



Risk Assessment of Air Contaminants

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Outline

- Background: risk, toxicity, and exposure
- How OEHHA determines toxicity
- Factors that influence toxicity
- Health concerns associated with some air contaminants
- How risk is determined from air monitoring data



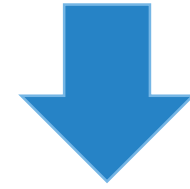
$$\text{Risk} = \text{Toxicity} \times \text{Exposure}$$



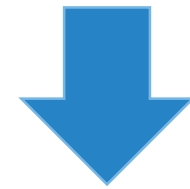
How dangerous
is the chemical?



Health Guidance
Values



Does chemical contact
or enter our body?



Air monitoring data



What is Exposure?



<https://www.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>
<https://www.portofstockton.com/>
<https://www.up.com/index.htm>

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)



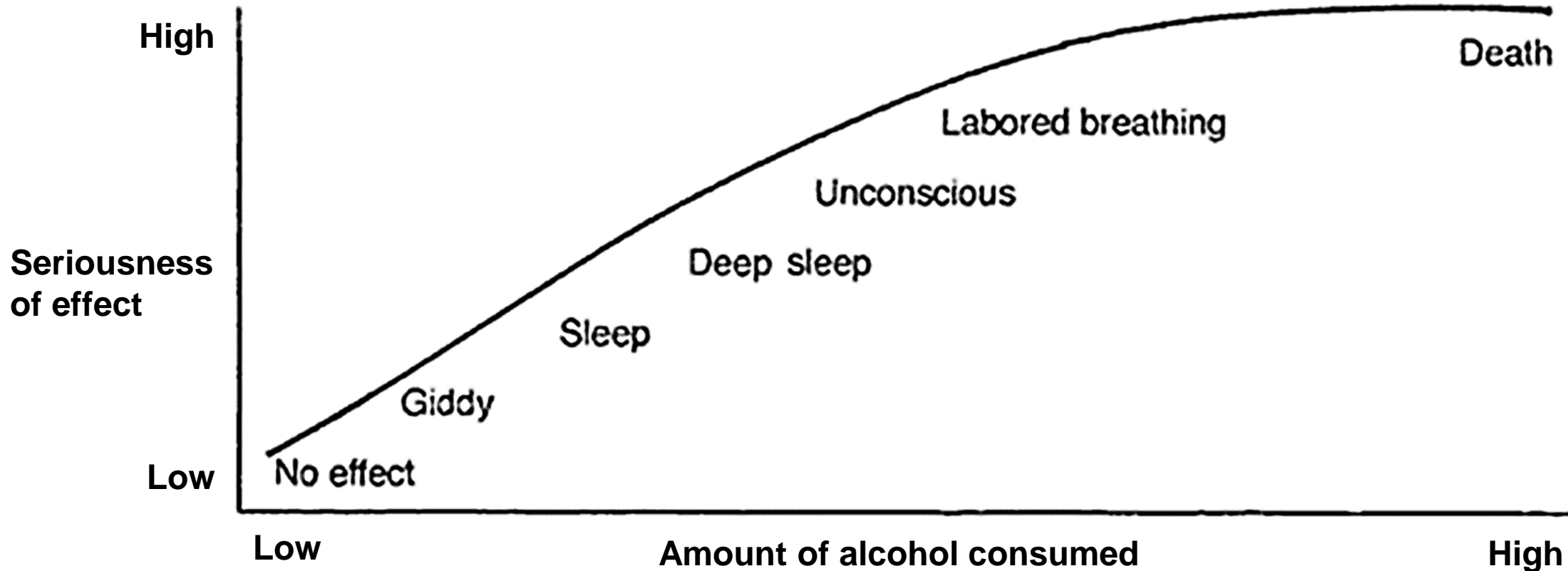
- Sensitivity



<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

Example: exposure to diesel exhaust

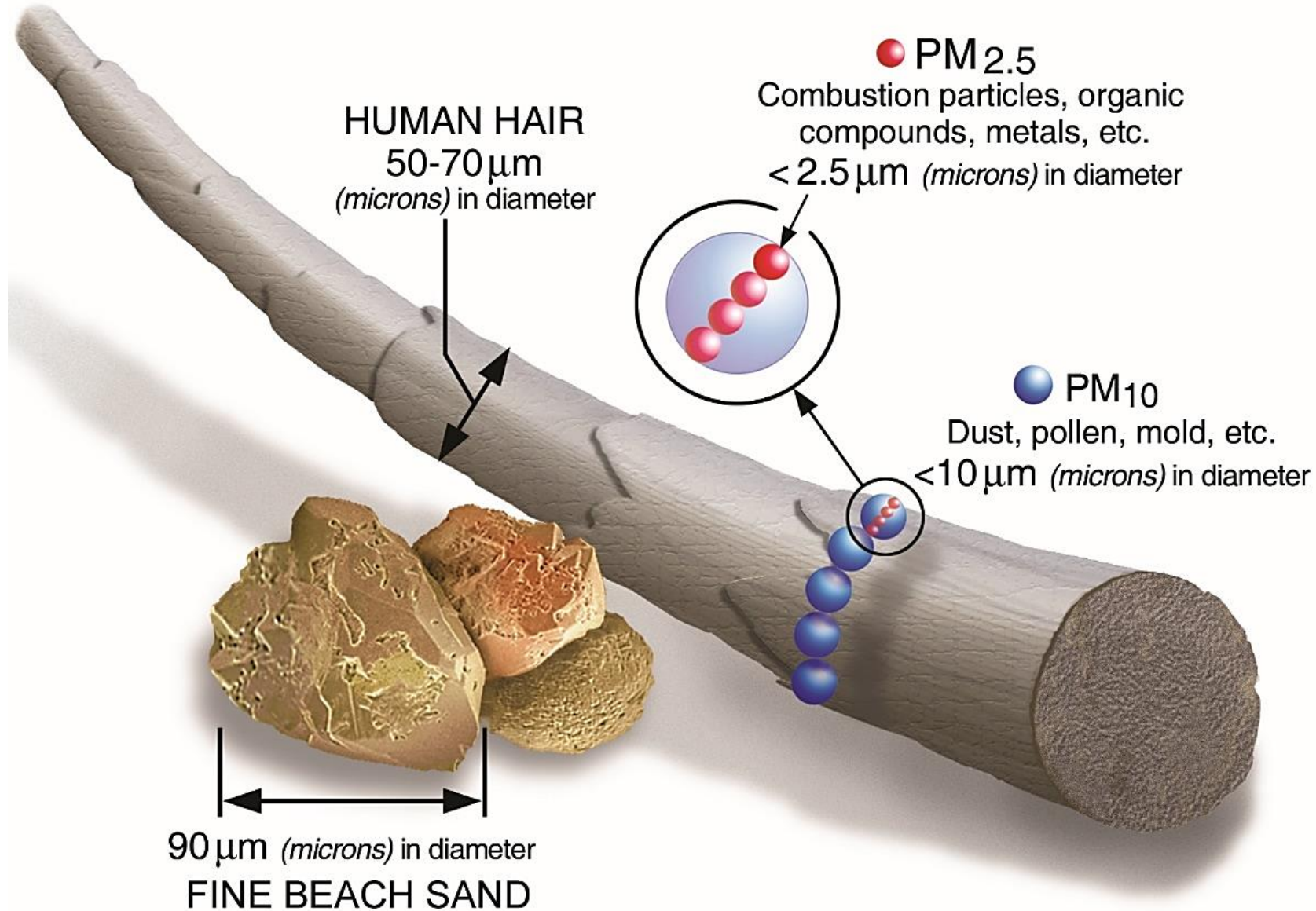


Acute: Mowing the lawn for 1 hour



Chronic:
Living next to a freeway

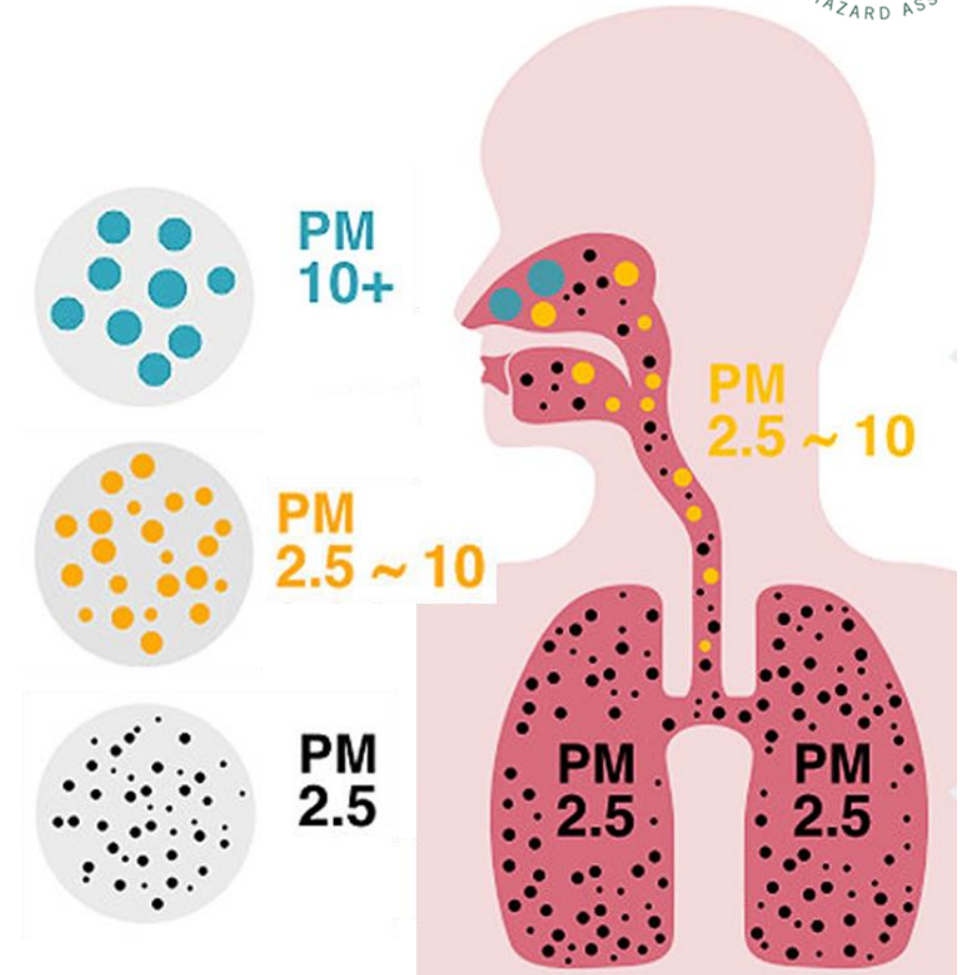
Particulate Matter (PM)



Health Concerns: PM_{2.5}



- Can reach deep into the lung
- *Short-term exposure*: respiratory irritation, ↓ lung function, asthma attacks, irregular heartbeat, ↑ respiratory symptoms
- *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 (↑ illnesses, ↓ lung function)
 - Pregnant women (↓ birth weight, preterm birth)



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/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 Concerns: Wood Smoke

Contains thousands of chemicals, most concerning are:

- PM₁₀ and PM_{2.5}
- 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

Reduction in residential wood burning (required by Rule 4901) was 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)

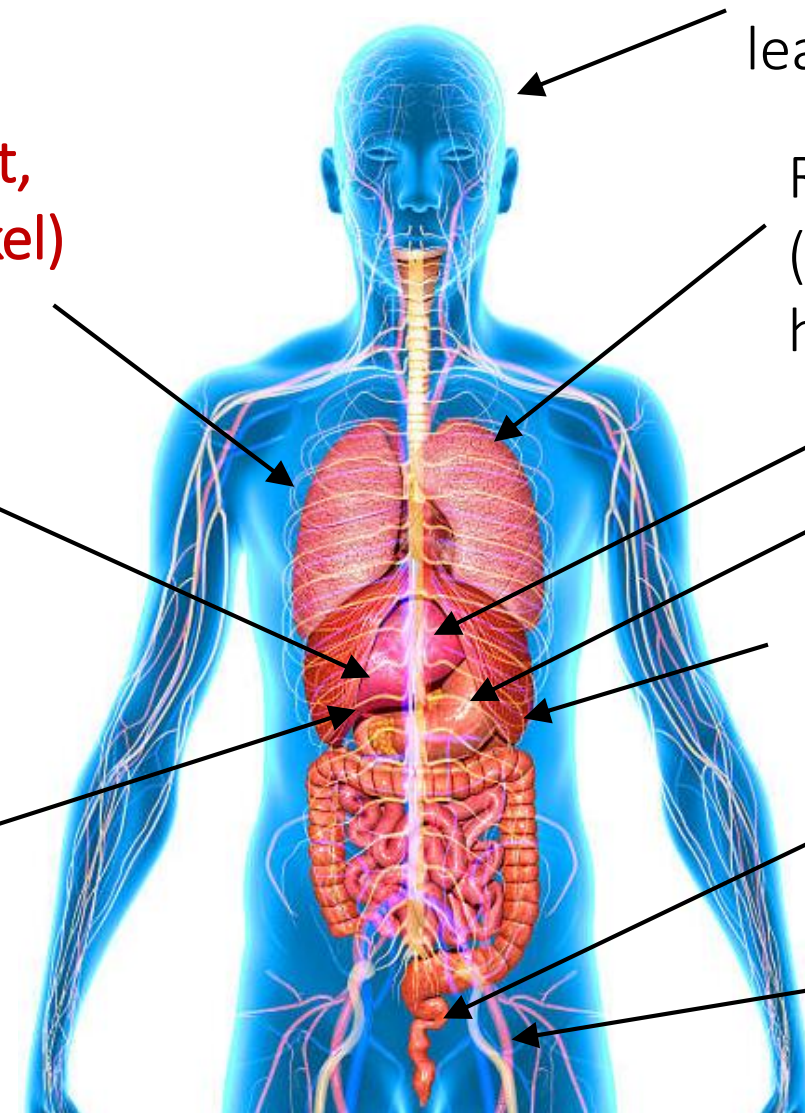
Kidney (cadmium)

Immune system (beryllium, nickel)

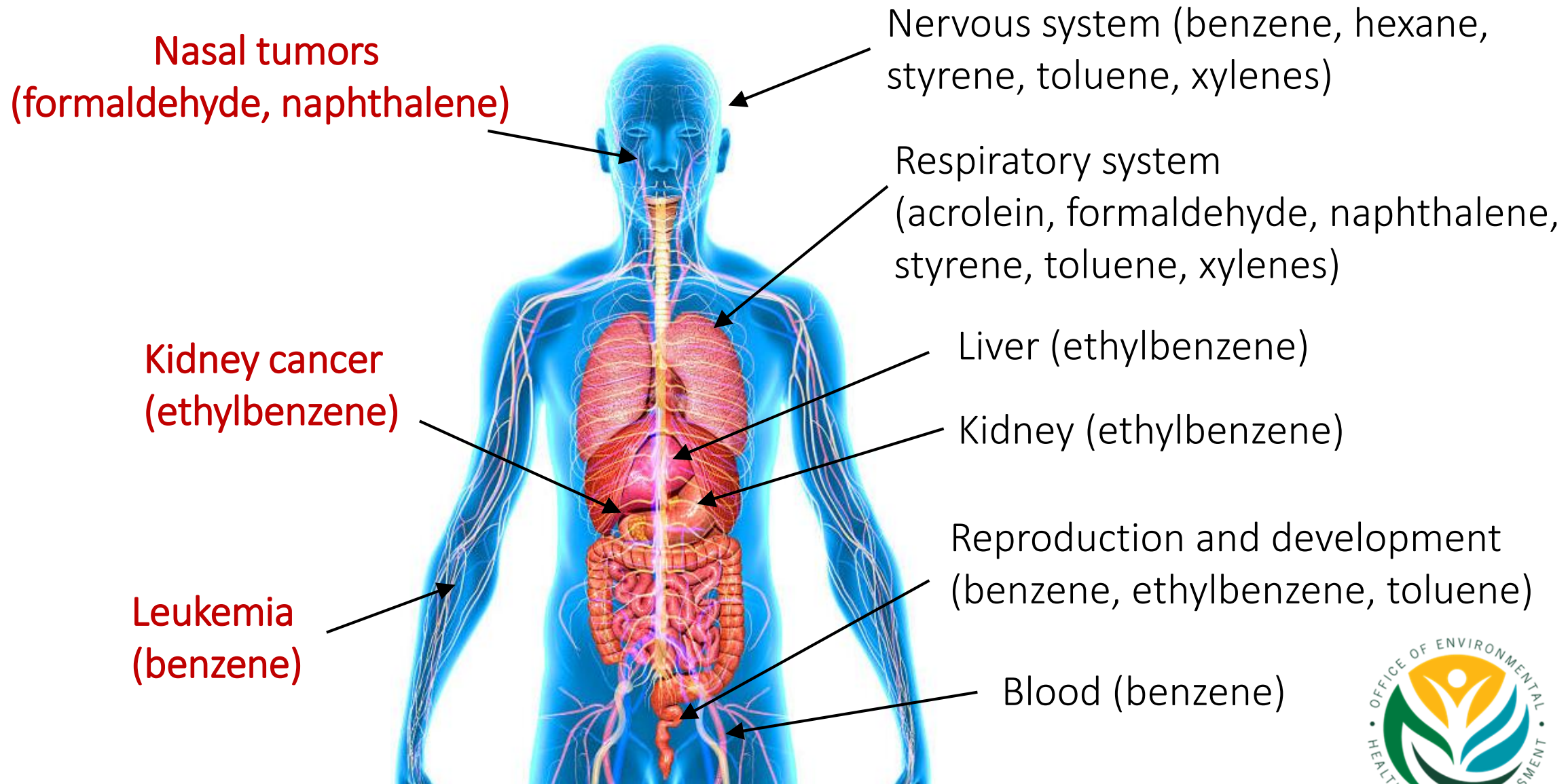
Reproduction and development (arsenic)

Blood (selenium)

Hair, skin, nails (selenium)



Health Concerns: Volatile Organic Compounds (VOCs)



<https://www.istockphoto.com/in/photo/human-organs-gm497303869-41750622>



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

Risk target (insignificant cancer risk)

▲ Lower? Less concern



Questions?

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