



Air Pollution Exposure in Urban Schools and the Influence on Childhood Asthma

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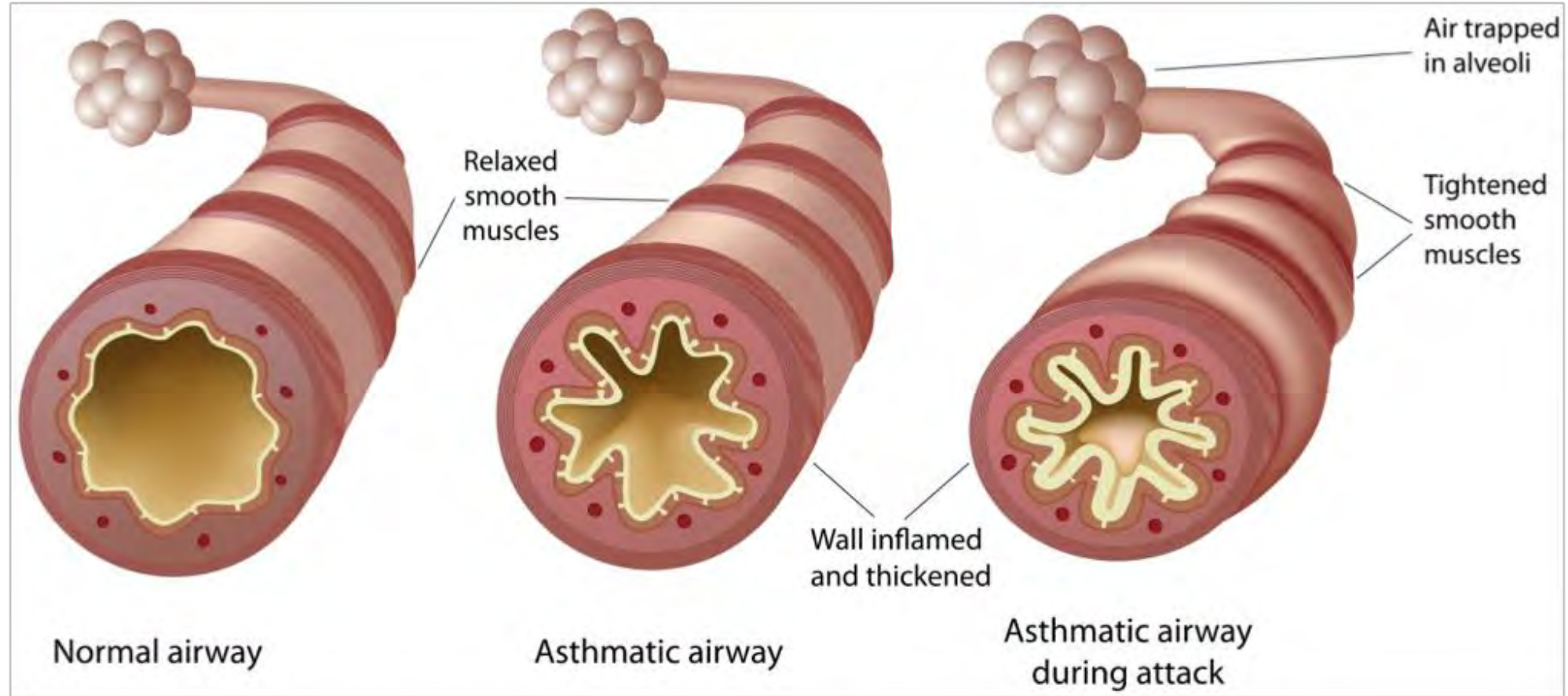
Disclosures = NONE

Learning Objectives

1. What do we know about air pollution exposure and childhood asthma?
2. How are children exposed to air pollution in the school environment?
3. What measures can be taken to reduce air pollution in the school environment?



Asthma is Both Chronic and Episodic

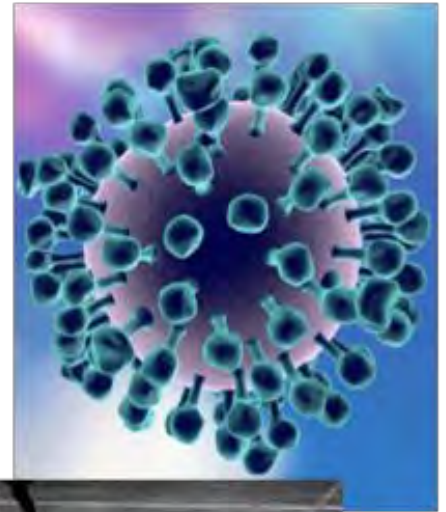


Triggers of Asthma

Allergens (pollen, mold, animal dander, and dust mites)



Respiratory infections



Weather

Tobacco smoke

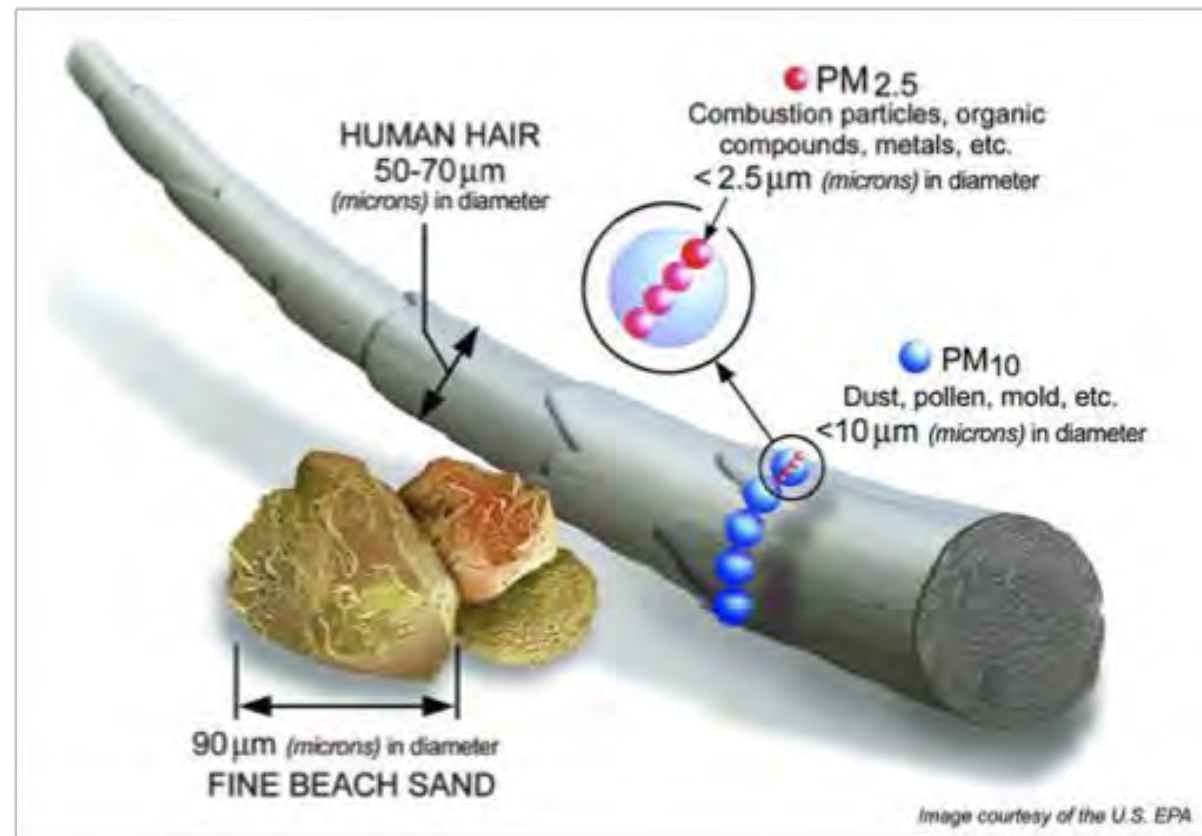
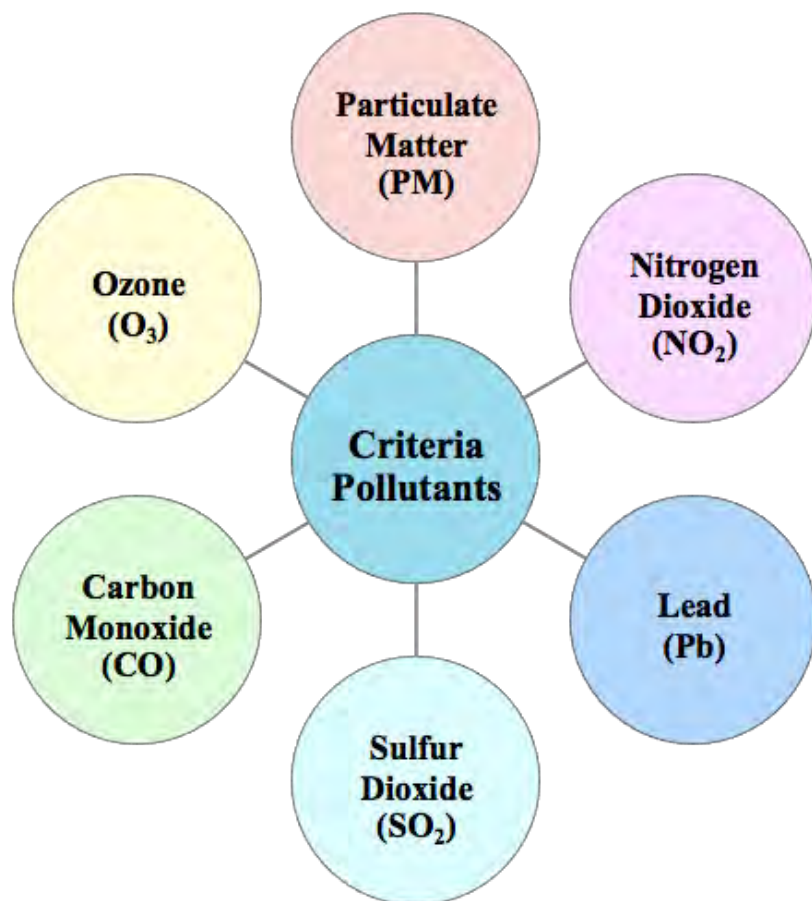


Exercise



Air pollution

Environmental Protection Agency – Criteria Pollutants





Cars and Trucks

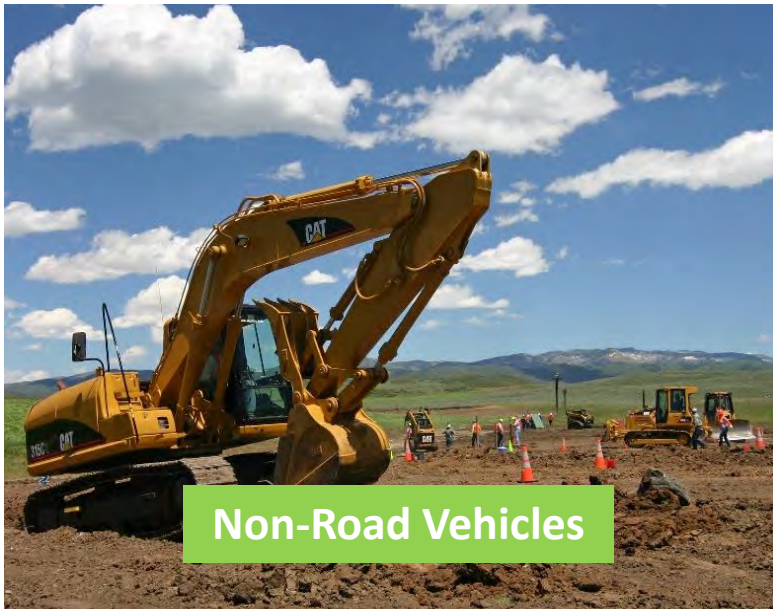


Power Plants



Forest Fires

Fine and Coarse Particles
Can Be Emitted
Directly or Formed in the
Air from Gases



Non-Road Vehicles



Heavy Duty Diesel Engines

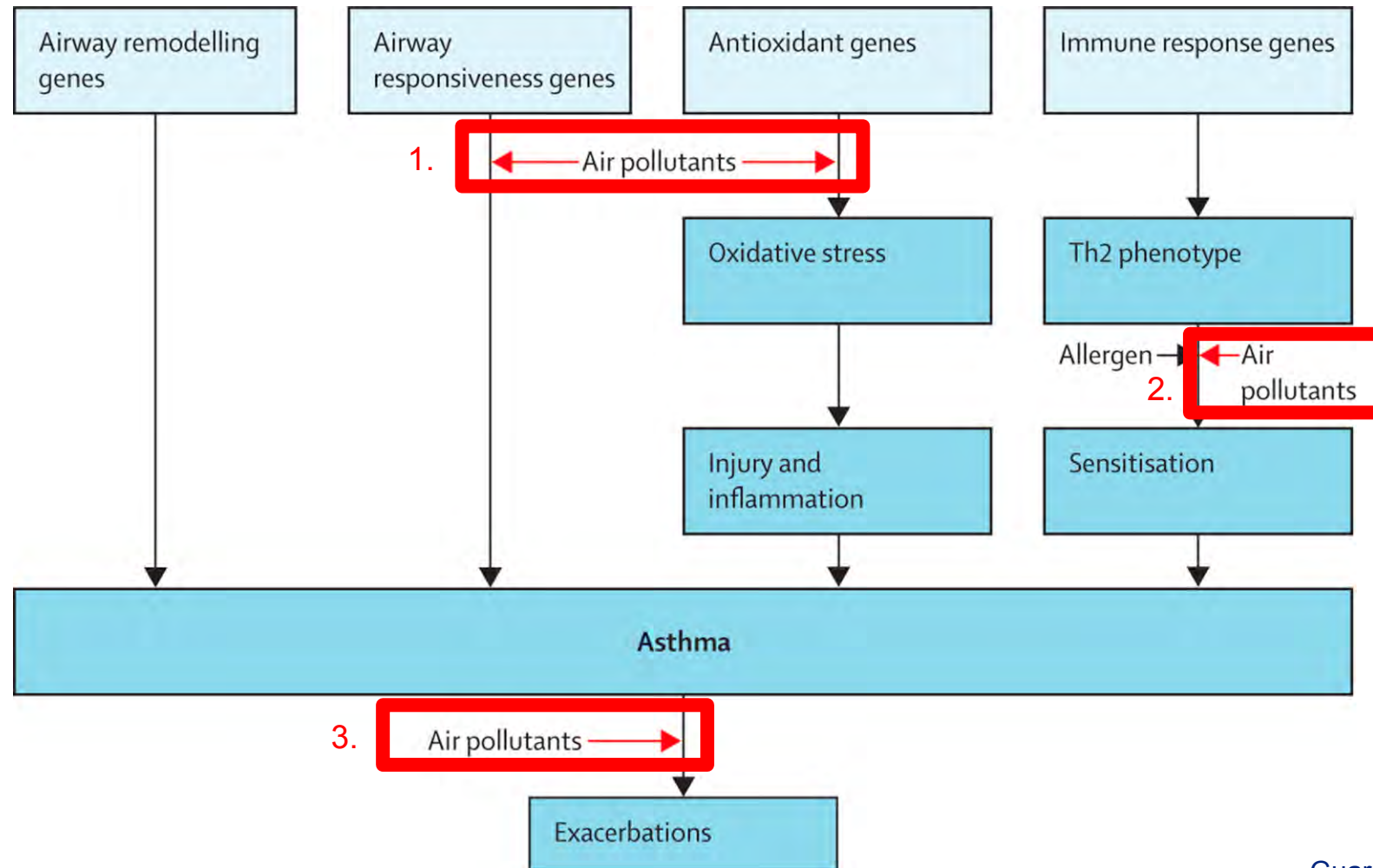


Wood-Burning Stoves

**What do we know about
air pollution exposure
and childhood asthma?**



Air pollution exposure and asthma



Guarnieri & Balmes. *Lancet*. 2014

Long-term Exposure to Air Pollution is a Cause of Childhood Asthma

Epidemiologic Evidence

- **Strong evidence** for childhood asthma and long-term air pollution especially TRAP (NO₂ and BC)

Mechanistic Evidence

- Support for **biological plausibility**
- Air pollution, especially PM_{2.5} and O₃ causes airway remodeling and increased incidence/severity of asthma-like phenotypes

Clinical Considerations

- Air pollution causes lung function deficits, airway remodeling and other clinical parameters considered in the diagnosis of asthma
- Air pollution is a clinically plausible contributor to development and diagnosis of asthma

Workshop Conclusions

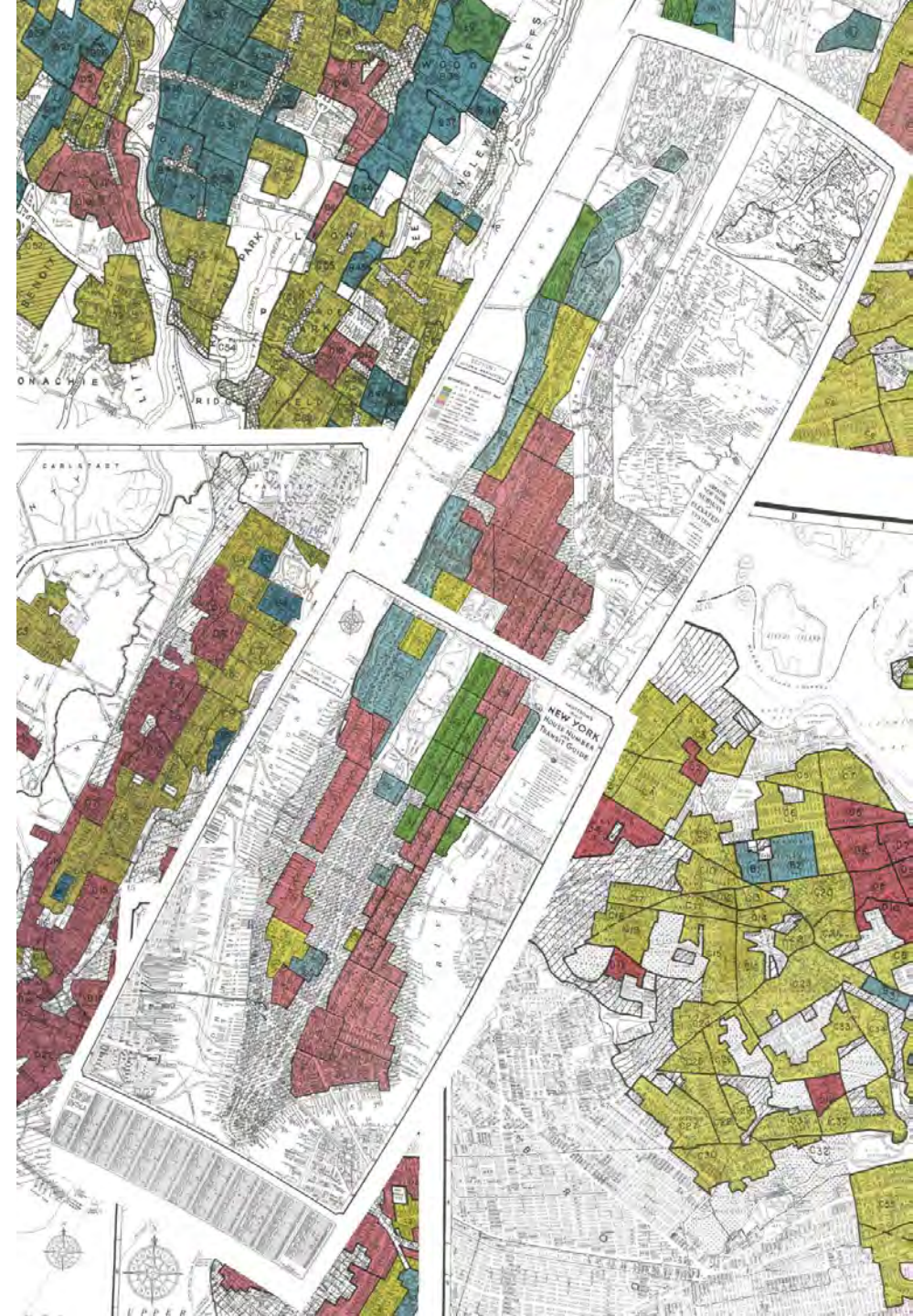
- Epidemiological and toxicological evidence convincingly indicate a causal induction of new childhood asthma by long-term outdoor air pollution exposure

Adapted from: Thurston G, et al. *Ann Am Thorac Soc.* 2020

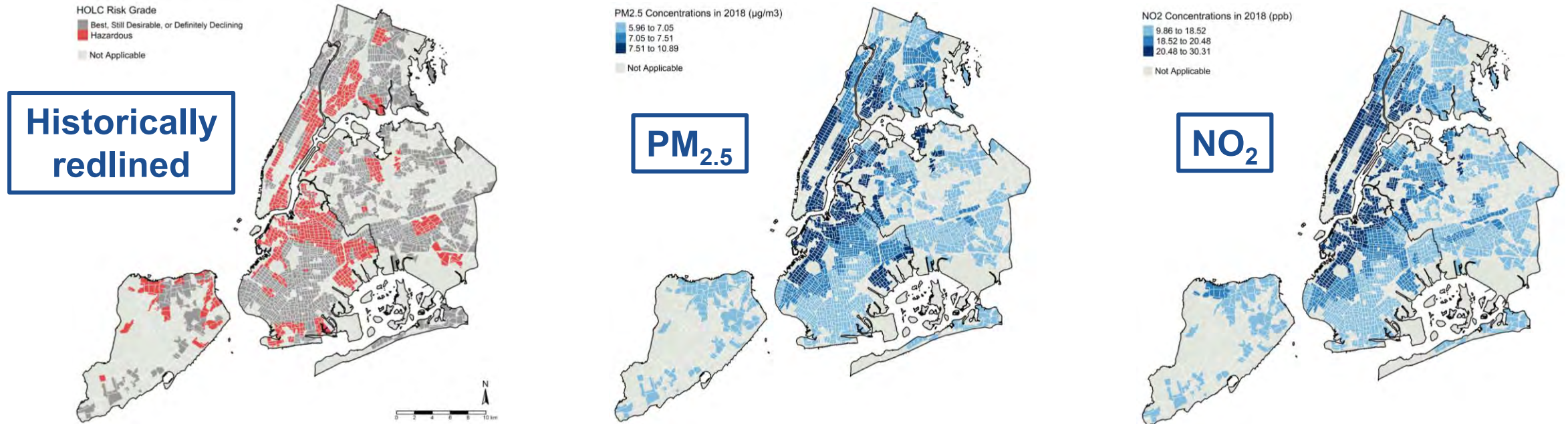
Historical Redlining

In the 1930s the Home Owners' Loan Corporation (HOLC) used maps to distinguish perceived risk for mortgage lending based on factors including racial composition

Discriminatory practices have perpetuated racial segregation, poverty, and influenced where highways and other point pollution sources were placed

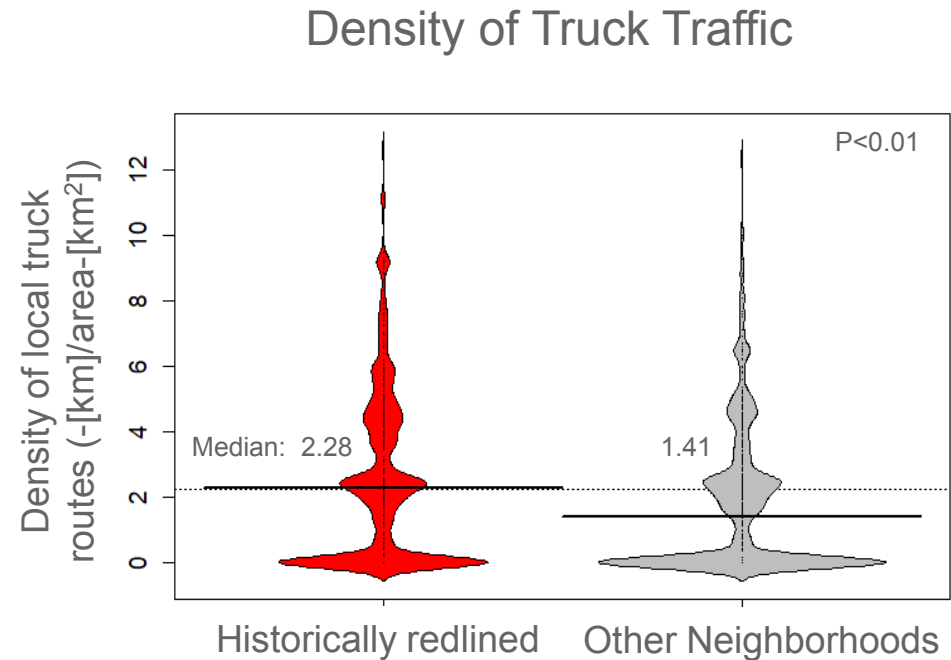
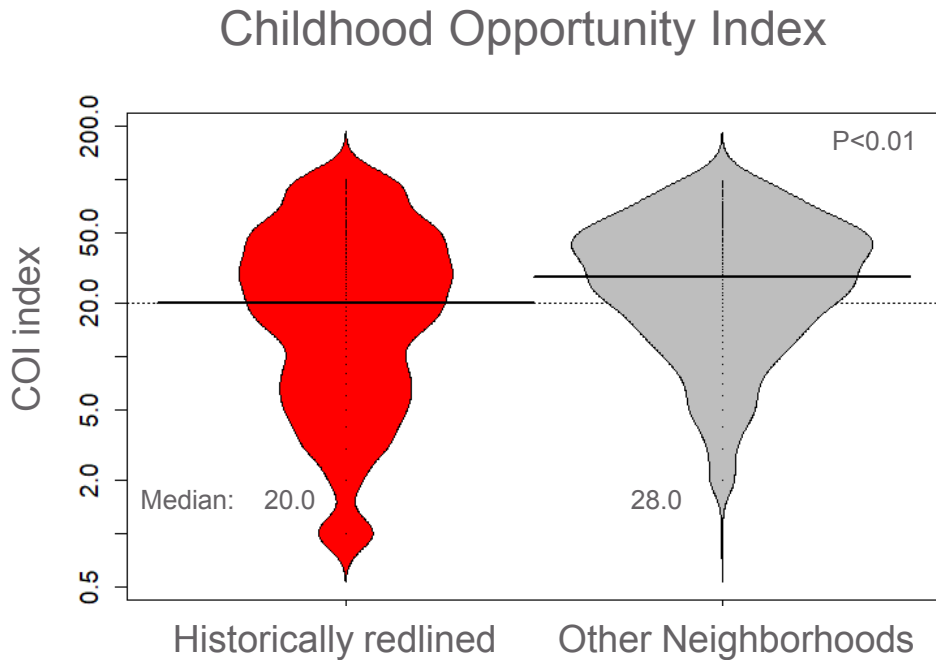


Pollution Concentrations are Higher in Redlined Compared to Other Neighborhoods in NYC



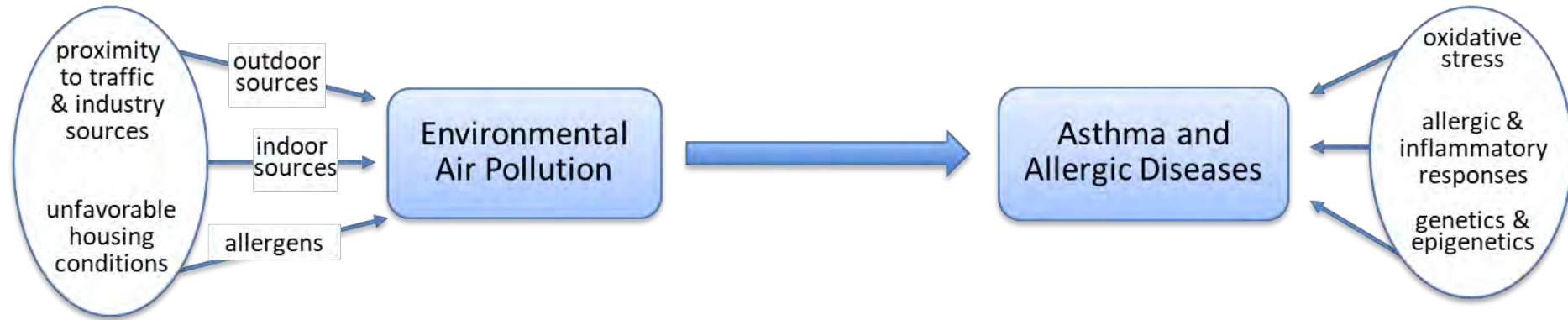
Lovinsky-Desir et al. *ISEE Conference*. 2021

Redlined neighborhoods have more social vulnerability and air pollution sources than non-redlined neighborhoods



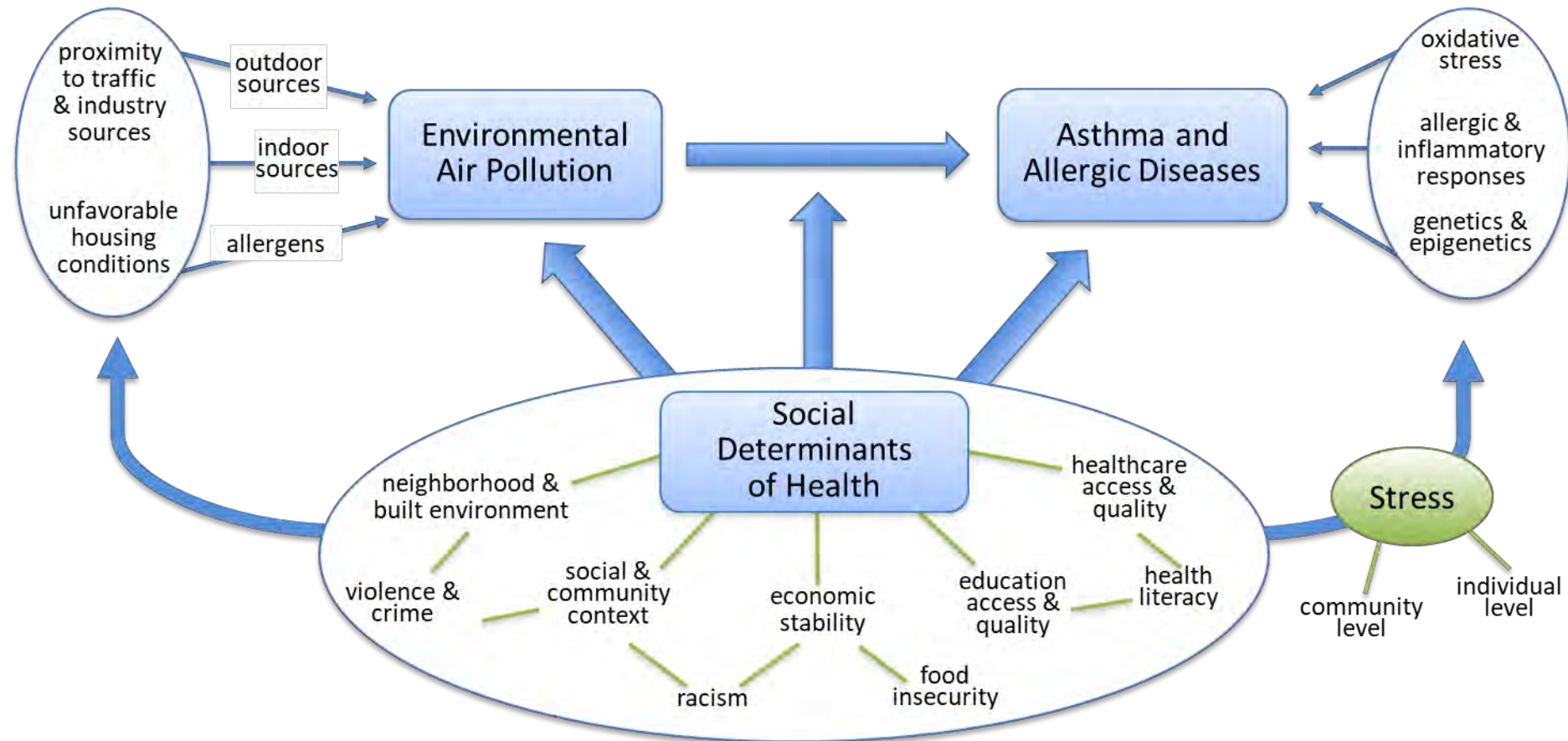
Jung et al. *Environment International*. 2022

Complex interactions between air pollution exposure, social determinants of health, and asthma



Cook, Argenio, & Lovinsky-Desir. *J Allergy Clin Immunol.* 2021

Complex interactions between air pollution exposure, social determinants of health, and asthma



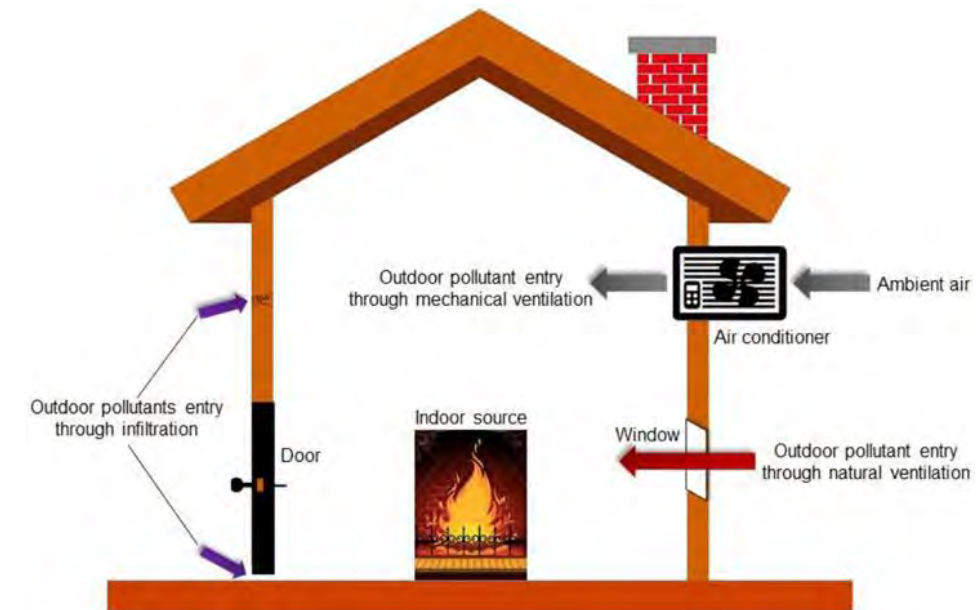
Cook, Argenio, & Lovinsky-Desir. *J Allergy Clin Immunol.* 2021

How are children exposed to air pollution in the school environment?



Common Indoor Sources of Pollution

Pollutant	Sources
PM	Cooking stoves, fireplaces, smoking, outdoor air
SO ₂	Cooking stoves, fireplaces, outdoor air
NO ₂	Cooking stoves, fireplaces, outdoor air
CO	Cooking stoves, fireplaces, water heater, outdoor air
Ozone	Air cleaning device with high voltage, outdoor air



Leung DYC, et al. *Front Environ Sci.* 2015

Schools are often located near major roadways

- 114,644 US public and private schools grades pre K-12 (2005-06)
- 3.2 million children (6.2%) attended schools within 100 meters of a major roadway
- Schools serving predominately Black students were 18% more likely to be near a major roadway



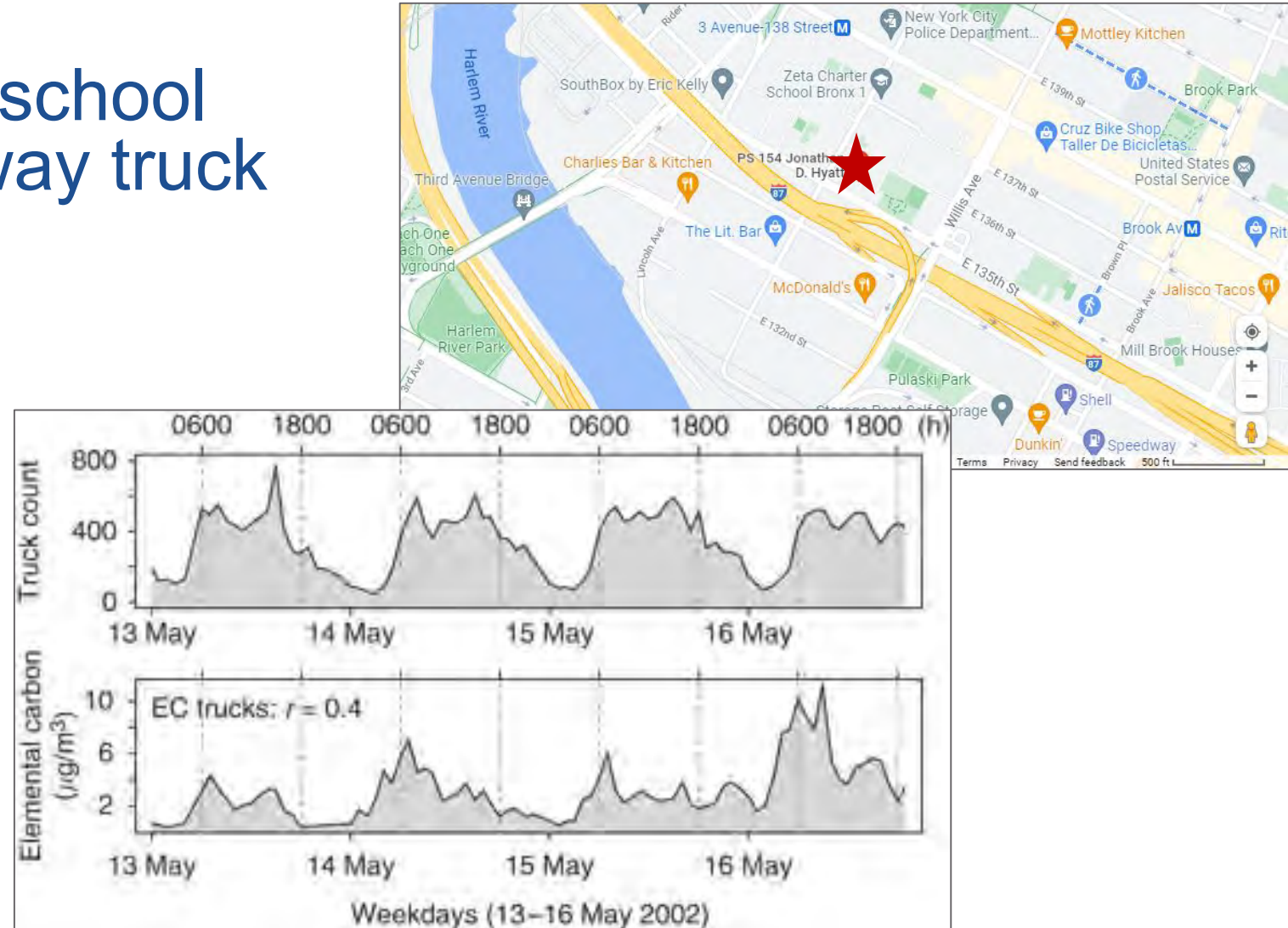
Kingsley SL, et al. *J Expo Sci Environ Epidemiol.* 2014

Outdoor pollution near school closely related to highway truck traffic counts

Truck traffic counts

School-site elemental carbon (EC) concentrations

Highest peaks early morning rush hour traffic

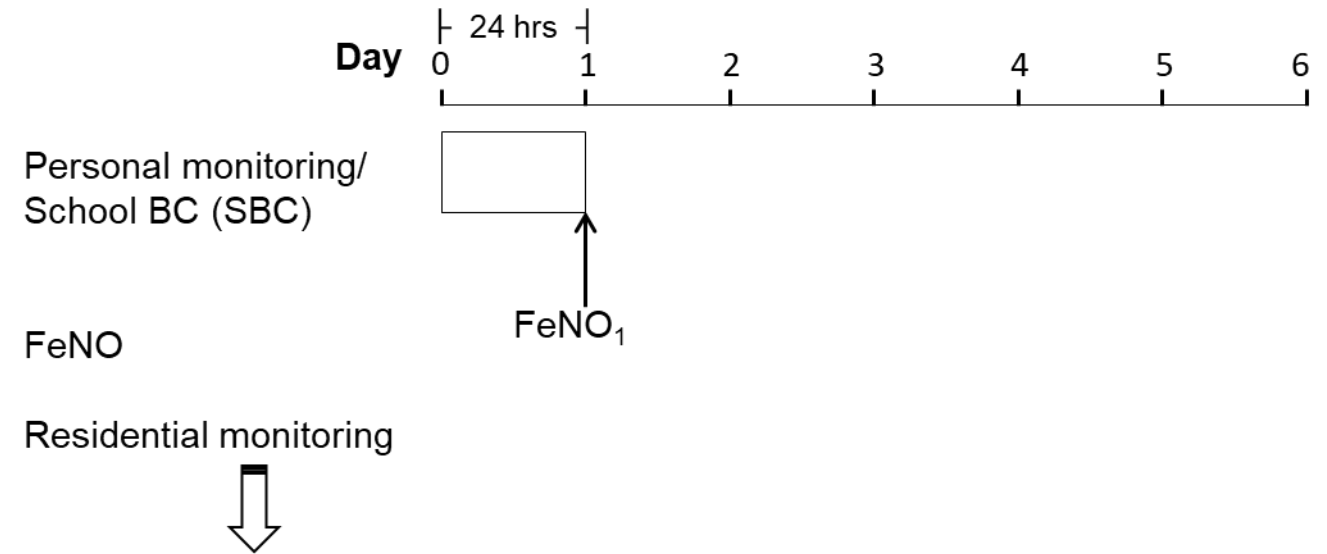


Spira-Cohen, et al. *J Expo Sci Environ Epidemiol*. 2011

Personal Pollution Monitoring in NYC Schools

- 114 children ages 1-14 years (61% Dominican, 39% Black)
- Personal Black Carbon monitors for two 24-hr periods, 5 days apart
- Airway inflammation measured after pollution monitoring

A. Time 1

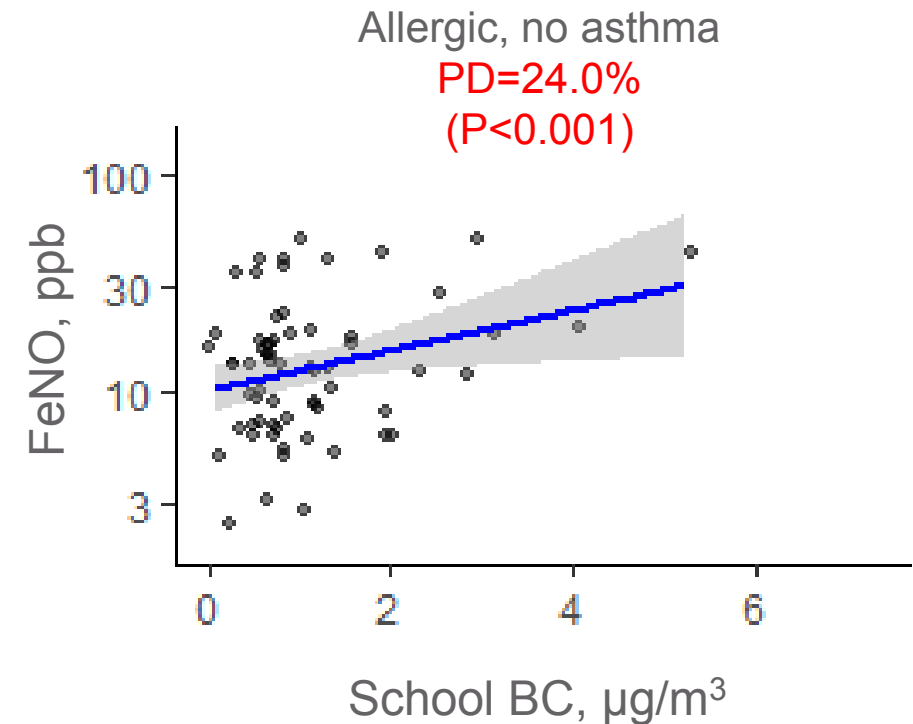


B. Repeated 6 months later (Time 2)

Jung KH, et al. *Environmental Health Perspect.* 2021

Personal exposure to BC during school associated with increased airway inflammation

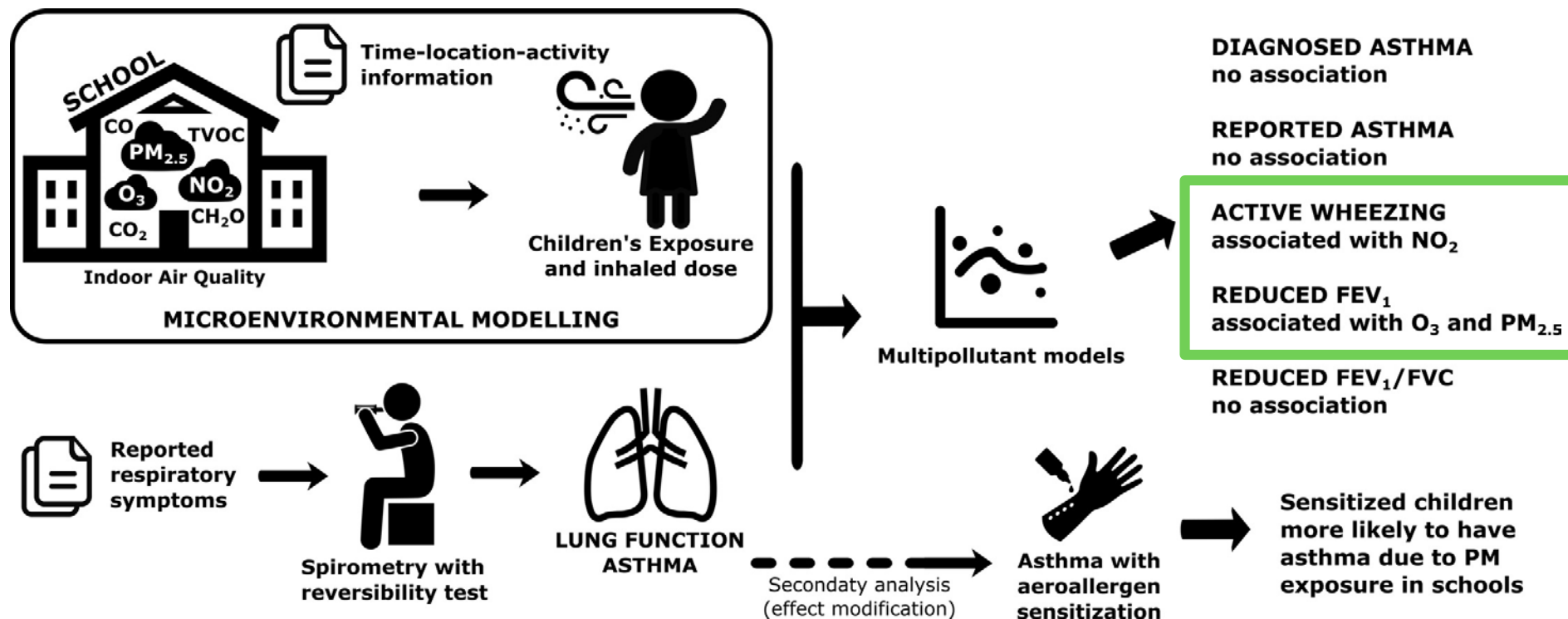
	% difference	95% CI	p-value
School BC	7.47%	1.31, 13.9	0.02
Commute BC	6.82%	0.70, 13.3	0.03
Non-school BC	1.92%	-1.09, 5.13	0.22
Residential BC	-0.50%	-9.88, 9.75	0.92



Jung KH, et al. *Environmental Health Perspect.* 2021

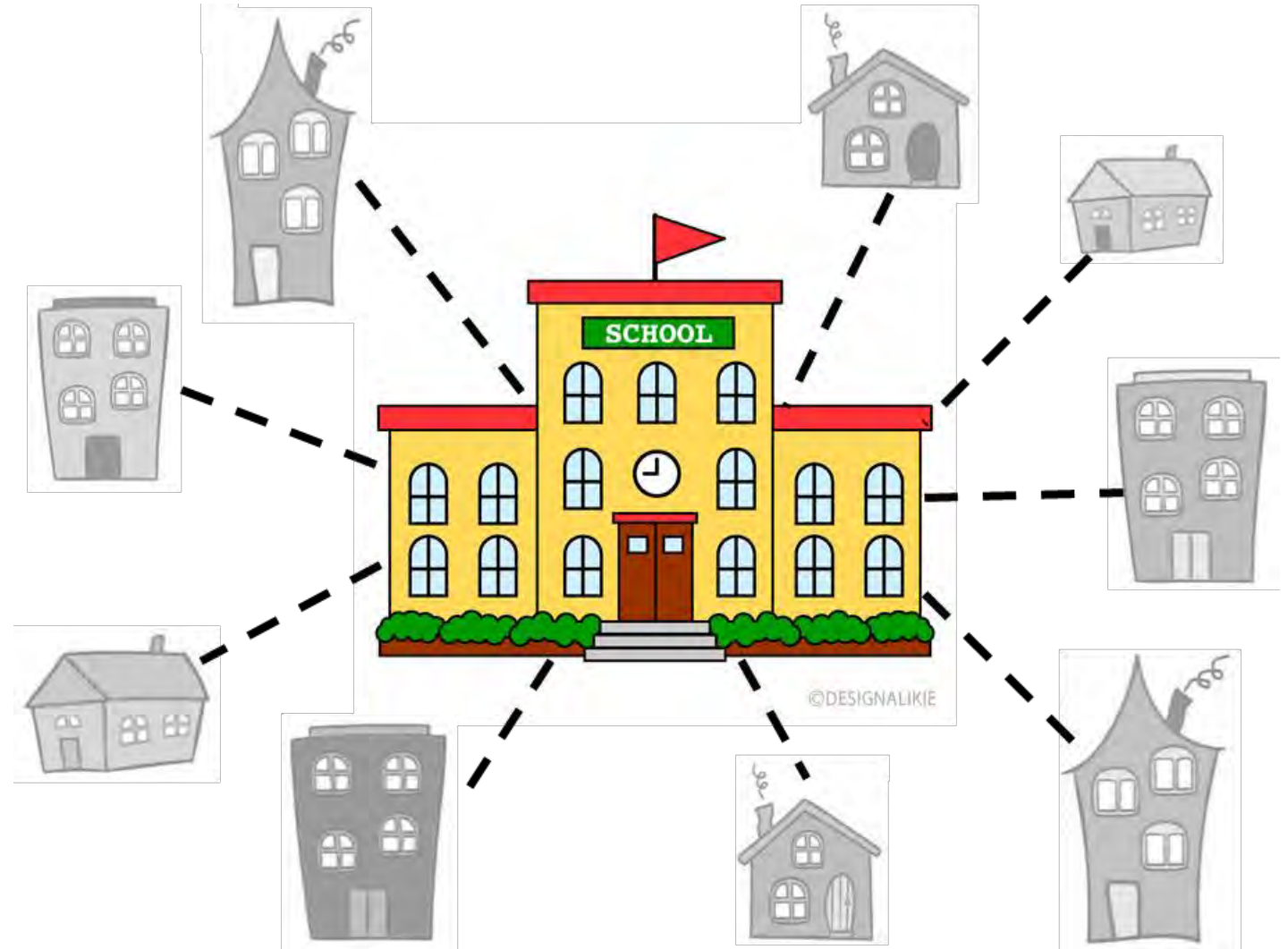
Indoor air pollution in nursery and primary schools in Portugal associated with asthma outcomes

648 pre-school and 882 primary school children in Portugal



Branco PTBS, et al, et al. *Environ Sci Technol.* 2018

School vs. Home Environmental Exposures and Respiratory Outcomes



ECHO

Environmental influences
on Child Health Outcomes

A program supported by the NIH



COLUMBIA

COLUMBIA UNIVERSITY
DEPARTMENT OF PEDIATRICS

**NewYork-
Presbyterian**

Morgan Stanley
Children's Hospital

What measures can be taken to reduce air pollution in the school environment?



Philadelphia school district to install new air purifiers despite concerns from air quality specialist

By Neena Hagen | Jul 21, 2021, 7:07pm EDT

Chalkbeat

PHILADELPHIA

f t REPUBLISH



Philadelphia school officials believe the new \$4.5 million air and surface purifiers are safe for students when they return for in-person learning. The district plans to install 9,500 devices by the end of the month.

| WHY?

Let's clear the air on air purifiers and COVID

By

The News & Observer

t f e r

UPDATED SEPTEMBER 20, 2021 9:17 AM



Photo: Tim Heffernan



Can HEPA Air Purifiers Capture the Coronavirus?

UPDATED NOVEMBER 18, 2020 We've updated this guide to reflect [current understanding about airborne transmission.](#)



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Morgan Stanley
Children's Hospital

High Efficiency Particulate Air (HEPA) Filter

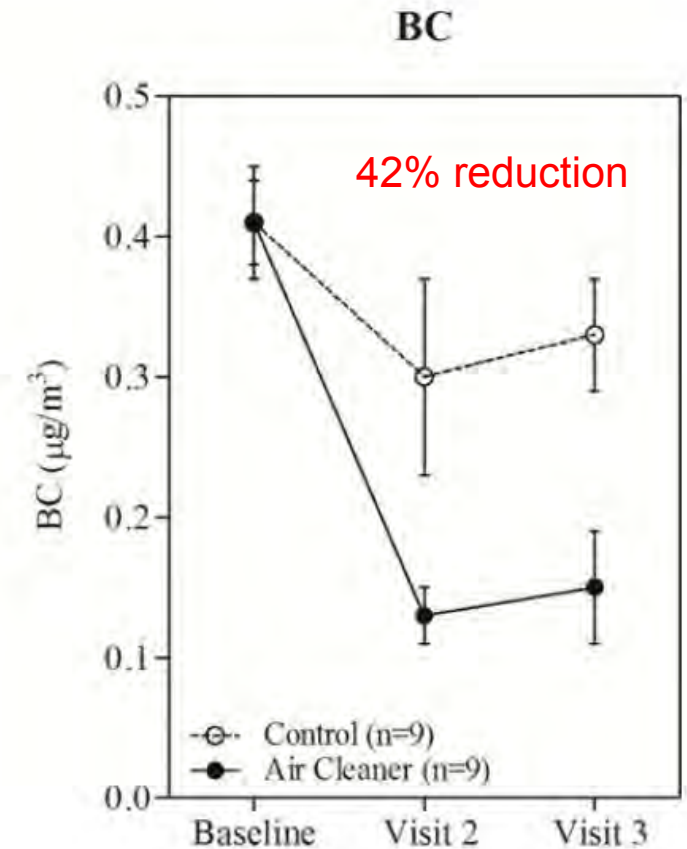
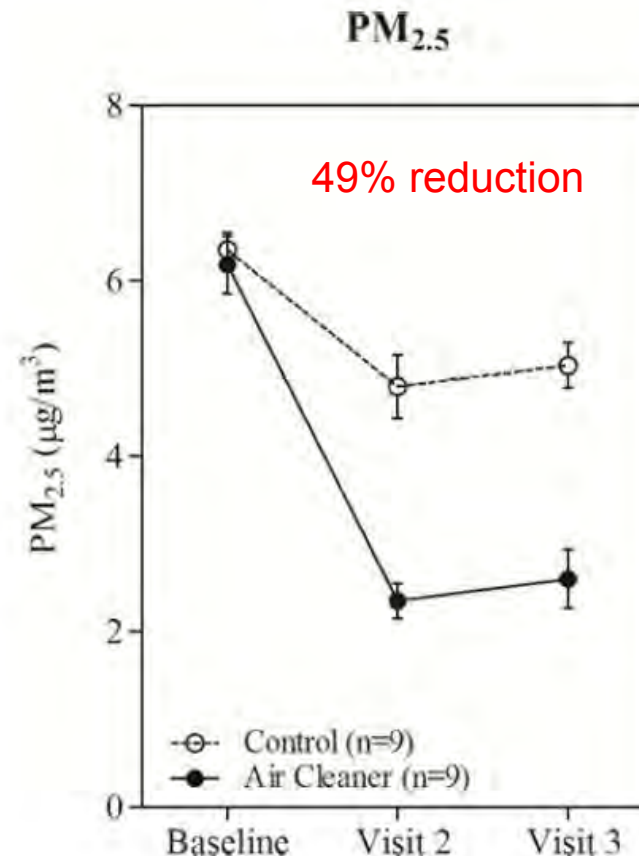


HEPA filters in Boston classrooms reduced pollution concentrations

25 children with asthma, age 6-10 years (60% Black, 24% Hispanic)

9 intervention (air cleaner with HEPA filter) and 9 control classrooms over 6 months

Modest improvements in lung function and asthma symptoms in intervention compared to control groups

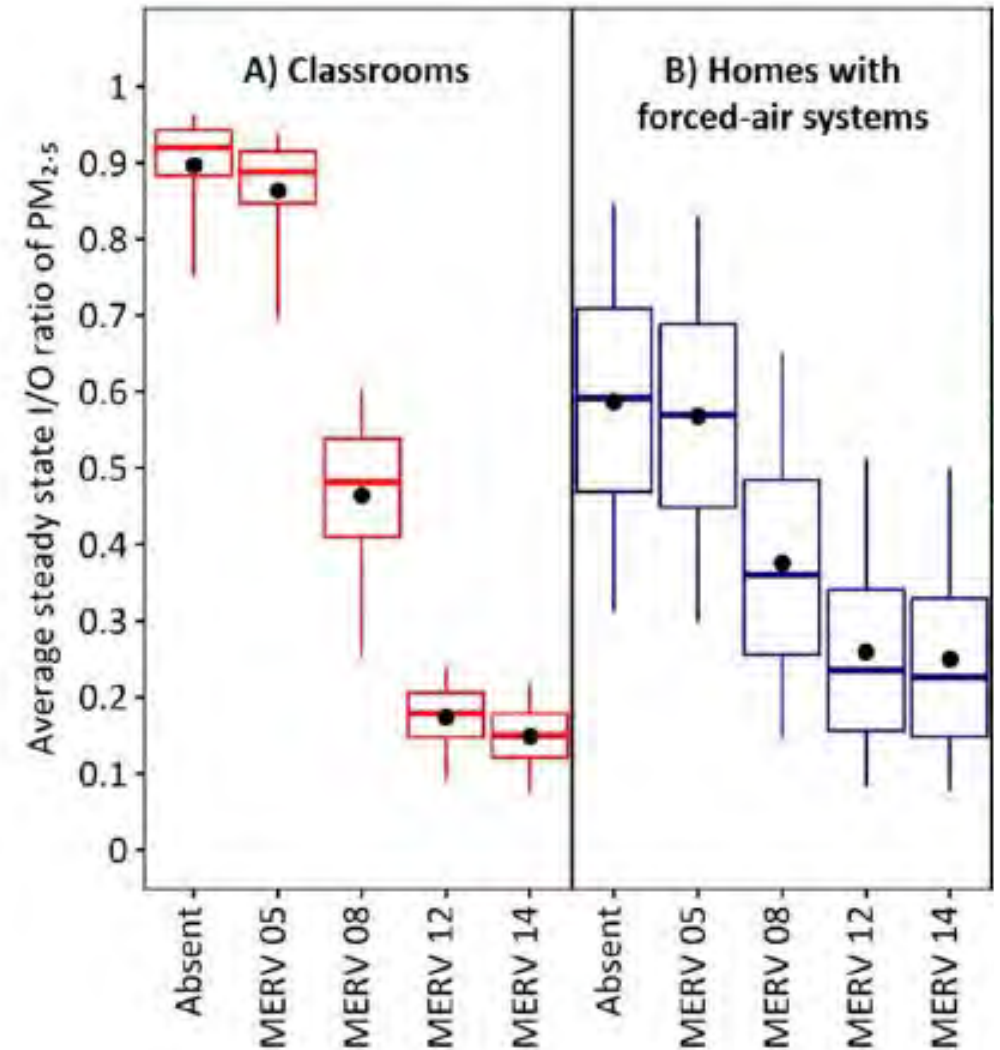


Jhun, et al. *J Allergy Clin Immunol Pract.* 2018

Enhanced filters in schools and homes to reduce indoor exposure to pollution in Detroit

Estimated indoor $PM_{2.5}$ in 290 schools in Detroit

More efficient filters in schools would reduce asthma-related health burden (decreased asthma symptom days)



MERV: minimum efficiency reporting value
(HEPA = MERV \geq 17)

Martenies & Batterman. *Environ Sci Technol*. 2018

Air Quality Flag Program

GOOD

MODERATE

UNHEALTHY
for Sensitive Groups

UNHEALTHY

VERY UNHEALTHY

**Raise a flag
to show the
air quality forecast
in your area.**

Learn more at:
airnow.gov/flag



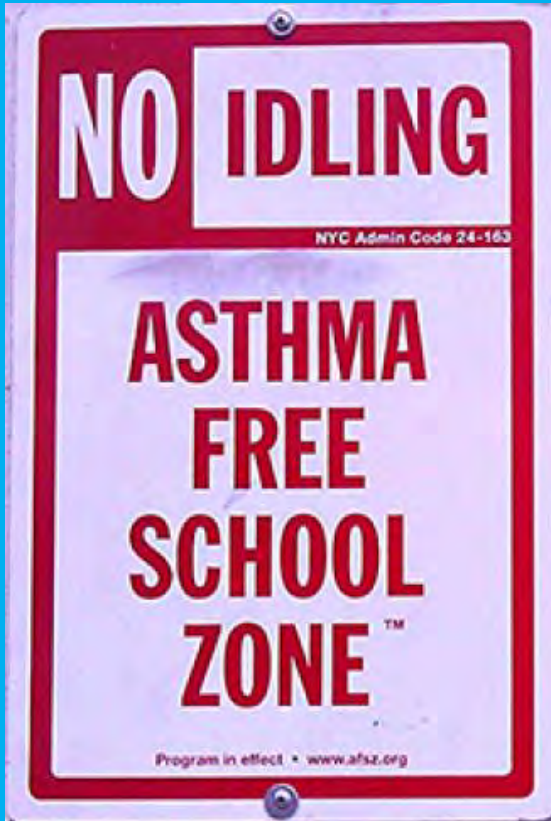
It's a great day to be active outside!

It's a good day to be active outside.

It's OK to go outside and be active for recess or PE class. For longer activities, take it a little easier.

Take it a little easier if you do any outside activities

It's a good day to play inside.



Around Schools...

- Ask bus driver and carpool drivers to turn off their engines if parked more than 30 seconds.
- Play or exercise as far as possible from busy roads.
- Check the Air Quality Index daily or download the mobile app at www.airnow.gov.

New York
46° | Clear

10-DAY FORECAST

Sun		43°		64°
Mon		54°		66°
Tue	 40%	58°		68°
Wed		54°		68°
Thu		51°		65°
Fri		52°		66°
Sat		56°		69°
Sun	 40%	55°		66°

AIR QUALITY

27 - Good

Air quality index is 27, which is similar to yesterday at about this time.



See More



Take home messages

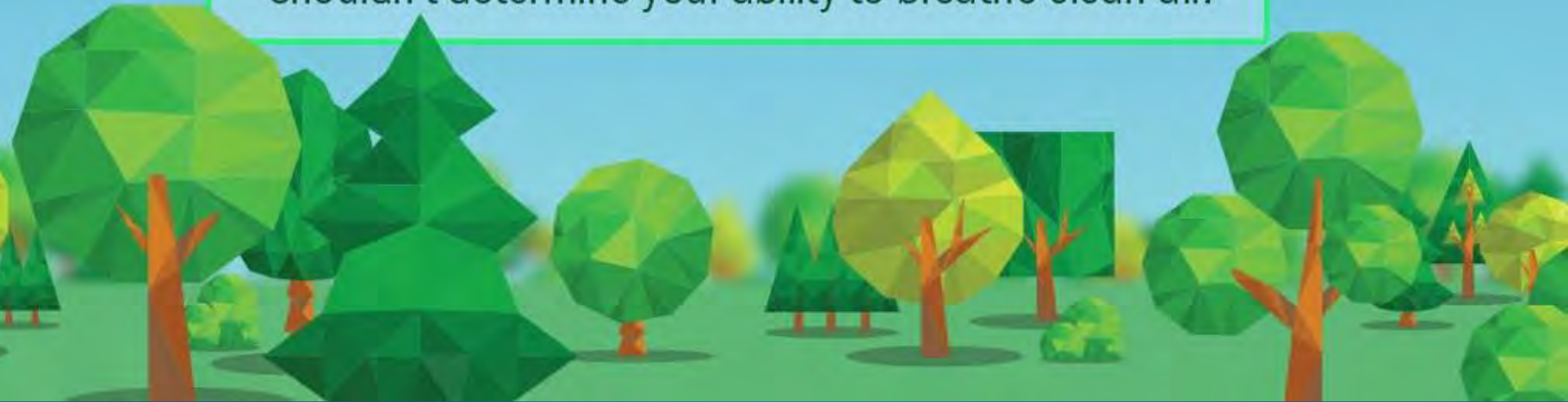
1. *What do we know about air pollution exposure and childhood asthma?*
 - Air pollution causes asthma and worsens asthma symptoms
2. *How are children exposed to air pollution in the school environment?*
 - The predominant source of indoor air pollution in school is from outdoor sources, particularly traffic related pollution
3. *What measures can be taken to reduce air pollution in the school environment?*
 - Air filtration devices that include HEPA filters can reduce air pollution in classrooms along with education programs such as the Air Quality Flag Program



ENVIRONMENTAL JUSTICE:

Adding the Freedom of Choice

“The color of your skin or the thickness of your wallet shouldn't determine your ability to breathe clean air.”



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