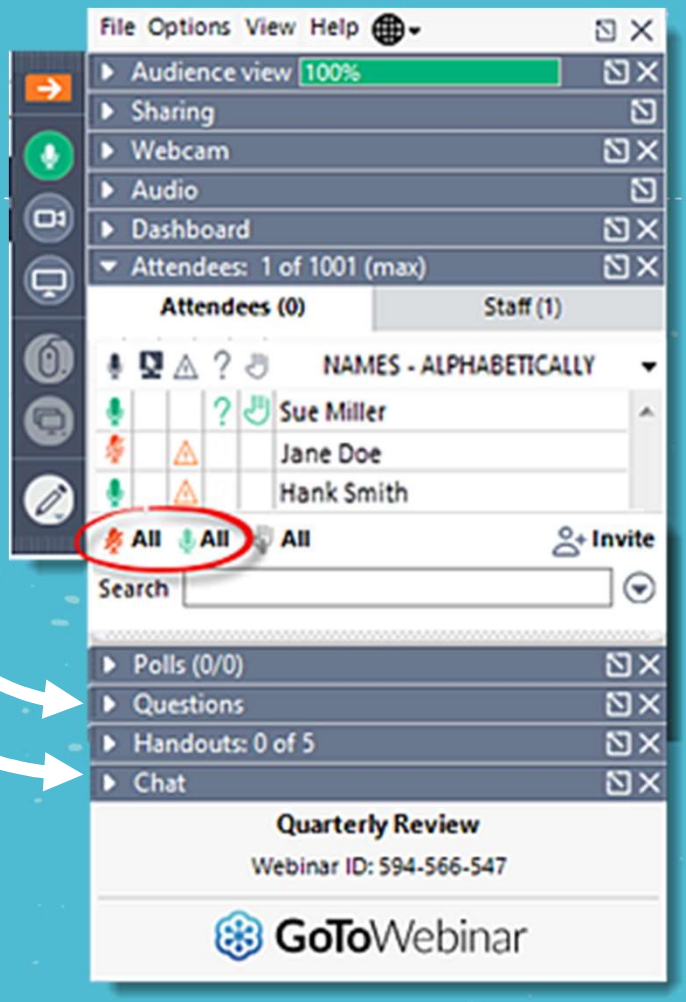
Low Cost Monitoring Project (LCMP) Cohort 48: Questions & Health Impacts

7:00 PM Monday, August 2, 2021

10:30 AM Tuesday, August 3, 2021

The Virtual Classroom

- Feel free to keep your mics on (mute if noisy)
- Use “Questions” tab in the control panel to ask questions, or raise hand
- All links will be placed in the “Chat” tab in the control panel. Comments can be added here as well.



This Meeting is Being Recorded

Your Name

Location

01

Send Emily an email if you want to do a short presentation of your data/experience.

Introduction

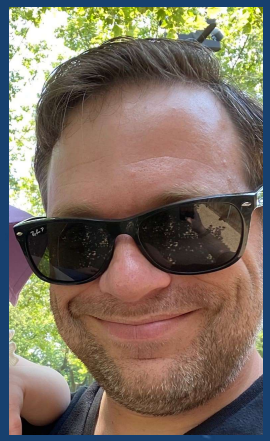
Cohort 48

Scott

Bill's family

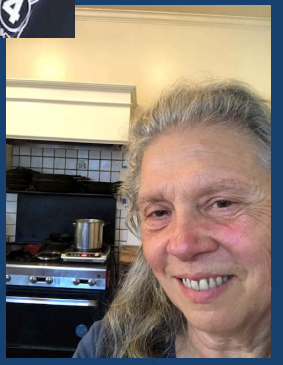
Kate

Alyssa's Family



George

Cathy's Family



Nickie

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LW1

02

Meeting Objectives

To address your questions about health impacts:

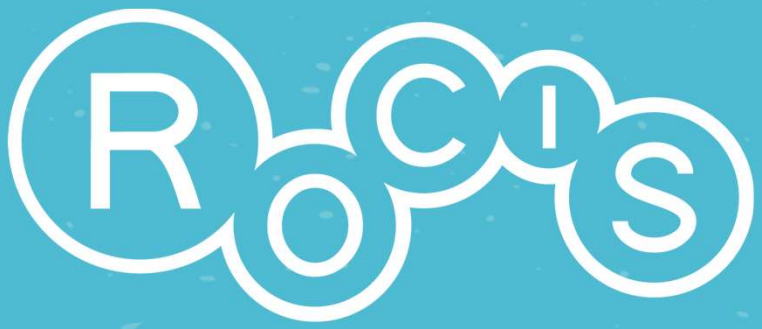
1. Toxics Release Inventory Explorer
2. Air quality –recent news and local findings
3. From the beginning to the end
   - Particles & fetuses
   - Dementia & particles
4. Radon
5. Particles and VOCs
6. Particles and Cooking
7. Local Organizations to Explore

Slide 6

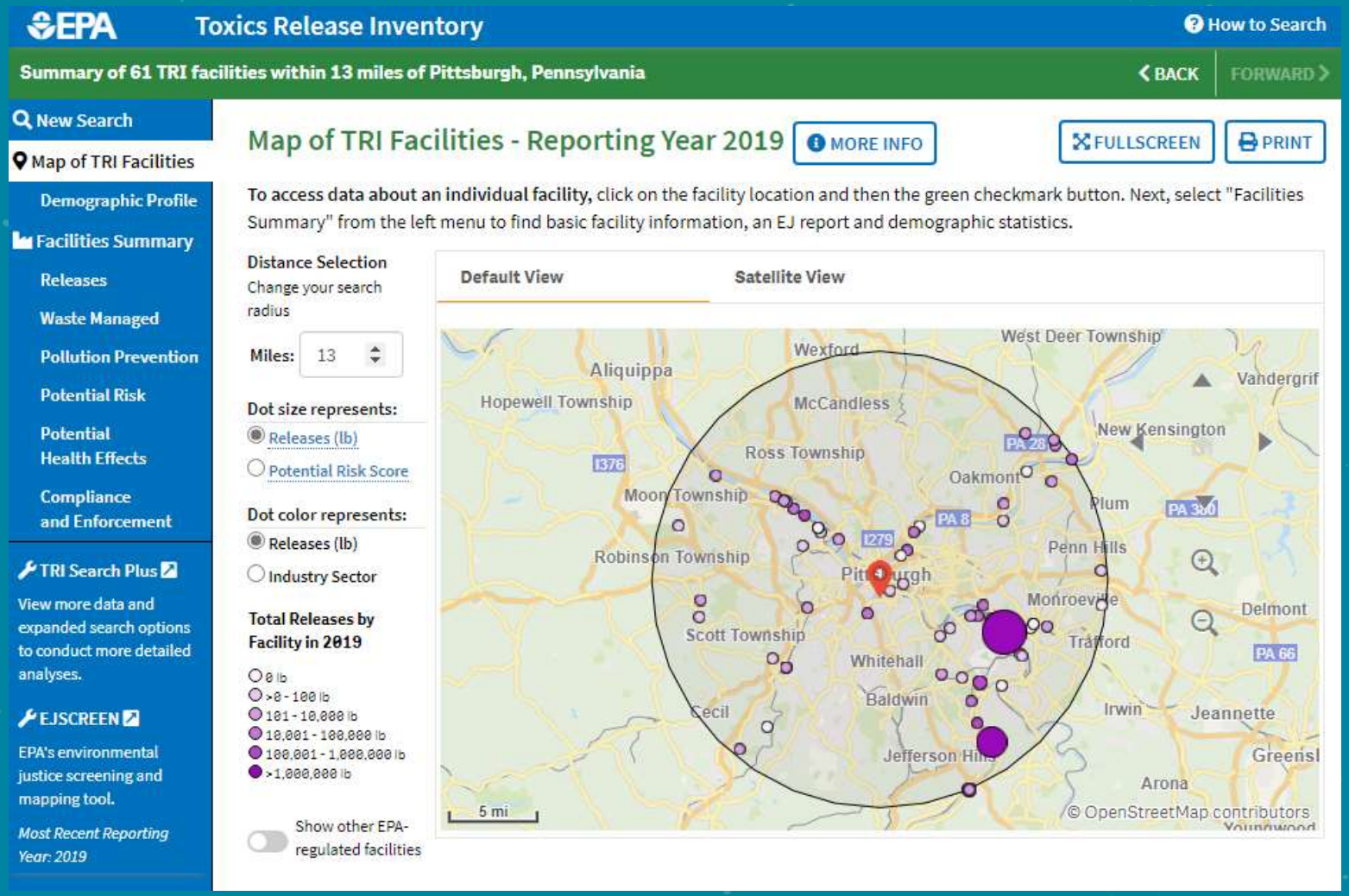
LW1 I suggest major adjustment to 3 "Your Questions" Maybe drop all of these
Linda Wigington, 7/30/2021

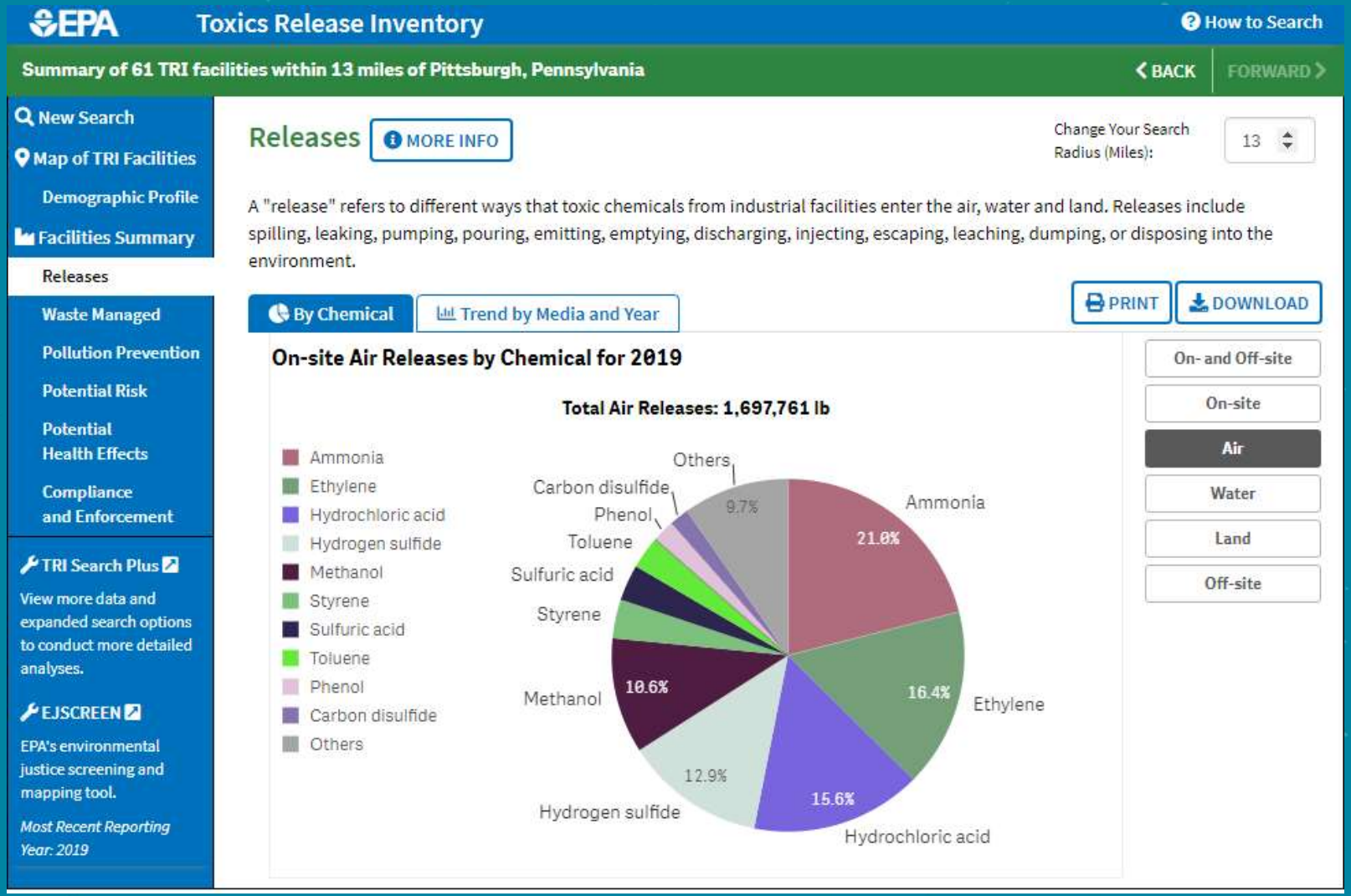
Toxics Release Inventory Explorer

03



Particle Size


EPA
Toxics Release Inventory
How to Search
Summary of 61 TRI facilities within 13 miles of Pittsburgh, Pennsylvania
BACK
FORWARD
New Search
Map of TRI Facilities
Demographic Profile
Facilities Summary
Releases
Waste Managed
Pollution Prevention
Potential Risk
Potential Health Effects
Compliance and Enforcement
TRI Search Plus
View more data and expanded search options to conduct more detailed analyses.
EJSCREEN
EPA's environmental justice screening and mapping tool.
Most Recent Reporting Year: 2019
Map of TRI Facilities - Reporting Year 2019
MORE INFO
FULLSCREEN
PRINT
To access data about an individual facility, click on the facility location and then the green checkmark button. Next, select "Facilities Summary" from the left menu to find basic facility information, an EJ report and demographic statistics.
Distance Selection
Change your search radius
Miles: 13
Dot size represents:
Releases (lb)
Potential Risk Score
Dot color represents:
Releases (lb)
Industry Sector
Total Releases by Facility in 2019
0 lb
>0 - 100 lb
101 - 10,000 lb
10,001 - 100,000 lb
100,001 - 1,000,000 lb
>1,000,000 lb
Show other EPA-regulated facilities
Default View
Satellite View
West Deer Township
Wexford
Aliquippa
Hopewell Township
McCandless
Vandergrif
New Kensington
Ross Township
Oakmont
Moon Township
Plum
Robinson Township
Penn Hills
Monroeville
Delmont
Scott Township
Trafford
Whitehall
Baldwin
Irwin
Jeannette
Cecil
Jefferson Hills
Greensl
Arona
5 mi
© OpenStreetMap contributors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EJSCREEN
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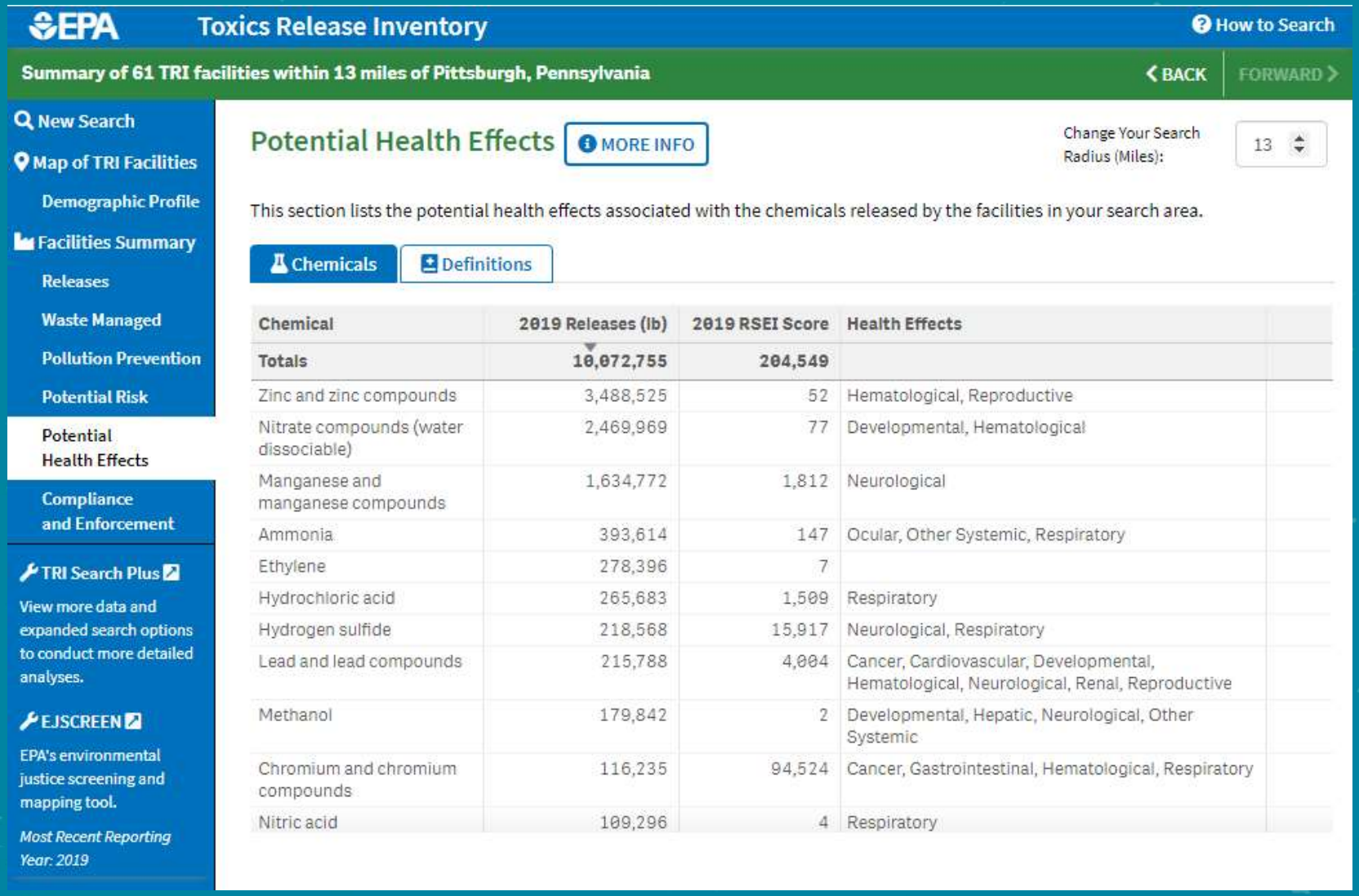
Most Recent Reporting Year: 2019
Releases
MORE INFO
Change Your Search Radius (Miles):
13
A "release" refers to different ways that toxic chemicals from industrial facilities enter the air, water and land. Releases include spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment.
By Chemical
Trend by Media and Year
PRINT
DOWNLOAD
On-site Air Releases by Chemical for 2019
Total Air Releases: 1,697,761 lb
Ammonia
Ethylene
Hydrochloric acid
Hydrogen sulfide
Methanol
Styrene
Sulfuric acid
Toluene
Phenol
Carbon disulfide
Others
21.0%
16.4%
15.6%
12.9%
10.6%
9.7%
On- and Off-site
On-site
Air
Water
Land
Off-site



EPA Toxics Release Inventory

How to Search

Summary of 61 TRI facilities within 13 miles of Pittsburgh, Pennsylvania

BACK FORWARD

New Search
Map of TRI Facilities
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TRI Search Plus
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EJSCREEN
EPA's environmental justice screening and mapping tool.

Most Recent Reporting Year: 2019

Potential Health Effects

MORE INFO

Change Your Search Radius (Miles): 13

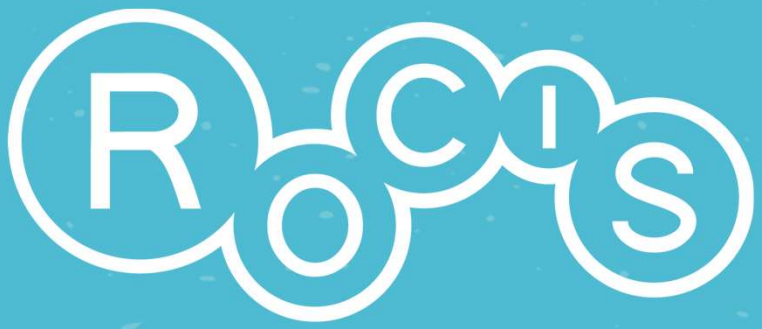
This section lists the potential health effects associated with the chemicals released by the facilities in your search area.

Chemicals | Definitions

Chemical	2019 Releases (lb)	2019 RSEI Score	Health Effects
Totals	**10,072,755**	**204,549**	
Zinc and zinc compounds	3,488,525	52	Hematological, Reproductive
Nitrate compounds (water dissociable)	2,469,969	77	Developmental, Hematological
Manganese and manganese compounds	1,634,772	1,812	Neurological
Ammonia	393,614	147	Ocular, Other Systemic, Respiratory
Ethylene	278,396	7	
Hydrochloric acid	265,683	1,509	Respiratory
Hydrogen sulfide	218,568	15,917	Neurological, Respiratory
Lead and lead compounds	215,788	4,004	Cancer, Cardiovascular, Developmental, Hematological, Neurological, Renal, Reproductive
Methanol	179,842	2	Developmental, Hepatic, Neurological, Other Systemic
Chromium and chromium compounds	116,235	94,524	Cancer, Gastrointestinal, Hematological, Respiratory
Nitric acid	109,296	4	Respiratory

Recent News and Local Findings

03



Particle Size

Deaths from fossil fuel emissions higher than previously thought

Fossil fuel air pollution responsible for more than 8 million people worldwide in 2018

By Leah Burrows | Press contact
February 9, 2021

Slide 12

LW3 This is new - keep

Linda Wigington, 7/30/2021

- More than 8 million people died in 2018 from fossil fuel pollution, significantly higher than previous research suggested
- Researchers estimated that exposure to particulate matter from fossil fuel emissions accounted for 18% percent of total global deaths in 2018
- Regions with the highest concentrations of fossil fuel-related air pollution — including Eastern North America, Europe, and South-East Asia — have the highest rates of mortality, according to the study published in the journal Environmental Research.

"This study demonstrates that the fossil fuel component of $PM_{2.5}$ contributes a large mortality burden."

Concluded that $PM_{2.5}$ reduction during the mitigation period lowered $PM_{2.5}$-related deaths

During the 30 day period after emergency declaration, average CA $PM_{2.5}$ decreased by an average of 45%.

"We estimated a total of 483 (95% CI: 307, 665) avoided $PM_{2.5}$-related deaths in the urban areas of California."

Estimated California avoided $PM_{2.5}$-related deaths included:

- 207 cardiopulmonary
- 67 ischemic heart disease
- 20 lung cancer

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THE ALLEGHENY FRONT

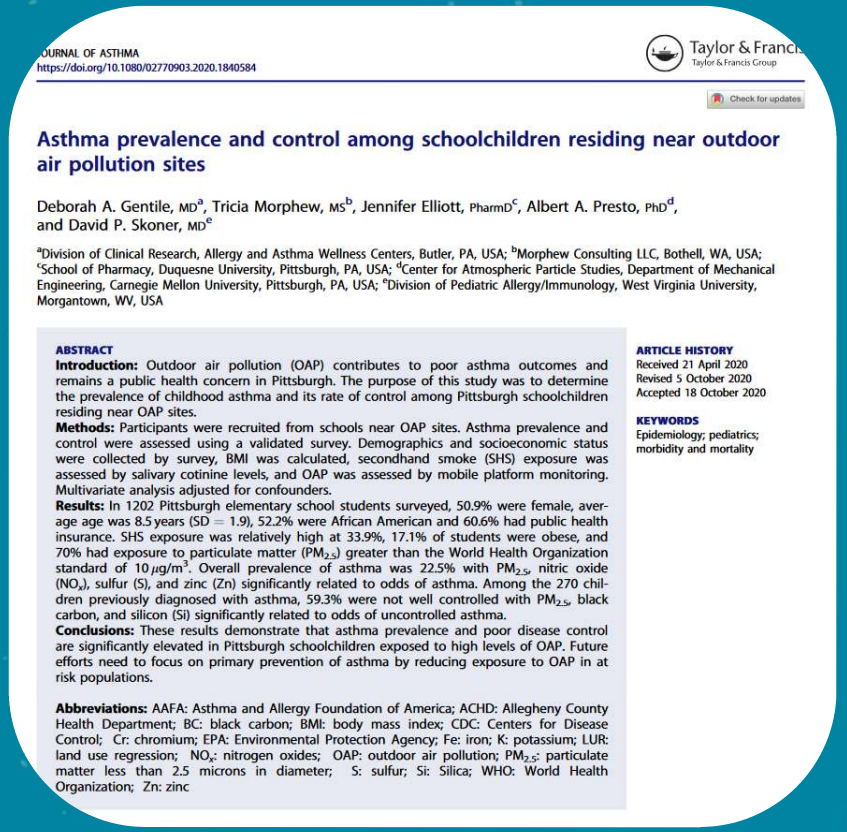
FULL EPISODES SERIES ENERGY CLIMATE CORONAVIRUS 2020 E

United States Steel Corp. Edgar Thomson Plant in Braddock, Pennsylvania, U.S. Photo: Justin Merriman / Bloomberg via Getty Images

STUDY: PITTSBURGH KIDS NEAR POLLUTING SITES HAVE HIGHER ASTHMA RATES

REID FRAZIER × NOVEMBER 10, 2020

ENVIRONMENTAL JUSTICE HAZARDOUS TO YOUR HEALTH HEALTH POLLUTION



JOURNAL OF ASTHMA
https://doi.org/10.1080/02770903.2020.1840584

Taylor & Francis
Taylor & Francis Group

Check for updates

Asthma prevalence and control among schoolchildren residing near outdoor air pollution sites

Deborah A. Gentile, MD[a], Tricia Morphew, MS[b], Jennifer Elliott, PharmD[c], Albert A. Presto, PhD[d], and David P. Skoner, MD[e]

[a]Division of Clinical Research, Allergy and Asthma Wellness Centers, Butler, PA, USA; [b]Morphew Consulting LLC, Bothell, WA, USA; [c]School of Pharmacy, Duquesne University, Pittsburgh, PA, USA; [d]Center for Atmospheric Particle Studies, Department of Mechanical Engineering, Carnegie Mellon University, Pittsburgh, PA, USA; [e]Division of Pediatric Allergy/Immunology, West Virginia University, Morgantown, WV, USA

ABSTRACT

Introduction: Outdoor air pollution (OAP) contributes to poor asthma outcomes and remains a public health concern in Pittsburgh. The purpose of this study was to determine the prevalence of childhood asthma and its rate of control among Pittsburgh schoolchildren residing near OAP sites.

Methods: Participants were recruited from schools near OAP sites. Asthma prevalence and control were assessed using a validated survey. Demographics and socioeconomic status were collected by survey, BMI was calculated, secondhand smoke (SHS) exposure was assessed by salivary cotinine levels, and OAP was assessed by mobile platform monitoring. Multivariate analysis adjusted for confounders.

Results: In 1202 Pittsburgh elementary school students surveyed, 50.9% were female, average age was 8.5 years (SD = 1.9), 52.2% were African American and 60.6% had public health insurance. SHS exposure was relatively high at 33.9%, 17.1% of students were obese, and 70% had exposure to particulate matter ($PM_{2.5}$) greater than the World Health Organization standard of 10 $\mu g/m^3$. Overall prevalence of asthma was 22.5% with $PM_{2.5}$, nitric oxide (NO_x), sulfur (S), and zinc (Zn) significantly related to odds of asthma. Among the 270 children previously diagnosed with asthma, 59.3% were not well controlled with $PM_{2.5}$, black carbon, and silicon (Si) significantly related to odds of uncontrolled asthma.

Conclusions: These results demonstrate that asthma prevalence and poor disease control are significantly elevated in Pittsburgh schoolchildren exposed to high levels of OAP. Future efforts need to focus on primary prevention of asthma by reducing exposure to OAP in at risk populations.

Abbreviations: AAFA: Asthma and Allergy Foundation of America; ACHD: Allegheny County Health Department; BC: black carbon; BMI: body mass index; CDC: Centers for Disease Control; Cr: chromium; EPA: Environmental Protection Agency; Fe: iron; K: potassium; LUR: land use regression; NO_x: nitrogen oxides; OAP: outdoor air pollution; $PM_{2.5}$: particulate matter less than 2.5 microns in diameter; S: sulfur; Si: Silica; WHO: World Health Organization; Zn: zinc

ARTICLE HISTORY
Received 21 April 2020
Revised 5 October 2020
Accepted 18 October 2020

KEYWORDS
Epidemiology; pediatrics; morbidity and mortality

- Monitored air pollution levels near the schools and found a correlation between high levels of PM and asthma rates.
- Children in these schools had a 22.5% asthma rate, nearly triple the nationwide average of 8.3 percent. Allegheny County's overall child asthma rate is 11%.

Climate and Environment

Deadly air pollutant 'disproportionately and systematically' harms Americans of color, study finds

Black, Latino and Asian Americans face higher levels of exposure to fine particulate matter from traffic, construction and other sources

By **Juliet Eilperin** and **Darryl Fears**

Add to list

April 28, 2021 at 2:00 p.m. EDT

Interstate 15 carries heavy traffic between Southern California and Las Vegas. (David McNew/Getty Images)

> The study found that Black people are exposed to 21 percent more fine-particle pollution compared to average Americans, while exposure was 18 percent greater for Asian Americans and 11 percent more for Hispanics. White Americans, by contrast, have 8 percent less pollution exposure than the average.

“If air pollution levels in all of Allegheny County were lowered to match the levels seen in its least-polluted neighborhoods, about 100 fewer residents would die of coronary heart disease every year, according to a new study.

A majority of the lives that would be saved by such an initiative are in the region's poor and minority communities—people who are also particularly susceptible to contracting and dying from COVID-19.”

Jun 12, 2020

Environmental injustice in Pittsburgh: Poor, minority neighborhoods see higher rates of deaths from air pollution

"Systemic racism is not limited to one system."

Kristina Marusic

Research | Open Access | Published: 16 March 2020

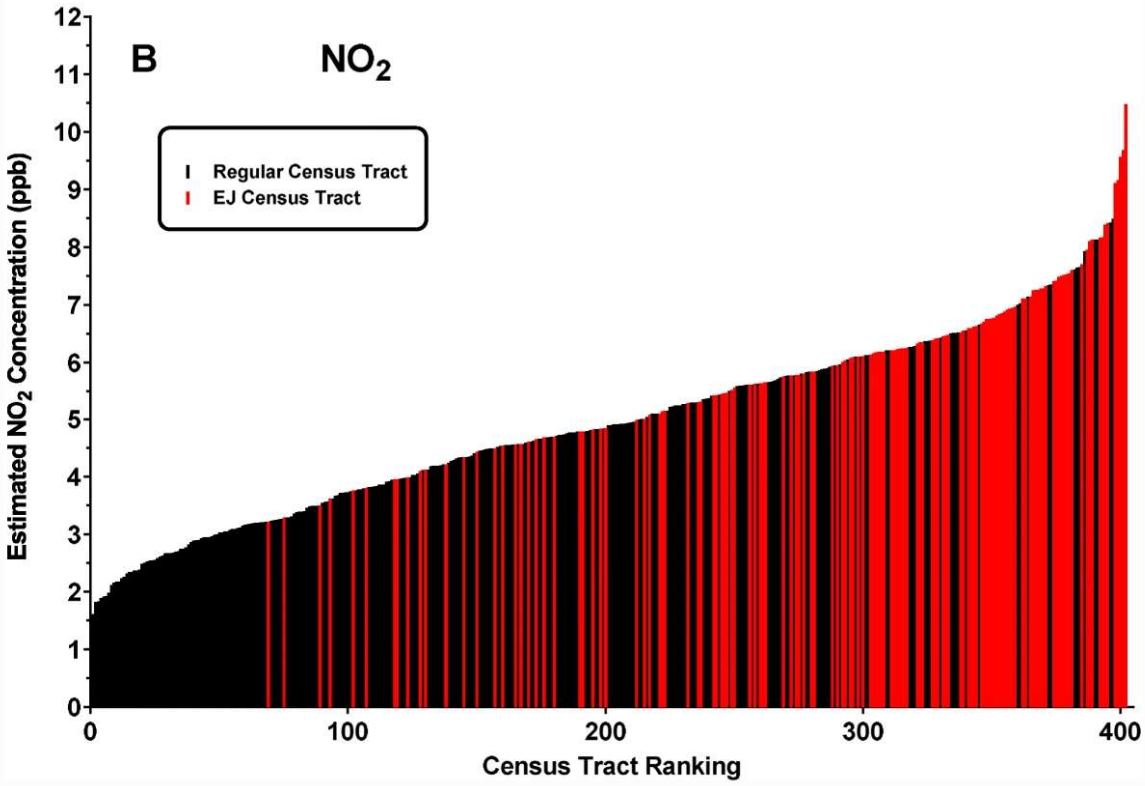
A risk-based model to assess environmental justice and coronary heart disease burden from traffic-related air pollutants

James P. Fabisiak, Erica M. Jackson, LuAnn L. Brink & Albert A. Presto

Environmental Health **19**, Article number: 34 (2020) | Cite this article

1747 Accesses | **1** Citations | **14** Altmetric | Metrics

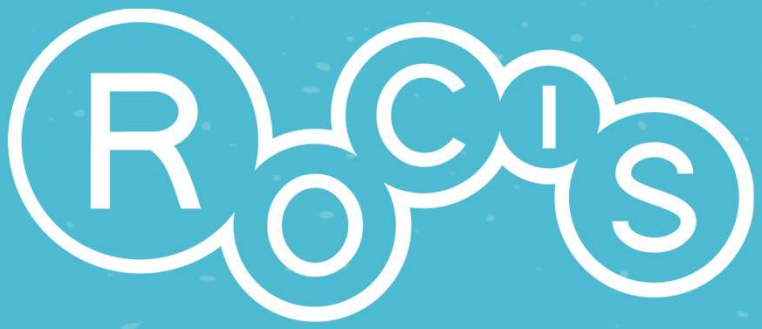
For black carbon and NO_2, Environmental Justice tracts (> 20% poverty and/or > 30% non-white) were 4 to 25 times more likely to be in the highest areas of exposure compared to the lowest areas of exposure for BC and NO_2.



Distribution of EJ census tracts along the exposure continuum of black carbon (**a**) and nitrogen dioxide (**b**) in Allegheny County. Average long-term exposure estimates for each pollutant were derived for each census tract in the county following land-use regression as described in Methods. Based on the resulting exposure metric, tracts are ranked from lowest to highest exposure and those designated as EJ sensitive are displayed in red

From the beginning to the end

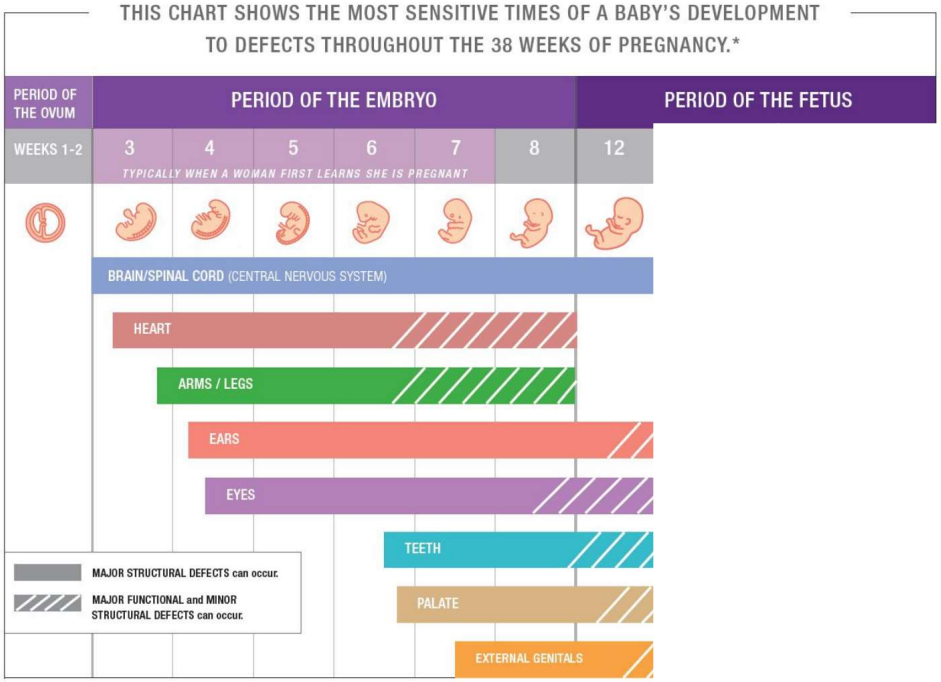
04



Health Impacts on the Fetus

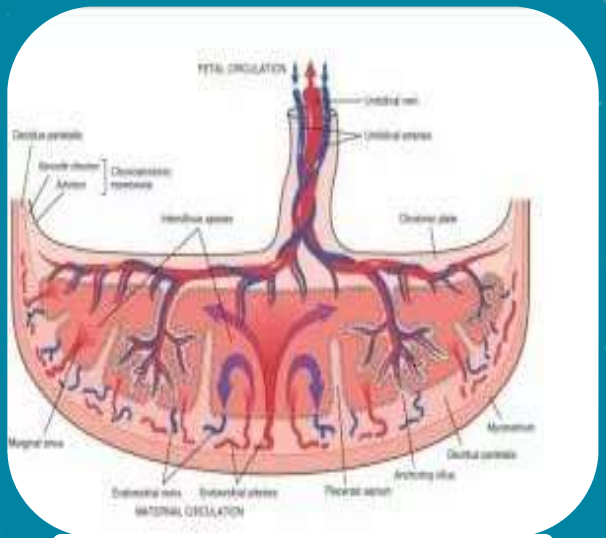
- Teratogens are complicated….

Teratogens:
Substances that may produce physical or functional defects in human embryo or fetus, or the outcomes of the pregnancy



https://mothertobaby.org/wp-content/uploads/2020/02/Adapted-from-Moore-1993-and-the-National-Organization-of-Fetal-Alcohol-Syndrome-NOFAS-2009.-3.png

Black Carbon Particles DO cross the Placental Blood Barrier



https://biologydictionary.net/placenta/

nature communications

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nature › nature communications › articles › article

Article | Open Access | Published: 17 September 2019

Ambient black carbon particles reach the fetal side of human placenta

Hannelore Bové, Eva Bongaerts, Eli Slenders, Esmée M. Bijnens, Nelly D. Saenen, Wilfried Gyselaers, Peter Van Eyken, Michelle Plusquin, Maarten B. J. Roeffaers, Marcel Ameloot & Tim S. Nawrot ✉

Nature Communications **10**, Article number: 3866 (2019) | Cite this article

"Our finding that BC particles accumulate on the fetal side of the placenta suggests that ambient particulates could be transported towards the fetus and represents a potential mechanism explaining the detrimental health effects of pollution from early life onwards."

JAMA Network | Open

Original Investigation | Environmental Health

Association of Air Pollution and Heat Exposure With Preterm Birth, Low Birth Weight, and Stillbirth in the US
A Systematic Review

Bruce Bekkar, MD; Susan Pacheco, MD; Rupa Basu, PhD; Nathaniel DeNicola, MD, MSHP

Abstract

IMPORTANCE Knowledge of whether serious adverse pregnancy outcomes are associated with increasingly widespread effects of climate change in the US would be crucial for the obstetrical medical community and for women and families across the country.

OBJECTIVE To investigate prenatal exposure to fine particulate matter ($PM_{2.5}$), ozone, and heat, and the association of these factors with preterm birth, low birth weight, and stillbirth.

Findings In this systematic review of 57 of 68 studies including a total of 32 798 152 births, there was a statistically significant association between heat, ozone, or fine particulate matter and adverse pregnancy outcomes. Heterogeneous studies from across the US revealed positive findings in each analysis of exposure and outcome.

"Our findings here suggest that exacerbation of air pollution and heat exposure related to climate change may be significantly associated with risk to pregnancy outcomes in the U.S."

Nathaniel DeNicola, MD – assistant professor of obstetrics and gynecology at the George Washington University School of Medicine and Health Science

Early-life cockroach allergen and polycyclic aromatic hydrocarbon exposures predict cockroach sensitization among inner-city children

Matthew S. Perzanowski, PhD,1,2 Ginger L. Chew, ScD,1,2 Adnan Divjan,1,2 Kyung Hwa Jung,1,3 Robert Ridder,1,3 Deliang Tang, PhD,1,2 Diurka Diaz, MA,1,2 Inge F. Goldstein, DrPH,1,4 Patrick L. Kinney, ScD,1,2 Andrew G. Rundle, Dr.PH,1,4 David E. Camann,5 Frederica P. Perera, DrPH,1,2 and Rachel L. Miller, MD1,2,3

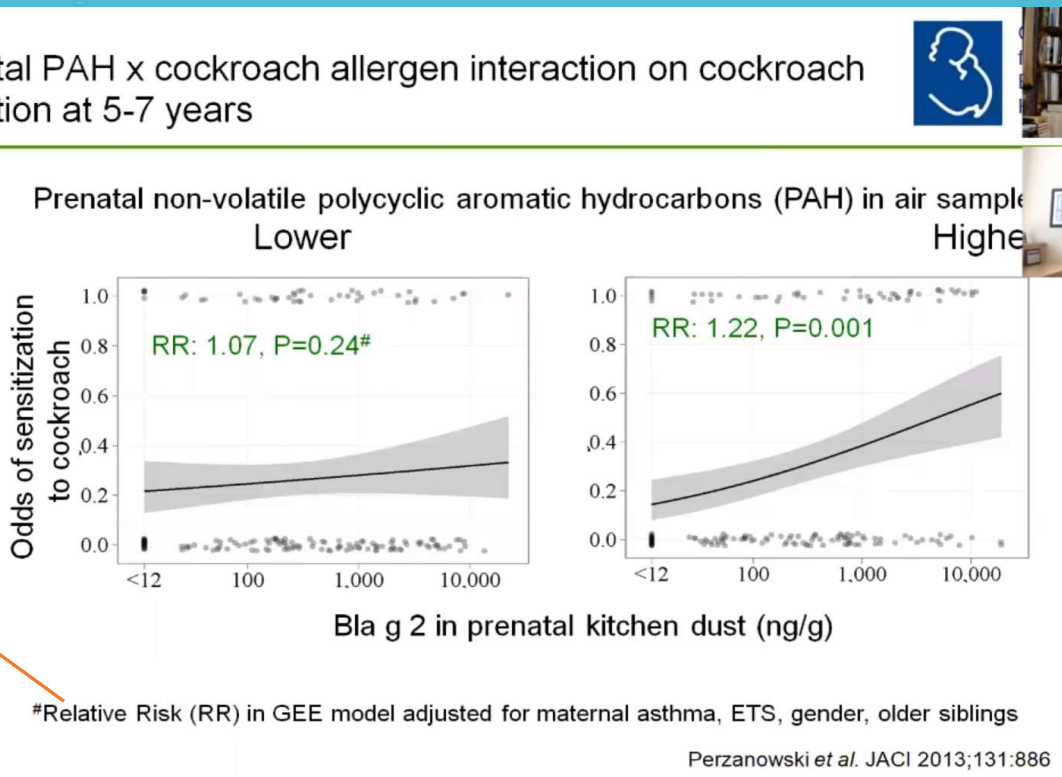
Conclusions

Prenatal exposure to cockroach allergen was associated with a greater risk of developing allergic sensitization. This risk was increased by exposure to nonvolatile PAHs, with children null for the GSTM1 mutation particularly vulnerable.

Key messages

- Domestic exposure to cockroach allergen measured prenatally predicted sensitization to cockroach at age 5–7 years.
- Cockroach allergen predicted sensitization only among children also exposed to higher levels of airborne non-volatile polycyclic aromatic hydrocarbons, indicating that these combustion byproducts may act as adjuvants in the development of cockroach sensitization in urban environments.
- These findings suggest that targeting either allergen or combustion sources with primary prevention could be successful in reducing the development of cockroach sensitization.

J Allergy Clin Immunol. 2013 Mar; 131(3): 886–893.
Published online 2013 Feb 4. doi: 10.1016/j.jaci.2012.12.666



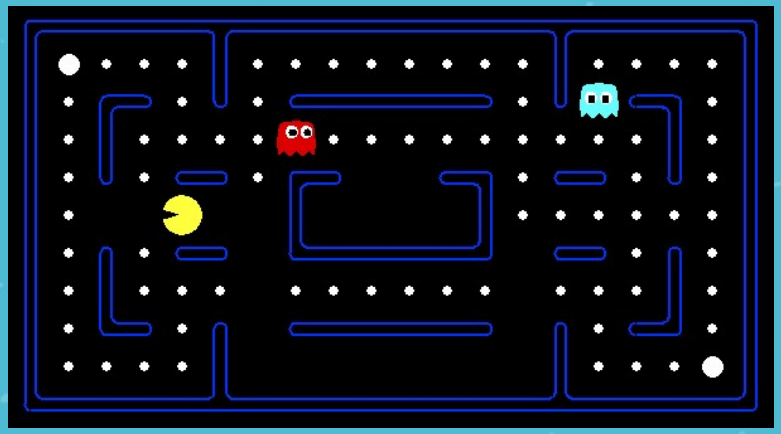
Something to keep in mind: Genetics!

05

ROCIS

Dementia and Particles

AKA:
Particulate Matter and Pacman in our brains

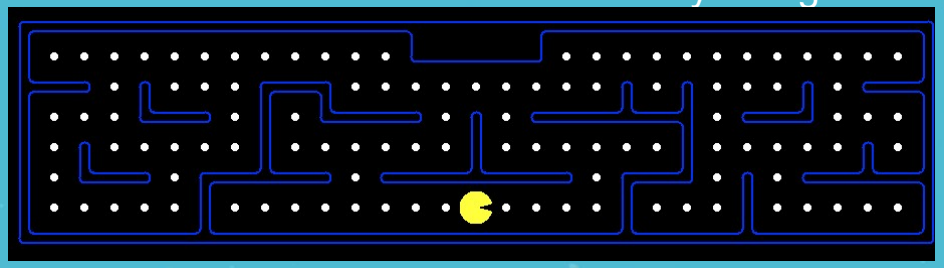


Transl Psychiatry. 2017 Jan; 7(1): e1022.
Published online 2017 Jan 31. doi: 10.1038/tp.2016.280
PMCID: PMC5299391
PMID: 28140404

Particulate air pollutants, APOE alleles and their contributions to cognitive impairment in older women and to amyloidogenesis in experimental models

M Cacciottolo,[1] X Wang,[2] I Driscoll,[3] N Woodward,[1] A Saffari,[4] J Reyes,[5] M L Serre,[5] W Vizuete,[5] C Sioutas,[4] T E Morgan,[1] M Gatz,[6,7] H C Chui,[7,8] S A Shumaker,[9] S M Resnick,[10] M A Espeland,[11] C E Finch,[1,7,*] and J C Chen[2,7,*]

Beta-amyloid is sticky compound that accumulates in the brain, disrupting communication between brain cells and eventually killing them.



PM – interferes with this process

Apolipoprotein E (**APOE**) is a protein that influences the probability of *beta-amyloid aggregation.*

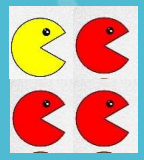
There are three types of the APOE gene, called alleles: APOE2, E3 and E4.

E2 – very efficient at clearing Beta-amyloid

E3 – ok at clearing Beta-amyloid

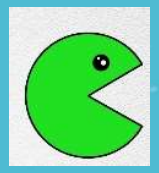
E4– Not efficient at clearing Beta-amyloid

We inherit these in team of 2: 

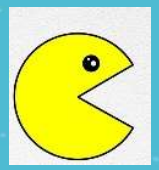
Having  can increase your risk for Alzheimer's by 2 to 3 times;

increases risk for by 12 times

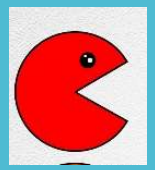
Worldwide Frequency:



8.4%



77.9%



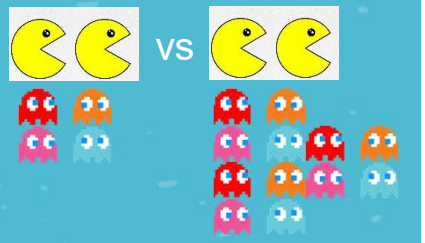
13.7%; 40% in patients with AD

Study: Part A - Humans

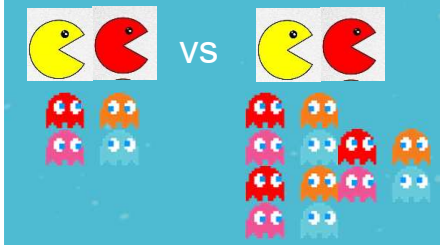
Participants from the Women's Health Initiative Memory Study (WHIMS).
Community-dwelling (>95% in urban areas) across 48 states, aged 65 to 79 years, and free of dementia when enrolled, 1995–1999
Annual screening of cognitive function

Researchers looked at:

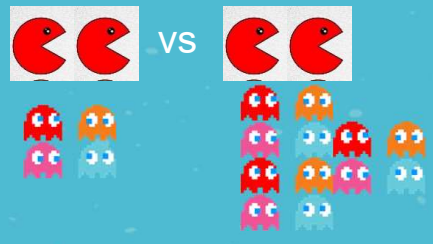
For Women Residing at Locations with low $PM_{2.5}$ vs High $PM_{2.5}$ (1999-2010)



68% increase in hazard for all-cause dementia



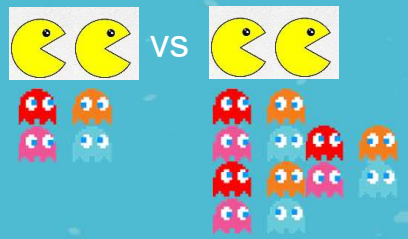
91% increase in hazard for all-cause dementia

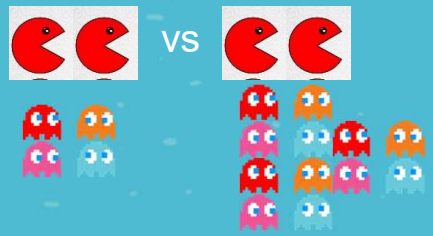


295% increase in hazard for all-cause dementia

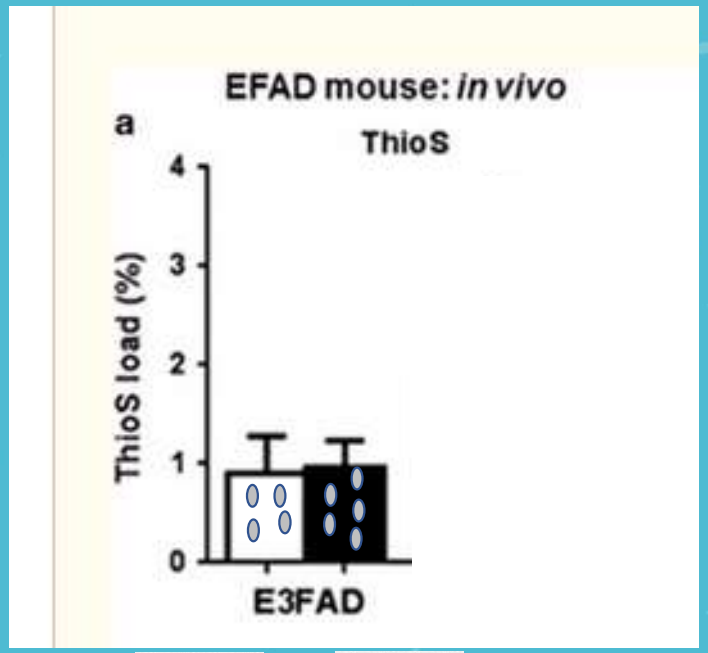
Study: Part B - Mice

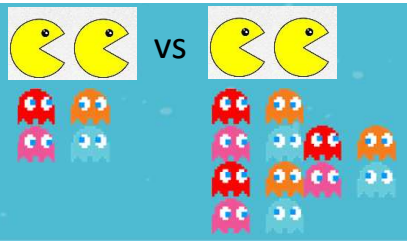
What happened inside the brains of those exposed to high nPM (aerodynamic diameter <200 nm) vs low nPM?

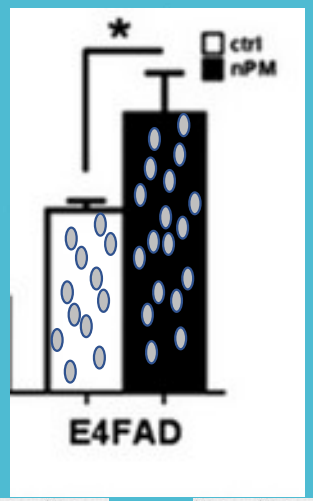


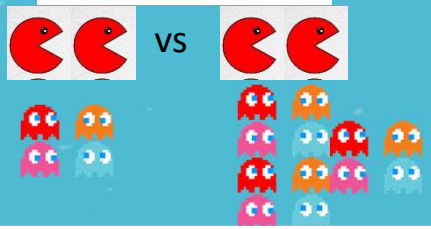


Mice: Cerebral cortex sagittal sections were analyzed for Aβ plaque load









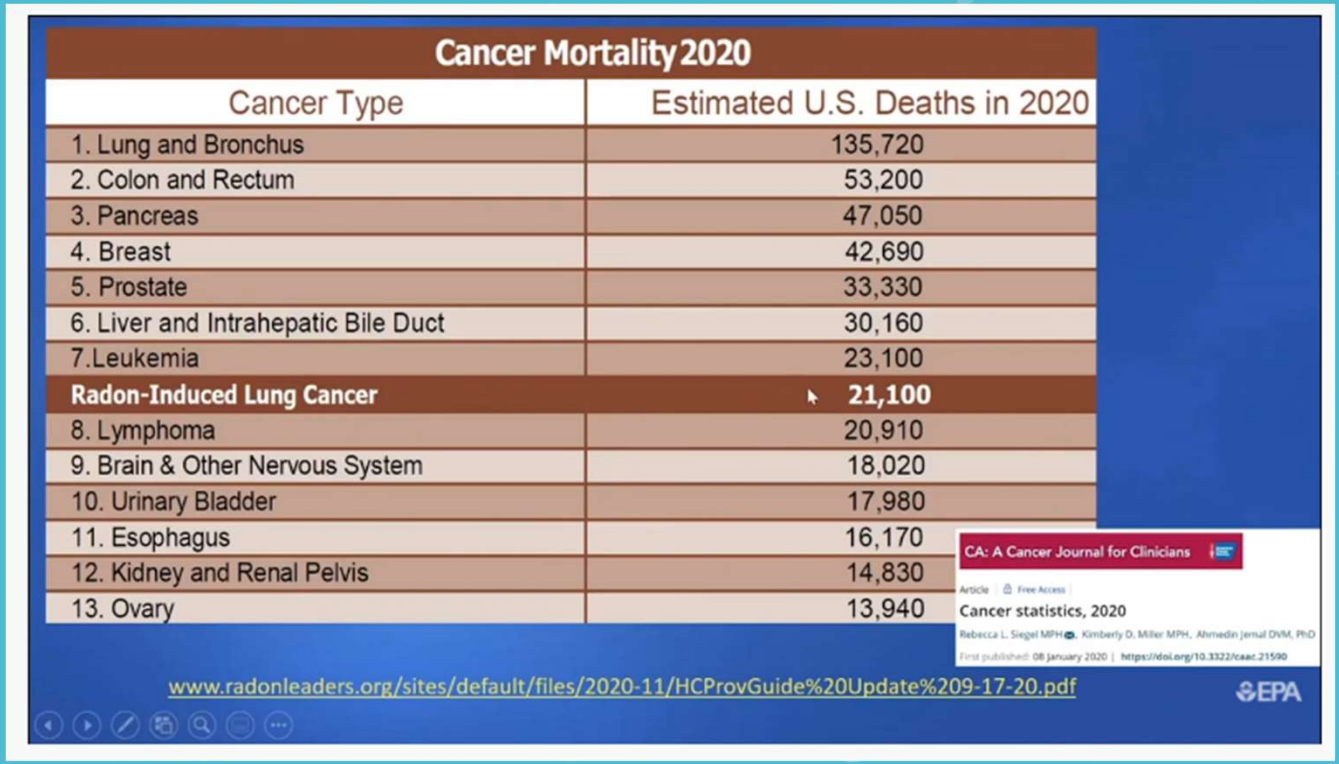
"We provide clear evidence that the hazards of particulate air pollutants for brain health extend to dementia risk in a US-wide sample of older women…

….the first evidence that neurodegenerative effects of airborne PM may involve gene-environment interactions with APOE ε4…

The association between $PM_{2.5}$ exposure and increased dementia risk suggests that the global burden of disease attributable to $PM_{2.5}$ pollution has been underestimated, especially in regions with large populations exposed to high ambient $PM_{2.5}$."

Radon

Evaluating the Health Risks of Radon: Fundamentals and New Scientific Insights - YouTube


Cancer Mortality 2020
Cancer Type
Estimated U.S. Deaths in 2020
1. Lung and Bronchus 135,720
2. Colon and Rectum 53,200
3. Pancreas 47,050
4. Breast 42,690
5. Prostate 33,330
6. Liver and Intrahepatic Bile Duct 30,160
7.Leukemia 23,100
Radon-Induced Lung Cancer 21,100
8. Lymphoma 20,910
9. Brain & Other Nervous System 18,020
10. Urinary Bladder 17,980
11. Esophagus 16,170
12. Kidney and Renal Pelvis 14,830
13. Ovary 13,940
CA: A Cancer Journal for Clinicians
Article
Free Access
Cancer statistics, 2020
Rebecca L. Siegel MPH, Kimberly D. Miller MPH, Ahmedin Jemal DVM, PhD
First published: 08 January 2020 | https://doi.org/10.3322/caac.21590
www.radonleaders.org/sites/default/files/2020-11/HCProvGuide%20Update%209-17-20.pdf
EPA

Radon From Geologic Sources

3.8 days

Radon

1,600 years

Radium

4.5 billion years

Uranium

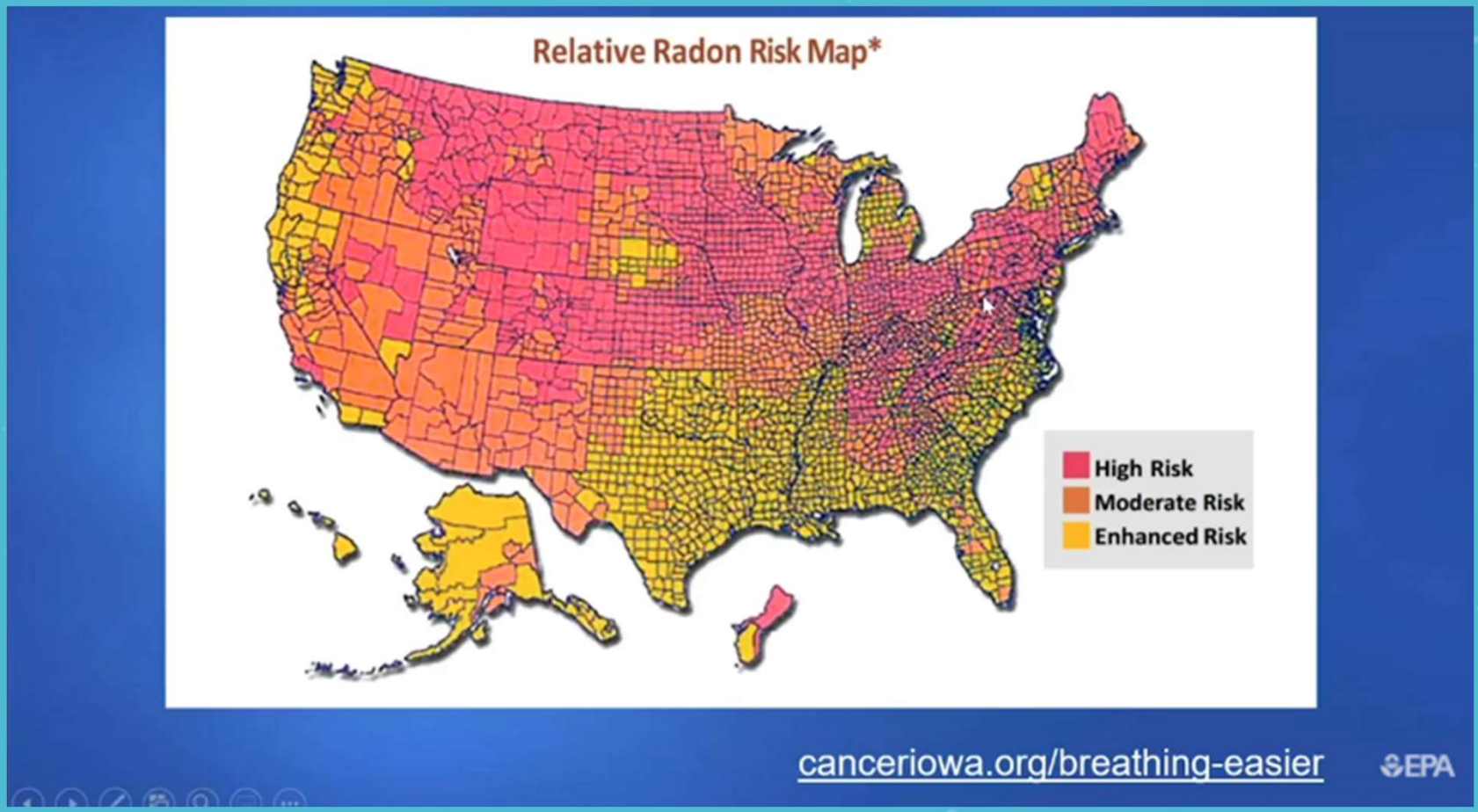
- Radon is a radioactive noble gas.
- It is naturally occurring outdoors.
- You cannot see or smell it.
- It enters buildings primarily from the soil.

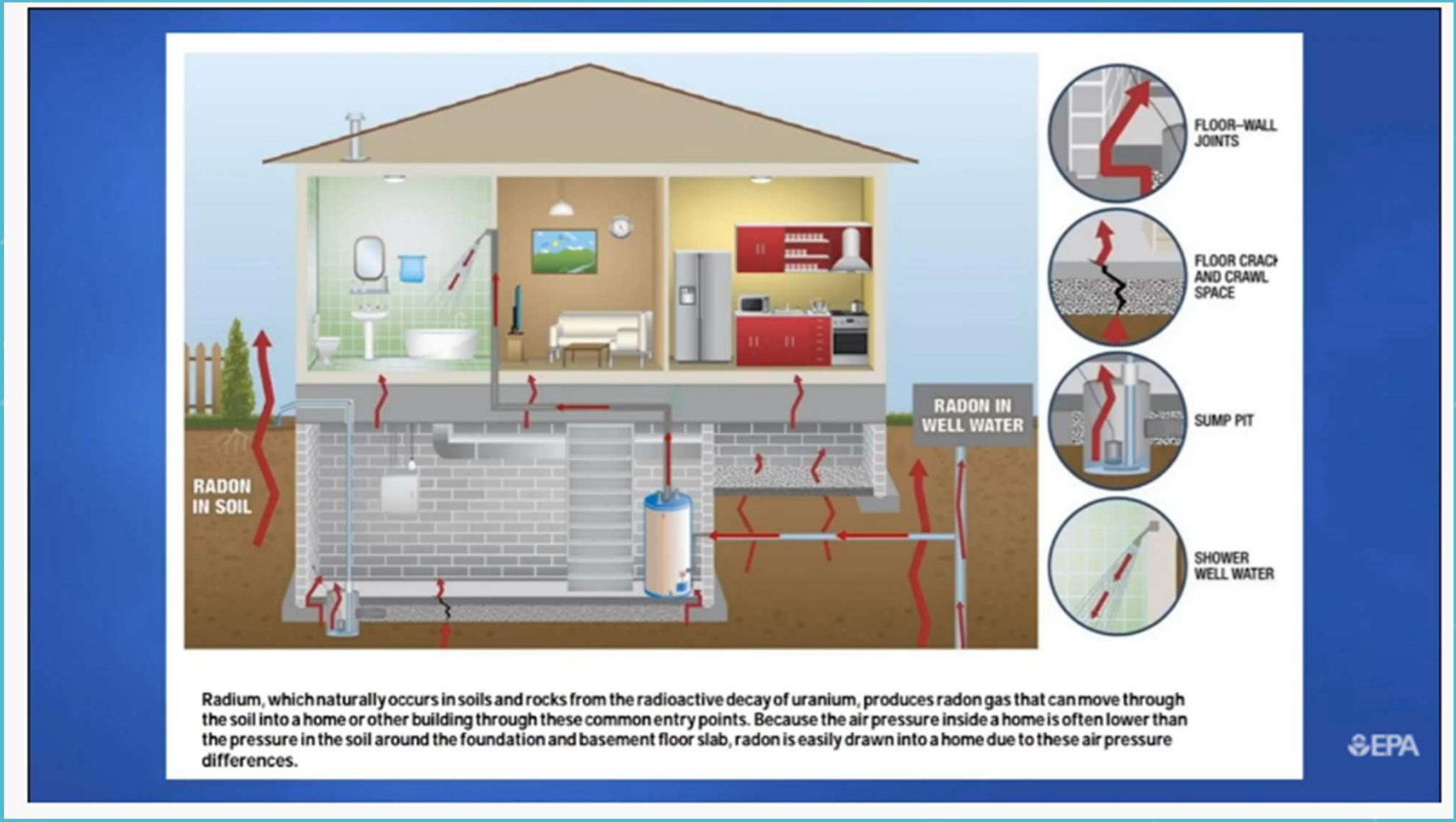
EPA

Radon Measurement

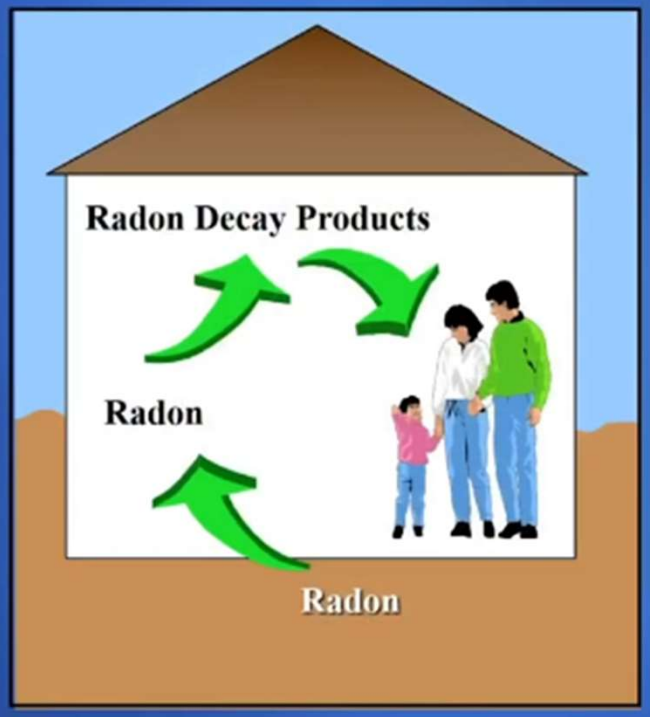
- picoCurie/Liter = pCi/L 1 pCi = 2.2 dpm (disintegrations per minute)
- U.S. Environmental Protection Agency (EPA) Radon Action Level = 4 pCi/L
- World Health Organization Reference Level = 2.7 pCi/L
- National Average Indoor Radon Concentration = 1.3 pCi/L
- National Average Outdoor Radon Concentration = 0.4 pCi/L

EPA

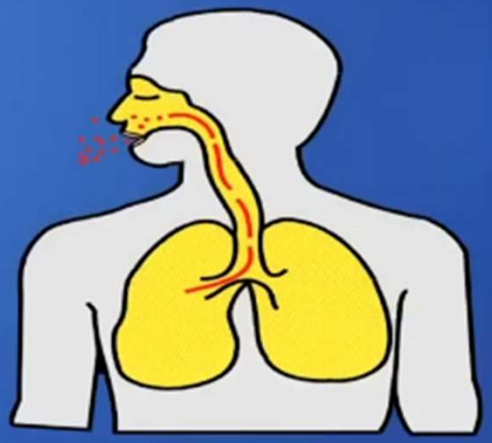

Relative Radon Risk Map*
High Risk
Moderate Risk
Enhanced Risk
canceriowa.org/breathing-easier
EPA


RADON IN SOIL
RADON IN WELL WATER
FLOOR–WALL JOINTS
FLOOR CRACK AND CRAWL SPACE
SUMP PIT
SHOWER WELL WATER
Radium, which naturally occurs in soils and rocks from the radioactive decay of uranium, produces radon gas that can move through the soil into a home or other building through these common entry points. Because the air pressure inside a home is often lower than the pressure in the soil around the foundation and basement floor slab, radon is easily drawn into a home due to these air pressure differences.
EPA

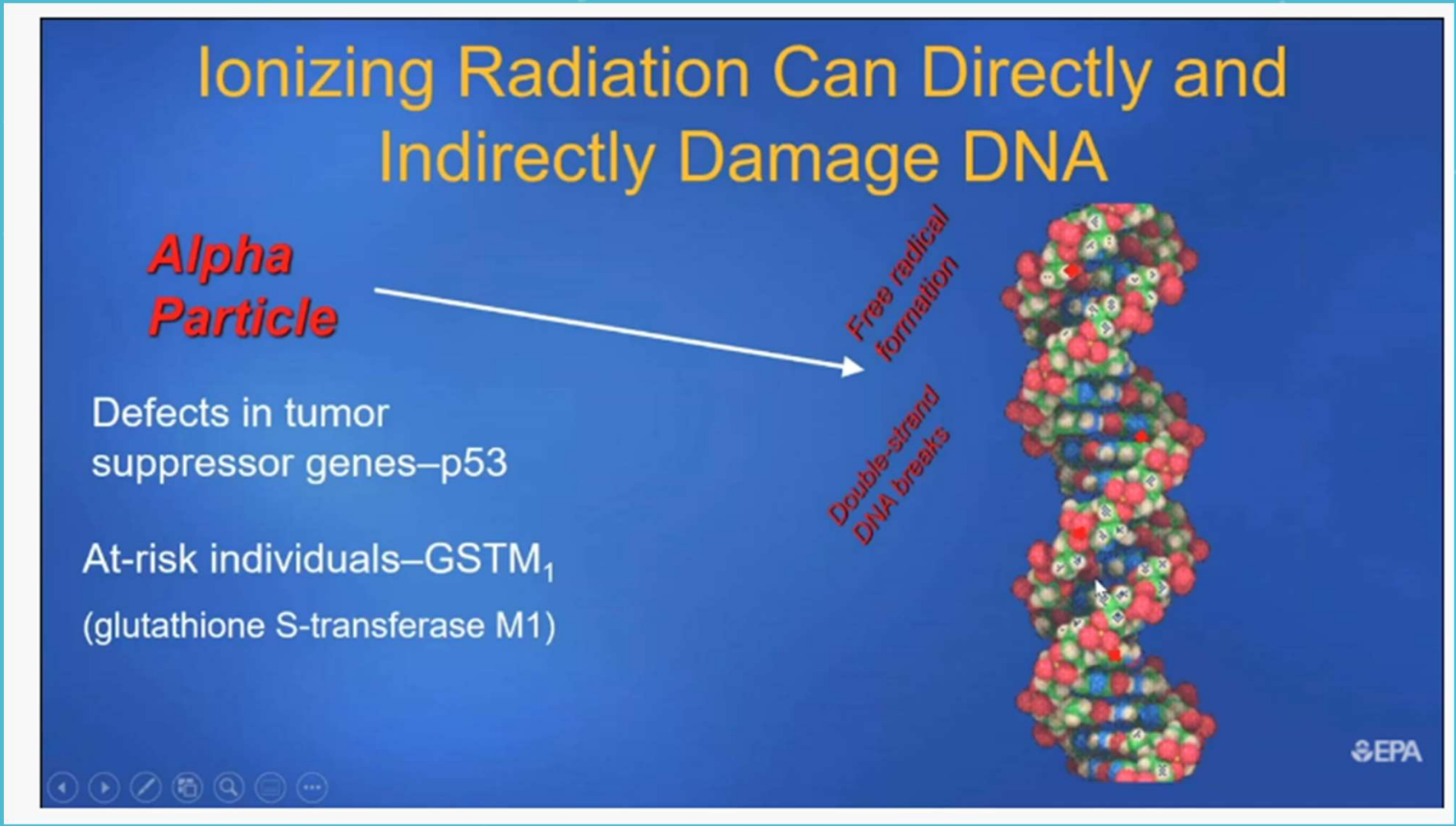
Why Are Radon Decay Products a Health Concern?



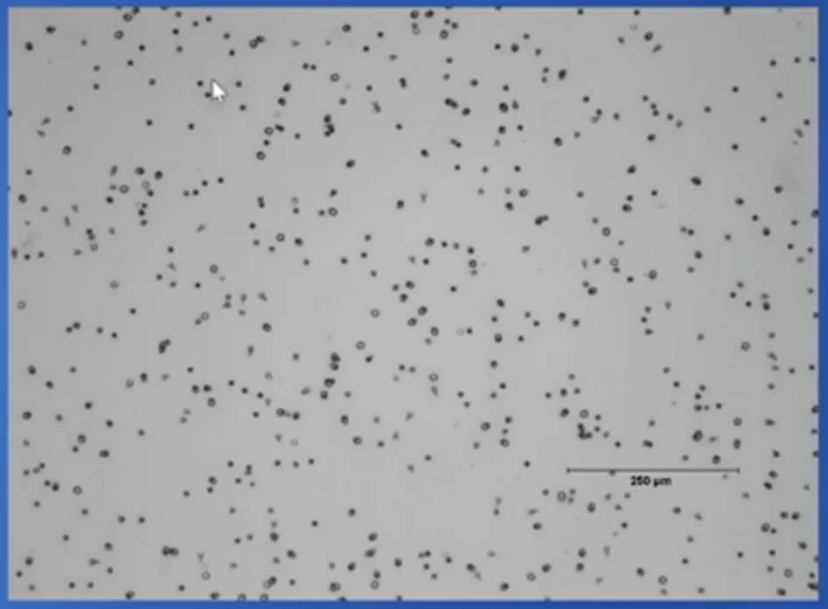
These particles are easily inhaled and deposited in the lungs, where they can damage sensitive lung tissue.



EPA


Ionizing Radiation Can Directly and Indirectly Damage DNA
Alpha Particle
Free radical formation
Double-strand DNA breaks
Defects in tumor suppressor genes–p53
At-risk individuals–GSTM1
(glutathione S-transferase M1)
EPA

Alpha Tracks



EPA

Radiation Protection Dosimetry (2015), Vol. 163, No. 3, pp. 325–332
Advance Access publication 16 June 2014
doi:10.1093/rpd/ncu185

COMPARATIVE SURVEY OF OUTDOOR, RESIDENTIAL AND WORKPLACE RADON CONCENTRATIONS

Nirmalla Barros[1], Dan W. Field[2], Daniel J. Steck[3] and R. William Field[1,*]
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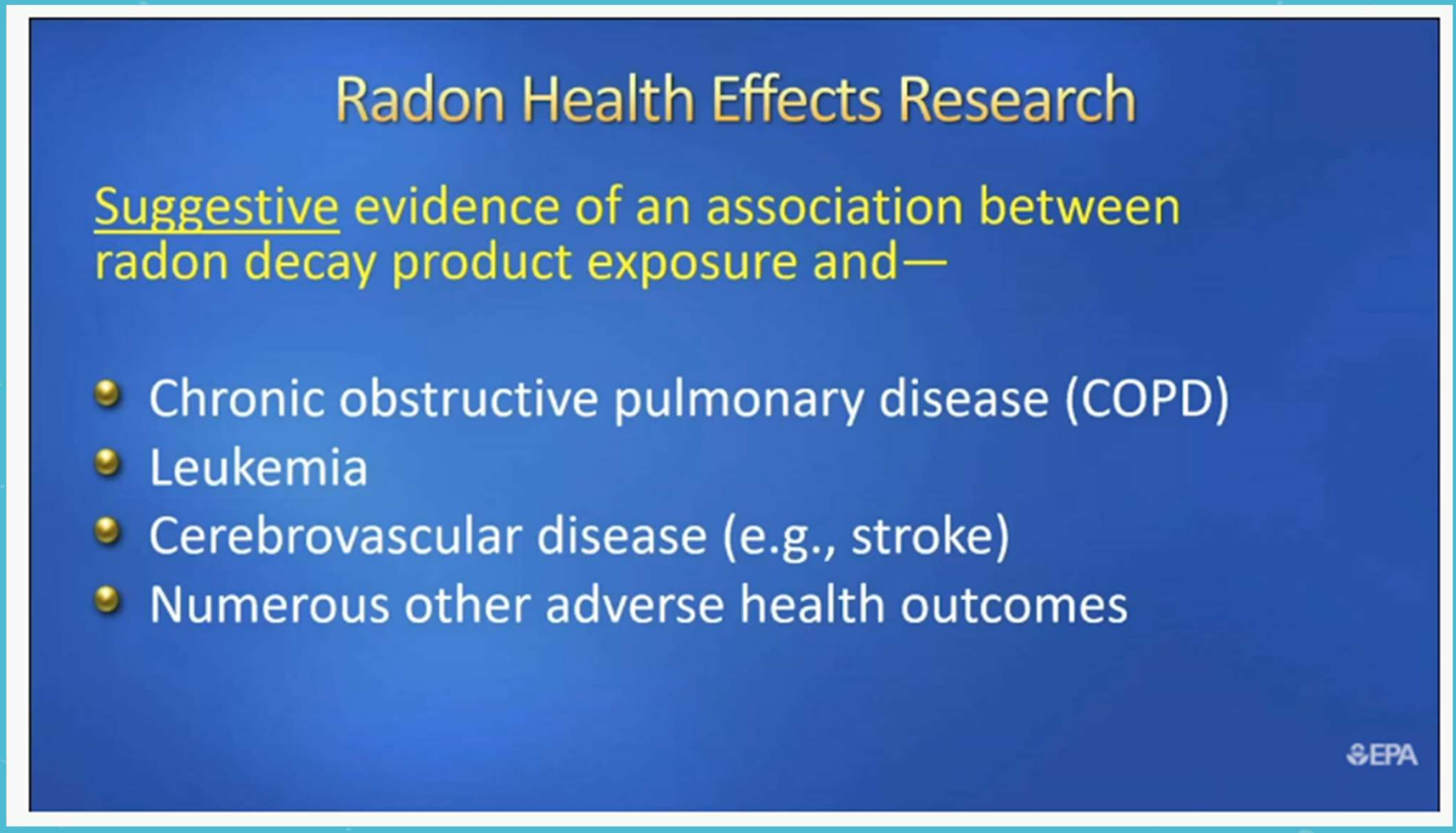
[2]Department of Geographical and Sustainability Sciences, University of Iowa, Iowa City, IA 52242, USA
[3]Department of Physics, St. John's University, Collegeville, MN 56321, USA

Table 1. Characteristics of radon concentrations (Bq m^{-3}) by sampling environment.

Environment	*N*	Geometric mean (GSD)	Range	Percentage ≥148 Bq m^{-3}
Indoor	164	53 (2.2)	7.4–400	9.8
Home	83	54 (2.2)	11–400	9.6
Workplace	81	51 (2.2)	7.4–333	9.9
County office	62	57 (2.0)	15–333	11
Retail	5	33 (2.3)	11–104	0
School	6	27 (2.1)	11–70	0
Service	8	43 (3.0)	7.4–233	13


Radon Health Effects Research
Suggestive evidence of an association between radon decay product exposure and—
Chronic obstructive pulmonary disease (COPD)
Leukemia
Cerebrovascular disease (e.g., stroke)
Numerous other adverse health outcomes
EPA

Environment International 146 (2021) 106285

Contents lists available at ScienceDirect

Environment International

journal homepage: www.elsevier.com/locate/envint

Residential radon exposure and hypertensive disorders of pregnancy in Massachusetts, USA: A cohort study

Stefania Papatheodorou [a,*], Weiyu Yao [b], Carolina L.Z. Vieira [b], Longxiang Li [b], Blair J. Wylie [c,d,e], Joel Schwartz [a,b], Petros Koutrakis [b]

[a] Department of Epidemiology, Harvard T.H. Chan School of Public Health, Boston, MA, USA
[b] Department of Environmental Health, Harvard T.H. Chan School of Public Health, Boston, MA, USA
[c] Department of Obstetrics and Gynecology, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA, USA
[d] Harvard Medical School, Boston, MA, USA
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ARTICLE INFO

Handling Editor: Zorana Andersen

Keywords:
Radon
Inhalation
Hypertensive disorders of pregnancy

ABSTRACT

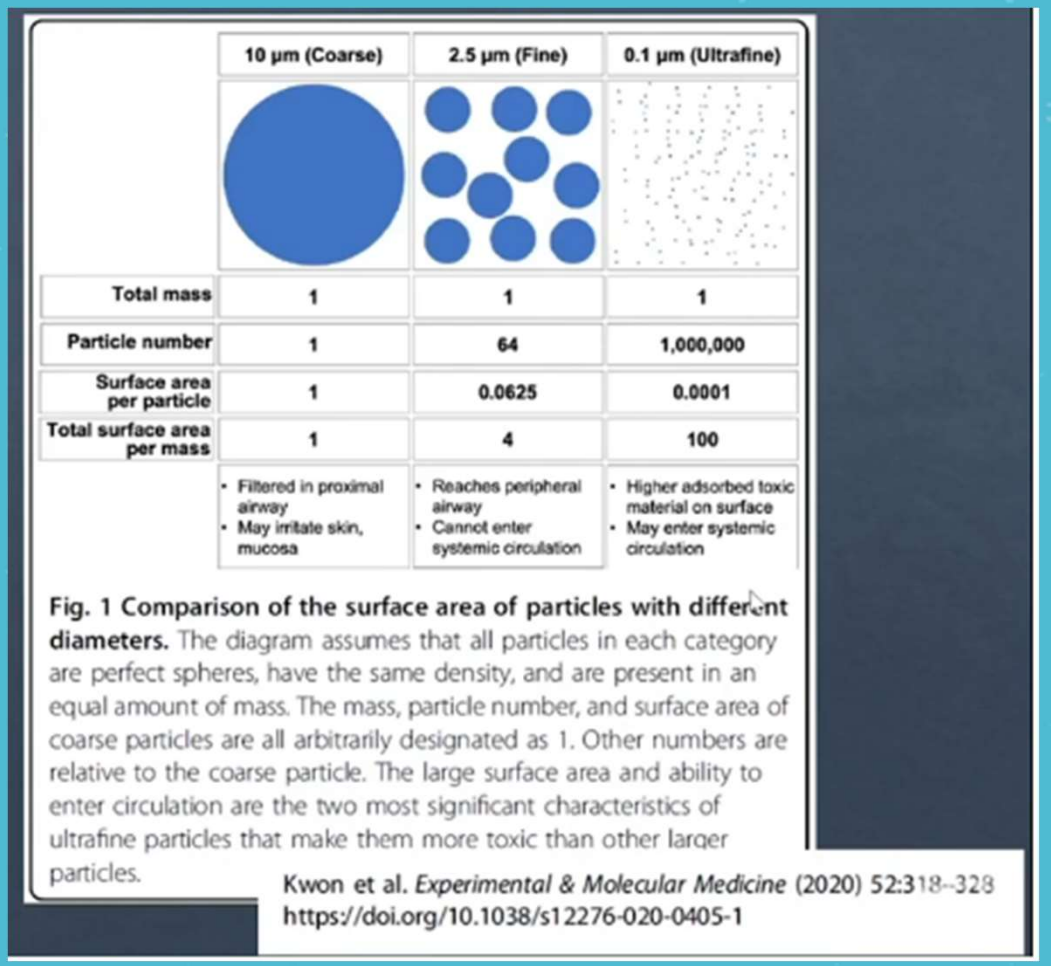
Background: Exposure to ionizing radiation has been associated with hypertension, but the relationship between residential radon exposure and hypertensive disorders of pregnancy (HDP) has not been examined.

Methods: We used the Massachusetts Birth Registry of Vital Records from 2001 to 2015 including women with a singleton pregnancy without prior hypertension. The binary outcome (HDP) included gestational hypertension and pre-eclampsia cases and was assessed using birth certificate data. We obtained 141,665 basement radon measurements from Spruce Environmental Technologies, Inc. and modeled the monthly zip code basement radon level. We used a logistic regression model adjusted for sociodemographic covariates, maternal comorbidities, $PM_{2.5}$, season, temperature, and relative humidity. We examined effect modification by maternal age, race, and maternal education as an indicator of socio-economic status.

Results: Of 975,528 women, 3.7% (36,530) of them developed HDP. Zip code level radon ranged from 22 to 333 mBq/m^3. An interquartile range (IQR) increase in zip code radon level throughout pregnancy was associated with a 15% increase in the odds of HDP (95% CI 13% to 18%). In women less than 20 years old, an IQR increase in zip code level radon was associated with 38% increase in the odds of HDP (95% CI 24% to 50%), while the effect was smaller in older women. There was no effect modification by maternal race or education.

Conclusions: In this cohort, higher levels of residential radon are associated with increased odds of HDP. After stratifying by age, this effect was stronger in participants younger than 20 years old. Since the burden of hypertensive disorders of pregnancy is increasing and affects women's future cardiovascular health, identification of modifiable risk factors is of great importance.

"What's really lacking in the research arena is 'What are the health effects of radon decay products in relation to particulate matter or on attached radon exposure?'"



	10 μm (Coarse)	2.5 μm (Fine)	0.1 μm (Ultrafine)
Total mass	1	1	1
Particle number	1	64	1,000,000
Surface area per particle	1	0.0625	0.0001
Total surface area per mass	1	4	100
	• Filtered in proximal airway • May irritate skin, mucosa	• Reaches peripheral airway • Cannot enter systemic circulation	• Higher adsorbed toxic material on surface • May enter systemic circulation

Fig. 1 Comparison of the surface area of particles with different diameters. The diagram assumes that all particles in each category are perfect spheres, have the same density, and are present in an equal amount of mass. The mass, particle number, and surface area of coarse particles are all arbitrarily designated as 1. Other numbers are relative to the coarse particle. The large surface area and ability to enter circulation are the two most significant characteristics of ultrafine particles that make them more toxic than other larger particles.

Kwon et al. *Experimental & Molecular Medicine* (2020) 52:318–328
https://doi.org/10.1038/s12276-020-0405-1

LW15

Particles & VOCs

15

ROCIS

Slide 48

LW15 Keep

Linda Wigington, 7/30/2021

Sources of Volatile Organic Compounds (VOCs)

Indoor Sources

Building materials:
- Paint, paint strippers
- Varnishes & finishes
- Caulks & sealants
- Adhesives
- Flooring, carpet, pressed wood products

Home & personal care products:
- Cleaners & disinfectants
- Furniture
- Pesticides
- Air fresheners
- Cosmetics & deodorants
- Fuel oil, gasoline

Outdoor Sources

- Gasoline
- Diesel emissions
- Wood burning
- Oil / gas extraction & processing
- Industrial emissions

Activities:
- Tobacco smoke
- Dry-cleaned clothing
- Arts & crafts products: glues, permanent markers, etc.
- Wood burning stoves
- Office printers a copiers

Volatile organic compounds, or VOCs are organic chemical compounds whose composition makes it possible for them to evaporate under normal indoor atmospheric conditions of temperature and pressure

Under sunlight, VOCs react with nitrogen oxides emitted mainly from vehicles, power plants and industrial activities to form ozone, which in turn helps the formation of fine particles.

Information on VOCs – Health Effects

From the Health Canada site: “Short-term exposure to high levels of some Volatile Organic Compounds (VOC) can cause:

- breathing problems
- irritation of the eyes, nose, throat
- headaches”

Long term exposure to VOCs can potentially cause neurological effects, leukemia, altered immune response, and cancer, depending upon the VOC and the dose

Particulate Matter + VOCs

- A brief example from:

Gaseous VOCs rapidly modify particulate matter and its biological effects – Part 2: Complex urban VOCs and model PM

S. Ebersviller[1], K. Lichtveld[1], K. G. Sexton[1], J. Zavala[1], Y.-H. Lin[1], I. Jaspers[1,2], and H. E. Jeffries[1]

[1]Environmental Sciences and Engineering, Gillings School of Global Public Health, The University of North Carolina at Chapel Hill, North Carolina, USA
[2]Center for Environmental Medicine and Lung Biology, Human Studies Facility, The University of North Carolina at Chapel Hill, North Carolina, USA

Correspondence to: S. Ebersviller (sebersviller@gmail.com)

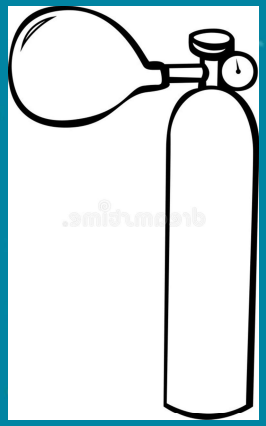
Received: 13 January 2012 – Published in Atmos. Chem. Phys. Discuss.: 13 March 2012
Revised: 23 October 2012 – Accepted: 15 November 2012 – Published: 21 December 2012

VOCs: They create whole other kinds of VOCs in the sunlight

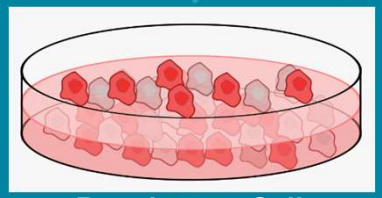
"Fresh" VOCs

"Aged" VOCs

EXPERIMENT

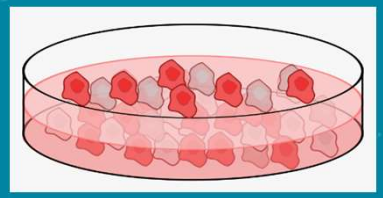


Clean Air



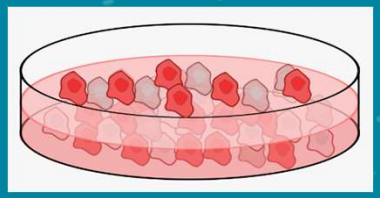
Respiratory Cells

"Fresh" VOCs



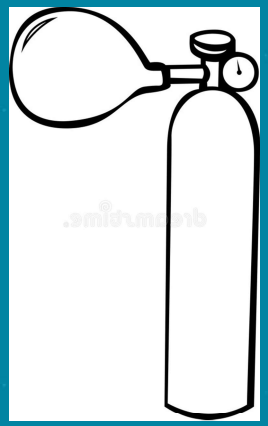
Respiratory Cells

"Aged" VOCs



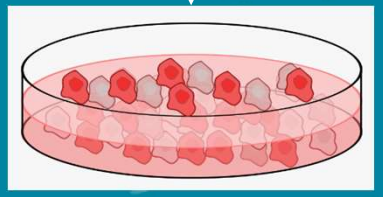
Respiratory Cells

EXPERIMENT



Clean Air

Particulate Matter

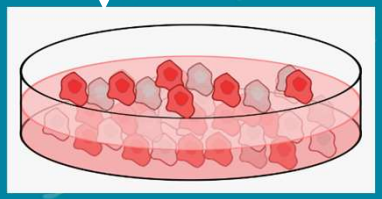


Respiratory Cells

Experiment

"Fresh" VOCs

Non-toxic Particulate Matter

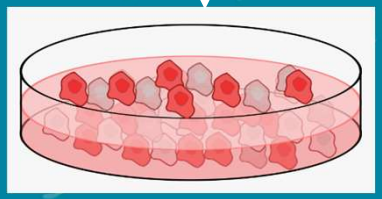


Respiratory Cells

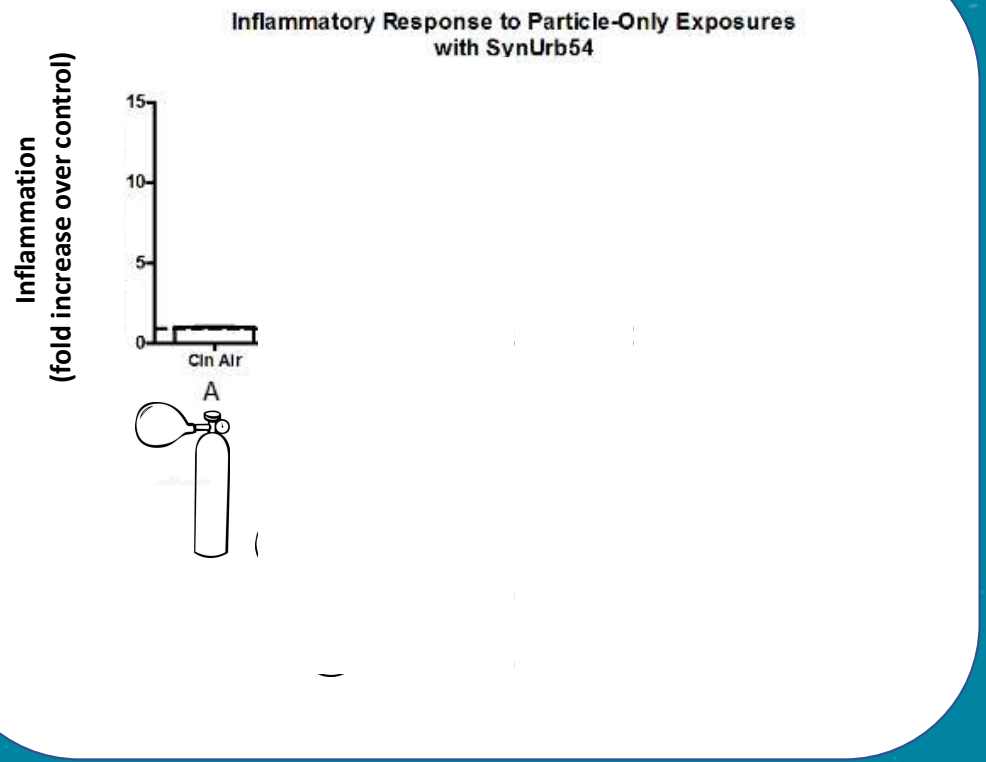
EXPERIMENT

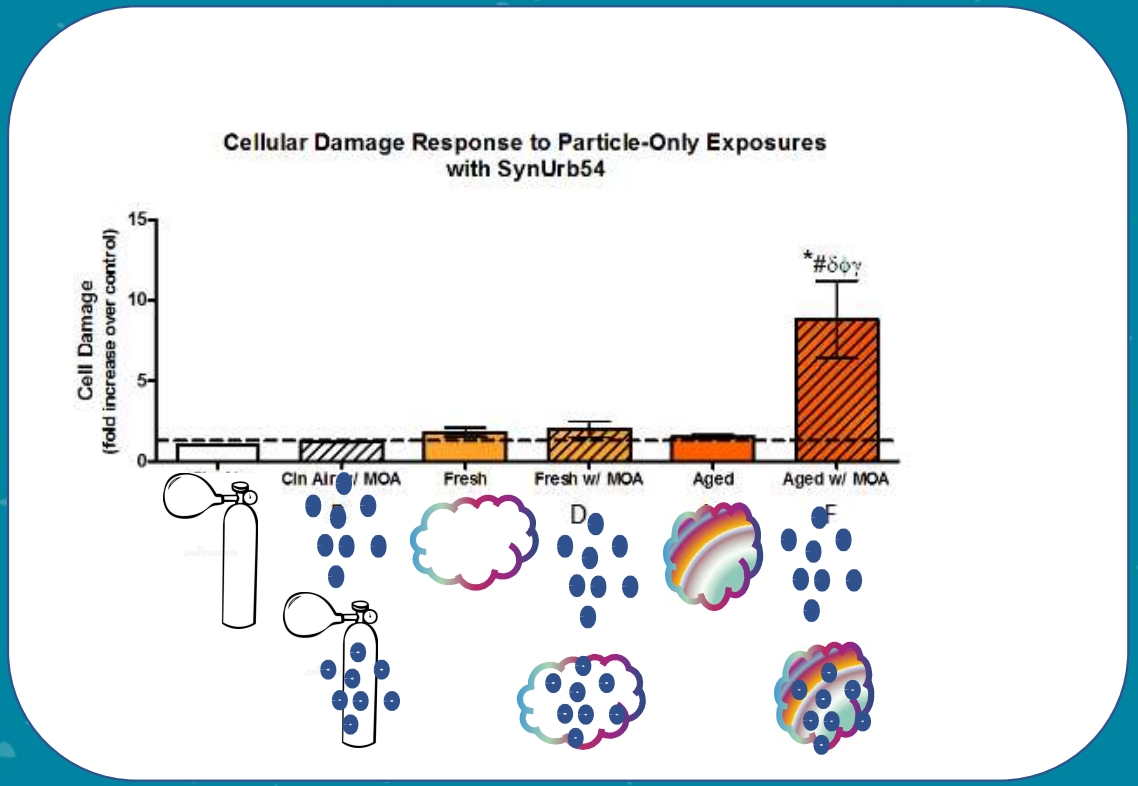
"Aged" VOCs

Non-toxic Particulate Matter



Respiratory Cells

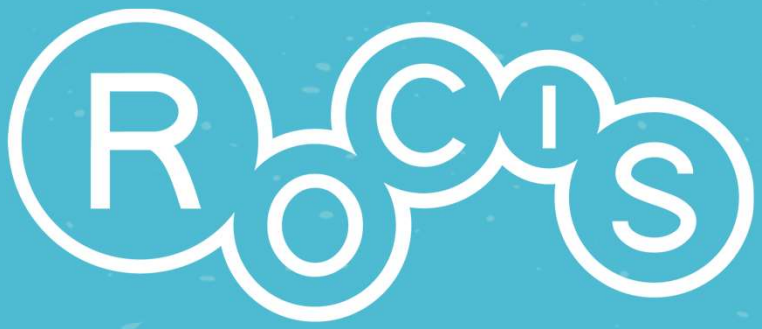

Inflammatory Response to Particle-Only Exposures with SynUrb54
Inflammation (fold increase over control)
15
10
5
0
Cln Air
A


Cellular Damage Response to Particle-Only Exposures with SynUrb54
Cell Damage (fold increase over control)
15
10
5
0
*#δϕγ
Cln Air
Cln Air w/ MOA
Fresh
Fresh w/ MOA
Aged
Aged w/ MOA
D
F

VOCs Modified the Effect that Particulate Matter had on Respiratory Cells

Health Effects of Particles: Don’t Ignore Cooking Particles!

07



Cooking Particles and You

- 52.5% of indoor fine particles (≤ 2.5μm) exposure is attributed to cooking.
  ***in non-smoking homes**
- Fine particles from cooking have been suggested to:
  - Cause oxidative stress in lung cells
  - Enhance pulmonary inflammation
  - Induces pre-symptomatic allergic & asthmatic reactions

- Cooking particles have been associated with cardiovascular and kidney-related health effects among others.

Study found that a large contributor to elevations in indoor $PM_{2.5}$ was not using the stove hood when cooking.

"Specifically, this preliminary study suggests that cooking behaviors may contribute to the burden of $PM_{2.5}$ in the homes of children with asthma and thus to asthma symptoms."

Reminder: several pollutants can be emitted from cooking

- Particles (fine, ultrafine)
- NO_2
- Polycyclic aromatic hydrocarbons (PAHs)
- VOCs
- Carbon Monoxide
- Carbonyl Compounds

LW20

For more information, see the Behavioral Interventions recording

Slide 64

LW20 Change to - for more info listen to Behavioral interventsions - and provide link to our website site cooking stuff
Linda Wigington, 7/30/2021

Reduce Cooking Emissions

Check out ROCIS guidance document & webpage

- ROCIS ISSUE BRIEF, *Ducted Range Hoods: Recommendations for New and Existing Homes*

  http://rocis.org/kitchen-range-hoods

- Online Kitchen Ventilation group

  https://www.buildingperformancecommunity.org/groups/kitchen-ventilation

Online closed group on Building Performance Community

https://www.buildingperformancecommunity.org/groups/inexpensive-residential-particle-monitoring

Local Organizations to Explore

16

ROCIS

BREATHE PROJECT

The Air We Share

ABOUT THE BREATHE COLLABORATIVE

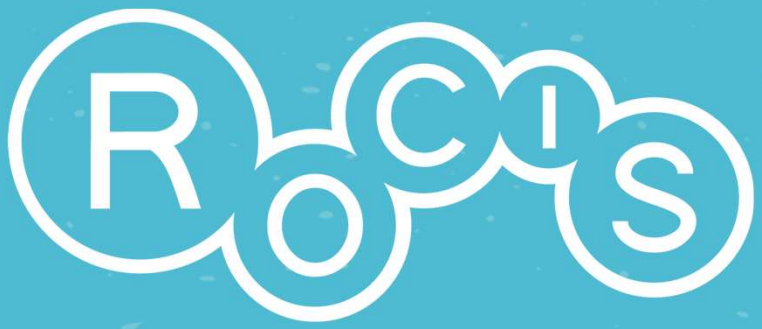
The Breathe Collaborative is a coalition of citizens, environmental advocates, public health professionals and academics working to improve air quality, eliminate climate pollution and make our region a healthy and prosperous place to live. The Collaborative powers the Breathe Project through science-based work and a community outreach platform.

BREATHE COLLABORATIVE MEMBERS INCLUDE:

- 350 Pittsburgh
- Allegheny County Clean Air Now
- American Lung Association in Pennsylvania
- Beaver County Marcellus Awareness Community
- Better Path Coalition
- Blue Lens
- Carnegie Mellon University Center for Atmospheric Particle Studies (CAPS)
- Carnegie Mellon University CREATE Lab
- Center for Coalfield Justice
- Center for Healthy Environments & Communities (CHEC), University of Pittsburgh
- Civic Science for Environmental Futures Collaborative
- Clean Air Council
- Clean Air Task Force
- Clean Water Action
- Climate Reality Pittsburgh & SWPA
- Communities First – Sewickley Valley
- Community Foundation for the Alleghenies
- Community Partners in Asthma Care
- East End Neighbors – Fight Pollution
- Environmental Health Project, Southwest Pennsylvania
- Environmental Integrity Project
- Fair Shake Environmental Legal Services
- Food & Water Watch
- Frac Tracker Alliance
- Freshwater Accountability Project
- Group Against Smog and Pollution (GASP)
- Lawrenceville Clean Air Now
- Lowell Center for Sustainable Production at the University of Massachusetts
- Marcellus Outreach Butler
- Mom's Clean Air Force
- Mountain Watershed Association
- Nine Mile Watershed Association
- North Braddock Residents For Our Future
- Northside Leadership Conference
- Ohio River Valley Institute
- PennEnvironment Research and Policy Center
- PennFuture
- Physicians for Social Responsibility Pennsylvania
- Plant Five For Life
- Protect Franklin Park
- Protect PT
- Rail Pollution Protection Pittsburgh
- Reimagine Appalachia
- ROCIS (Reducing Outdoor Contaminants in Indoor Spaces)
- Sierra Club Pennsylvania
- St. Paul's Working for Justice
- Sustainability Pioneers
- The Heinz Endowments
- Thomas Merton Center EcoJustice Working Group
- Uptown Partners of Pittsburgh
- UrbanKind Institute
- Valley Clean Air Now (VCAN)
- Women for a Healthy Environment

Wrap-Up

17



LW18

To address your questions about health impacts:

1. Toxics Release Inventory Explorer
2. Air quality –recent news and local findings
3. From the beginning to the end
   - Particles & fetuses
   - Dementia & particles
4. Radon
5. Particles and VOCs
6. Particles and Cooking
7. Local Organizations to Explore

18

Meeting Objectives Reviews

Slide 69

LW18 Update

Linda Wigington, 7/30/2021

To address your questions about health impacts:

1. Recent Local Findings
2. From the beginning to the end
   - Particles & fetuses
   - Dementia & particles
3. Your Questions
   - Health Impacts of Particles
     - Don't ignore cooking particles!
   - Opening windows in summer
   - Pollen
   - Plants and indoor air quality
   - Pet birds and indoor air quality
4. Particles and VOCs
5. Local Organizations to Explore

18

Meeting Objectives Review

Need Help? Who to Contact

- **Coordination & Logistics:**
  - Emily Dale - text: 724-833-8223 or ke_dale@hotmail.com
- **Equipment issues:**
  - Linda Wigington - text: 724-986-0793 or lwigington1@outlook.com
  - Rob Busher - text: 412-437-8454 or robb@rocis.org
  - Samantha Totoni - text: 217-390-1842 or skc35@pitt.edu
- **Interpretation of monitoring readings:**
  - Don Fugler - dfugler@gmail.com
  - Linda Wigington - text: 724-986-0793 or lwigington1@outlook.com
- **Social Media Postings:**
  - Jessie Kester - text: 814-937-7365 jessicalkester@gmail.com

ROCIS

Cohort 48 Challenge
Any Questions?

Step 1: Select a Dylos spike (with a known specific source) you have observed that ideally occurs several times a week

Step 2: Identify several ways you can reduce the intensity and/or duration of that spike

Step 3: Experiment to reduce that spike as much as possible

Step 4: At the Wrap-up meeting, let us know what you learned & what worked!

Accessing Cohort 48 Resources

- Limited Access Website page*
  - Handouts
  - Forms
  - Slide decks from meetings
  - Links to recordings

http://rocis.org/rocis-lcmp-cohort-48

Schedule & Topics

75-minute Online Meetings
7 PM Mon. & Thurs., Repeated 10:30 AM Tues. & Fri.

Important Dates:

Aug 7 Dylos Downloads
- Upload with photos of log & incident report

Aug 10 Kit Pick up

Meetings:

Aug 5 or 6 **Wrap-up Meeting**
– please consider contributing you experiences

Meetings in blue are required.

Thanks!

Thanks to Phil Johnson & The Heinz Endowments for support of the ROCIS initiative (Reducing Outdoor Contaminants in Indoor Spaces) and our 385+ LCMP participants

QUESTIONS?

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LCMP Technical Advisor
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jessicalkester@gmail.com

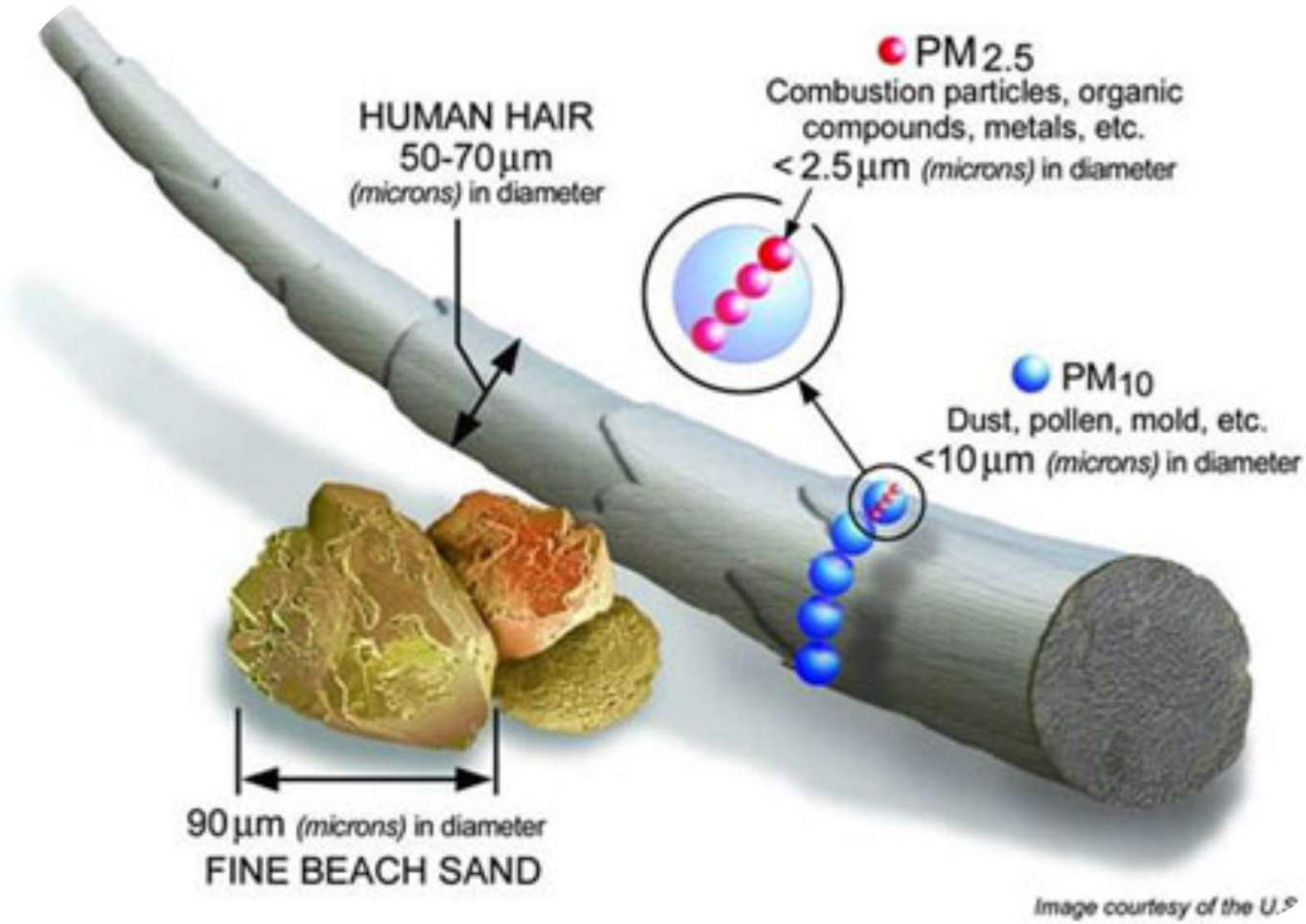
LW19

Health Effects of Particles

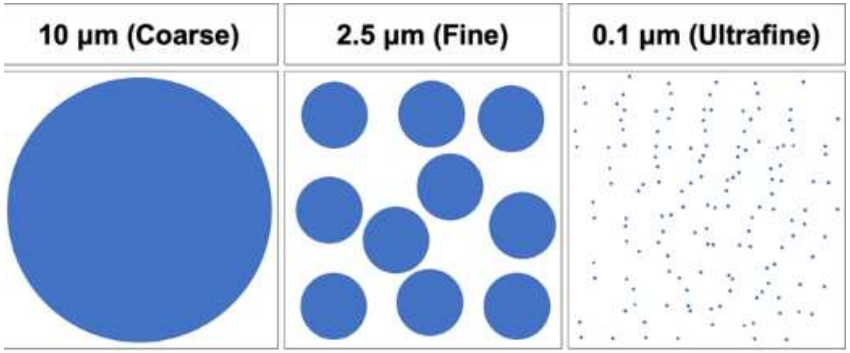
06

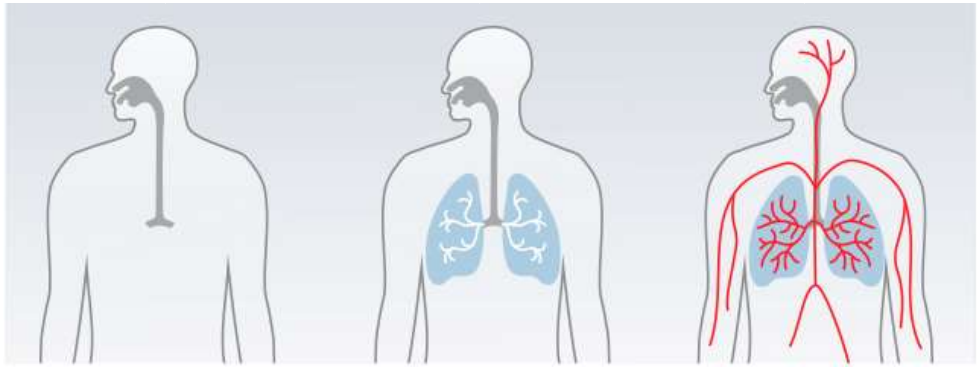
Slide 78

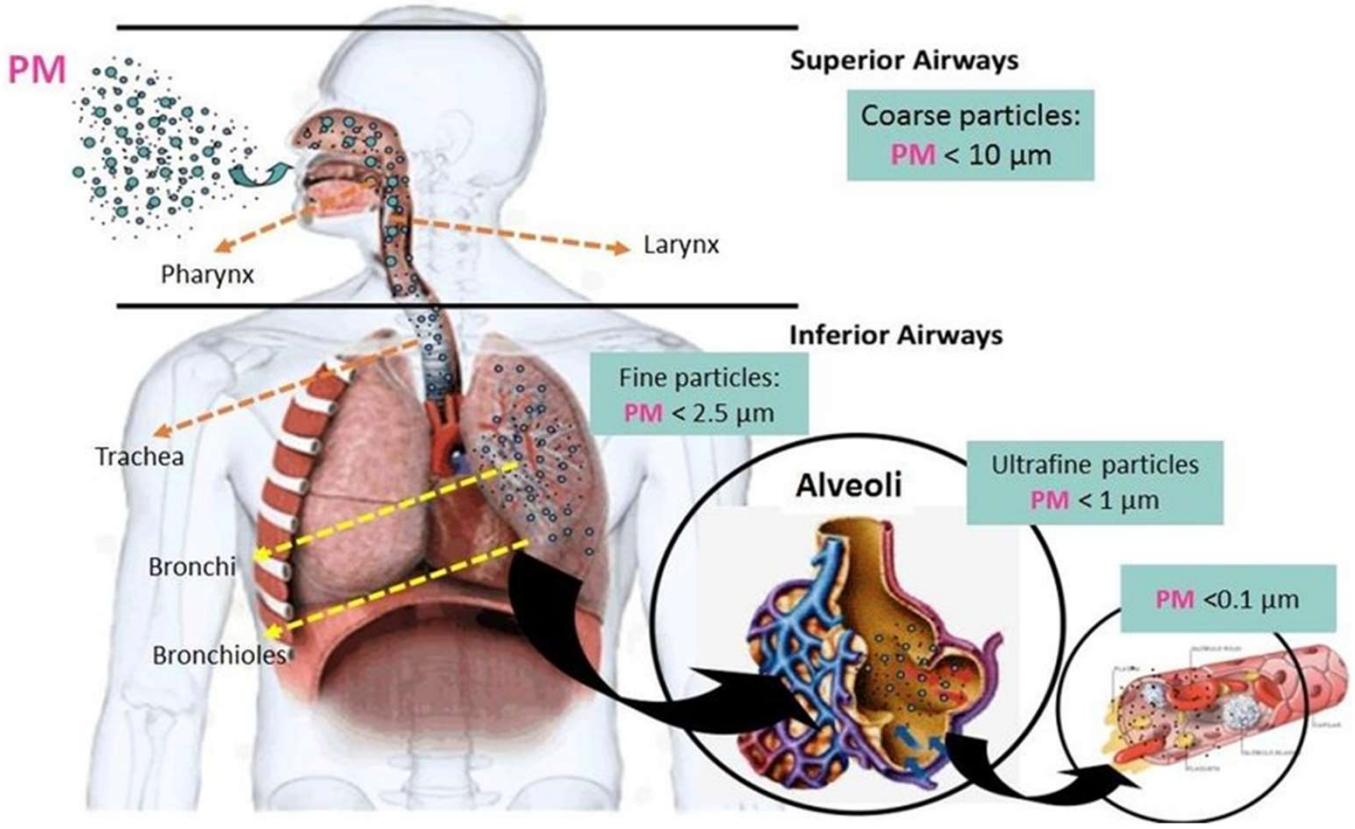
LW19 Seems like much/some of this is reoeated from early meetings
Linda Wigington, 7/30/2021


HUMAN HAIR
50-70 µm
(microns) in diameter
PM2.5
Combustion particles, organic compounds, metals, etc.
<2.5 µm (microns) in diameter
PM10
Dust, pollen, mold, etc.
<10 µm (microns) in diameter
90 µm (microns) in diameter
FINE BEACH SAND
Image courtesy of the U.S.

Particle Size Matters!



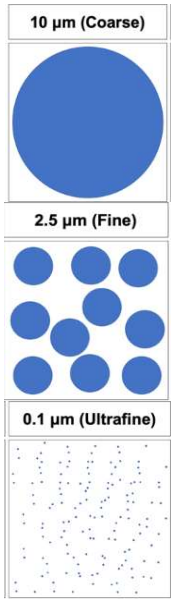


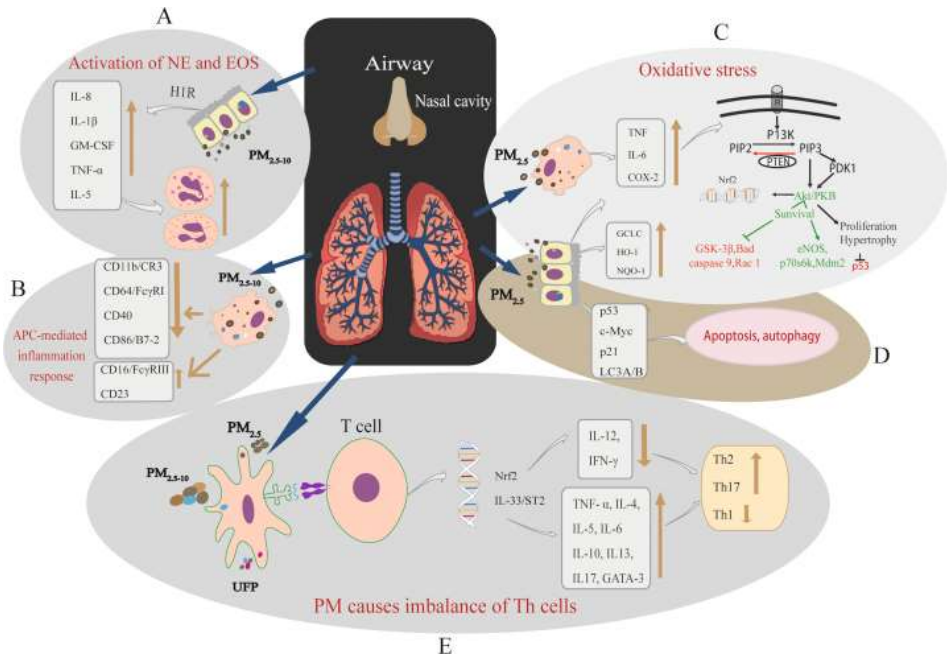


From Castelo, Fiorella Barraza. *Human exposure assessment related to oil activities in Ecuador: from the air quality monitoring to the study of metallic contaminants transfer in the soil-plant continuum*. Diss. 2017.

Particle Size Matters

But that doesn’t mean you can ignore larger particles!





Health Concerns - <PM_{10}

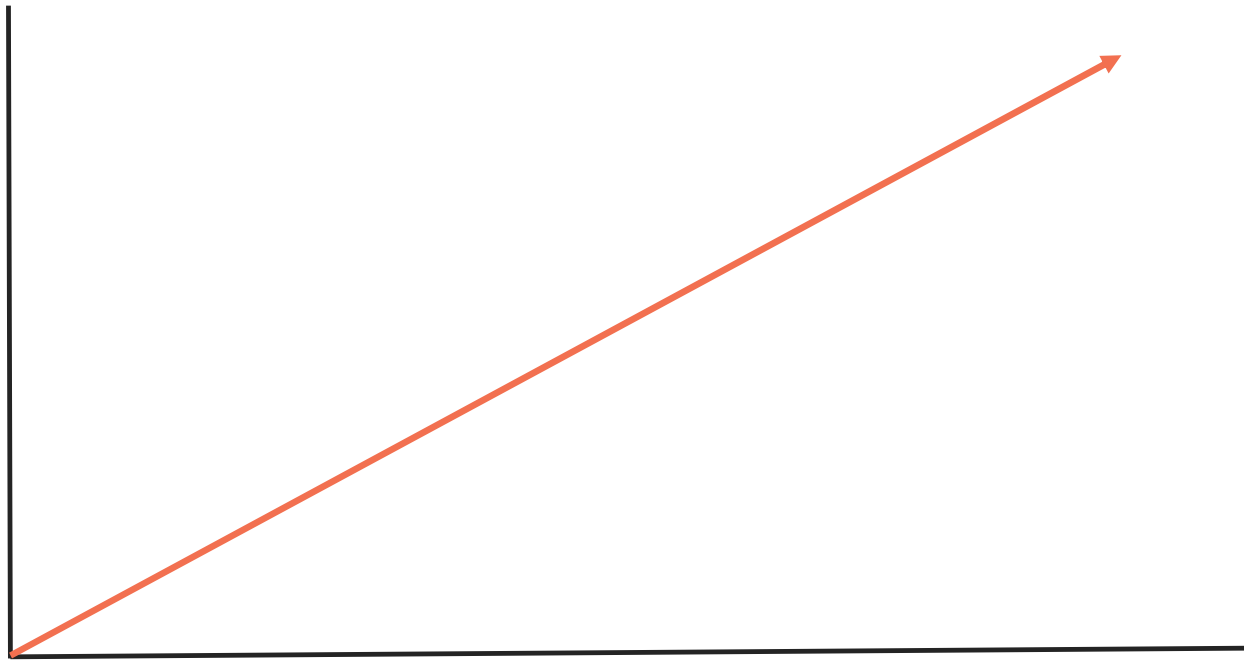
- Established PM-associated diseases:
  cardiovascular disease, asthma, & lung cancer
- Recent associations with PM exposure include:
- idiopathic pulmonary fibrosis, type 2 diabetes, Alzheimer's disease, & decreased cognitive function as well as premature birth

Loxham, M., & Nieuwenhuijsen, M. J. (2019). ***Particle and fibre toxicology***

Health Concerns - Particles

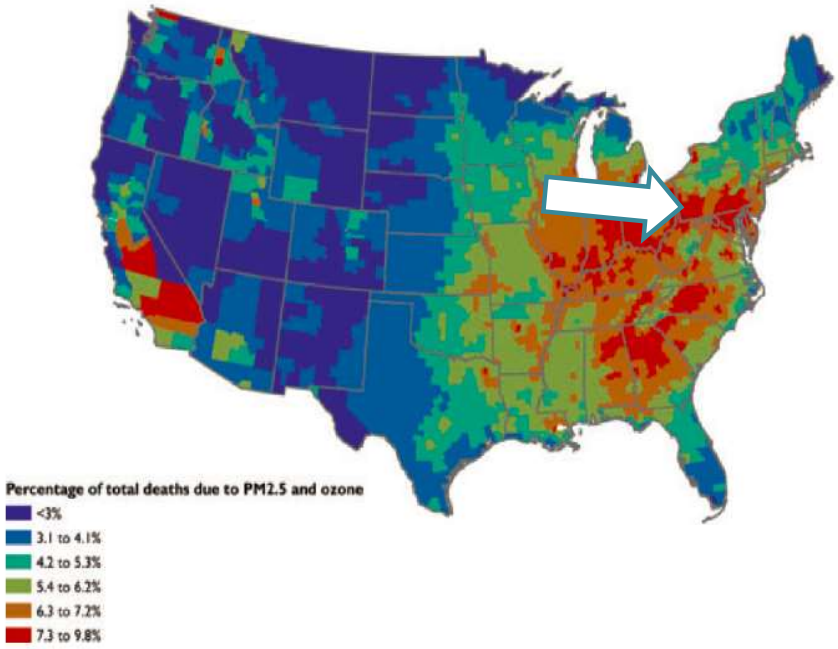
Our premise:

“Precautionary principle” – avoid or minimize your exposure.



https://www.epa.gov/pmcourse/particle-pollution-exposure

Outdoor particulate matter and human health

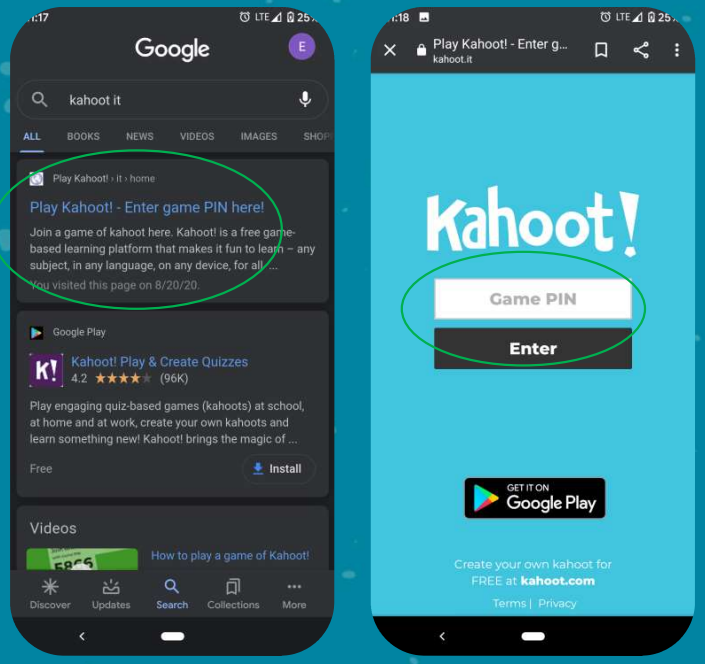


Fann et al. 2012 *Risk Analysis*

JESSIE'S EDITS END HERE

Particle Sizes & Body Defense

- Large
  - PM_5 PM_{10}
  - Trapped by nasopharyngeal mucosa
- Fine
  - $PM_{2.5}$
  - Trapped by lower respiratory tract; bronchi, bronchioles, and can enter circulation
- Very fine
  - PM_1 $PM_{.5}$
  - Trapped by alveoli: can enter circulation
- Ultrafine (UFP)
  - $PM_{.1}$
  - Remain un-trapped by respiratory system; cross directly into circulatory system, and even dermally transmissible



QUIZ!
ROCIS XXXXXXX

- Type kahoot.it in your browser
- We will give you the pin

Cohort 47 Challenge

Step 1: Select a Dylos spike (with a known specific source) you have observed that ideally occurs several times a week

Step 2: Identify several ways you can reduce the intensity and/or duration of that spike

Step 3: Experiment to reduce that spike as much as possible

Step 4: At the Wrap-up meeting, let us know what you learned & what worked!

Slide 90

ED2 Not sure what is happening with the challenge?
Emily Dale, 4/16/2021

Accessing Cohort 47 Resources

- Limited Access Website page*
  - Handouts
  - Forms
  - Slide decks from meetings
  - Links to recordings

http://rocis.org/rocis-lcmp-cohort-47