

**OEHHA**

SCIENCE FOR A HEALTHY CALIFORNIA



# Risk Assessment of Air Contaminants

Shafter Community Steering Committee Meeting  
May 13, 2019

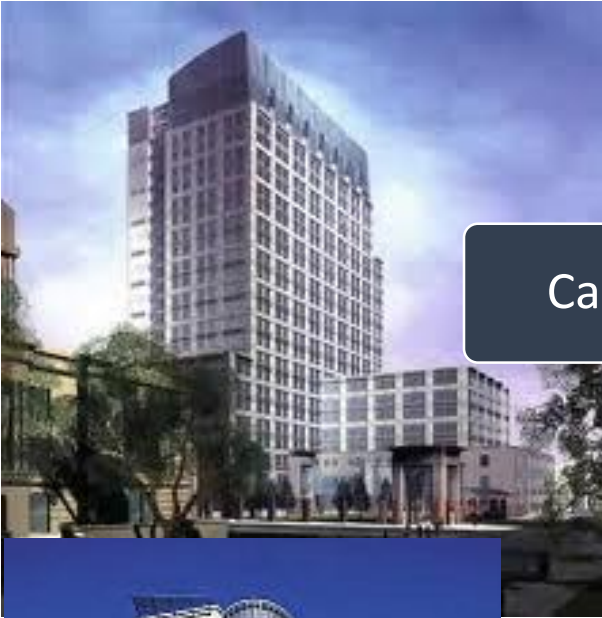
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CalEPA



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State Office  
Building

Office of Environmental Health  
Hazard Assessment

Air Resources Board

CalRecycle

Department of Pesticide  
Regulation

Department of Toxic Substances  
Control

State Water Resources Control  
Board



# OEHHA Assessments Support CalEPA Environmental and Public Health Activities



## CalEPA Mission:

To restore, protect and enhance the environment, to ensure public health, environmental quality and economic vitality.



## OEHHA Mission:

To protect and enhance the health of Californians and our state's environment through scientific evaluations that inform, support and guide regulatory and other actions.

# Outline

- Background: risk, toxicity, and exposure
- How OEHHA determines toxicity
- Factors that influence toxicity
- How OEHHA determines Health Guidance Values for use in estimating risk
- Health concerns associated with some of the chemicals being measured
- How risk is determined from air monitoring data
- How do improvements in air quality affect health?



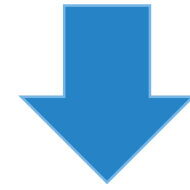
$$\text{Risk} = \text{Toxicity} \times \text{Exposure}$$



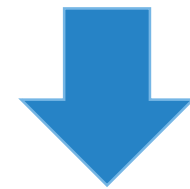
How dangerous  
is the chemical?



Health Guidance  
Values



Does chemical contact  
or enter our body?



Air monitoring data



# What is Exposure?



<https://www.kvpr.org/post/hearings-begin-over-kern-county-ordinance-allows-70000-new-oil-and-gas-wells>  
<https://www.nytimes.com/2015/05/04/business/energy-environment/how-growth-in-dairy-is-affecting-the-environment.html>

<http://www.associatesinsectary.com/about-associates-insectary/spraying-2/>  
<https://commons.wikimedia.org/wiki/File:Diesel-smoke.jpg>



# How do we determine the toxicity of chemicals?

OEHHA develops benchmarks for toxicity called Health Guidance Values:

*Noncancer: Reference Exposure Levels (RELs)*

The amount of chemical in the air that is not likely to cause noncancer health effects (like asthma) even in sensitive populations like children and pregnant women

*Cancer: Unit risks or cancer potency factors*

Describe increase in cancer risk per unit of exposure



# What influences toxicity?

- Amount



- Length of exposure (time)



- Sensitivity

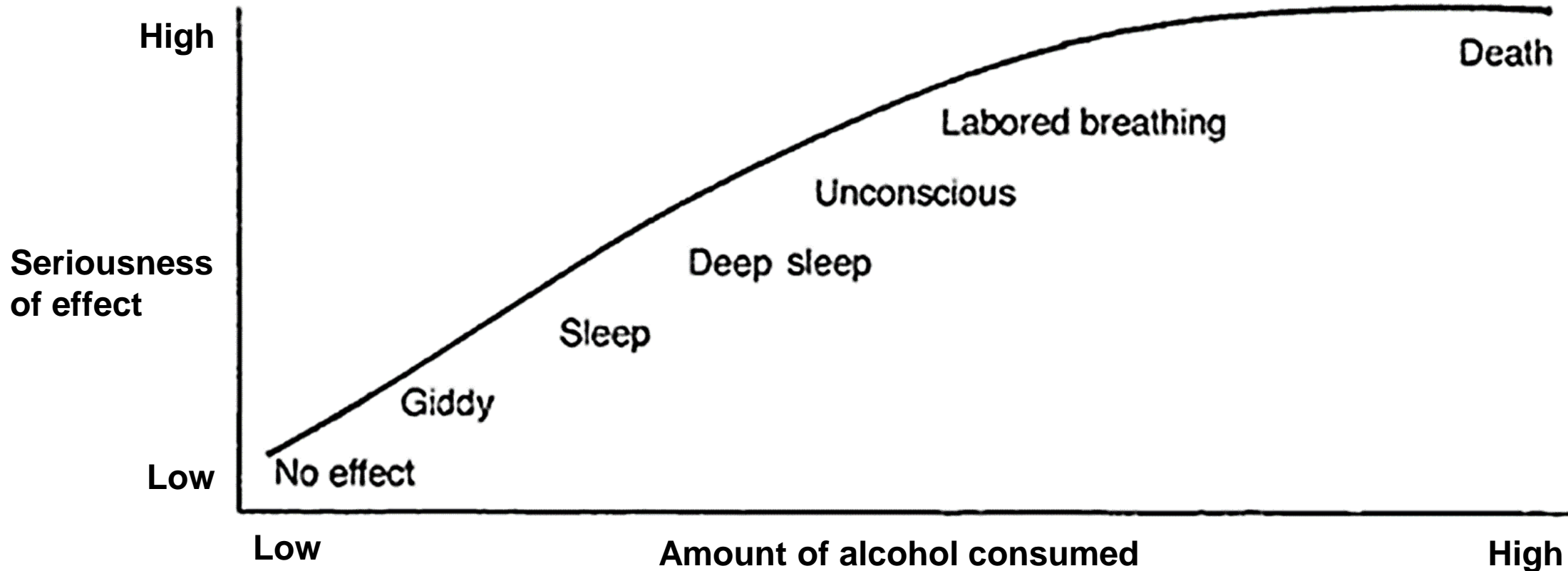


<https://www.meadindoor.com/for-physicians/>





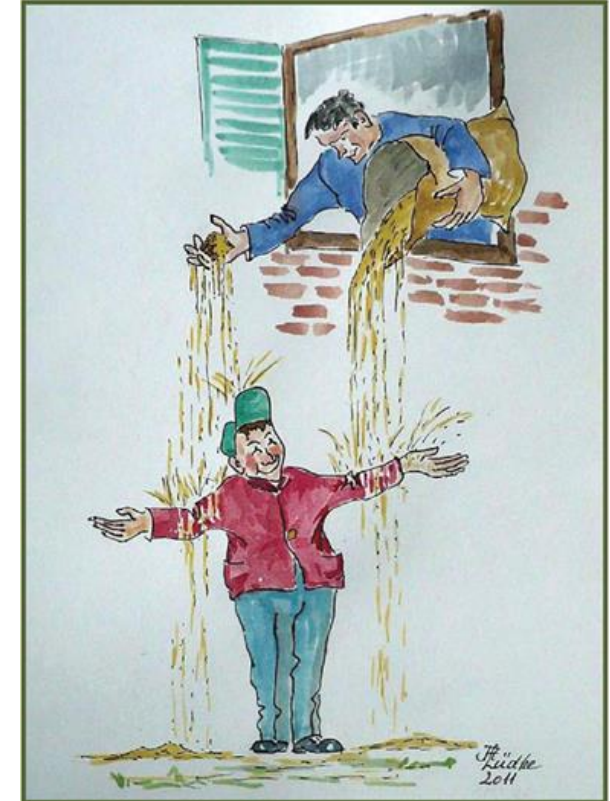
# Health effects can become more serious as the amount someone is exposed to increases



# Toxicity depends on the amount of time someone is exposed to a chemical

OEHHA develops Reference Exposure Levels for specific amounts of time

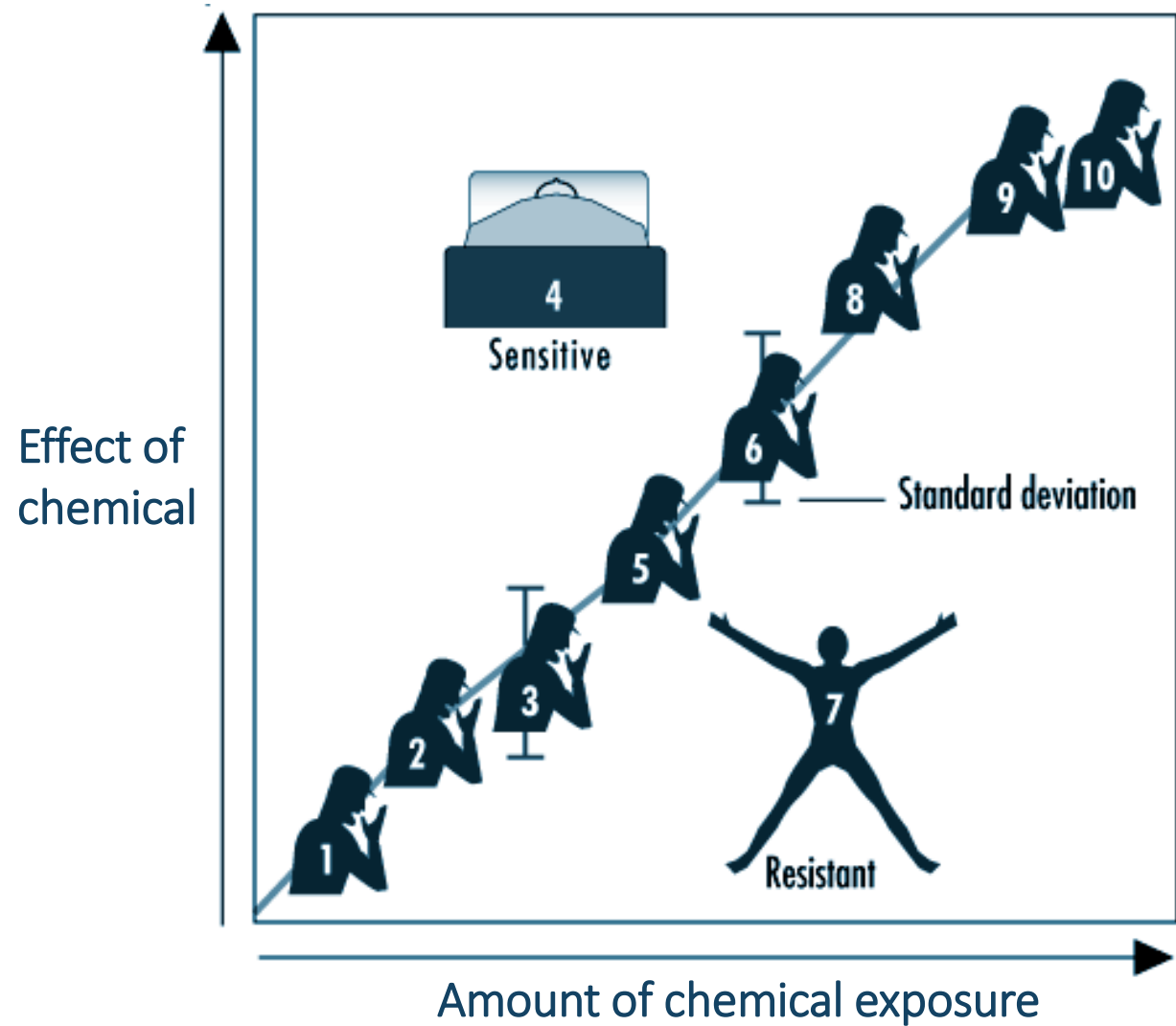
- Brief exposure (acute): occasional 1-hour exposures
- Moderate exposure: repeated 8-hour exposures over a significant fraction of a lifetime
- Constant exposure (chronic): continuous exposures from 1 year to a lifetime



<https://accesspharmacy.mhmedical.com/content.aspx?bookid=2462&sectionid=194918140>

# More people are affected as the amount of chemical they are exposed to increases

People differ – some are more sensitive than others (like children and pregnant women), while others are less sensitive (resistant)



# How are health guidance values developed?



Review health effects information



Identify most sensitive effects



Determine relationship between amount of chemical and effect



Determine amount that causes a specific effect



Adjust amount for route, species, length of exposure



Adjust amount for uncertainty (time differences, missing information, species)



Adjust amount for differences in sensitivity between people



**Health Guidance Value**

Hypothetical example

1000 parts per billion (ppb) (rat)



100 ppb (human)



÷ 10 (no developmental study)

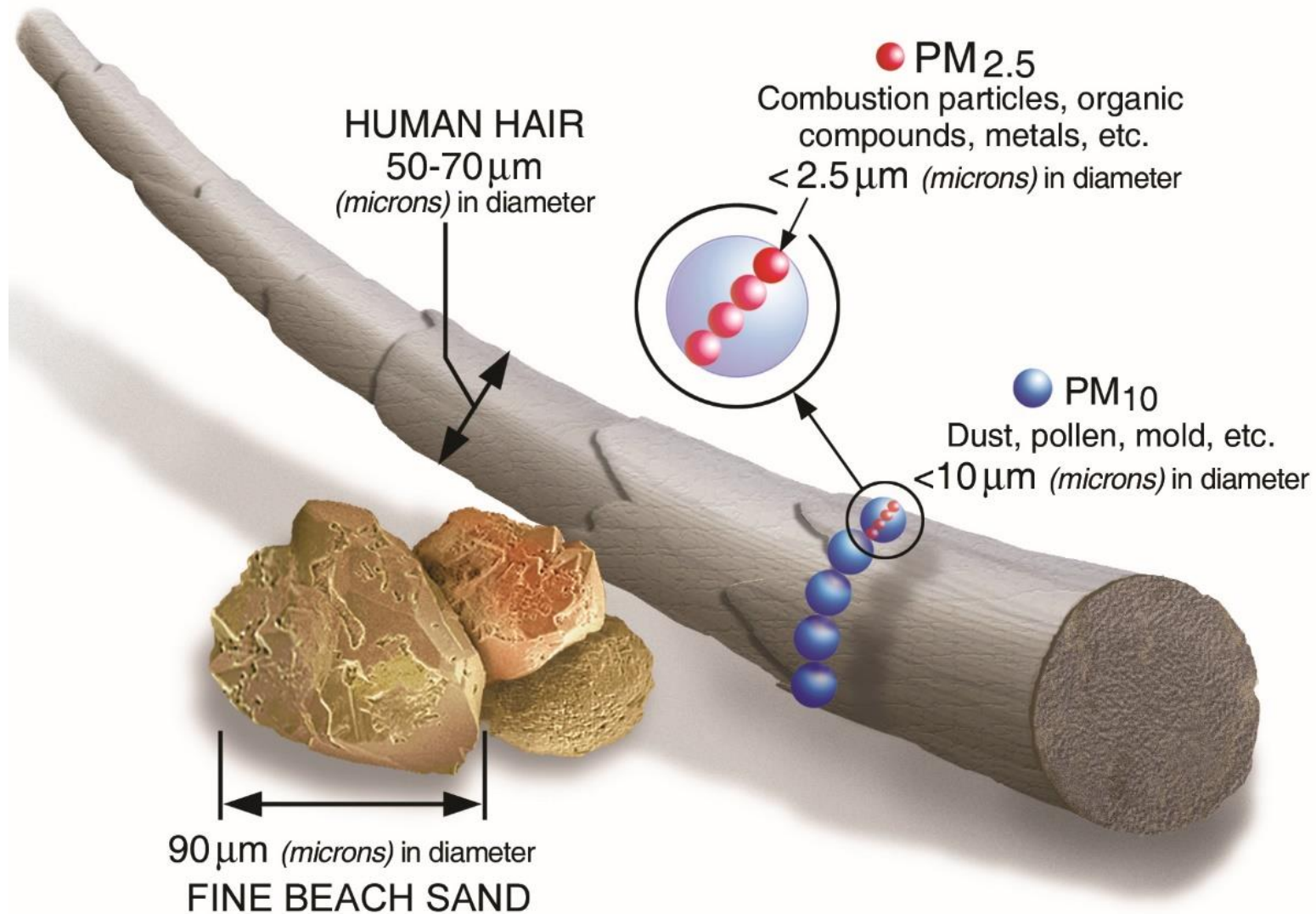


÷ 10 (asthmatic children)



**1 ppb**

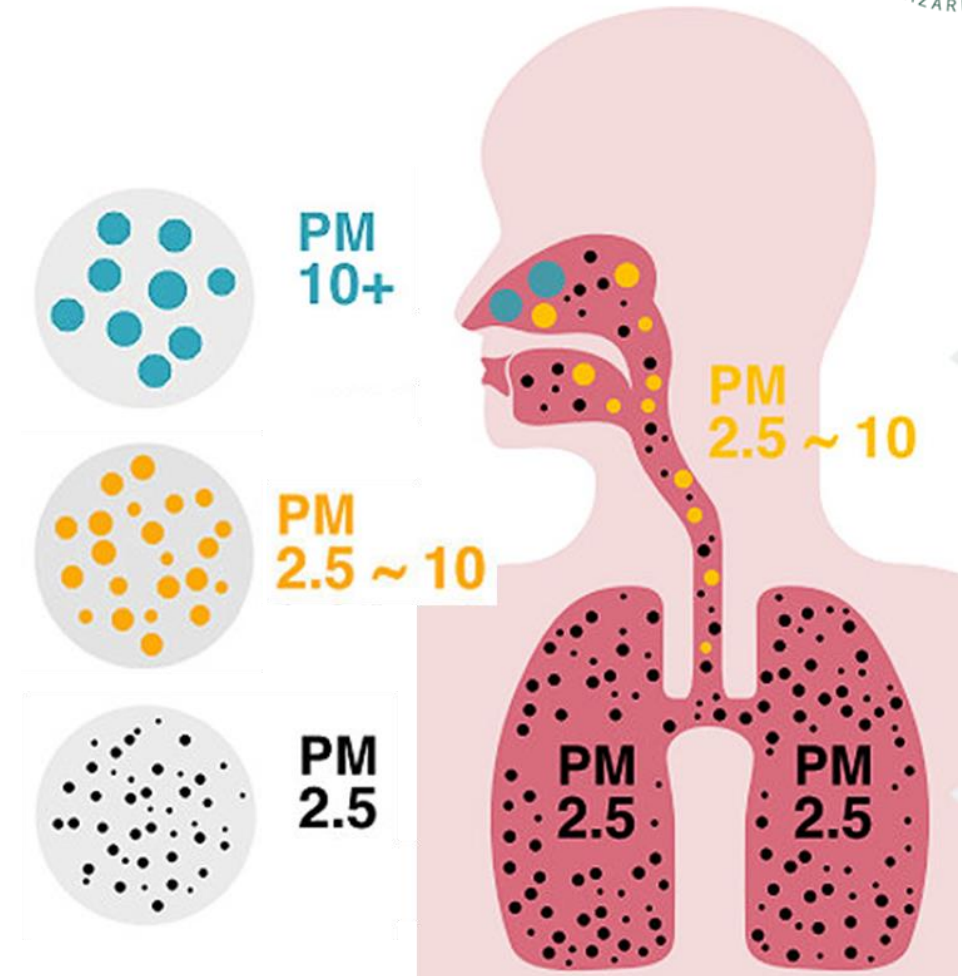
# Particulate Matter



# Health Concerns: PM<sub>2.5</sub>



- Can reach deep into the lung
- Short-term exposure: respiratory irritation, ↓ lung function, asthma attacks, irregular heartbeat, ↑ respiratory symptoms like coughing, wheezing, shortness of breath
- Short- and long-term exposure: premature death, cardiovascular mortality and hospitalizations, respiratory and asthma hospitalizations
- Sensitive populations
  - Elderly
  - Those with emphysema, asthma, chronic heart/lung disease
  - Infants/children (↑ childhood illnesses, ↓ lung function)
  - Pregnant women (↓ birth weight, preterm birth)



[https://www.masters.tw/wp-content/uploads/2015/07/pm2\\_52.jpg](https://www.masters.tw/wp-content/uploads/2015/07/pm2_52.jpg)

# Health Concerns: Diesel Exhaust

## Noncancer

Respiratory irritation, cough, allergies, lung inflammation

↑ hospitalizations, ER visits, asthma attacks, premature deaths

### Sensitive populations

- Those with respiratory and cardiovascular conditions
- Children
- Elderly

## Cancer

Increased cancer risk

~70% of average Californian's cancer risk from air pollution (CARB)



<https://commons.wikimedia.org/wiki/File:Diesel-smoke.jpg>

# Health Guidance Values for Diesel Exhaust

## Non-cancer

Chronic REL:  $5.0 \mu\text{g}/\text{m}^3$

Effect: Changes in rat lung

## Cancer

Unit risk:  $0.0003 \text{ per } \mu\text{g}/\text{m}^3$

Inhalation Cancer Potency Factor:  
 $1.1 (\text{mg}/\text{kg}\text{-day})^{-1}$

Effect: Lung tumors in workers





# Health Concerns: Wood Smoke

Contains thousands of chemicals, most concerning are:

- PM<sub>10</sub> and PM<sub>2.5</sub>
- Carbon monoxide
- Irritants (nitrogen dioxide, sulfur oxides, aldehydes like acrolein and formaldehyde)
  - May play a role in smoke-triggered asthma attacks
- Carcinogens, including polyaromatic hydrocarbons (PAHs), benzene, 1,3-butadiene, formaldehyde

Contributes to indoor air pollution, particularly for PAHs

SJVAPCD program requiring reduction of residential wood burning associated with decreased hospitalization for cardiovascular disease (Yap & Garcia, 2015)



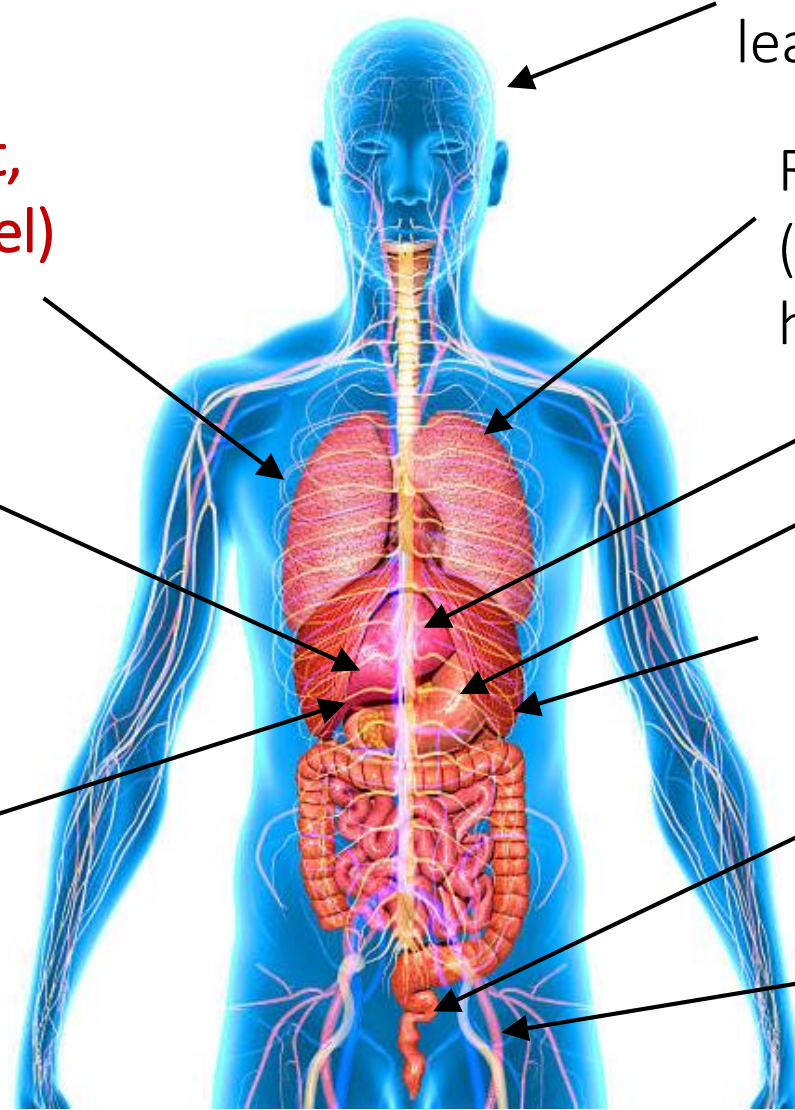
# Health Concerns: Metals



Lung cancer (arsenic, beryllium, cadmium, cobalt, hexavalent chromium, nickel)

Adrenal cancer (cobalt)

Kidney cancer (lead)



Nervous system (arsenic, lead, manganese, selenium)

Respiratory system (beryllium, cadmium, cobalt, hexavalent chromium, nickel)

Liver (selenium)

Kidney (cadmium)

Immune system (beryllium, nickel)

Reproduction and development (arsenic)

Blood (selenium)

Hair, skin, nails (selenium)

# Health Concerns: Volatile Organic Compounds (VOCs)

**Nasal tumors  
(formaldehyde, naphthalene)**

**Kidney cancer  
(ethylbenzene)**

**Leukemia  
(benzene)**

Nervous system (benzene, hexane, styrene, toluene, xylenes)

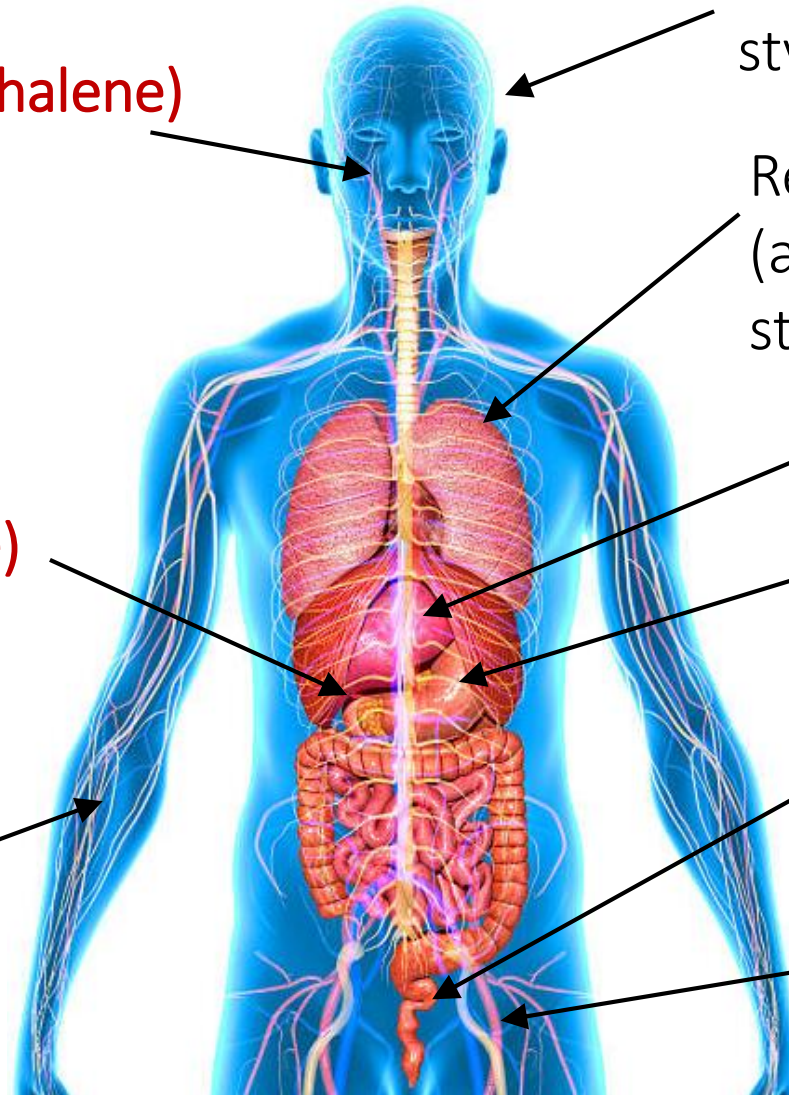
Respiratory system  
(acrolein, formaldehyde, naphthalene, styrene, toluene, xylenes)

Liver (ethylbenzene)

Kidney (ethylbenzene)

Reproduction and development  
(benzene, ethylbenzene, toluene)

Blood (benzene)



# Health Concerns: Ammonia



Colorless gas with a sharp and very irritating odor

Contributes to PM<sub>2.5</sub>

Acute REL

- 3200 µg/m<sup>3</sup>
- Effect: respiratory and eye irritation in humans

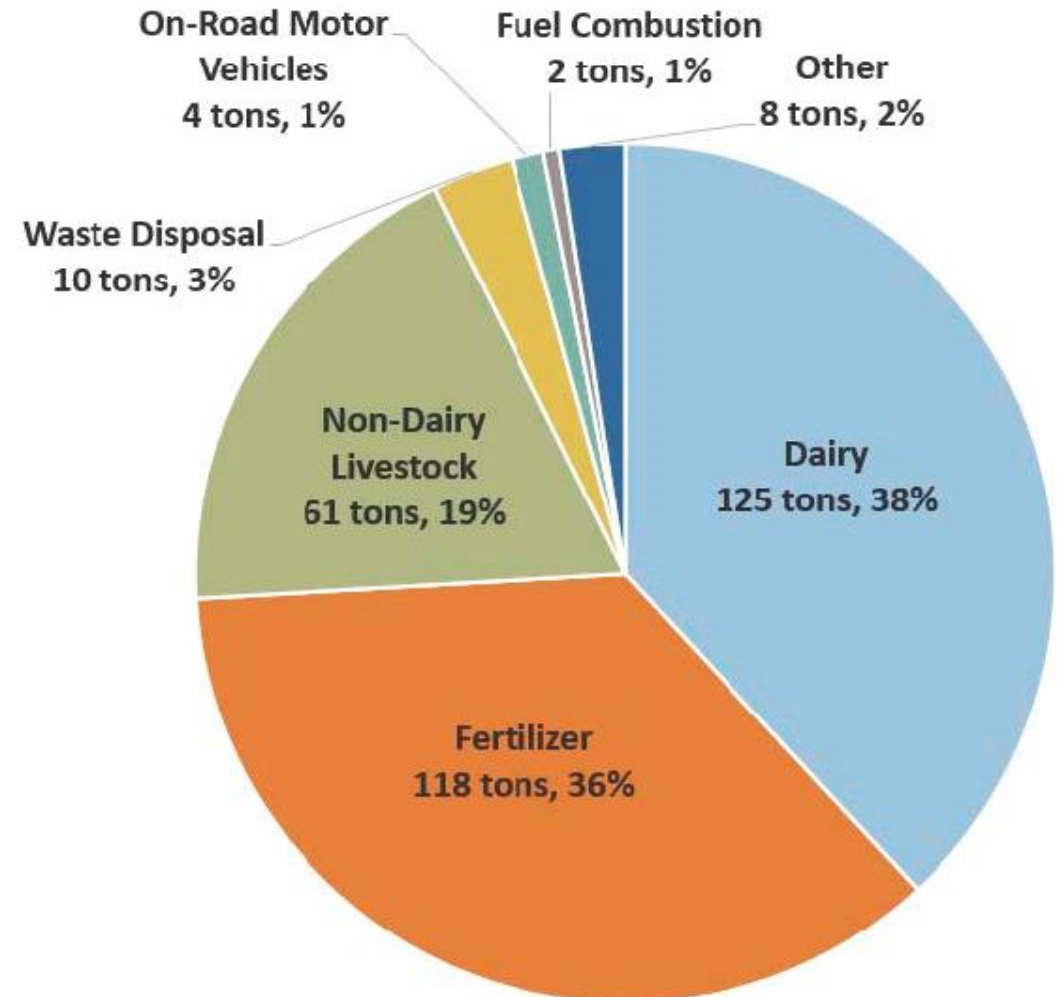
Chronic REL

- 200 µg/m<sup>3</sup>
- Effect: symptoms of exposure and effects on lung function in workers

Susceptible populations

- Persons with asthma and other respiratory conditions, including cardiopulmonary disease

## Ammonia sources in San Joaquin Valley (2013)



# How do we determine the risk from the amount of a chemical measured in air?

## Noncancer

How does the amount in air compare to the Reference Exposure Level?



Higher? May be some concern

Reference Exposure Level

Lower? Little concern

## Cancer

How much does the amount in air increase cancer risk by?



Higher? Concern

Lower? Less concern



# Reduced PM exposures linked with clear health improvements

- Utah Valley - Steel mill shutdown reduced PM and respiratory hospital admissions
- Dublin, Ireland - Coal sale ban reduced PM and death from heart and lung disease
- So. California - Children who moved to less polluted areas had improved lung function growth; those who moved to more polluted areas had decreased growth rates
- Review of cardiovascular mortality and PM in 51 U.S. metro areas shows PM reductions increased life expectancy
- Reduced diesel PM expected to decrease cancer risk



# Questions?

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<https://cityofshafterpublicart.wordpress.com/public-art/>

