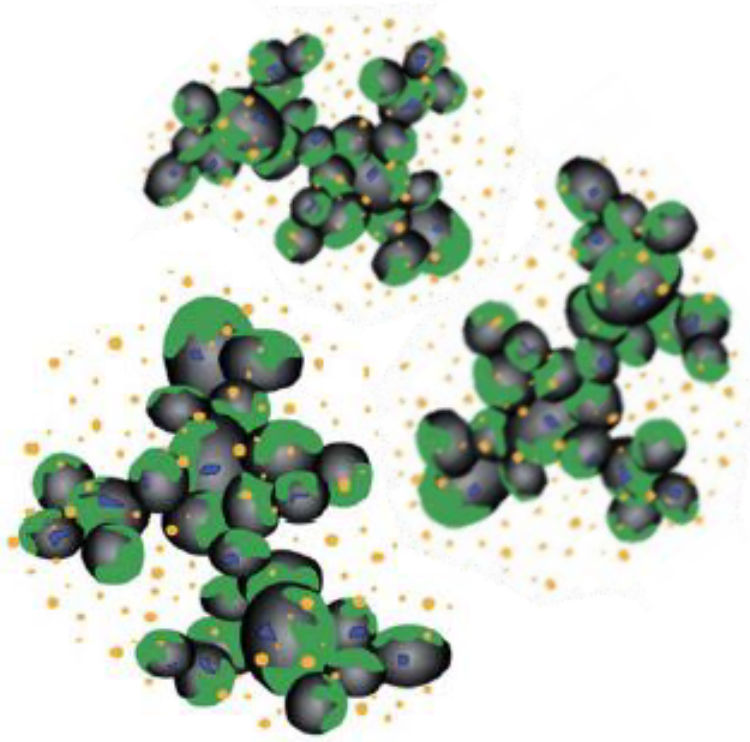
Air quality questionnaire, sampling & focus group engagements (co-production)

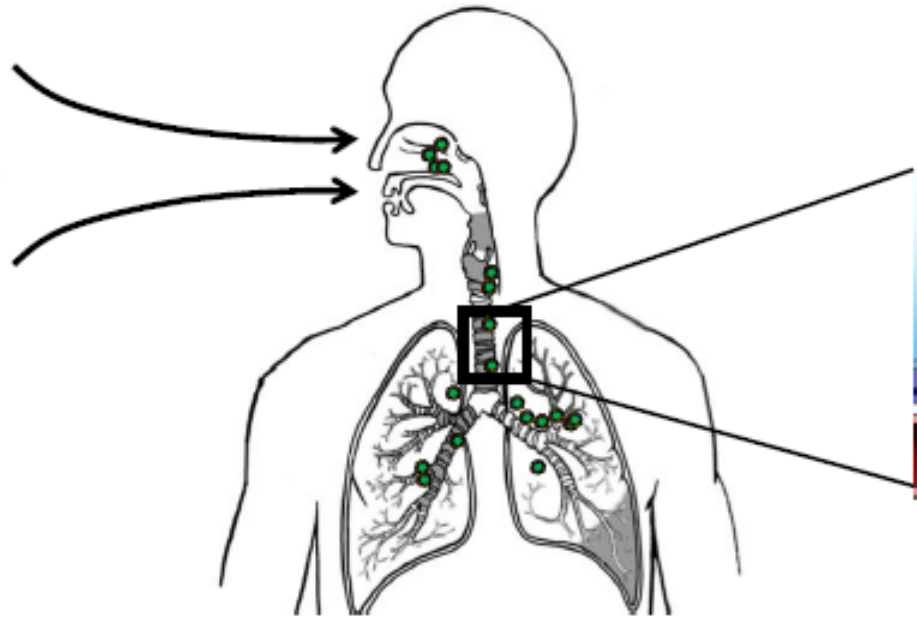
Raphael E Arku, ScD

www.equitablehealthycities.org

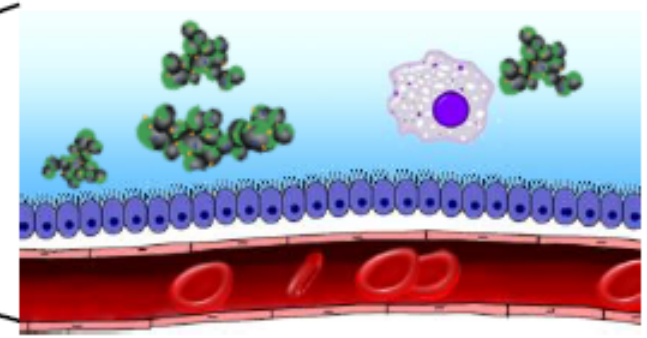
Exposure to the Chemical 'Pea' Soup



Ambient Air Pollutants



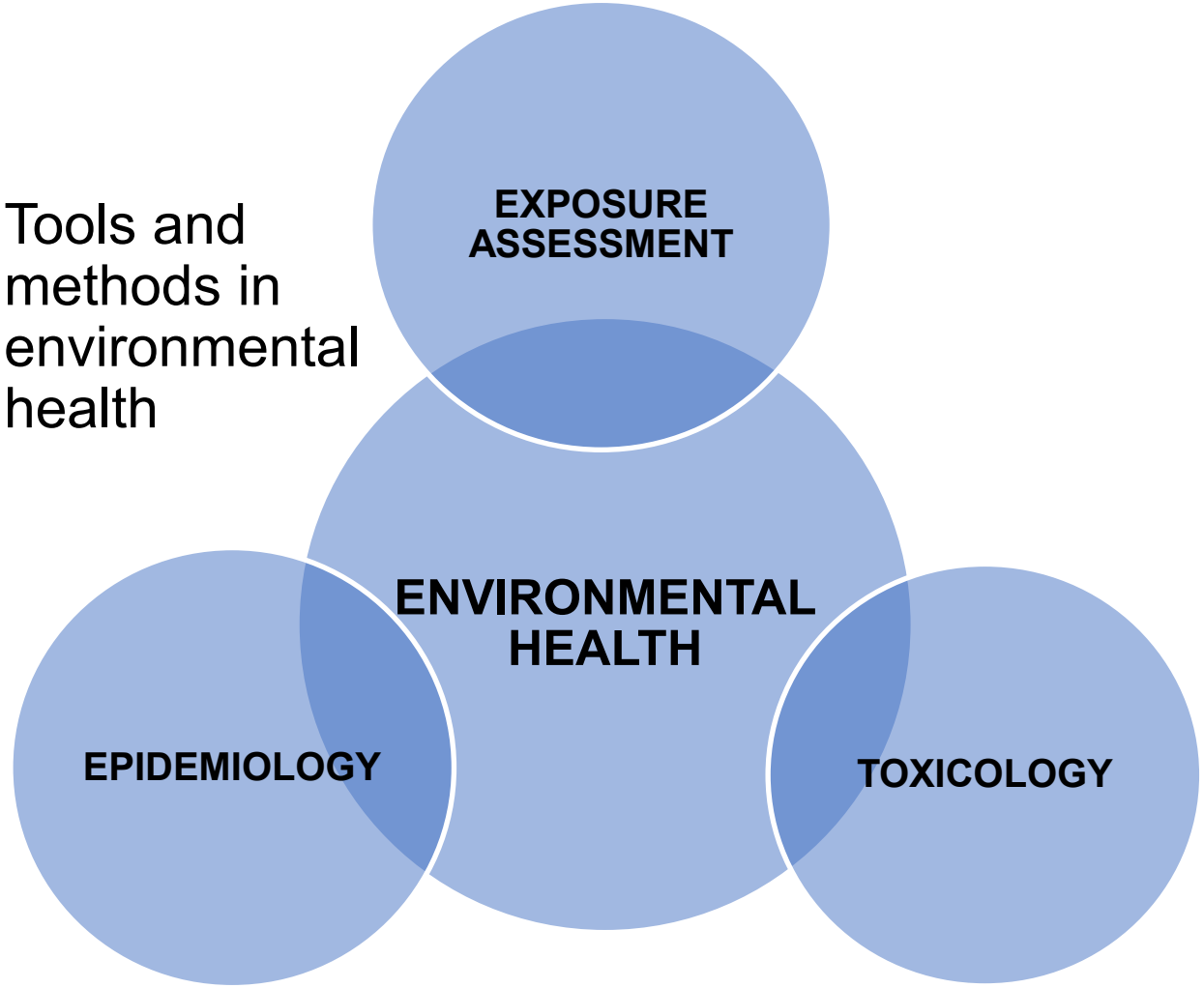
Exposure



Biological Response

Evaluating the health effects of air pollution

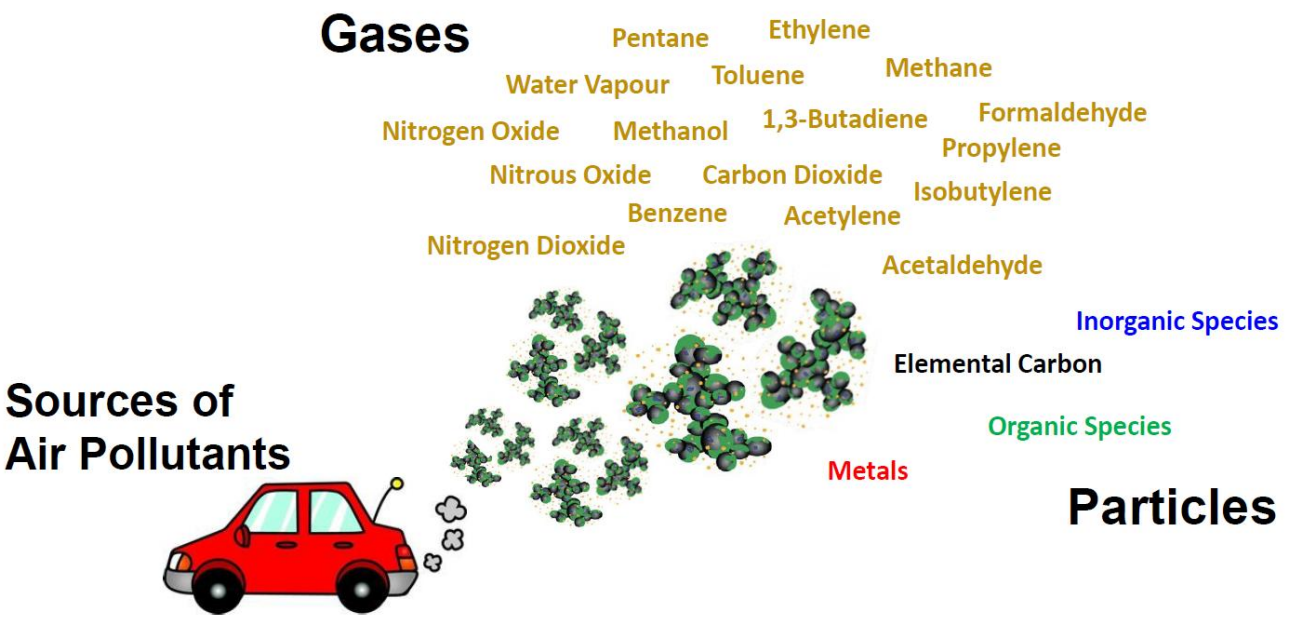
Tools and methods in environmental health



‘Think before you leap’

- Study aims and objectives
- Study design
- Analytical methods

The air is chemical ‘pea’ soup



Each Source is Unique…

…with respect to composition ...and size

Vehicle Exhaust

0.5 µm

Organic Compounds

Nitrogen Dioxide

Black Carbon

Metals

2.5 µm

Water

Particulate Matter

Coal Fired Power Plants

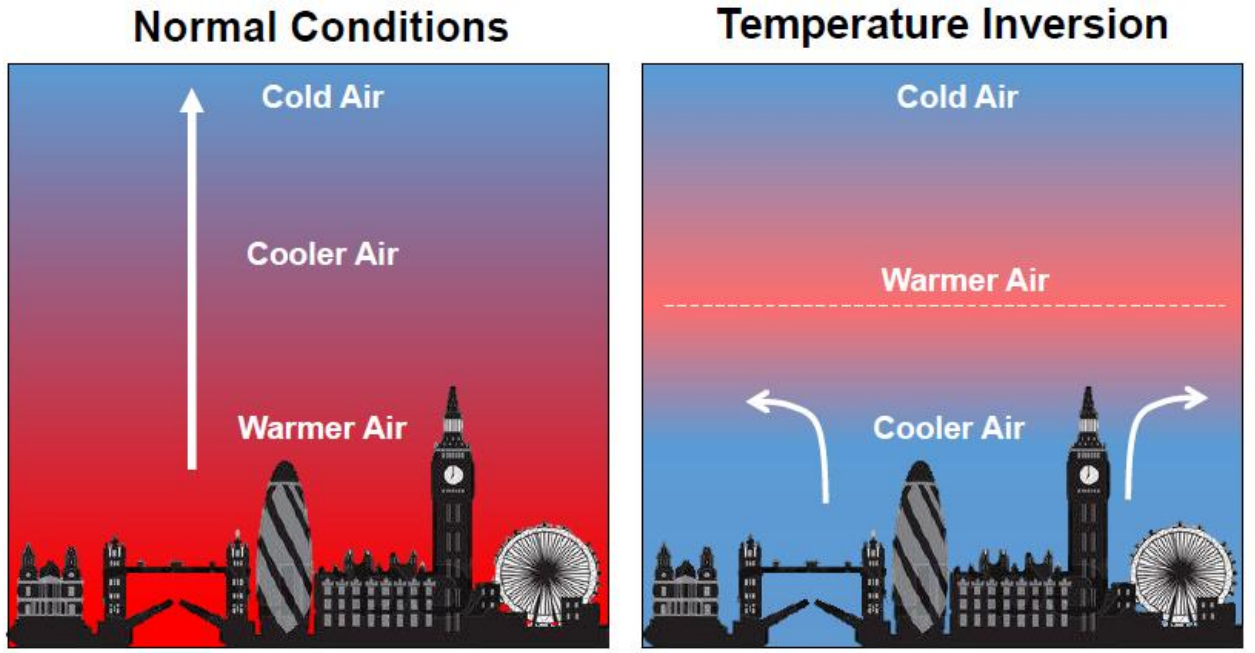
Sulphur Dioxide

Metals

Organic Compounds

Some places/groups of people are more vulnerable

- Disparities in exposure
  - Geography (e.g. Urban/rural location)
  - Microenvironment (indoor vs outdoor)
  - Lifestyle choices (smoking, cooking fuel,
  - Occupation
  - Socioeconomic status
  - Meteorology



Warm air blows in over a city, creating an inversion layer. This layer traps in all the emissions from the city, preventing dispersion.

The role of meteorology in great air pollution disasters

- Meuse Valley in Belgium (1930)
- Donora, Pennsylvania (1948)
- London, England (1952)

Meuse Valley, Belgium
1930

- Mill town with a steel mill, zinc smelter and sulphuric acid plant
- Donora is on a river bank and surrounded by steep hils
- Town of 14,0000 residents

Some places/groups of people are more vulnerable

- Disparities in outcome
  - Increased vulnerability with age
  - Underlying health conditions
  - Gender disparities
  - Socioeconomic

Measuring exposure

Ambient

Personal

Occupational

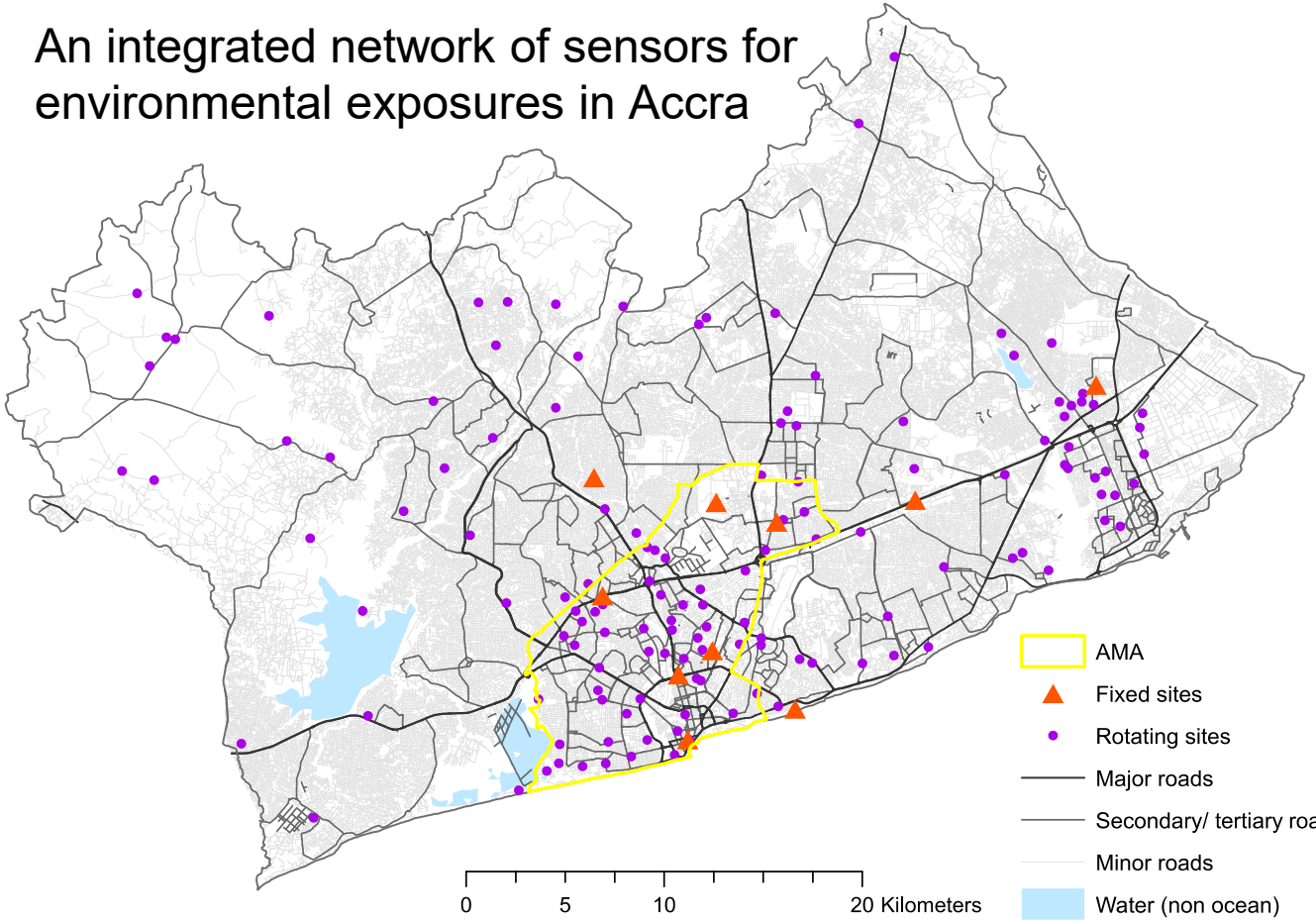
Household

Mobile

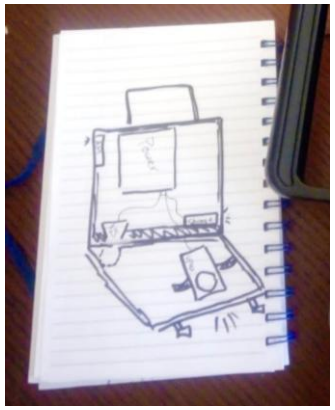
Occupational

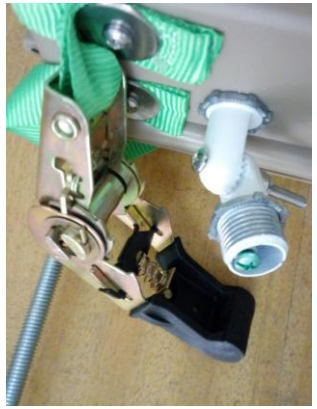
Study design is key

An integrated network of sensors for environmental exposures in Accra



Locations of fixed (5+ years) and rotating (1 week) monitoring sites





- Field validated
- Robust to elements
- Cost effective
- Power
- Positioning and mounting
- Small, discreet, and lightweight
- Permissions

Clark et al 2020

Measuring Personal Exposure

Real-time Monitors

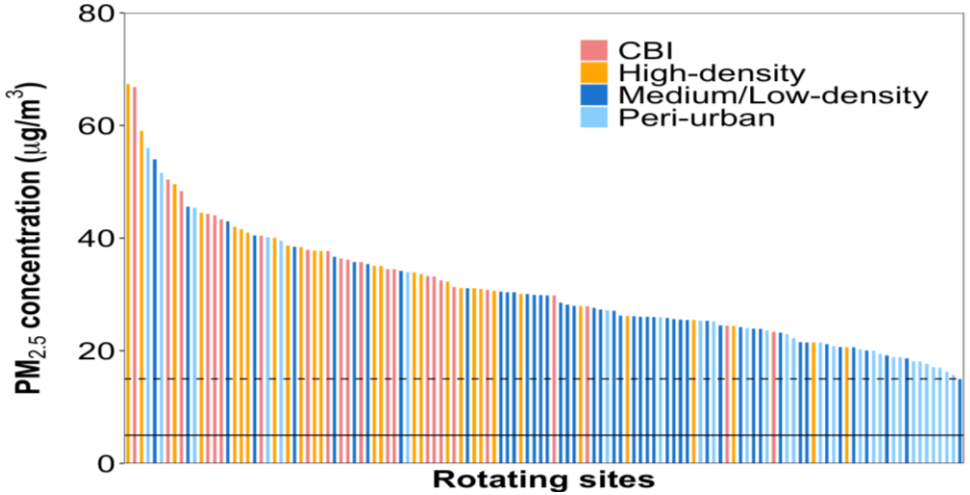
Active Samplers

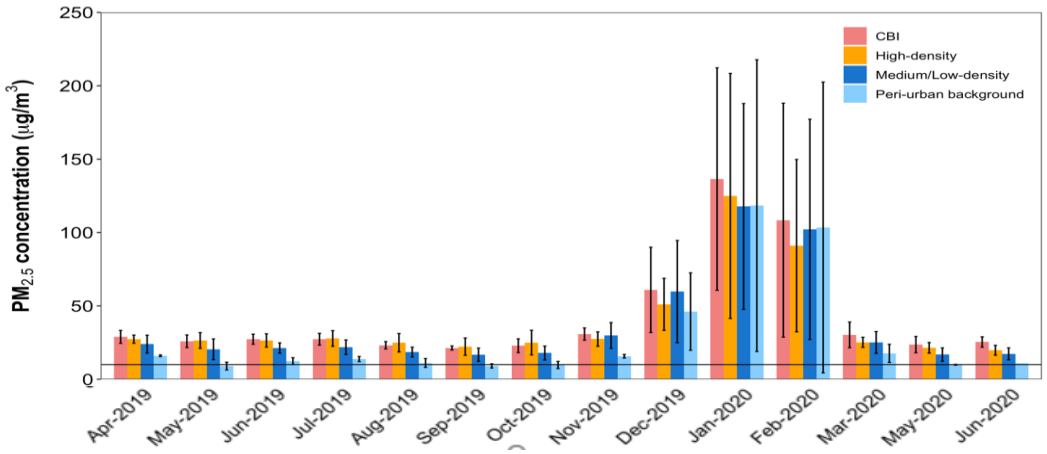
Filter for collecting particles

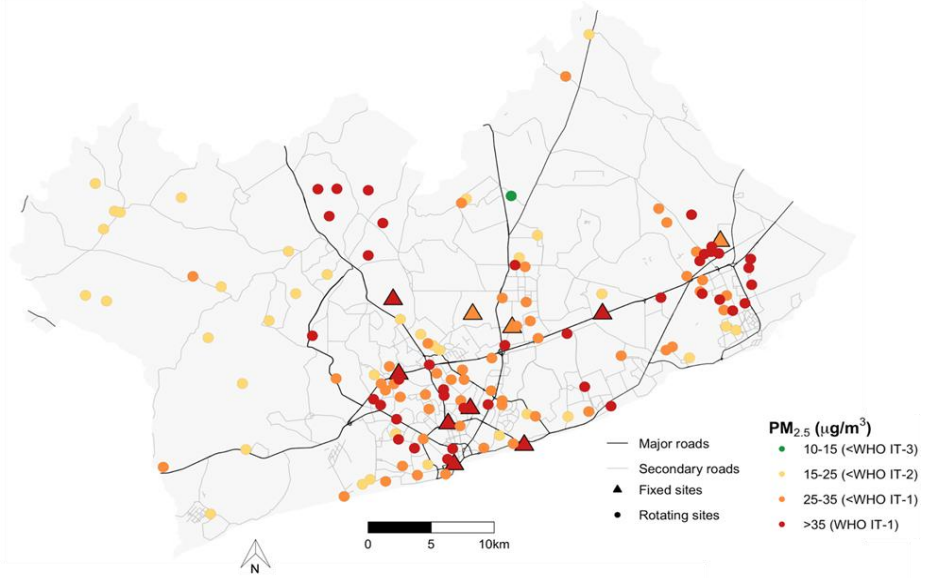
Passive Samplers

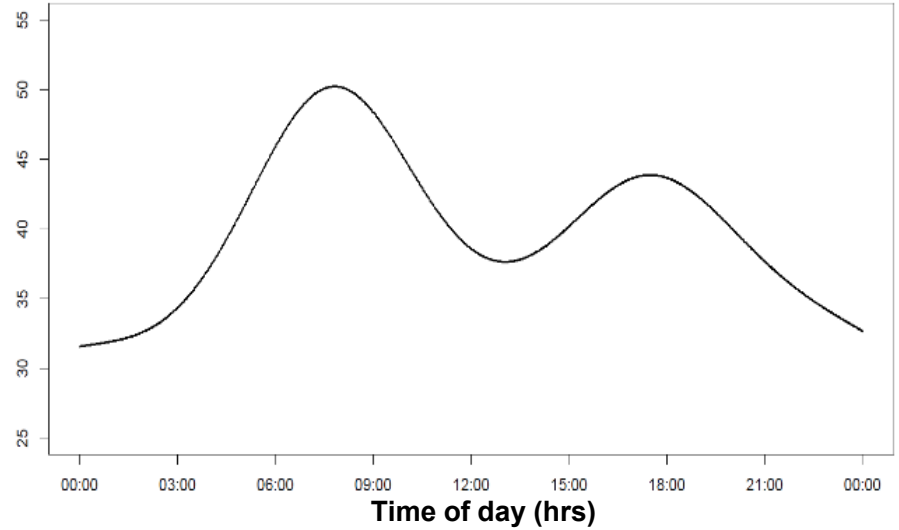
Biological Monitoring

Space-time patterns in environmental pollution

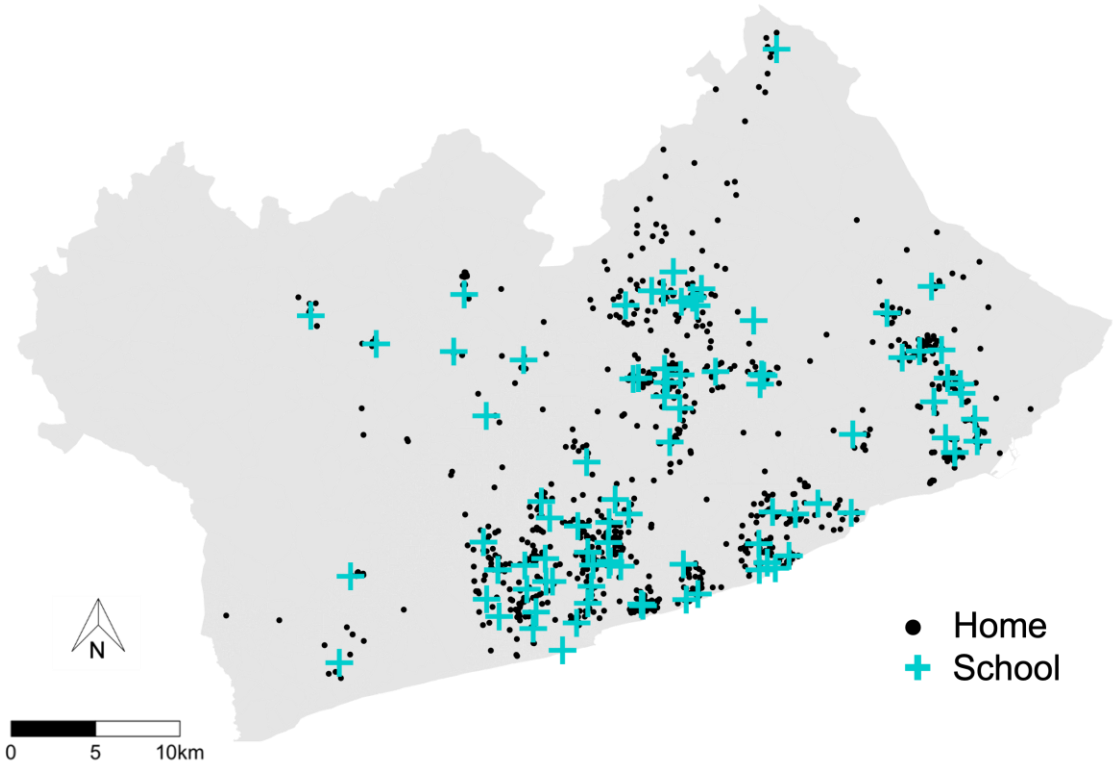








The Accra School Health and Environment Study (ASHES)



Environmental noise

- We conducted weeklong measurements of ambient $PM_{2.5}$, measured both gravimetrically and continuously), and black carbon (BC, measured gravimetrically in the yards of 90 public (74%) and private (26%) schools.

School environment survey

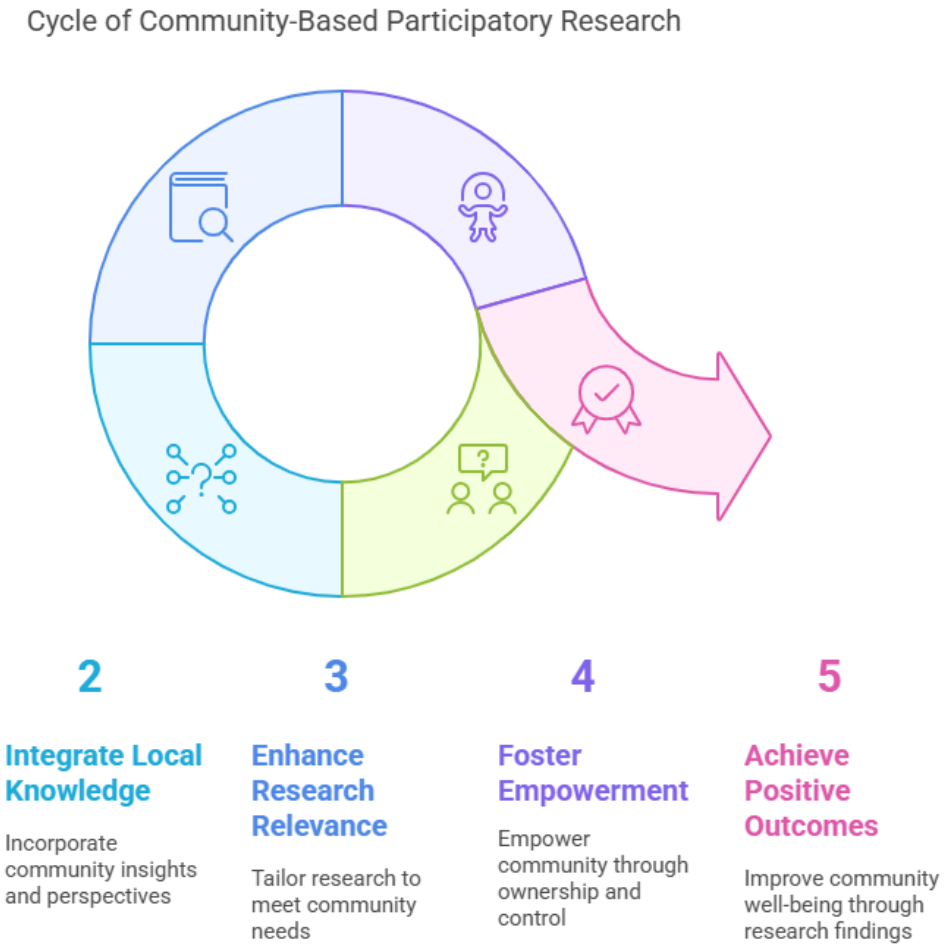
School ID	_____
School type	◯ Private ◯ Public
School name	_____
Classroom ID	_____ (class of interest)
School GhanaPostGPS code	_____
Neighborhood/ Street name	_____
Neighborhood type	◯ Low/Medium density ◯ High density ◯ Commercial/Business/Industrial ◯ Background/Other
Material of schoolyard surface	◯ Grass ◯ Paved ◯ Paved broken ◯ Packed and Loose dirt
Greenness in the school. Are there trees present in the schoolyard?	◯ Yes ◯ No
Estimate the number of trees in the schoolyard	_____
Does the school have a separate playground?	◯ Yes ◯ No
Material of playground surface	◯ Grass ◯ Paved ◯ Paved broken ◯ Packed and Loose dirt ◯ Other
Specify Other	_____
Material of classroom floor surface	◯ Finished ◯ Unfinished ◯ Finished and broken ◯ Other
Specify Other	_____

Material of classroom wall	◯ Finished ◯ Unfinished ◯ Finished and painted ◯ Other
Specify Other	_____
Dimension of the classroom (enter length X width)	_____ (in cm)
Number of children in class	_____ (class of interest)
Number of hours spent in school daily	_____
Start time	_____ (HH:MM format)
End time	_____ (HH:MM format)
Material of windows in the school building	◯ Glass and openable ◯ Louvre and openable ◯ Wooden and openable ◯ Hollow clockwork ◯ Other
Specify other	_____
Describe any general observed structural integrity of the school building (e.g., cracks in walls, floors, stairs, ceiling, etc.)	_____
Type of road closest to school	◯ Major road ◯ Secondary road ◯ Minor road
Material of road surface closest to school	◯ Paved ◯ Paved/Dirt ◯ Dirt
Traffic density on the nearest major road	◯ Low (1-lane, no congestion) ◯ Medium (1-2-lanes, some congestion) ◯ High (≥2 lanes, more congestion)
Commercial activity near the school (select all that apply)	☐ Industry ☐ Market ☐ Other

Co-production

- Involve a wide range of methods
  - Workshops
  - Individual meetings
  - Interviews
  - Focus groups
  - Surveys and participatory methods
- Outcome
  - Generate actionable knowledge through the inclusion of perspectives of non-researchers
  - Deeper transformation of norms, power structures and political systems, and the relationship between science and society

Community-Based Participatory Research (CBPR)



- Engages affected communities in environmental health research
- Empowers communities to advocate for policy changes

PATHWAYS TO EQUITABLE HEALTHY CITIES