How Air Pollution Is Affecting Our Health

Environmental Science Institute for Teachers
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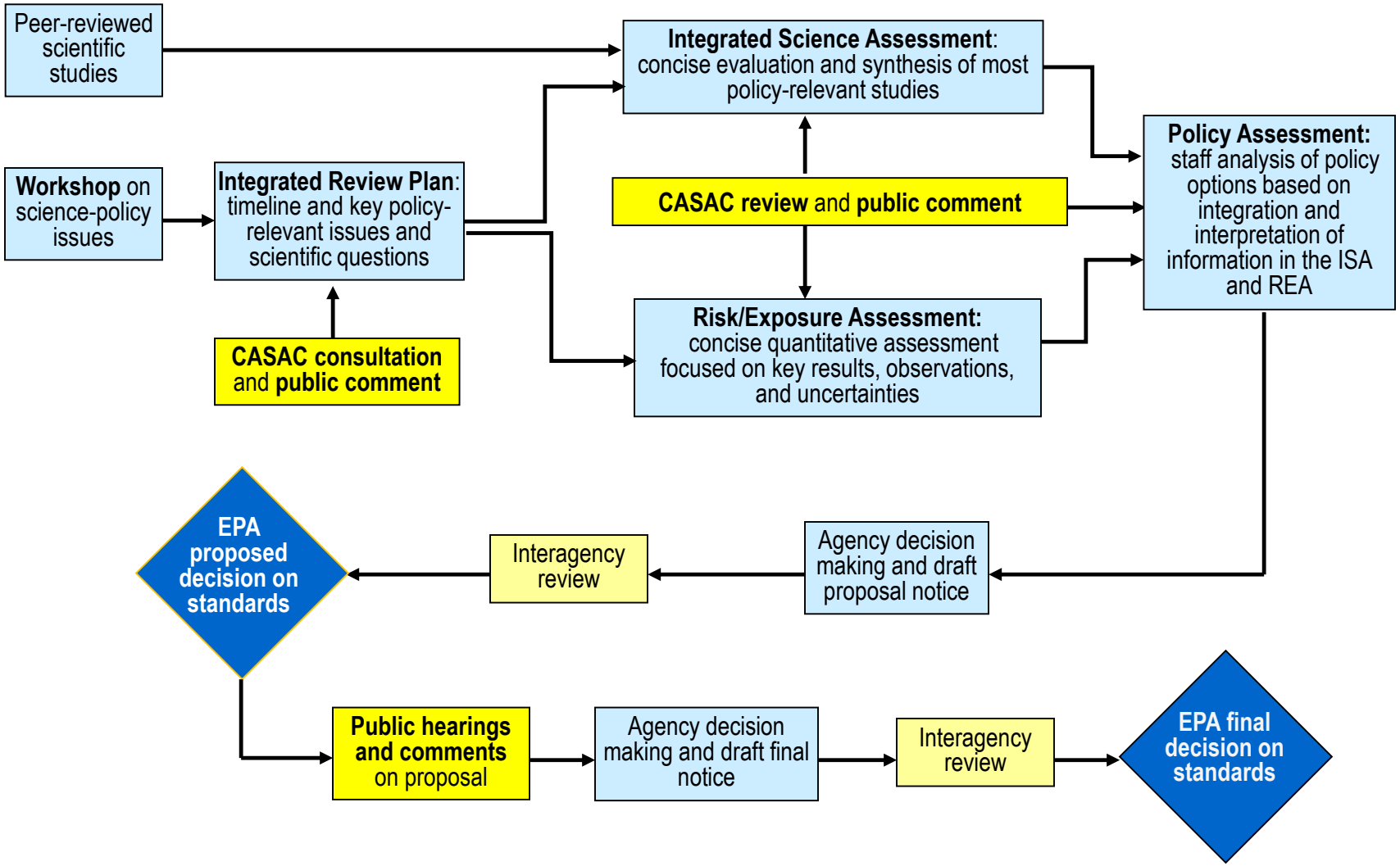
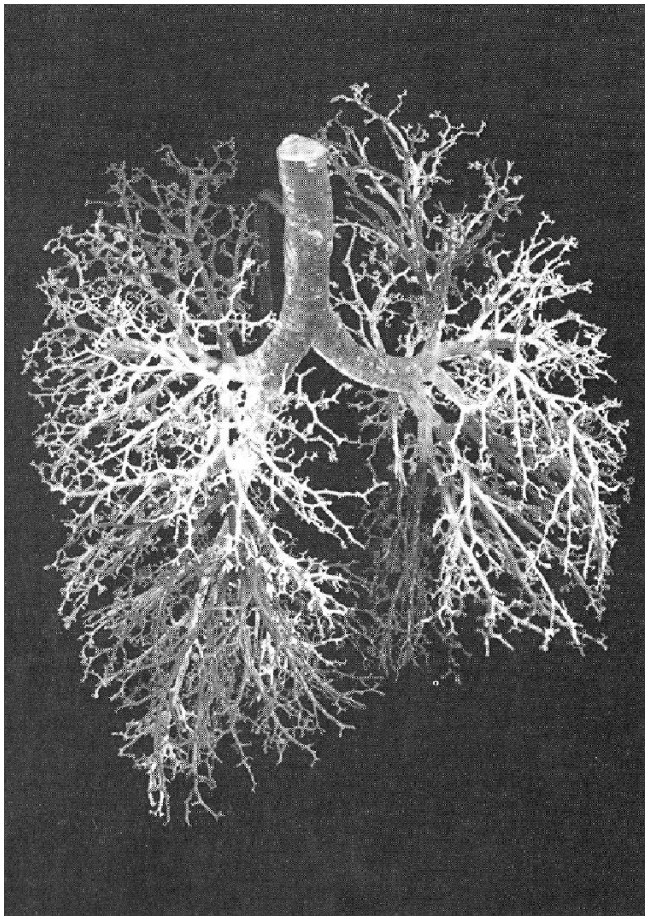
Overview of NAAQS Review Process



Human Lung

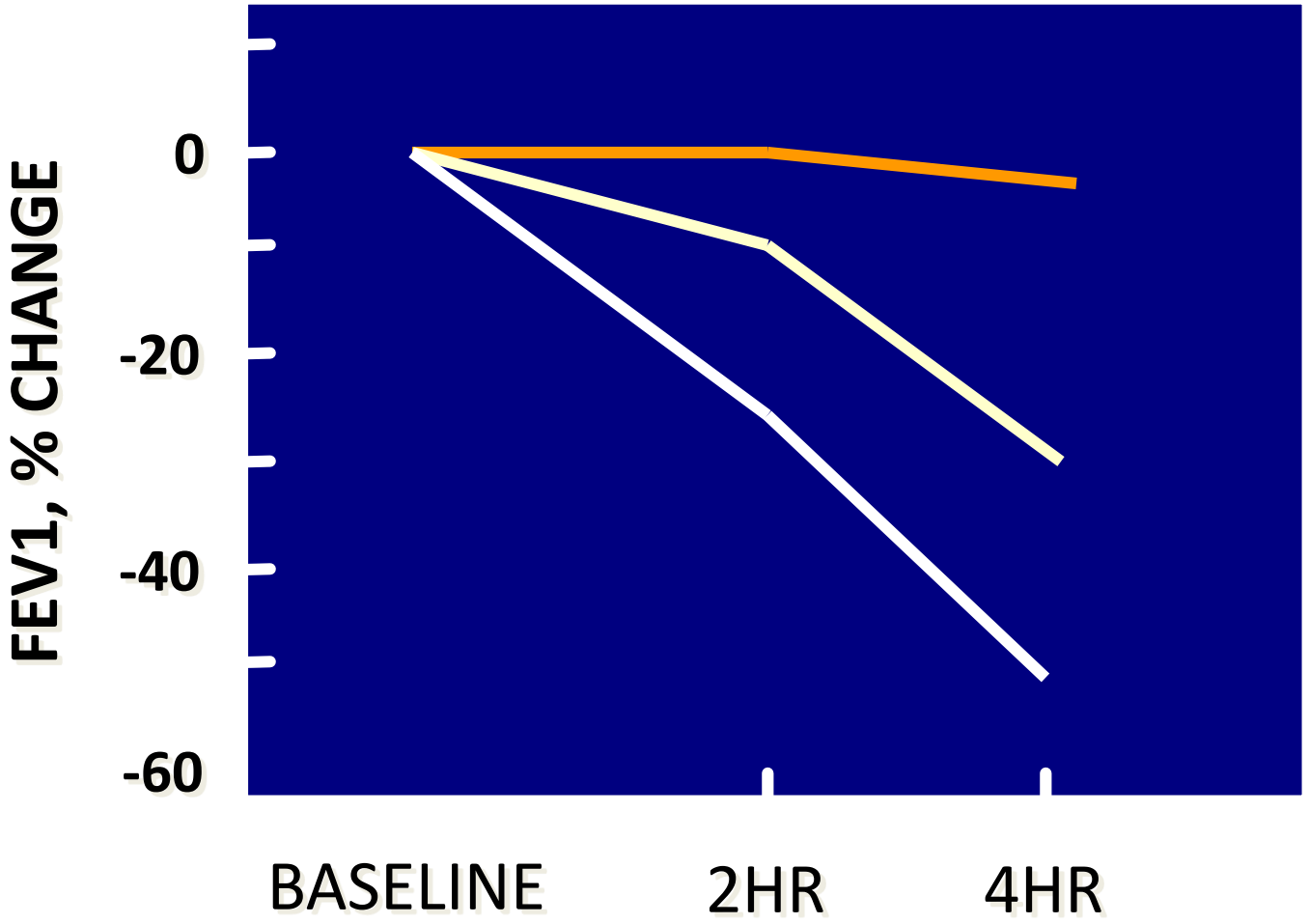
- Air conducting
  - Trachea
  - Bronchi
  - Bronchioles
- Gas exchange
  - Respiratory bronchioles
  - Alveoli

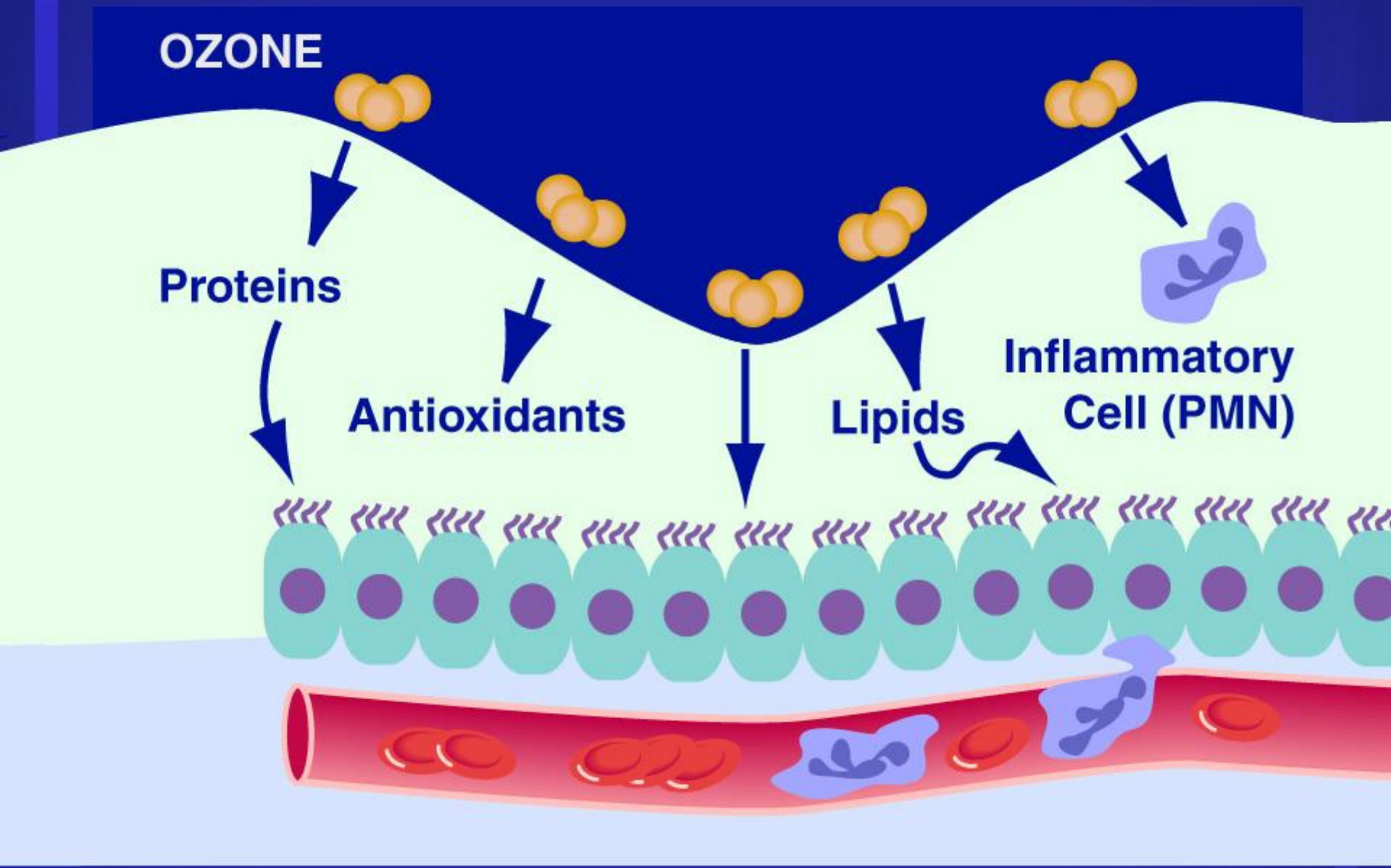


Ozone Irritates Airways

- Symptoms
  - Cough
  - Sore or scratchy throat
  - Pain with deep breath
  - Fatigue
- Rapid onset
- Asthma symptoms - greater in people with asthma, also occur in people without asthma

Variability in Lung Function Responses




OZONE
Proteins
Antioxidants
Lipids
Inflammatory Cell (PMN)

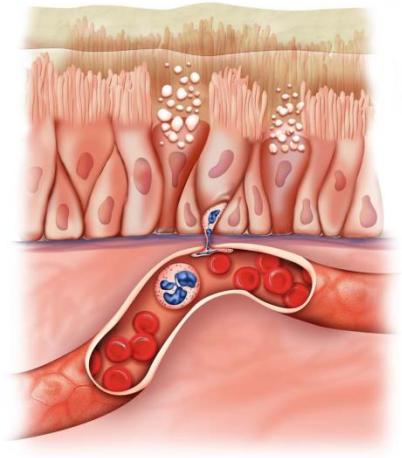
M-1c

Ozone Causes Inflammation

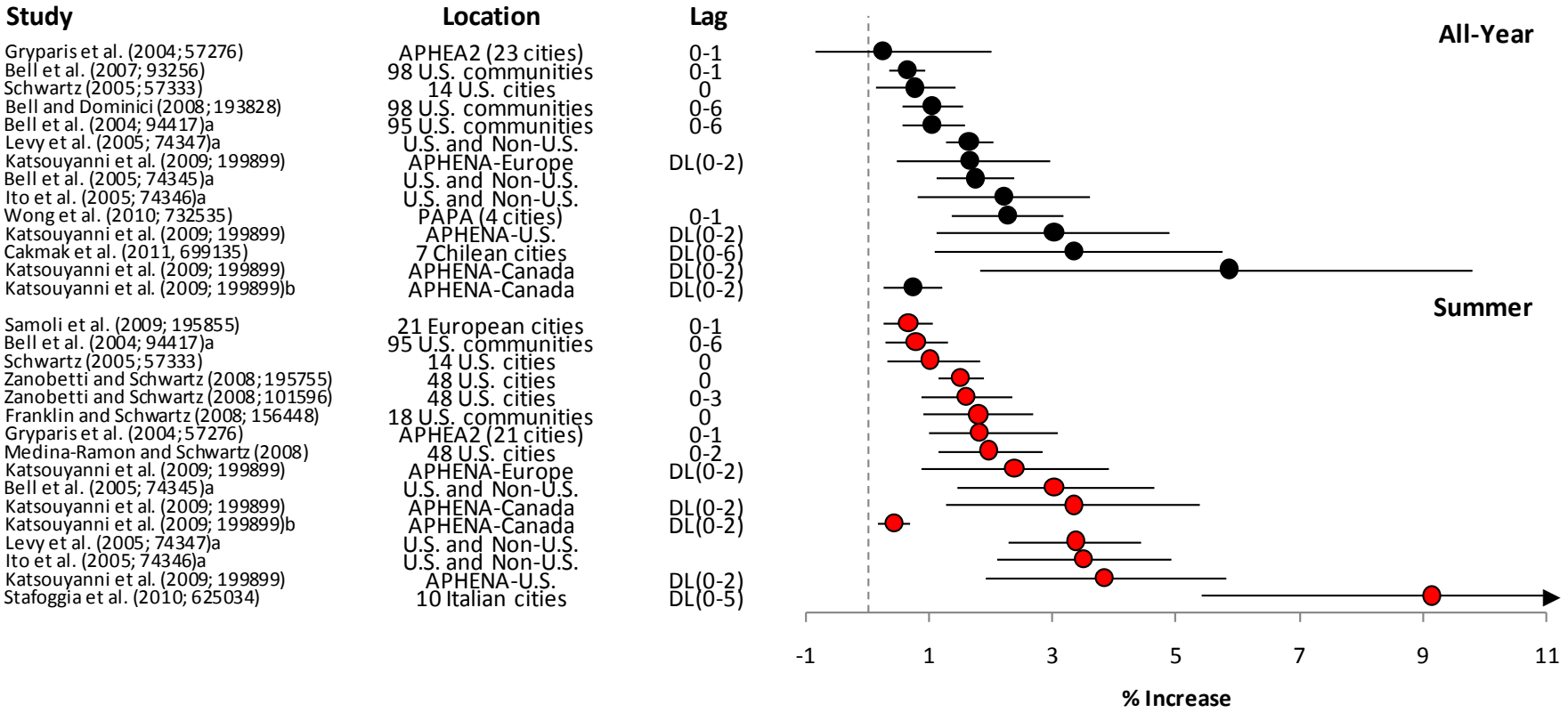
- Ozone reacts completely in surface layer - forms reactive oxygen molecules
- Increases permeability of cells that line airways
- Influx of white blood cells and proteins
- Damages cells that line the airways
- Effect is greater 24 hours after exposure
- Increases airway reactivity
- Concern about repeated exposures

Short-Term O_3 Exposure and Respiratory Effects

- Lung function decrements
  - Large body of clinical, toxicological, and epidemiologic evidence
  - Epidemiologic evidence for children, especially asthmatics
- Respiratory symptoms and asthma medication use
  - Clinical and epidemiologic evidence
- Airway inflammation and oxidative stress
  - Large body of toxicological and clinical evidence
  - New epidemiologic evidence with parallel findings in asthmatic children
- Increased airway permeability, airways hyperresponsiveness, allergic responses, and susceptibility to infection
  - Large body of clinical and toxicological evidence
- Hospital admissions/ED visits
  - Consistent positive associations across endpoints
  - Stronger associations during the summer, specifically for asthma and COPD



Short-Term O_3 Exposure and All-Cause (Nonaccidental) Mortality

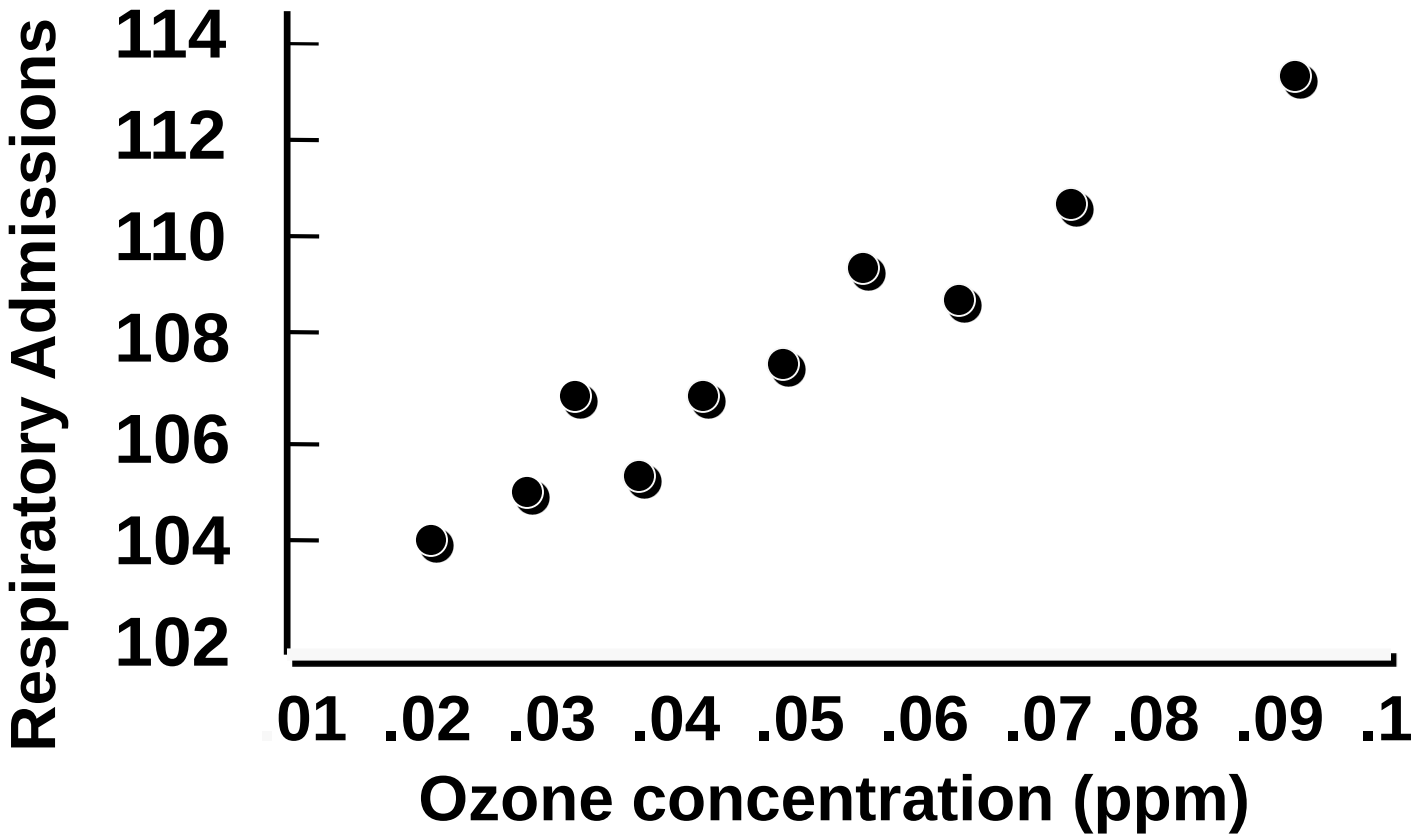


*Effect estimates standardized to 20 ppb increase in 24-h avg; 30 ppb increase in 8-h max; and 40 ppb increase in 1-h max O_3 concentrations.

ISA Figure 6-27

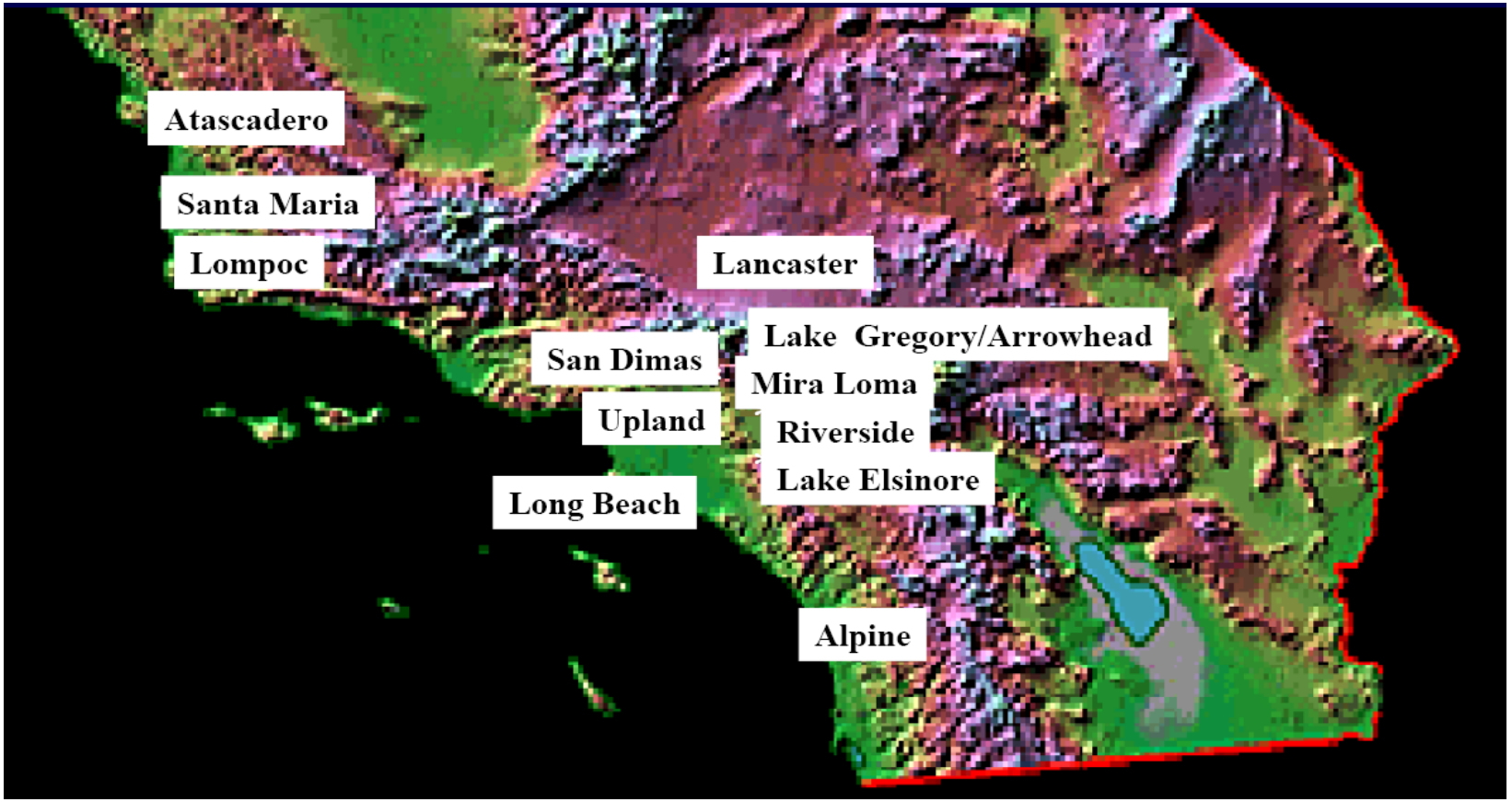
Respiratory Hospital Admissions by Daily Maximum Ozone Level, Lagged One Day

(Burnett et al, 1994)



California Children's Health Study

Study of Effects of Long-term Exposures



CHS: Ozone and School Absences

- 20 ppb increase in O_3 associated with an 83% increase in school absences for acute respiratory disease (Gilliland et al., 2001)

- Large economic impact of pollution-related school absences (Hall and Lurmann, 2003)

CHS: Ozone and New-onset Asthma

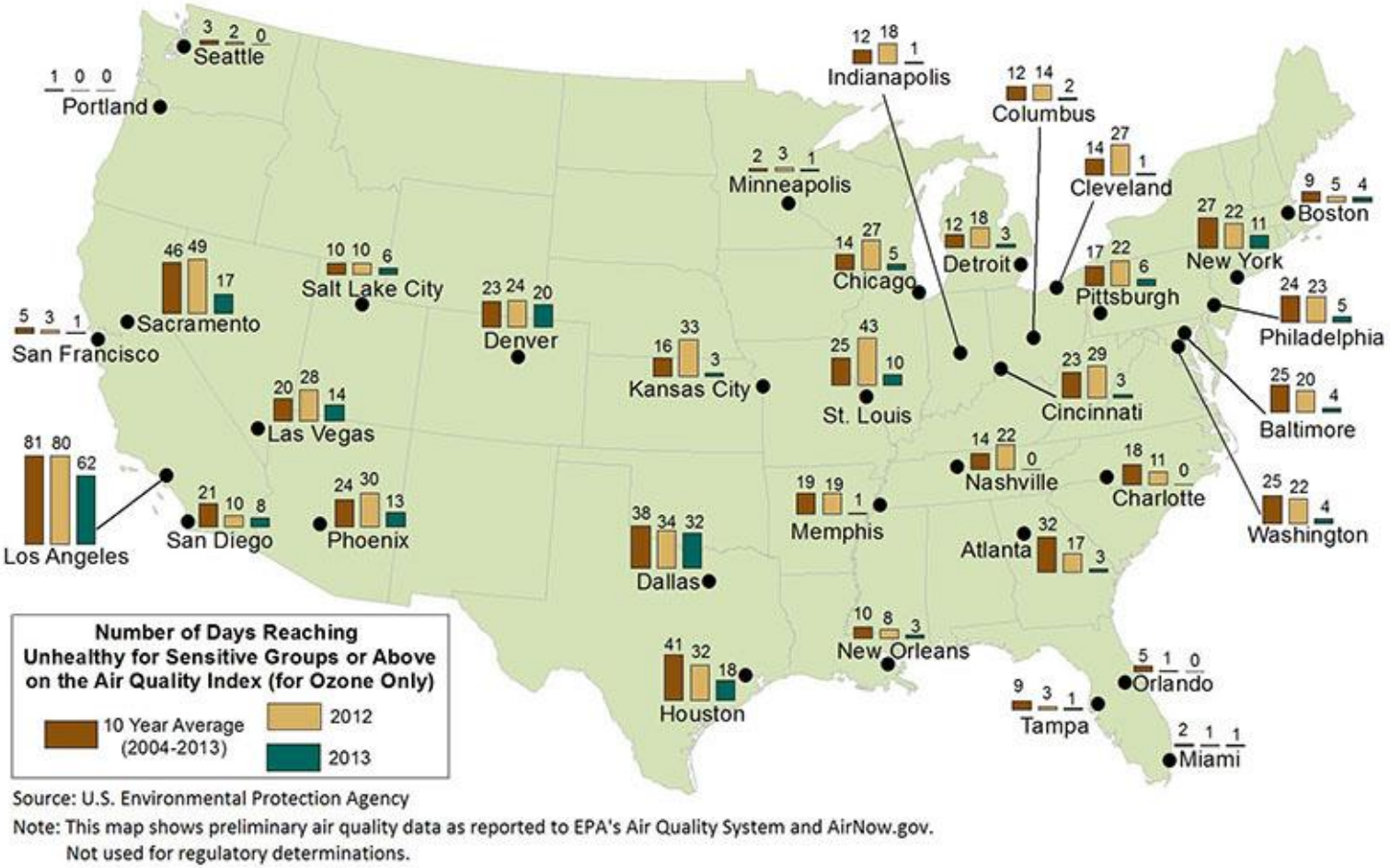
	Low O_3 Towns		High O_3 Towns	
Sports	# asthma	RR	# asthma	RR
0	58	1.00	46	1.00
1	50	1.28	40	1.28
2	20	0.82	16	1.28
≥3	9	0.79	20	3.31

McConnell et al., 2002

Sensitive Groups for Ozone

- People with asthma
- Children and older adults
- Outdoor workers and people who are active outdoors
- People with reduced intake of certain nutrients (e.g., vitamins C and E)
- People with certain genotypes, related to oxidative stress

A Look Back: Ozone in 2013



Source: U.S. Environmental Protection Agency

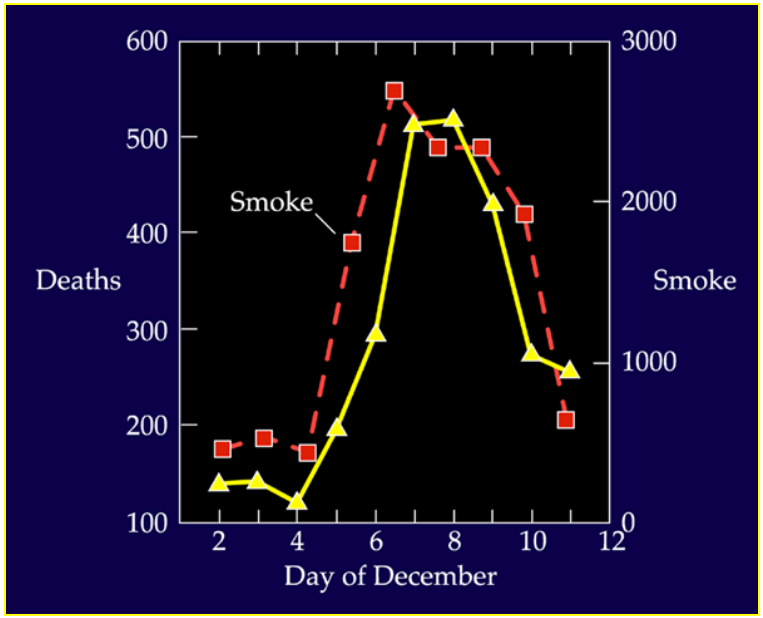
Note: This map shows preliminary air quality data as reported to EPA's Air Quality System and AirNow.gov. Not used for regulatory determinations.

Many U.S. cities saw a decrease in 2013 in the number of days when ozone levels reached "code orange" or "unhealthy for sensitive groups" on the Air Quality Index (AQI). A number of factors influence ozone formation, including emissions from cars, trucks, buses, power plants, and industries – and weather conditions. Weather is especially favorable for ozone formation when it's hot, dry and sunny, and winds are calm and light. Weather conditions were much wetter than average in the U.S. during the summer of 2013, which limited ozone formation in many regions of the country.

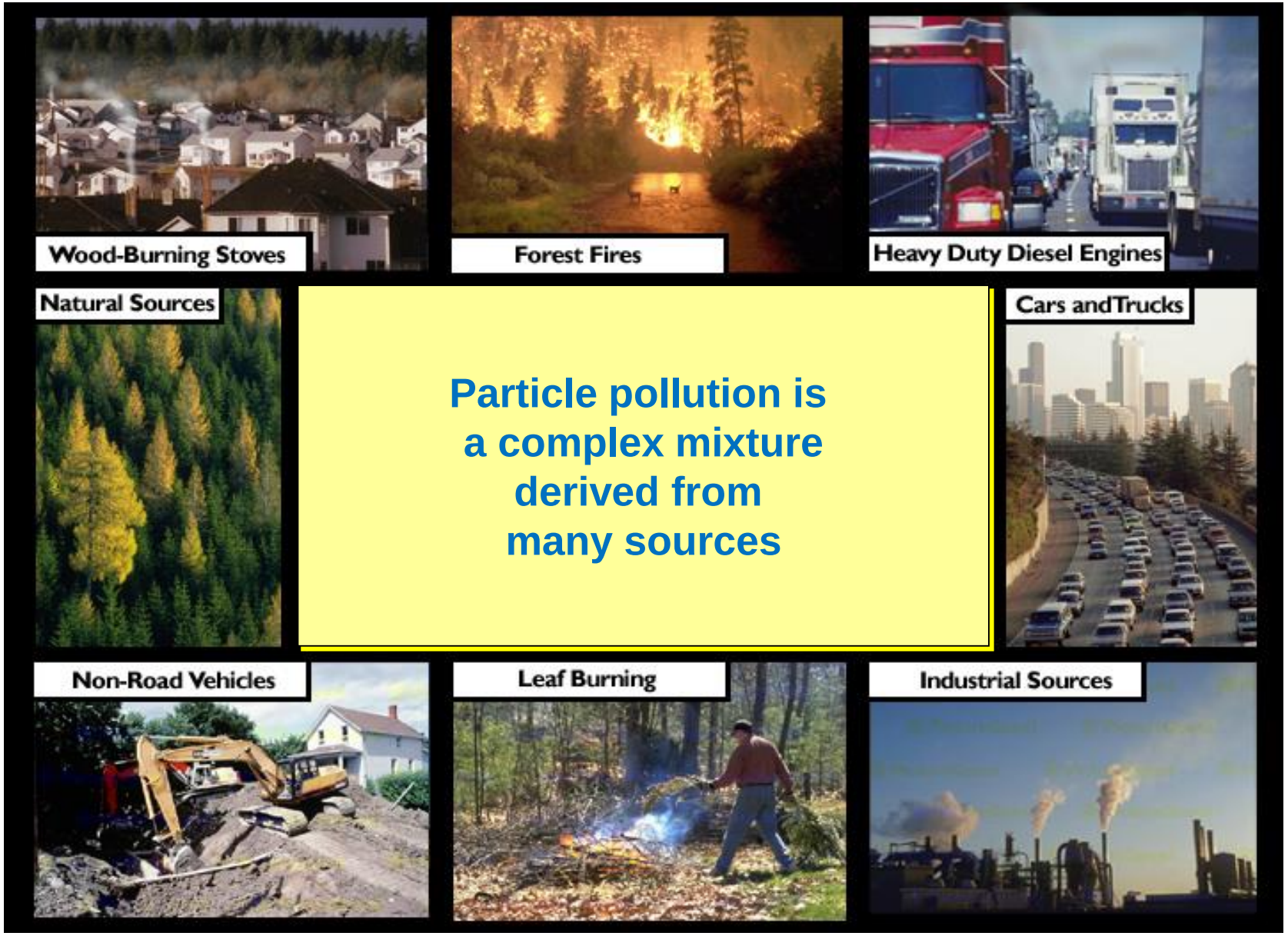
Source: www.AirNow.gov

Particle Pollution Disasters

Donora, PA at noon on Oct. 29, 1948

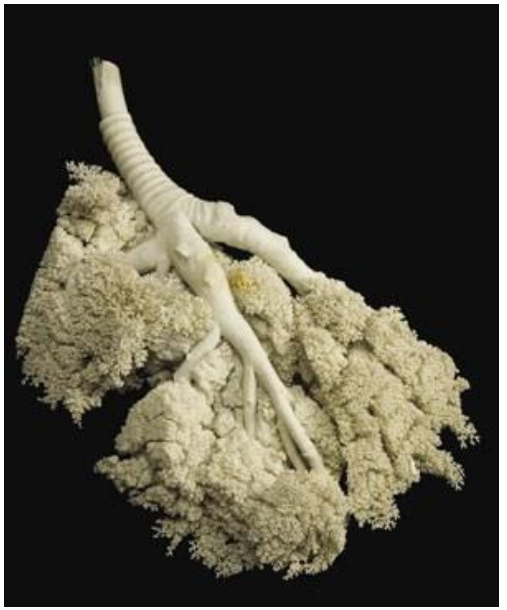


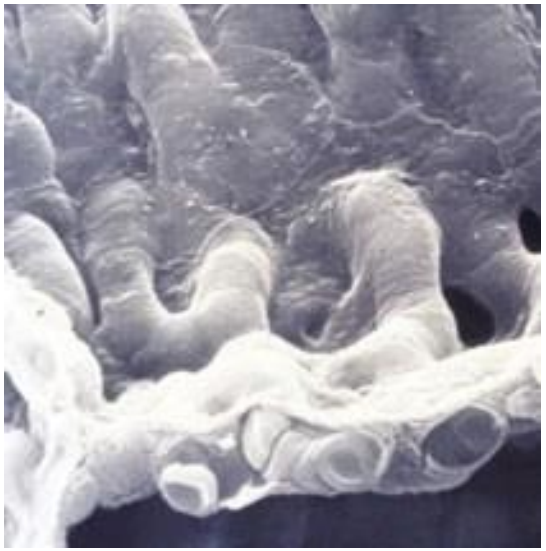
London buses are escorted by lantern at 10:30 in the morning.


Wood-Burning Stoves
Forest Fires
Heavy Duty Diesel Engines
Natural Sources
Particle pollution is a complex mixture derived from many sources
Cars andTrucks
Non-Road Vehicles
Leaf Burning
Industrial Sources

Particle Deposition

- Larger particles (> PM_{10}) deposit in the upper respiratory tract
- Inhalable particles ($\leq PM_{10}$) penetrate into lungs





- Some particles (e.g., less than 0.1 um) may enter bloodstream
- Particles may react, accumulate, be cleared or absorbed

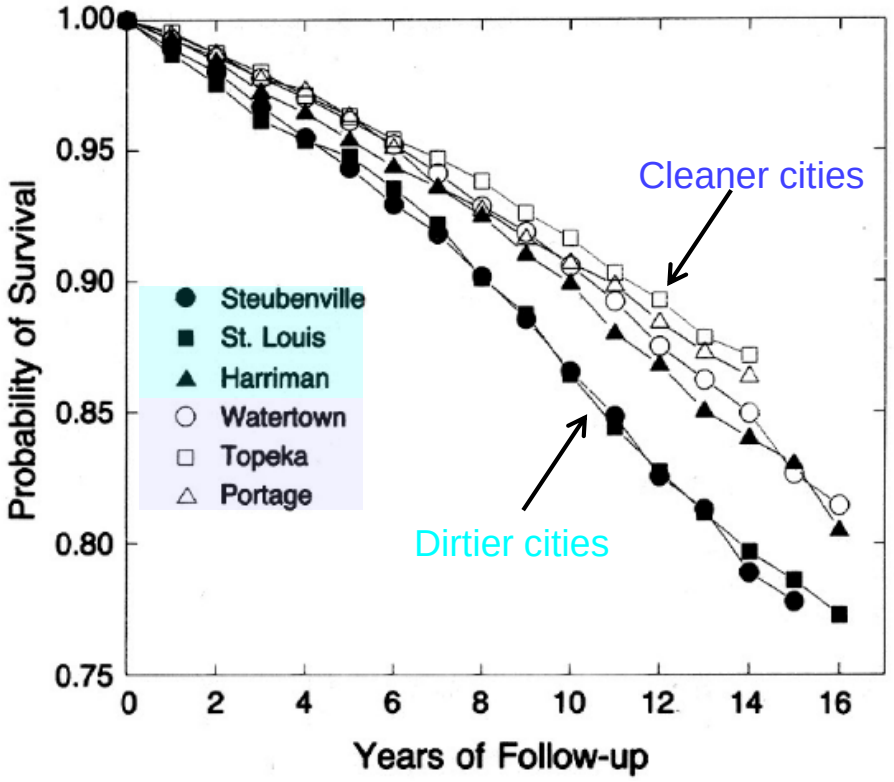
Living in Areas with High Air Pollution Associated with Shorter Life Expectancy

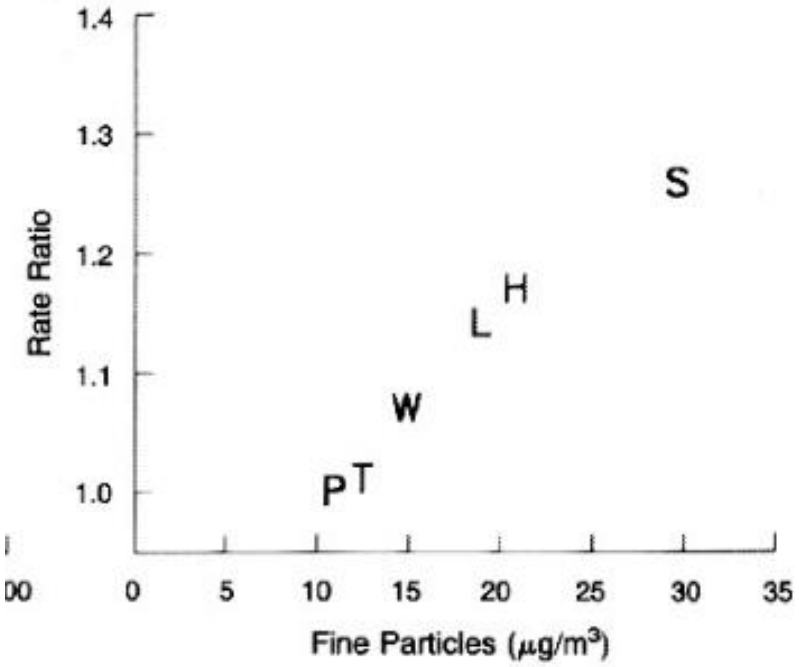
The NEW ENGLAND JOURNAL of MEDICINE

An Association between Air Pollution and Mortality in Six U.S. Cities

Douglas W. Dockery, C. Arden Pope, Xiping Xu, John D. Spengler, James H. Ware, Martha E. Fay, Benjamin G. Ferris, Jr., and Frank E. Speizer

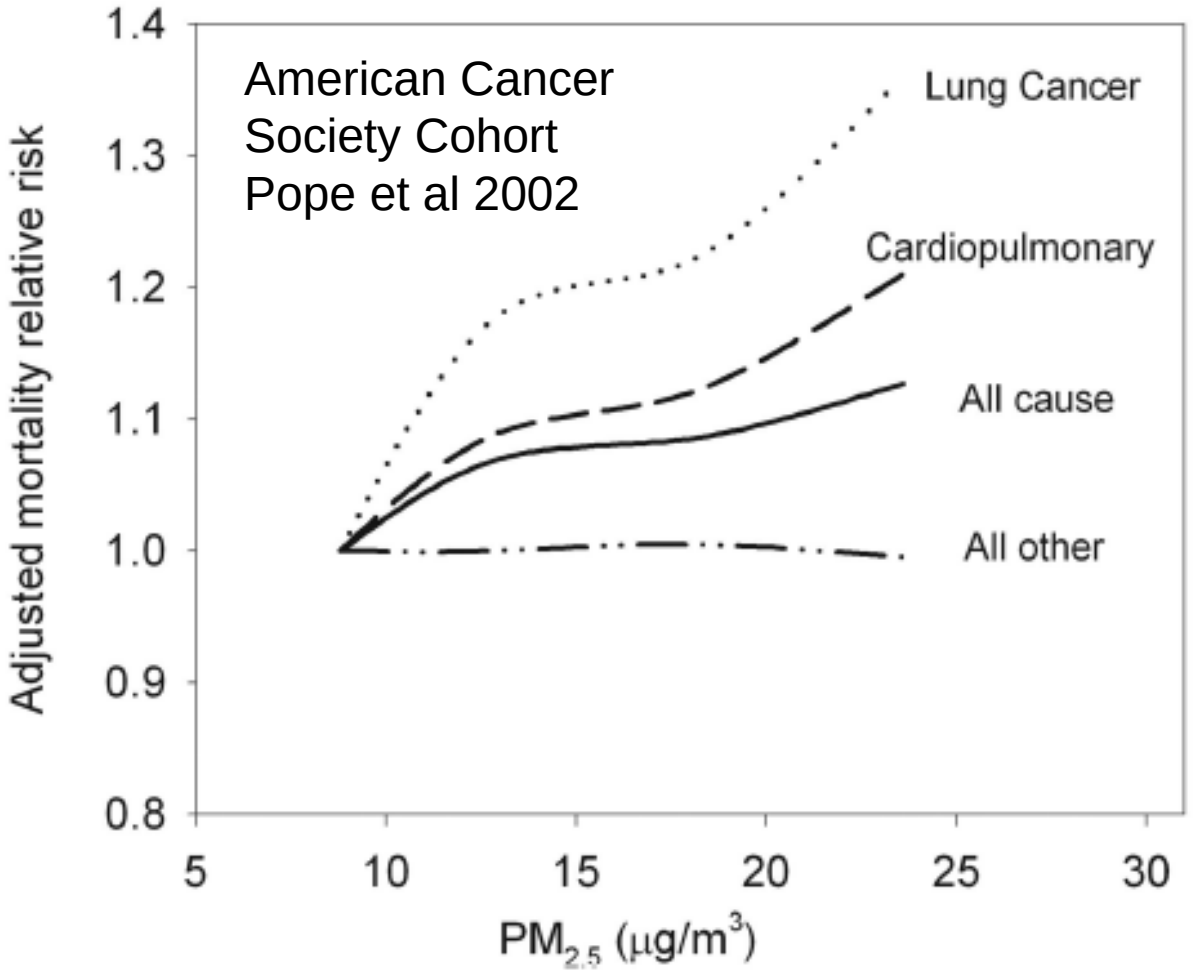
N Engl J Med 1993; 329:1753-1759 | December 9, 1993





- Linear relationship after control for traditional risk factors

Findings Replicated by Large American Study and Others



Pope and Dockery 2006

- >500,000 adults from 151 metropolitan areas
- Followed prospectively and controlled for traditional risk factors

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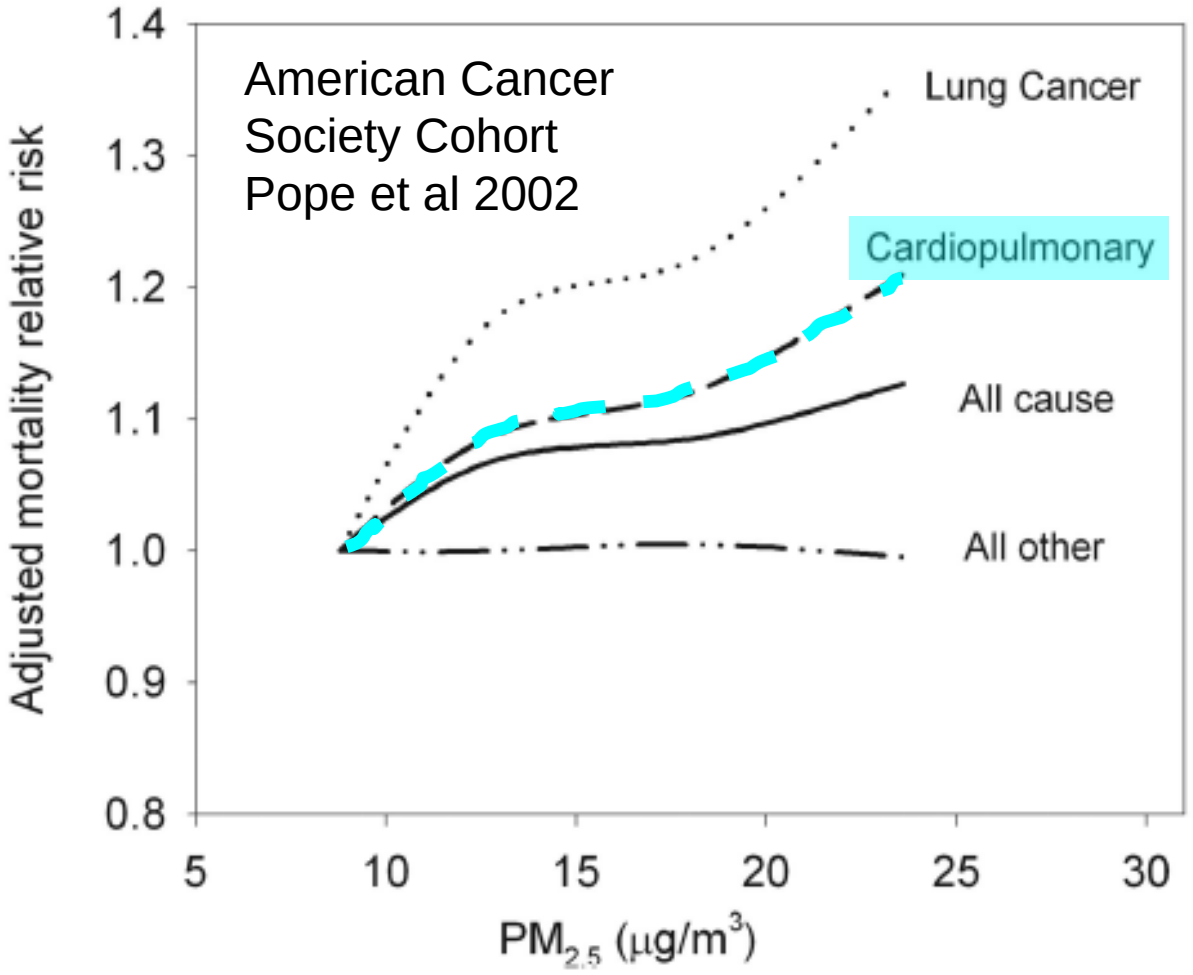

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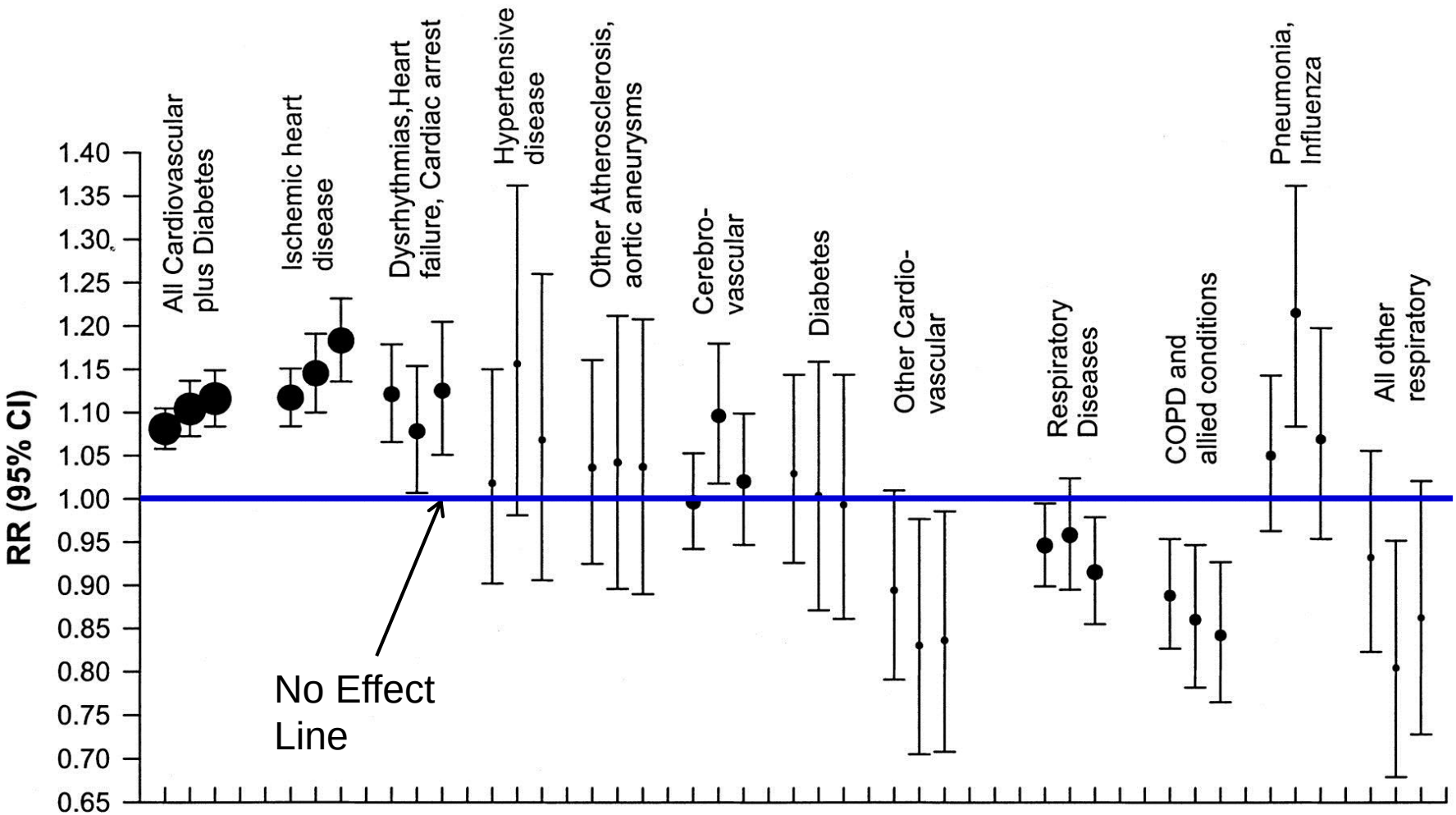
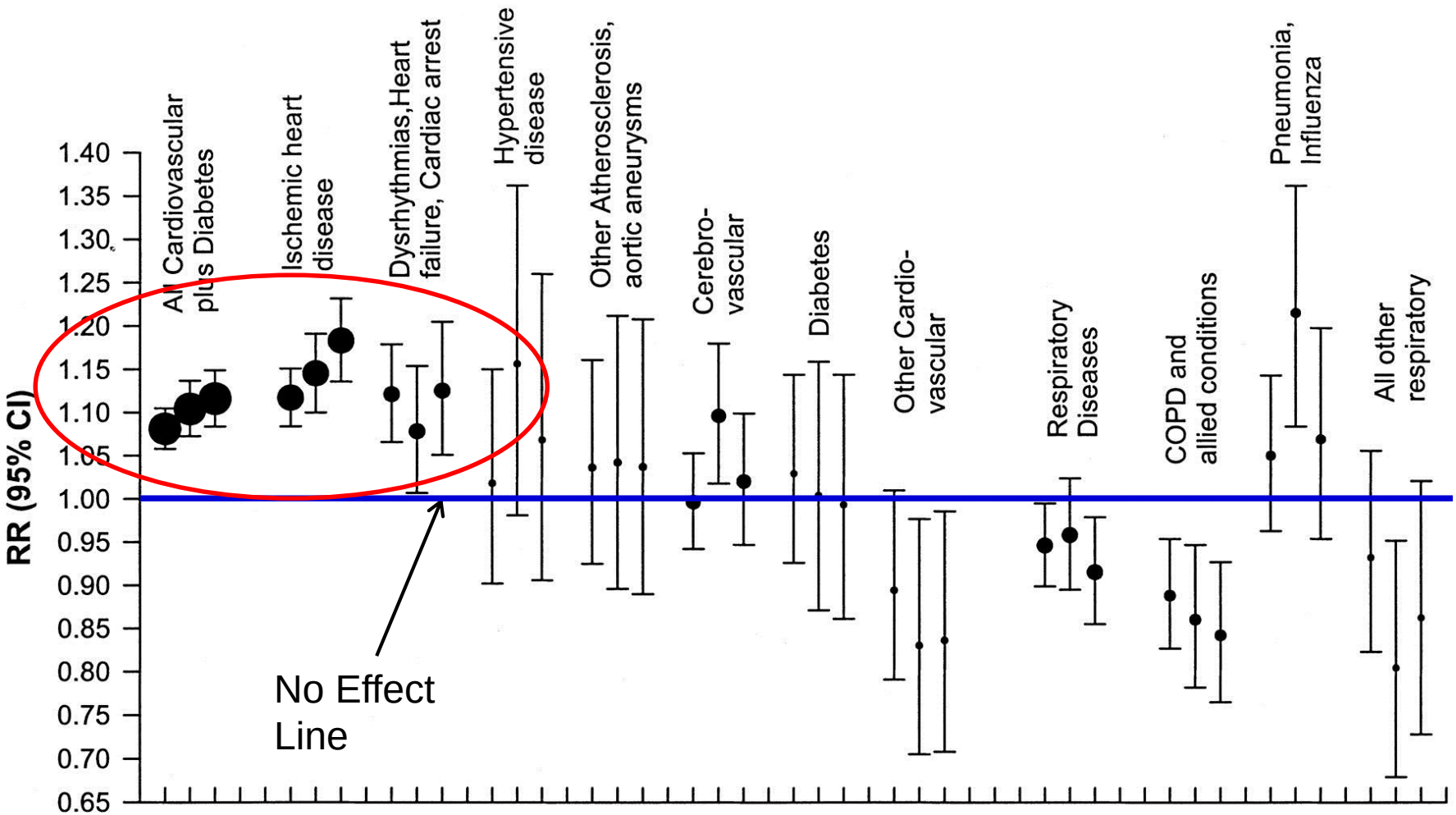
Strongest Associations For Cardiovascular Endpoints



Pope C A et al. Circulation 2004;109:71-77

American Heart Association
Learn and Live

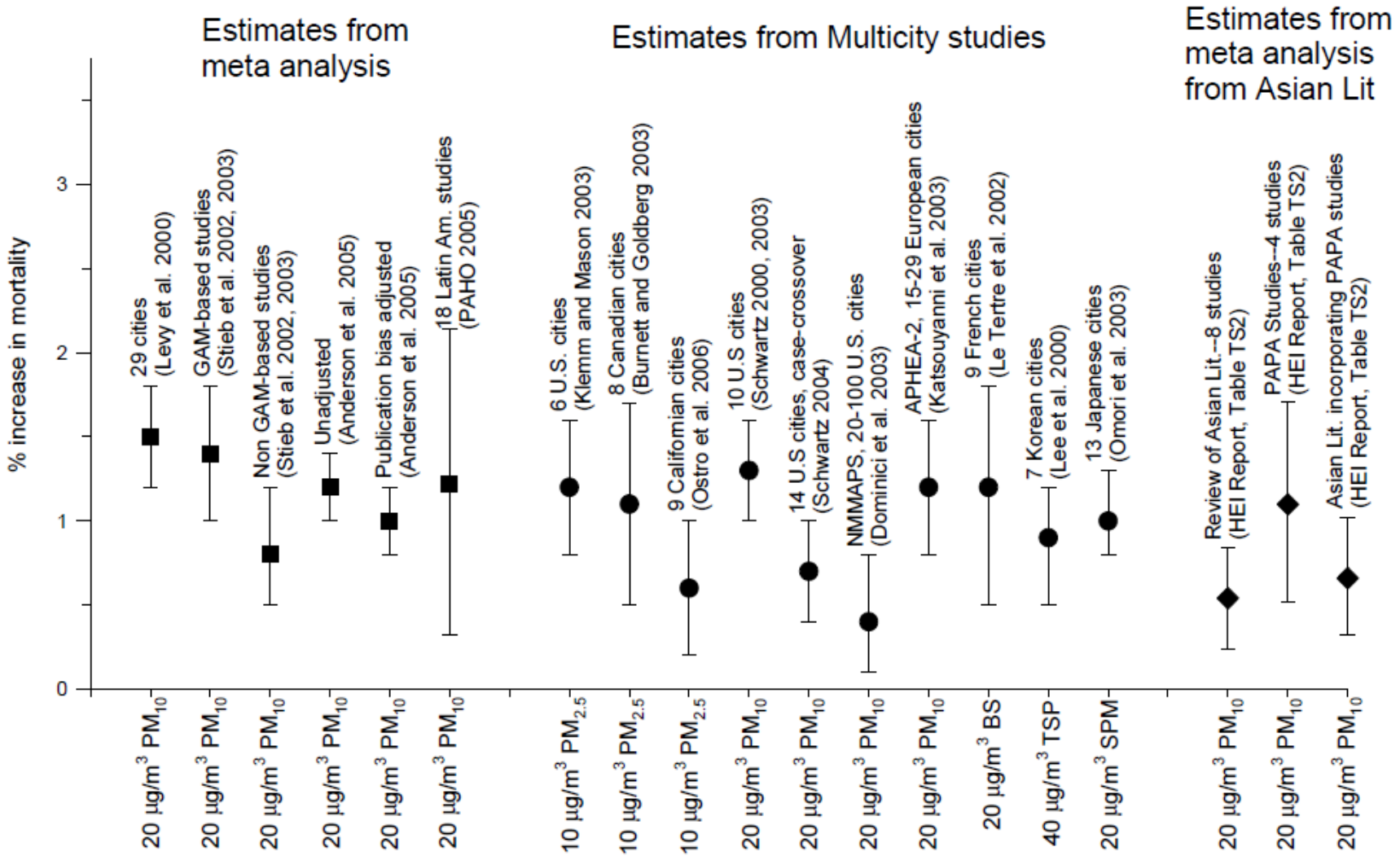
Strongest Associations For Cardiovascular Endpoints



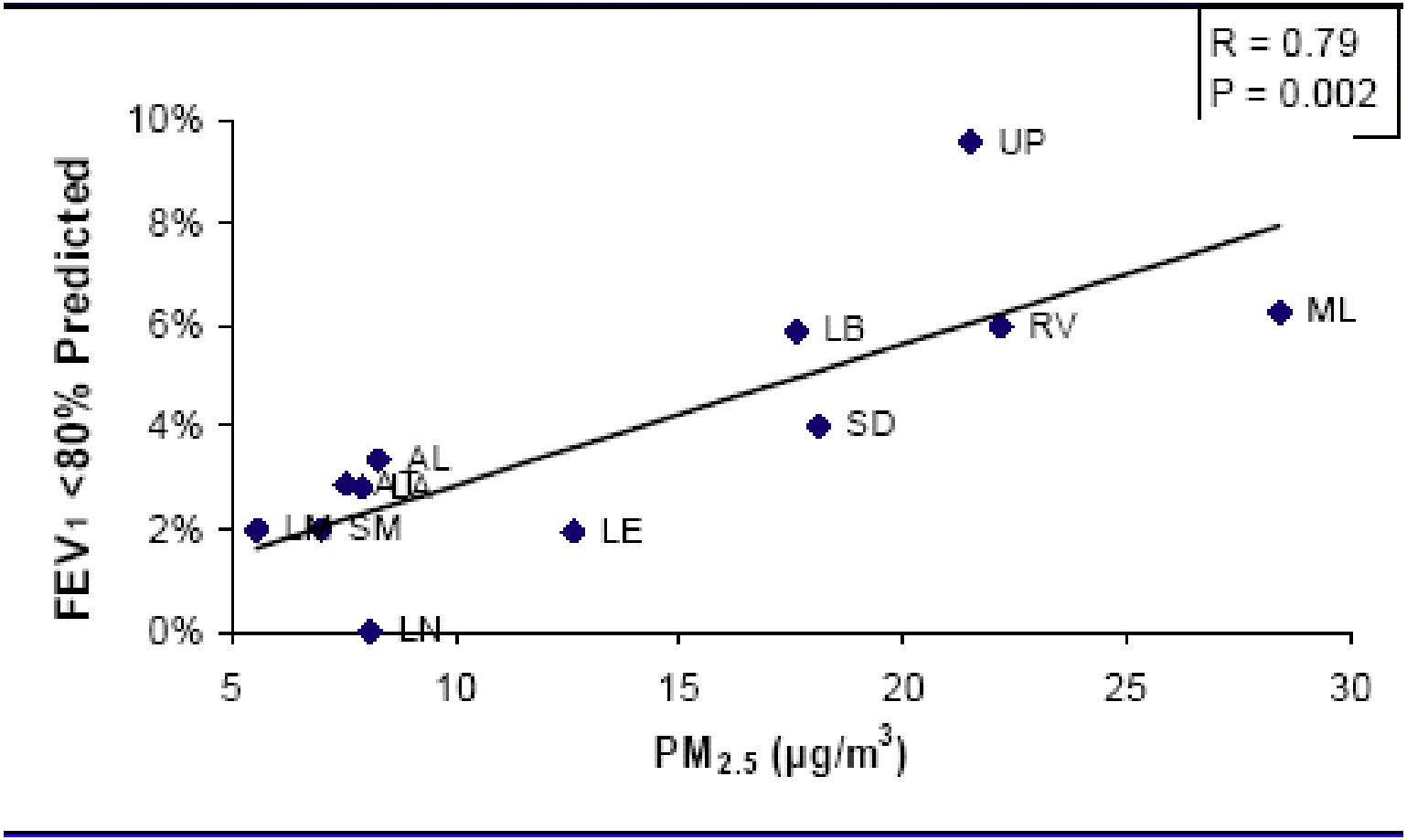
Pope C A et al. Circulation 2004;109:71-77

American Heart Association
Learn and Live

Small but Consistent Increases in Mortality with Short-Term Changes in PM

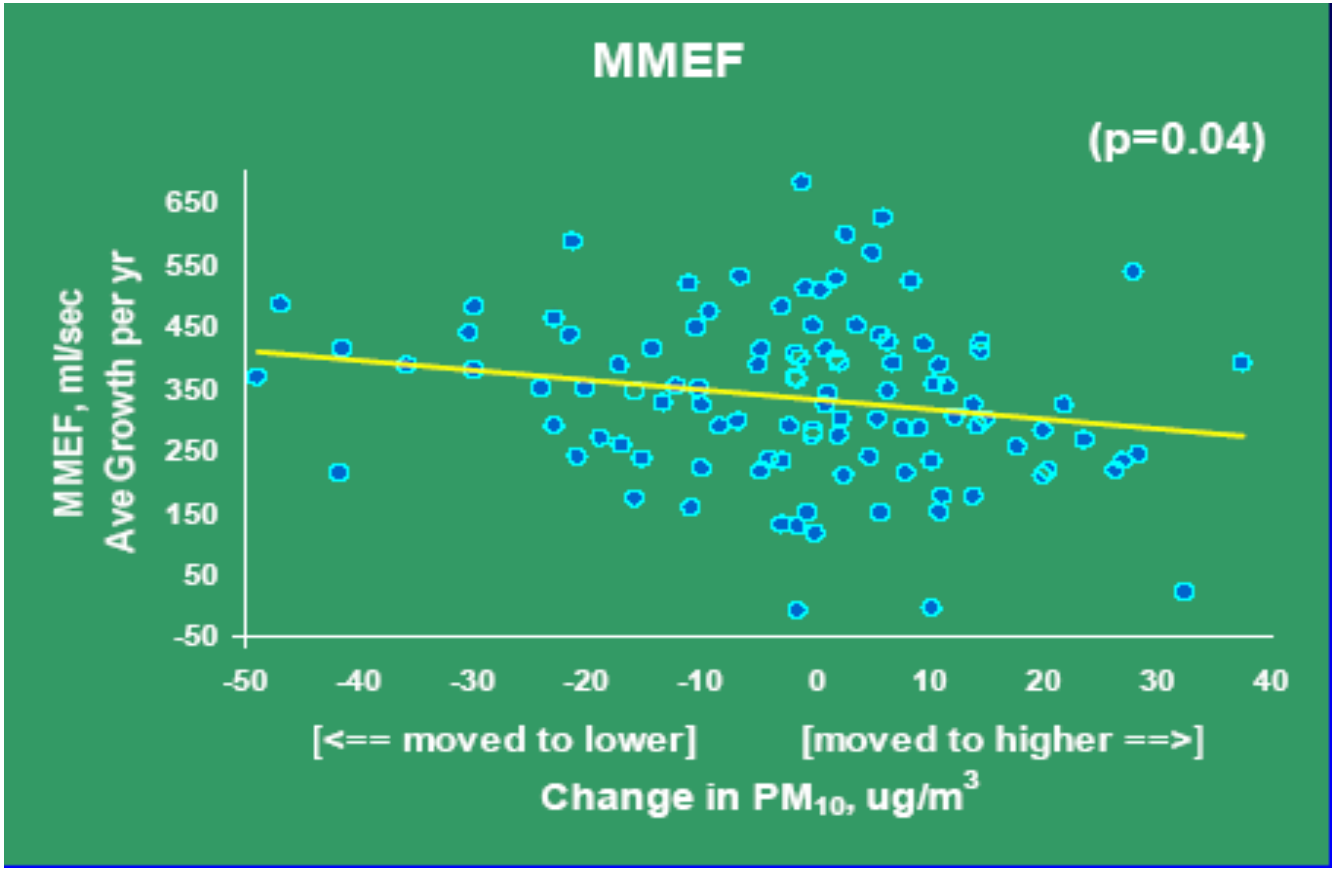


CHS: Low FEV_1 at Age 18 vs. Pollution



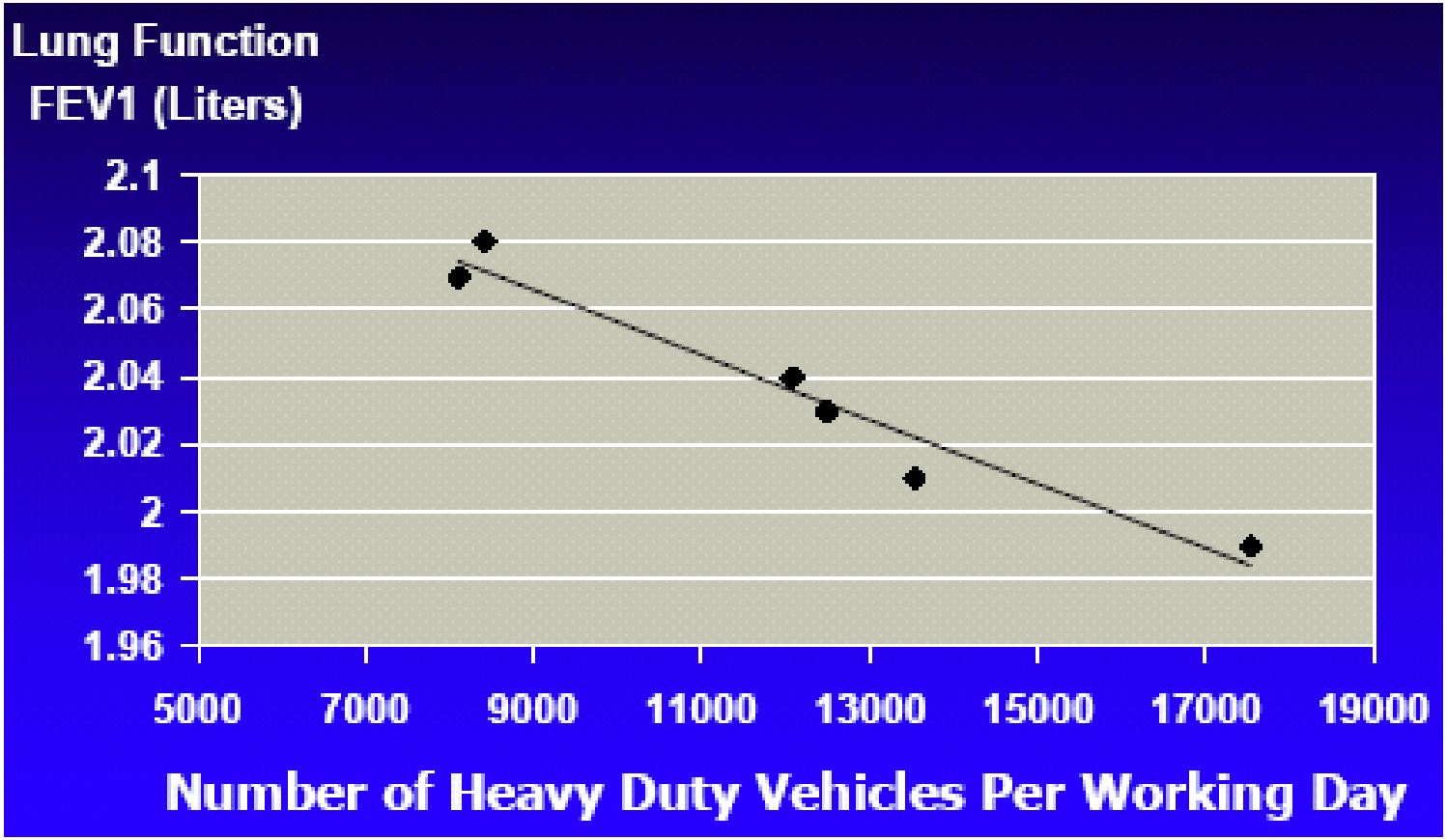
Gauderman et al., 2004

CHS: Lung Function Growth in Movers



Avol et al., 2001

Living Within 300 Meters of Local Roadways Affects FEV_1



Brunekreef et al., 1997

Traffic Exposures

- Traffic exposure linked to respiratory symptoms in several European studies
- San Francisco bay area study linking pollution exposures at schools to symptoms (Kim et al., 2004)
- CHS study of residential NO_2, traffic linked to asthma prevalence, symptoms, and medication use (Gauderman et al., 2005)

Sensitive Groups for PM

- People with cardiovascular disease
- People with lung disease
- Older adults
- Children
- People of lower socioeconomic status

Air Quality Index

Descriptors	Cautionary Statement
Good **0 – 50**	No message
Moderate **51 – 100**	Unusually sensitive individuals
Unhealthy for Sensitive Groups **101 - 150**	Identifiable groups at risk - different groups for different pollutants
Unhealthy **151 - 200**	General public at risk; sensitive groups at greater risk
Very Unhealthy **201 - 300**	General public at greater risk; sensitive groups at greatest risk

Air Quality Index

- Pollutant-specific health effects and cautionary statements address question “who will be affected”
- Based on health information supporting EPA’s air quality standards (www.epa.gov/ttn/naaqs)

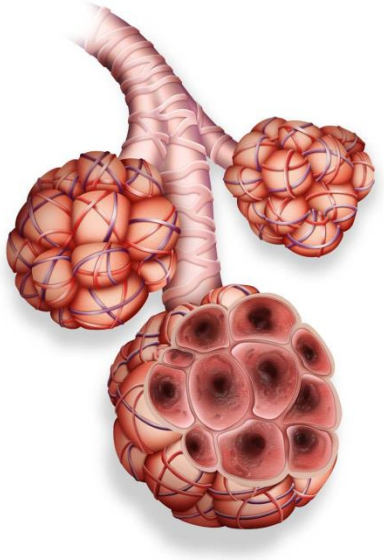
Dose = Concentration x Ventilation Rate x Time

C - be active outdoors when air quality is better

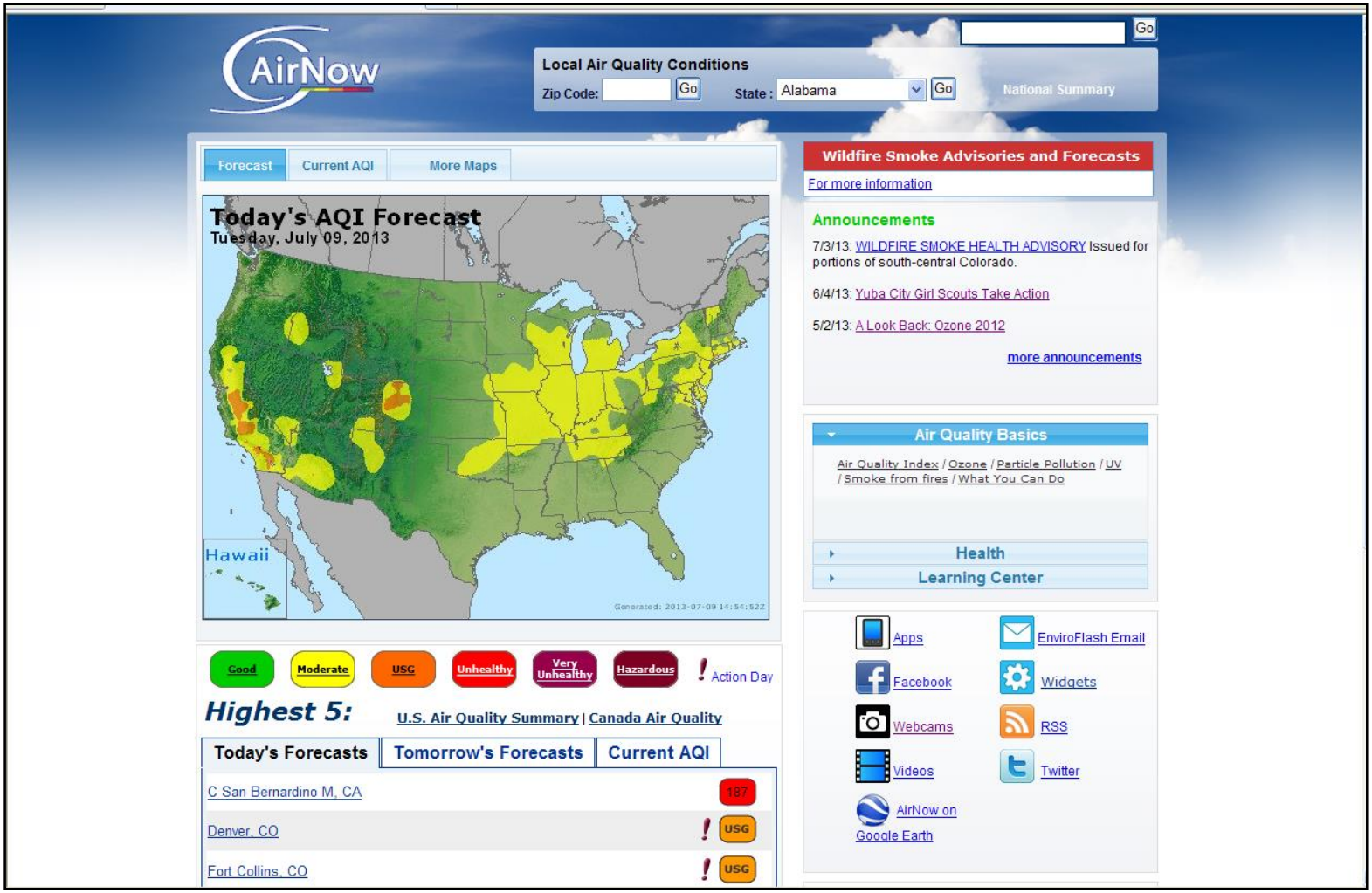
V - take it easier when active outdoors

T - spend less time being active outdoors

- Pay attention to symptoms
- People with asthma – follow asthma action plan
- Coaches – rotate players frequently
- People with heart disease – check with your doctor



AirNow



www.airnow.gov

Air Quality Notifications

- EnviroFlash Home
- EnviroFlash Challenge
- EnviroFlash Fact Sheet (PDF)
  Learn how EnviroFlash works!
- Free AIRNow iPhone & Android Apps!
  iPhone App | Android App
- EnviroFlash on Twitter!
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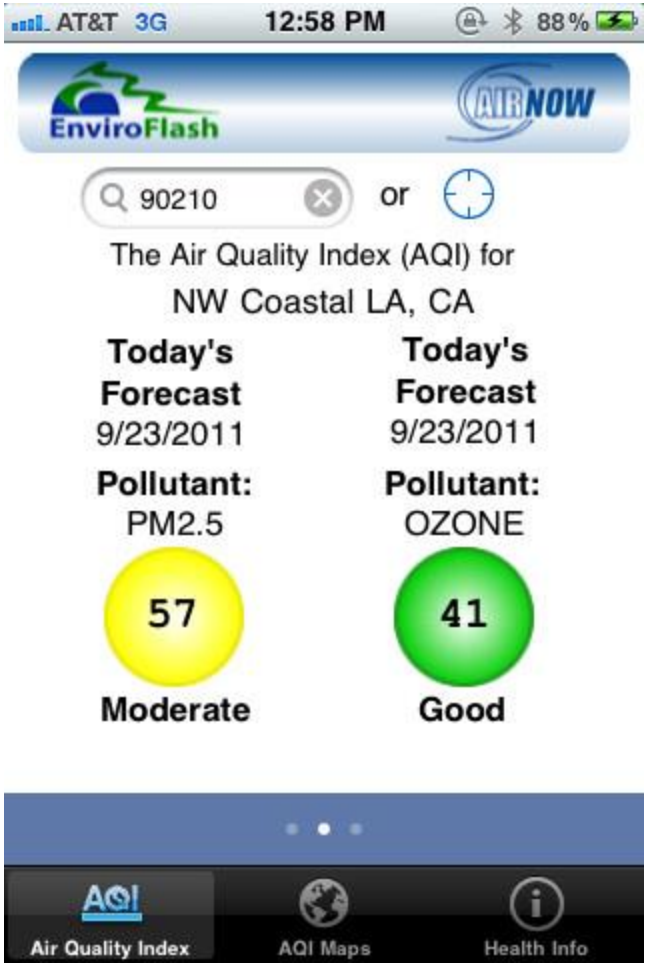
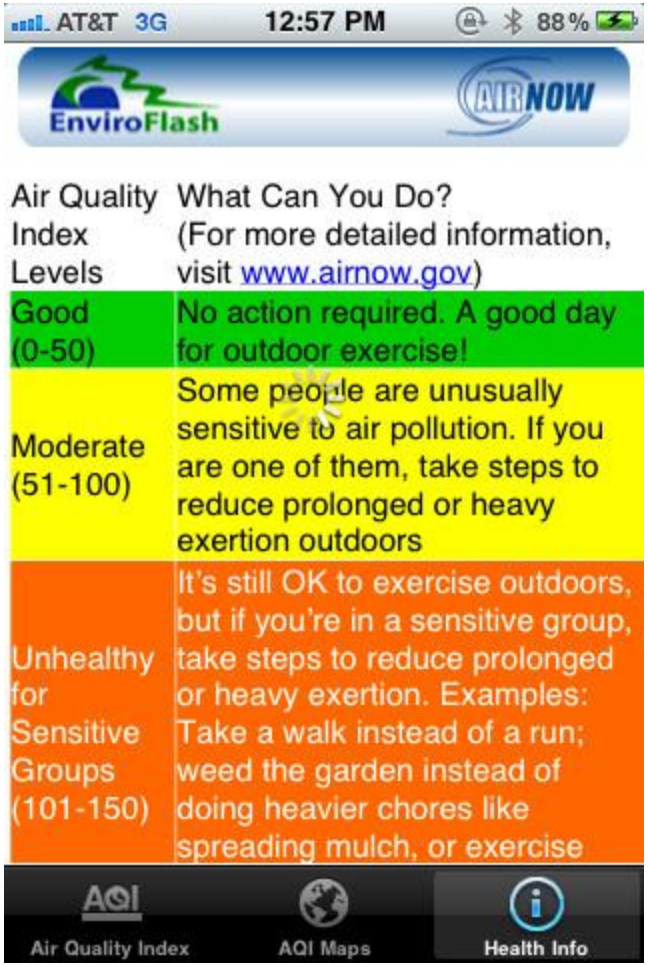
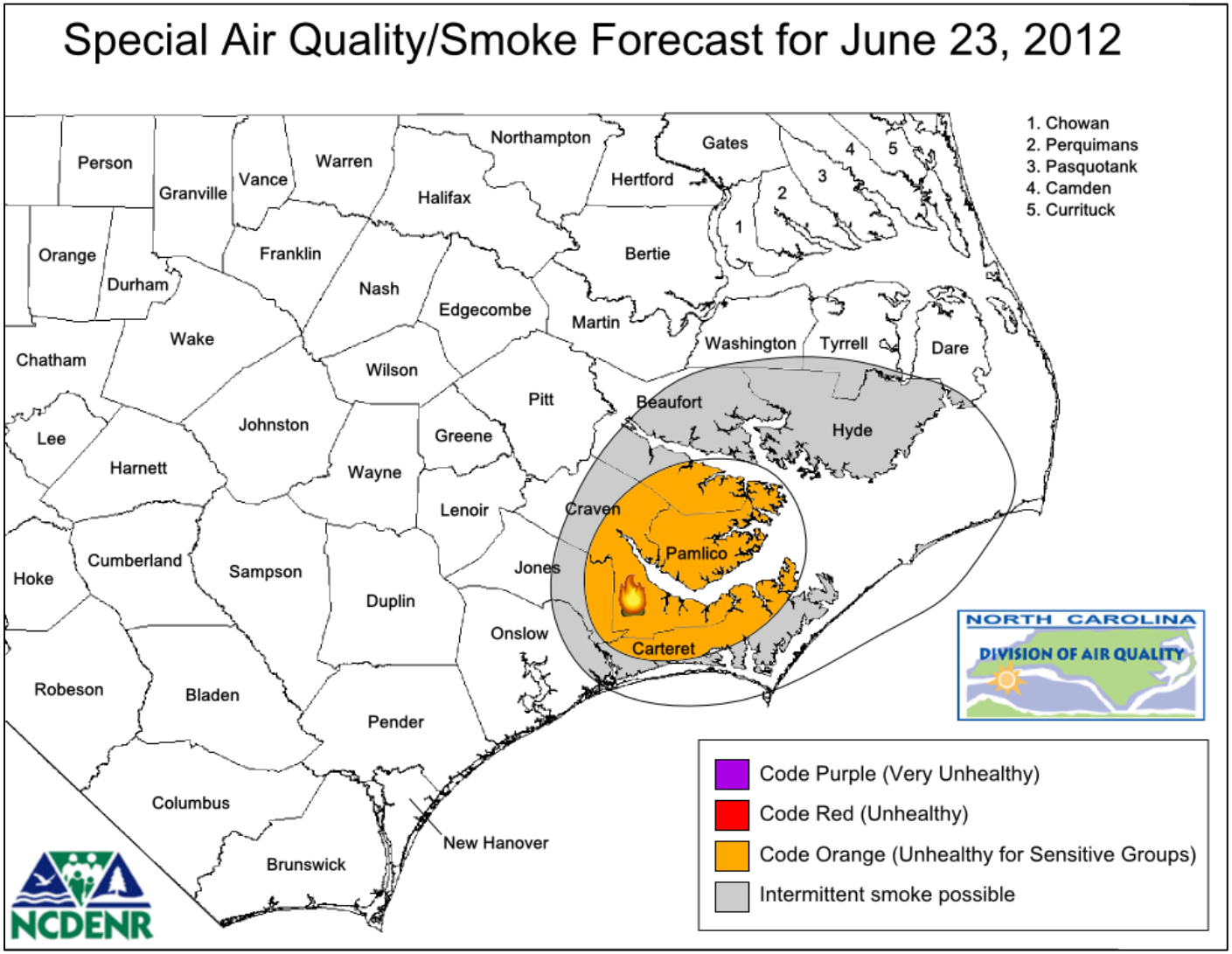


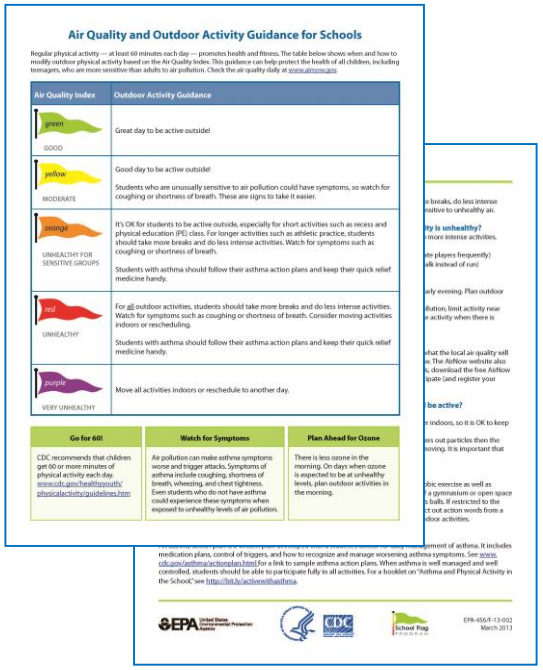


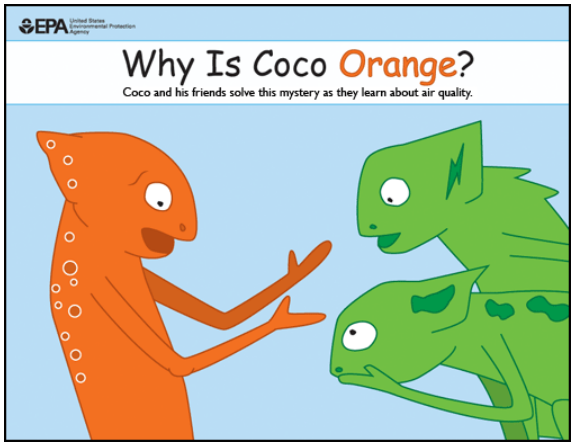
Special Air Quality/Smoke Forecast for June 23, 2012



School Flag Program and School Activity Guidelines

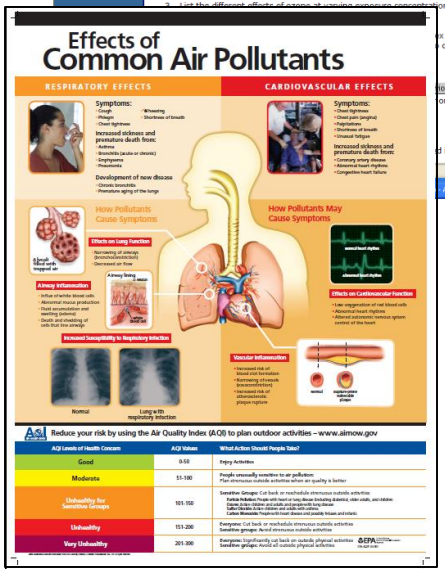
- Helps school and community be aware of daily air quality conditions
- Participating schools raise a flag in front of the school that signals the air pollution forecast for that day
- By comparing the colored flags to the Air Quality Index (AQI), members of the school can tell what daily air quality is, and adjust activities to reduce children's exposure to air pollution as needed
- We have partnered with CDC on air quality and outdoor activity guidelines for schools
- We have developed a picture book that explains AQI and flag program to children

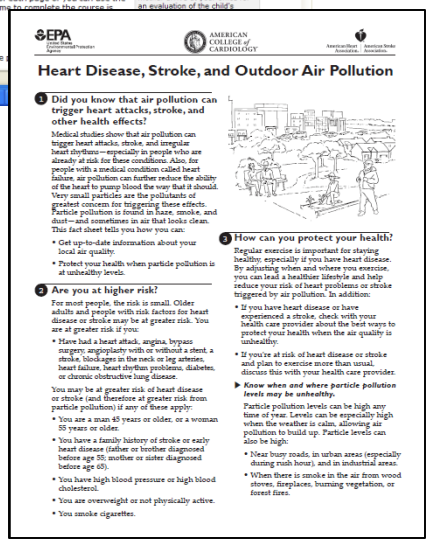




Web Courses for Healthcare Providers

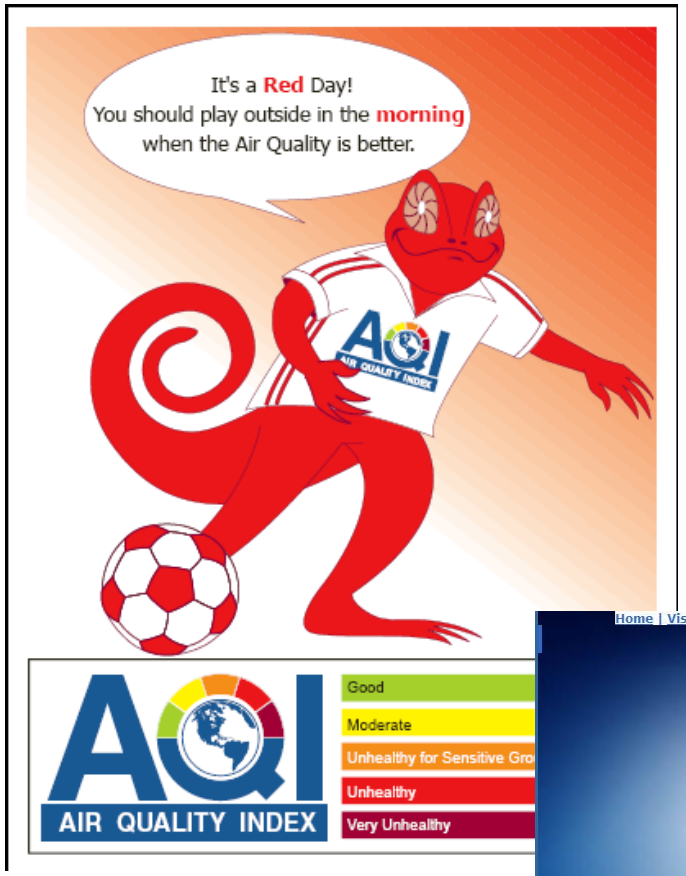
- Updated ozone Web course
  - Offers CME credit from the American Academy of Family Physicians (AAFP)
  - Supporting tools
- PM Web course
  - Developing with CDC
  - CDC will offer CME credit
  - Will contain section on emergency situations





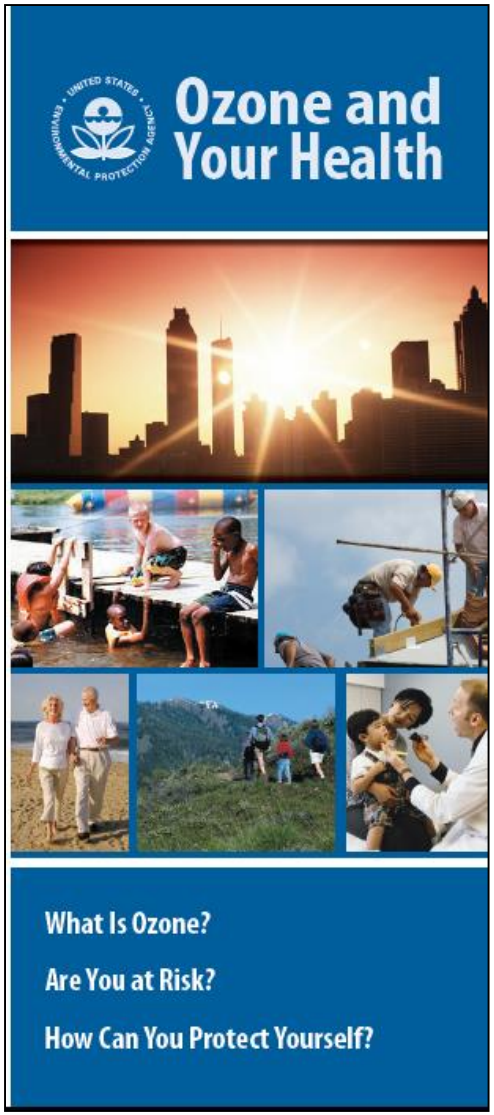
- Issue: Heart disease is the number one killer for women but many women think of a heart attack as a problem for men.
  - Each year, about 400,000 women in the U.S. die from heart disease; > 42 million women are currently living with cardiovascular disease.
  - Heart disease kills more women than the next seven causes of death combined
- Webinars are a key communications mechanism
- Provides information about where people can find out about daily air quality in their own community to reduce unhealthy exposures.
  - EPA has developed related materials, such as downloadable fact sheets, for use by healthcare providers
- EPA partnering with organizations such as American Heart Association, American College of Cardiology, CDC and CDC's Million Hearts Campaign

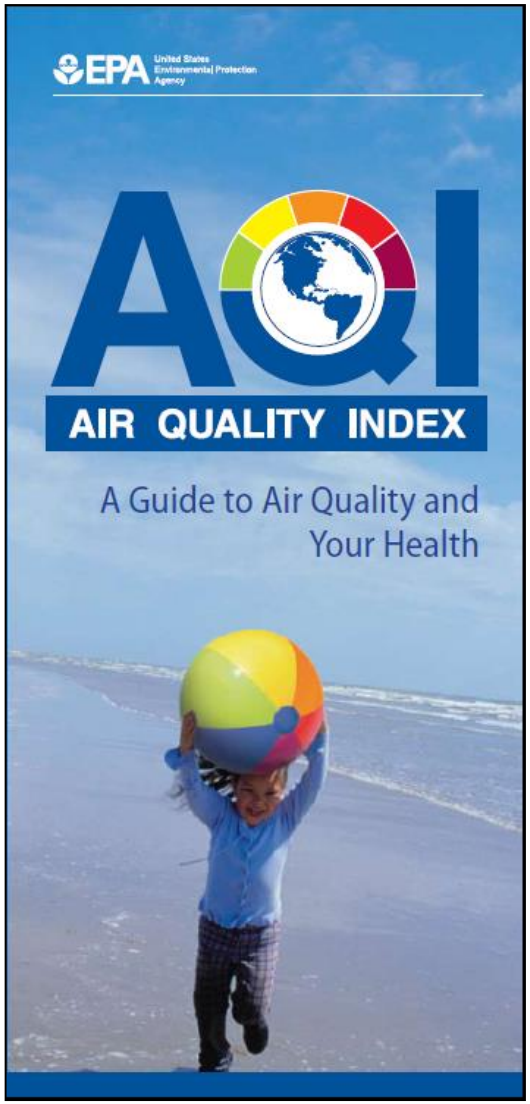
AQI Curriculum for Children and Students

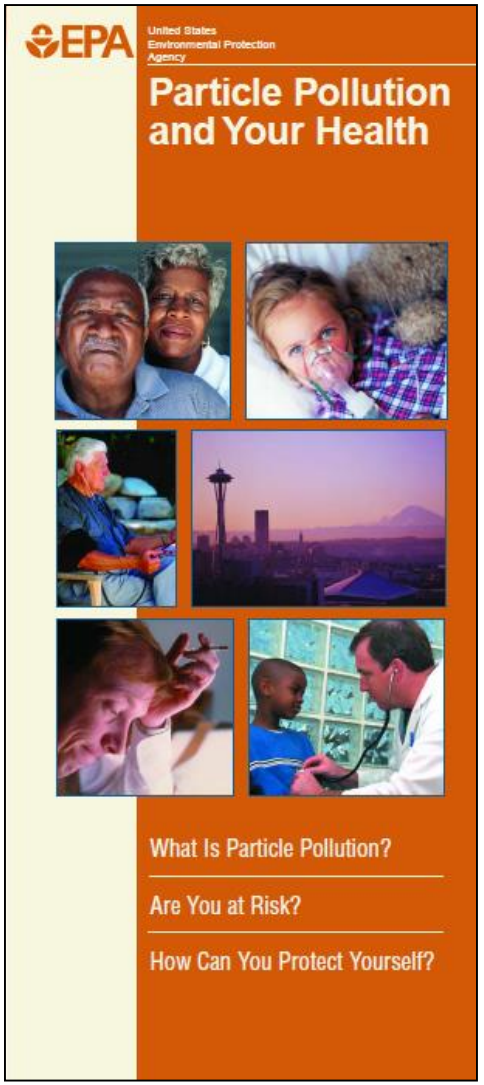


Colorful lessons and games for children and students

Pollutant-Specific Information

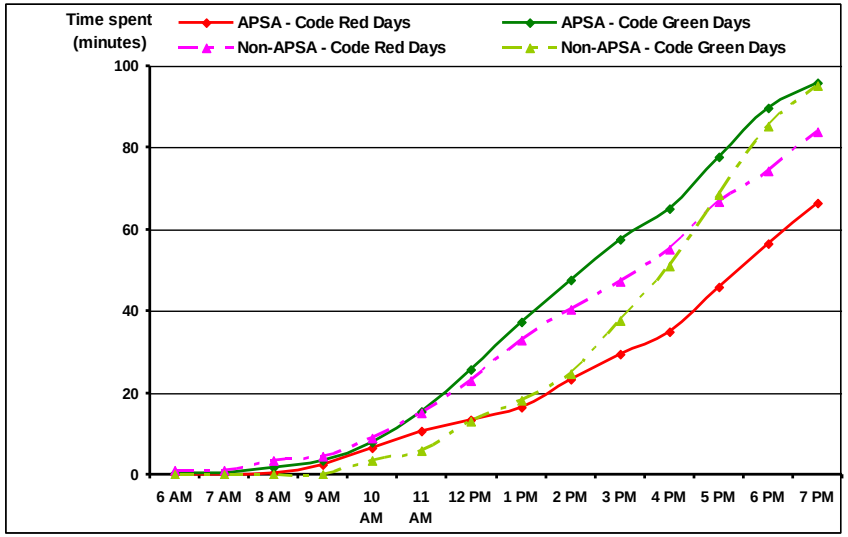




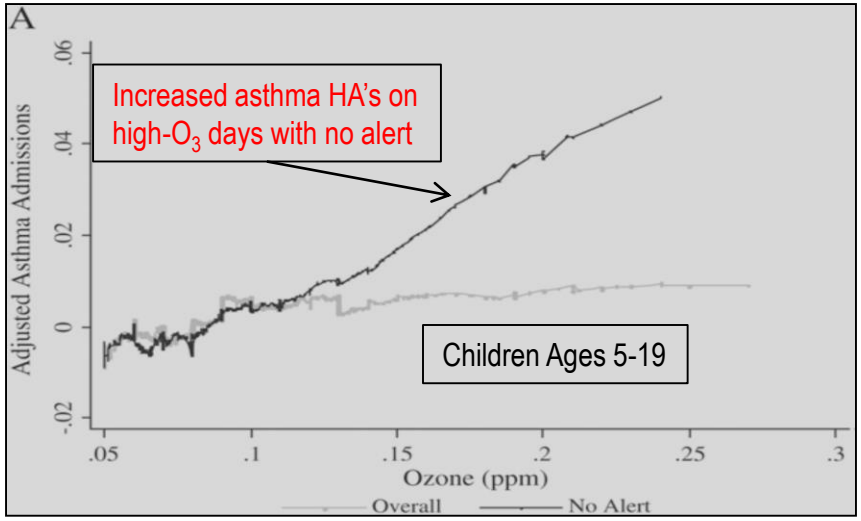


Public Health Benefits of the AQI

- Surveys indicated that 50 to 80% of public aware of AQI
  - Of those, 50% report taking exposure reduction measures
- People who are susceptible, more likely to report taking measures, including older adults, children, and people with heart or lung disease
- Activity studies provide evidence of exposure reduction
- Health studies provide evidence of reductions in hospital admissions and emergency department visits for asthma due to advisories



Mansfield et al., 2007



Neidell and Kinney 2009