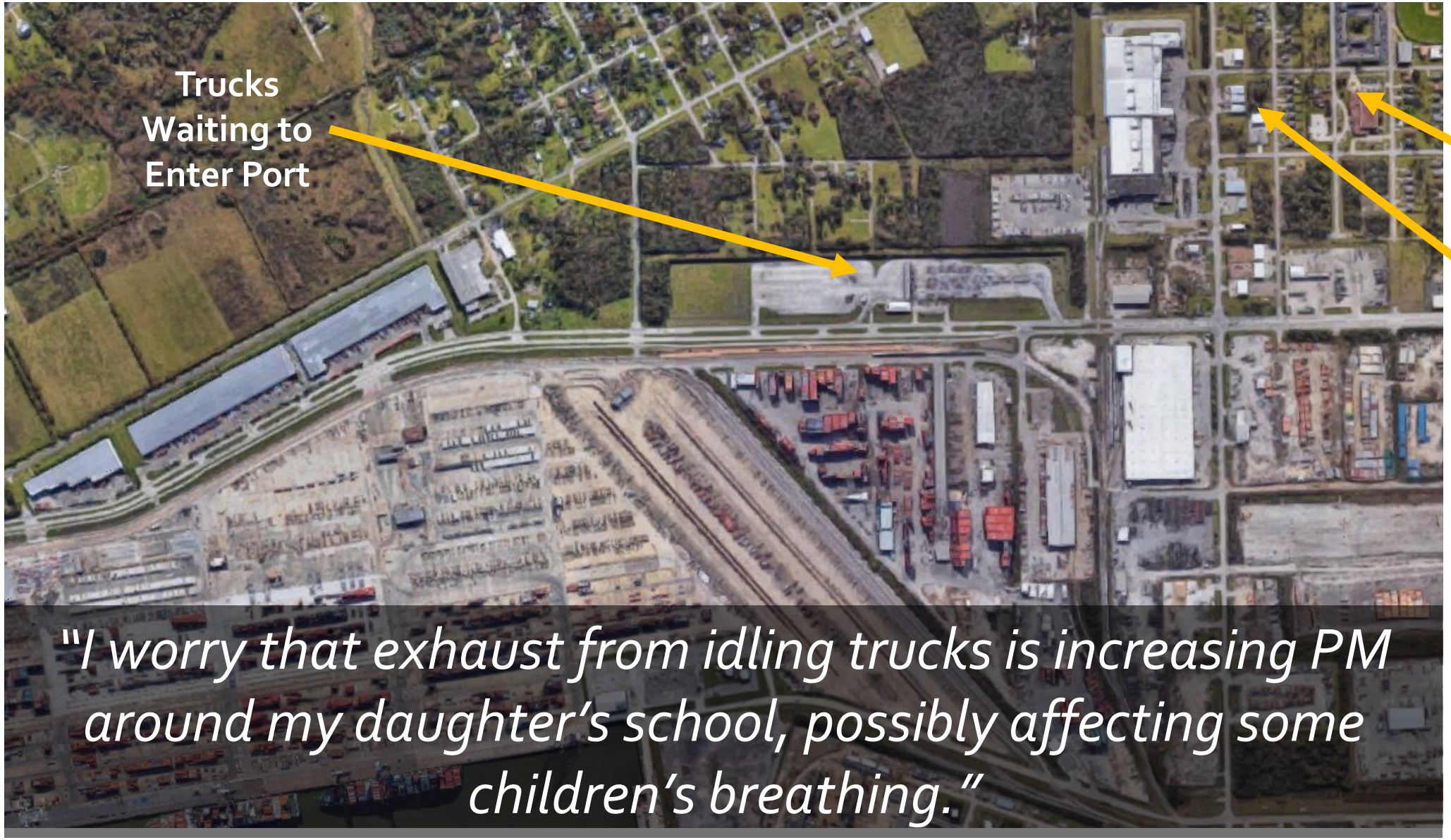


Strong smell of **wood smoke** during Friday evening walk

Sensors **enable community action** to reduce exposure

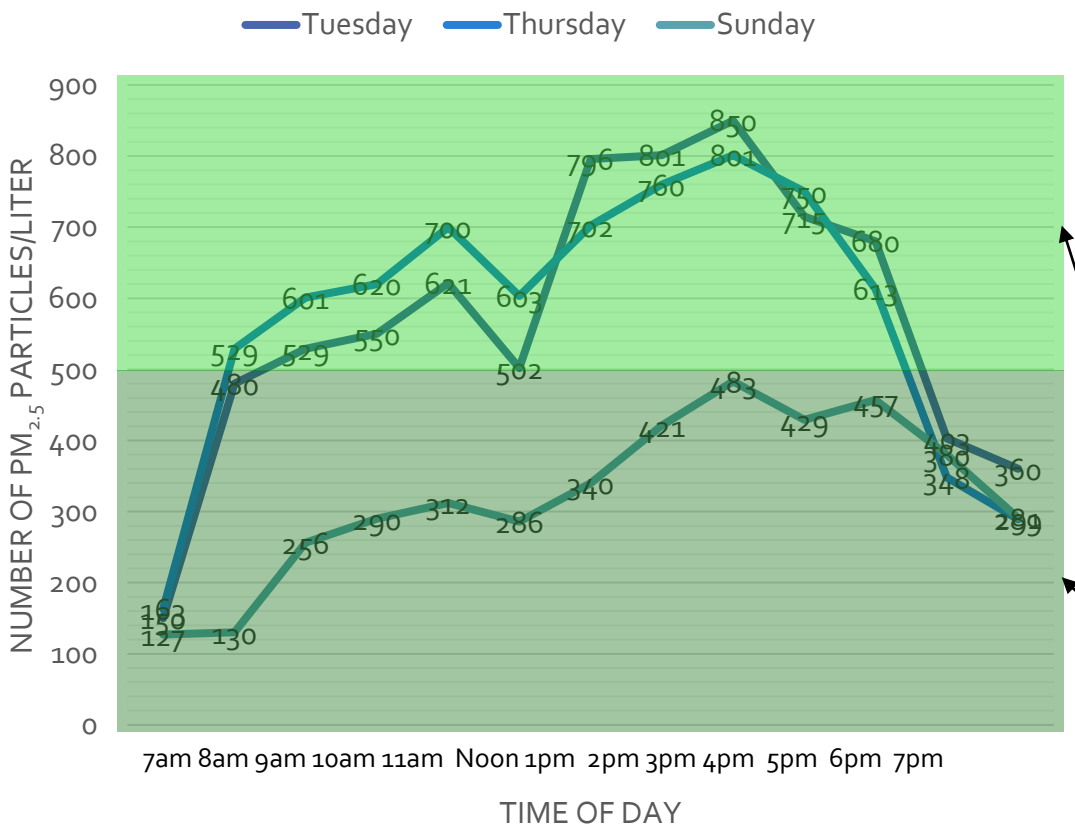
Marta and other parents were concerned about **PM exposure in the schoolyard**

- Neighborhood is near a **major port** that hosts a **large container terminal**
- **High volume** of **daily truck traffic**



"I worry that exhaust from idling trucks is increasing PM around my daughter's school, possibly affecting some children's breathing."

Data demonstrated daily PM patterns



Particle Counts (ppL)	Estimated Mass (µg/m³)	Rating	Description
8001 - 16000	321 - 640	Very High	This level of particles is unsafe and warrants more serious long-term health effects if sustained.
4001 - 8000	161 - 320	High	Air pollution levels are dangerous and everyone may experience coughing, itchy eyes or other symptoms. This level of particles may significantly trigger asthma and allergy symptoms. Work to decrease values as soon as possible or consider wearing a mask.
2001 - 4000	81 - 160	Elevated	Air pollution is unacceptably high and problematic for all persons due to significant particulate loading in the air. Brief exposures to this level often occur from cleaning, such as vacuuming a carpet. If this level is sustained during the nighttime, consider investing in an air filter for the bedroom.
1001 - 2000	41 - 80	Slightly Elevated	Air quality is problematic for vulnerable populations (elderly, respiro-compromised individuals or children). This level of pollution warrants taking steps to try to reduce: turn on your kitchen hood vent; consider opening or closing a window as appropriate, etc.
501 - 1000	21 - 40	Moderate	Air quality poses a slightly elevated risk of asthma, allergy and arrhythmia symptoms. Frequently seen moderate level of particulates are often caused by human behavior (cooking, candle burning, etc.).
0 - 500	0 - 20	Good	Air quality is considered good and there is little risk of particulates causing harm to your health.

https://www.specksensor.com/support/tech-specs

There were **increases in** PM2.5 in homes around the school **during times of heavier truck traffic** at the port

Supplemental materials: Action Plan

Air Monitoring Action Plan **helps people think about their story**

AIR MONITORING ACTION PLAN

Answering these questions will help you make a plan to monitor particle pollution in your environment.

1 What is your concern?

What?
Describe your concern about particle pollution.

Where?
Describe the location(s) of concern.

When?
When and how often does your concern arise?

Why?
Describe why you want to learn about particle pollution around you.

2 Using the air sensor

Where will you monitor?

When and how long will you monitor?
When, how often, and over what time period (hours/days/weeks/year) do you need to monitor?

What else do you need to document (e.g., traffic?) & how will you document (e.g., photos)?

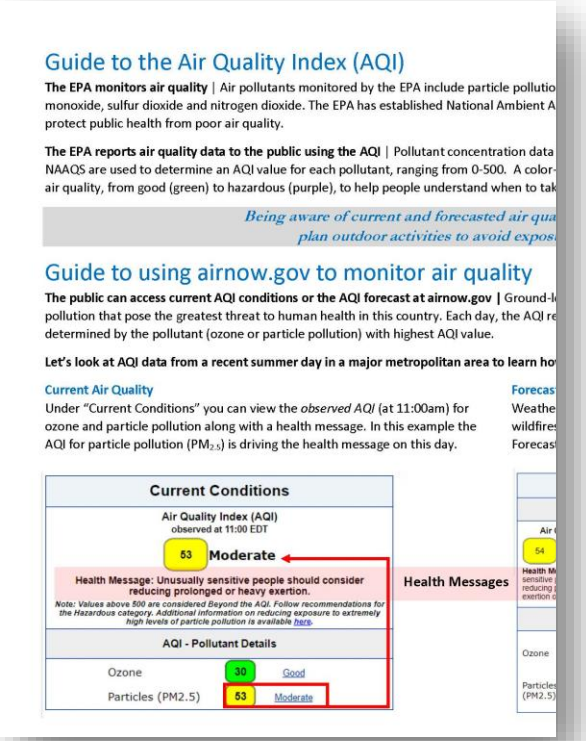
Are there other logistics that need to be considered?
(e.g., do you need permission to monitor?)

3 Using the results

So what?
Describe what you will do with the monitoring data you collect. How will you share it? With whom? What do you hope the impact will be? Have potential negative consequences of collecting the data been explored?

Supplemental materials: Demos and explanations

Guide to Interpreting the Air Quality Index **informs planning of outdoor activities**



Guide to the Air Quality Index (AQI)

The EPA monitors air quality | Air pollutants monitored by the EPA include particle pollutio
monoxide, sulfur dioxide and nitrogen dioxide. The EPA has established National Ambient A
protect public health from poor air quality.

The EPA reports air quality data to the public using the AQI | Pollutant concentration data
NAAQS are used to determine an AQI value for each pollutant, ranging from 0-500. A color-
air quality, from good (green) to hazardous (purple), to help people understand when to tak

Being aware of current and forecasted air qua
plan outdoor activities to avoid expos

Guide to using airnow.gov to monitor air quality

The public can access current AQI conditions or the AQI forecast at airnow.gov | Ground-l
pollution that pose the greatest threat to human health in this country. Each day, the AQI re
determined by the pollutant (ozone or particle pollution) with highest AQI value.

Let's look at AQI data from a recent summer day in a major metropolitan area to learn ho

Current Air Quality
Under "Current Conditions" you can view the *observed AQI* (at 11:00am) for ozone and particle pollution along with a health message. In this example the AQI for particle pollution ($PM_{2.5}$) is driving the health message on this day.

Forecas
Weathe
wildfires
Forecas

Current Conditions

Air Quality Index (AQI)
observed at 11:00 EDT

53 Moderate

Health Message: Unusually sensitive people should consider reducing prolonged or heavy exertion.

Note: Values above 500 are considered Beyond the AQI. Follow recommendations for the Hazardous category. Additional information on reducing exposure to extremely high levels of particle pollution is available here.

Health Messages

AQI - Pollutant Details

Ozone	30	Good
Particles (PM2.5)	53	Moderate

Interactive Activities **help diverse users understand key concepts**

- **Why Particle Size Matters for Health**
  Shows lung penetration, surface area
- **Understanding Units**
  Explains concentrations v. counts
- **Exploring Sensors**
  Activities to try out real sensors

Supplemental materials: Evaluation forms

Air Sensor Stories Workshop **Participant Feedback Form**

Location of Workshop: _____ Date: _____

Please respond to each of the following statements about this workshop:

	Strongly Agree ☺	Agree	Uncertain	Disagree	Disagree Strongly ☹
1. This experience was a valuable use of my time.	O	O	O	O	O
2. The presenter communicated information effectively.	O	O	O	O	O
3. As a result of this workshop, I am more informed about particle pollution in the environment.	O	O	O	O	O
4. I plan to share what I learned today with others (colleagues, stakeholders, friends, family, etc.).	O	O	O	O	O
5. As a result of this workshop, I will make a change to reduce exposure to particle pollution.	O	O	O	O	O

6. Please describe what actions, if any, you plan to take as a result of this workshop:

- Participant feedback form (left)
- Presenter feedback forms track use and invite input

Pilot testing: Rochester, NY

University of Rochester Medical Center EHSCC

Participants

- City of Rochester Department of Environmental Services (7)
- Smoking and Health Action Coalition of Monroe County (8)

Key Takeaways

- Participants **described air quality concerns** and **identified next steps** using *Action Plan*
  - City planners drafted ideas for "road diets"
  - Apartment owners considered how air sensors could help residents with allergies and asthma

Pilot testing: Galveston, TX

University of Texas Medical Branch EHSCC

Participants

- Community In-Power & Development Association (4)
- Other residents of port-adjacent neighborhoods (3)

Key Takeaways

- Participants learned about **complexity of air quality** and **how it is assessed**
- Participants **compared and contrasted individual and collective use of air sensors**, for monitoring, evaluating, and discussing air quality in their communities

Pilot testing: New York City

WE ACT for Environmental Justice

Participants

- Concrete Safaris- East Harlem Health Action Center (11)
- WE ACT office (6)

Key Takeaways

- Participants were **eager to learn about air quality** and **how to monitor air pollution** in their communities as an initial step toward protecting their health.

Pilot testing: Chapel Hill, NC

University of North Carolina at Chapel Hill EHSCC

Participants

- Explore More Initiative at Chapel Hill Public Library (17: 12 general public and 5 environmental professionals)

Key Takeaways

- Many **questions about the Air Quality Index**, led to *Guide to Interpreting the AQI*
- High interest in **using sensors** and **comparing results** to other data sources
- Interactive user stories helped participants understand **opportunities and limitations of sensors**

Dissemination

- Formal and informal science education settings
- Citizen science activities
- Online
- **Please share your ideas!**

Acknowledgements

Funding was provided by the **National Institute of Environmental Health Sciences**

Project Team

- **University of Rochester** Environmental Health Sciences Center (P30-ES01247)
- **University of North Carolina-Chapel Hill** Center for Environmental Health and Susceptibility (P30-ES010126)
- **University of Texas Medical Branch** Center for Environmental Toxicology (P30-ES006676)
- **Columbia University** Center for Environmental Health in Northern Manhattan and **We Act for Environmental Justice**

Many thanks to colleagues in USEPA and in the EHSCC Community Engagement Core network for their invaluable input on this project!

https://sensorstories.urmc.edu

Please use and **provide feedback by February 2019**!