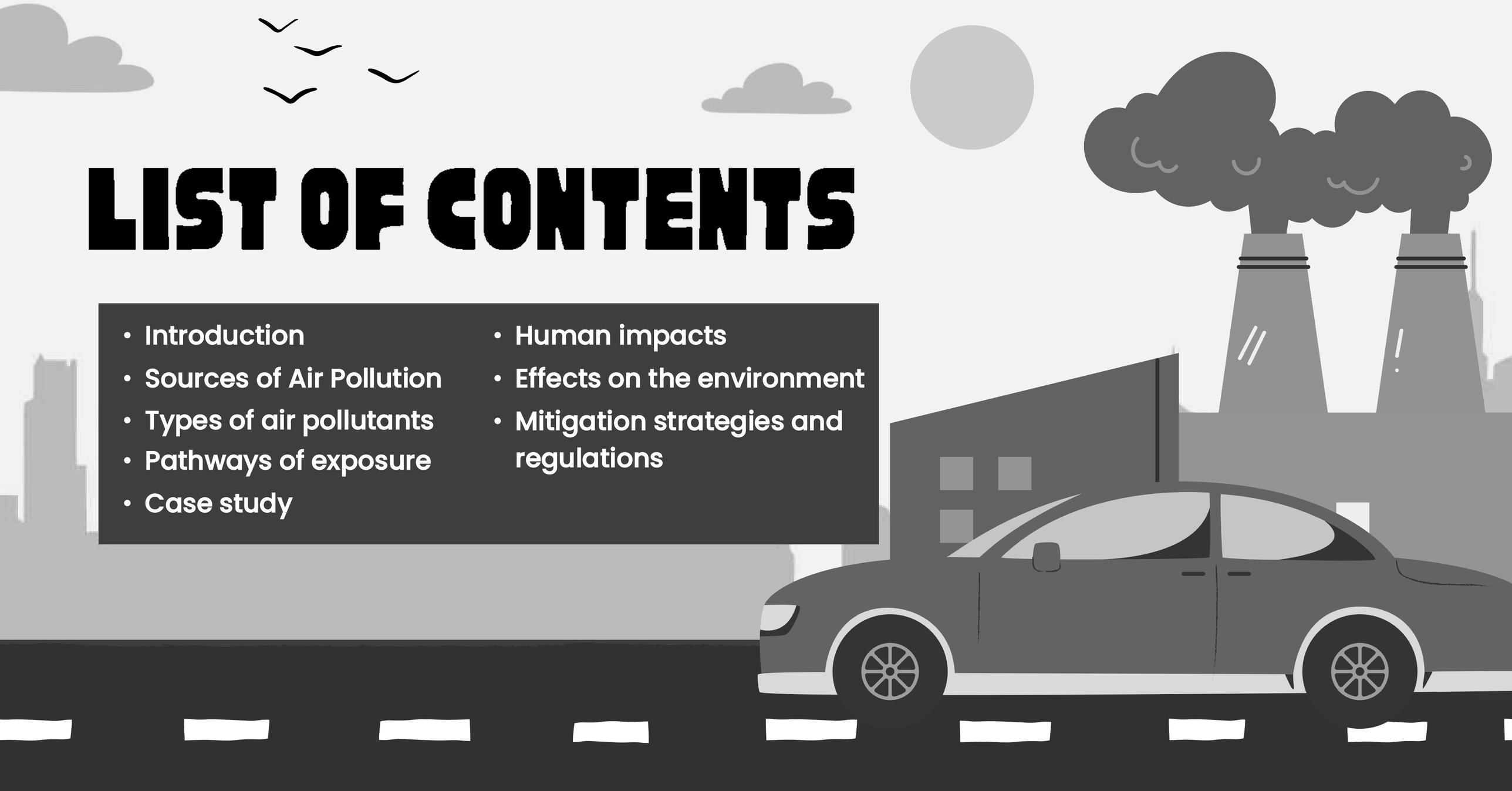
AIR POLLUTION

Risk assessment and management

LIST OF CONTENTS

- Introduction
- Sources of Air Pollution
- Types of air pollutants
- Pathways of exposure
- Case study
- Human impacts
- Effects on the environment
- Mitigation strategies and regulations



INTRODUCTION

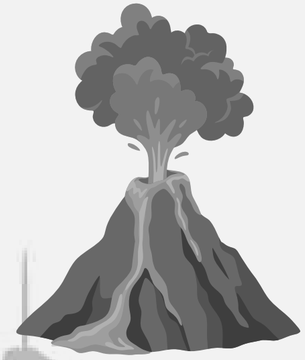
- Air quality
- Pollution.
- Major health problem.
- World Health Organization estimate.

SOURCES OF AIR POLLUTION

MOBILE

STATIONARY OR MAJOR

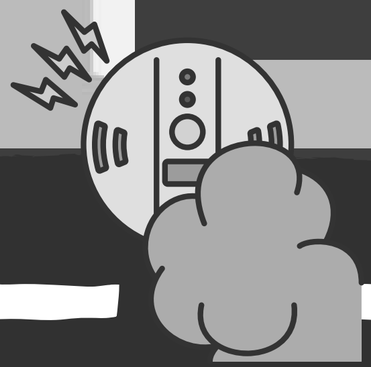
AREA

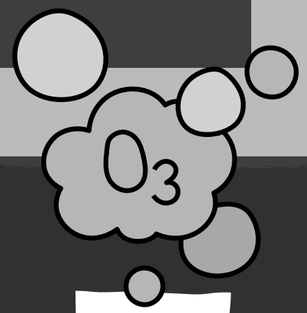


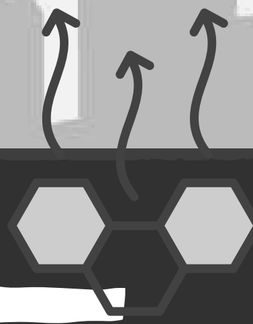
NATURAL

TYPES OF AIR POLLUTANTS

- PM
- Ground level ozone
- Carbon monoxide
- Sulfur oxides
- more







PATHWAYS OF EXPOSURE

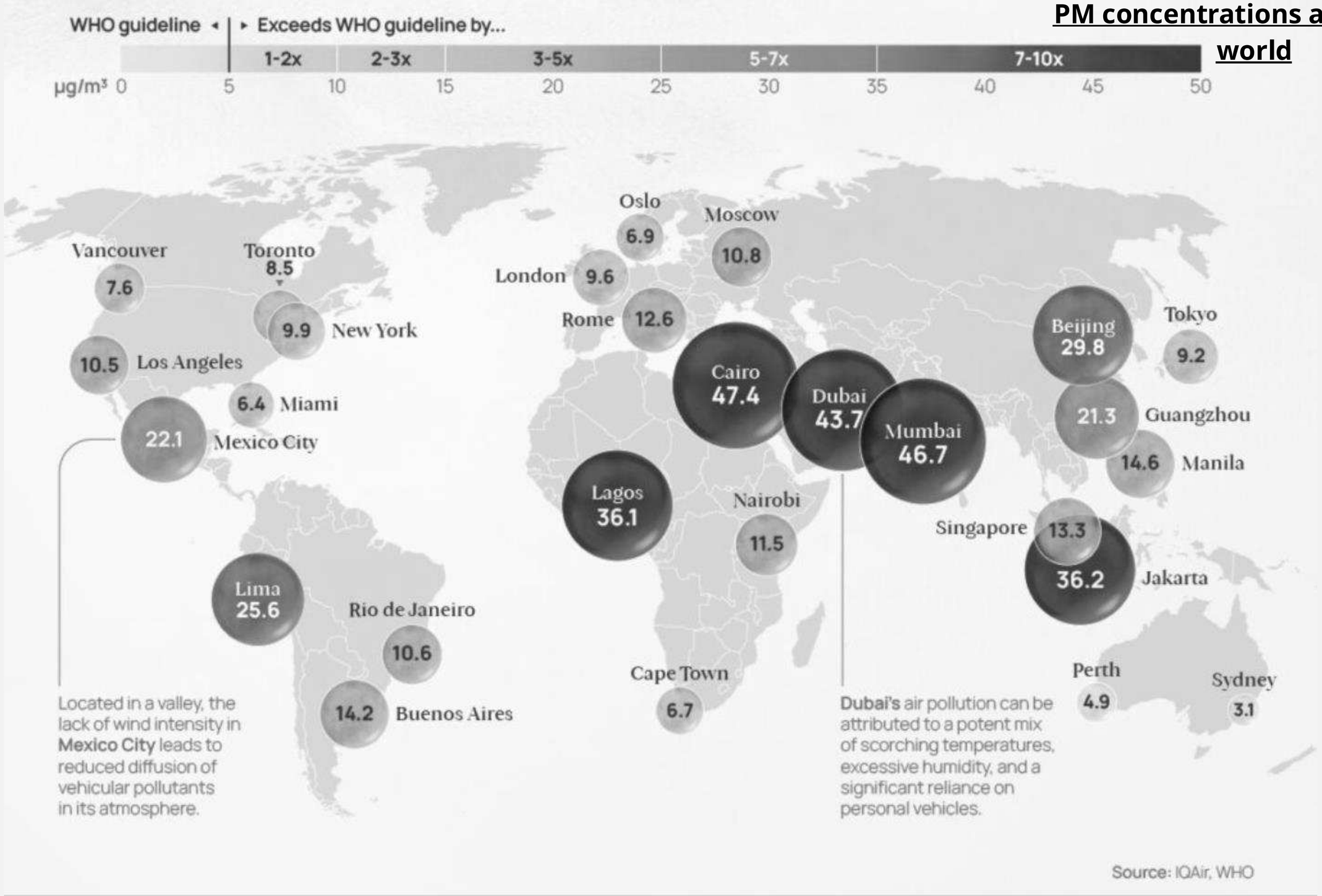
INHALATION

INGESTION

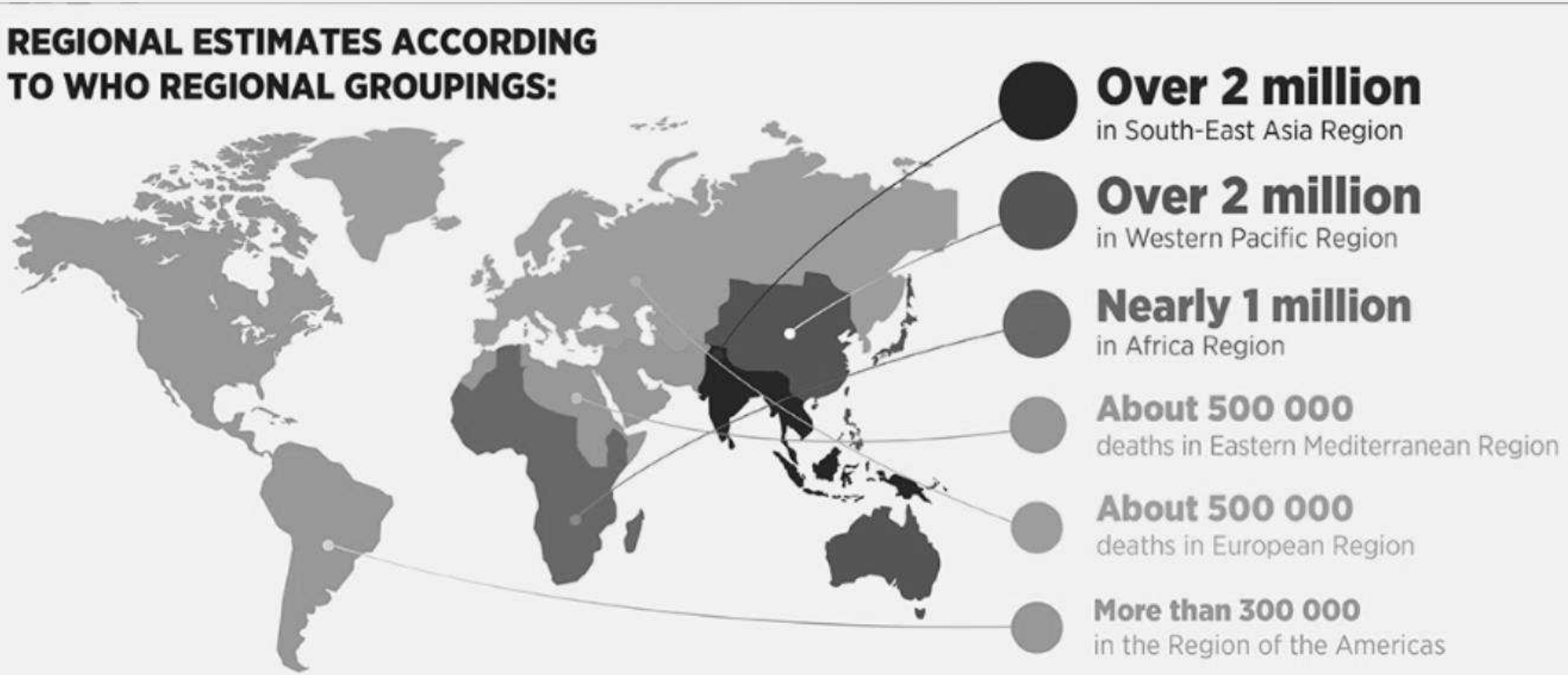
DERMAL ABSORPTION

TRANSPLACENTAL

PM concentrations around the world



Death estimates around the world caused by air pollution



(Rowling, 2019)

CASE STUDY

Environmental health indicators and a case study of air pollution in Latin American cities

OBJECTIVE

- Pollution levels in Latin America
- Effects on human and environmental health
- Children's health.

METHODS

- Cities in Latin America
- PM10
- Average PM10 level
- PM10 exposure

RESULTS

- Worst air quality
- Best air quality
- More than 10 million people exposed

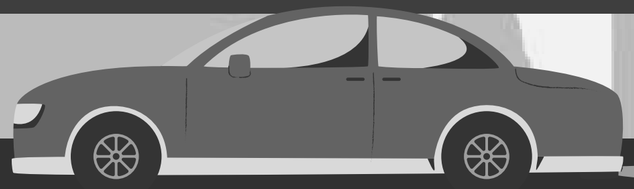


Table 3
Rankings of cities by various environmental health indicators.

	EHI-A	*EHI-B*	*EHI-C*	*EHI-D*	*EHI-E*
1	Curitiba	Curitiba	Curitiba	Managua	Montevideo
2	Toluca	Managua	Managua	Juarez	Managua
3	São Paulo	Toluca	Toluca	Montevideo	Juarez
4	Puebla	Juarez	Juarez	Quito	Quito
5	Guadalajara	Puebla	Puebla	Toluca	Curitiba
6	Managua	Quito	Quito	Curitiba	Toluca
7	Bogota	Salvador	Salvador	Puebla	Puebla
8	Salvador	Montevideo	Montevideo	Salvador	Salvador
9	Mexico City	Guadalajara	Guadalajara	Monterrey	Monterrey
10	Juarez	Monterrey	Monterrey	Guadalajara	Guadalajara
11	Monterrey	Santiago	Santiago	Santiago	Santiago
12	Santiago	Bogota	Bogota	Bogota	Bogota
13	Quito	São Paulo	São Paulo	Lima	Lima
14	Buenos Aires	Lima	Lima	São Paulo	Buenos Aires
15	Lima	Mexico City	Buenos Aires	Buenos Aires	São Paulo
16	Montevideo	Buenos Aires	Mexico City	Mexico City	Mexico City

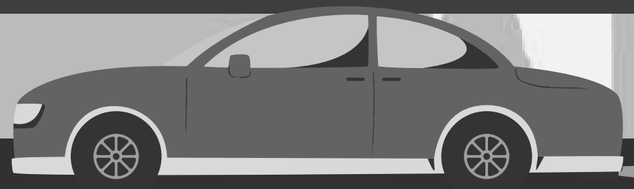
HUMAN HEALTH IMPACT

SHORT-TERM

- Bodily irritation
- Respiratory problems
- Cardiovascular problems
- Headaches, nausea, and dizziness

LONG-TERM

- Cancer
- Respiratory disorders
- Cell damage
- Neurological & psychological effects

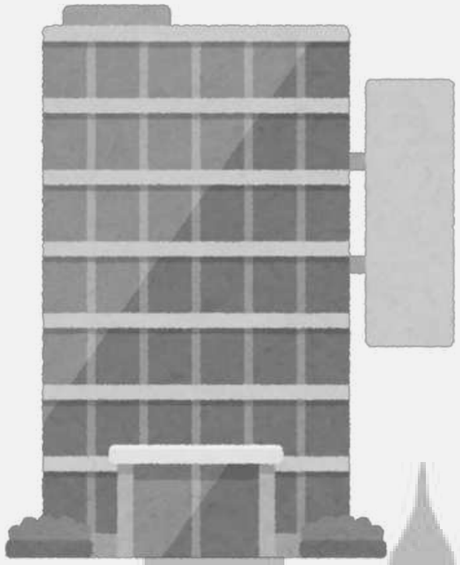


EFFECT ON THE ENVIRONMENT

- Global climate change
- Haze
- Acid rain
- Ozone
- Eutrophication

MITIGATION STRATEGIES

CITIZEN INVOLVEMENT



COMPANY/BUSINESS INVOLVEMENT

AUTHORITY INVOLVEMENT

CONCLUSION

Maintaining pollution-free air is our collective responsibility to create a healthy environment for future generations. Through cooperation between governments, companies, communities and individuals, we can achieve significant change in reducing air pollution.

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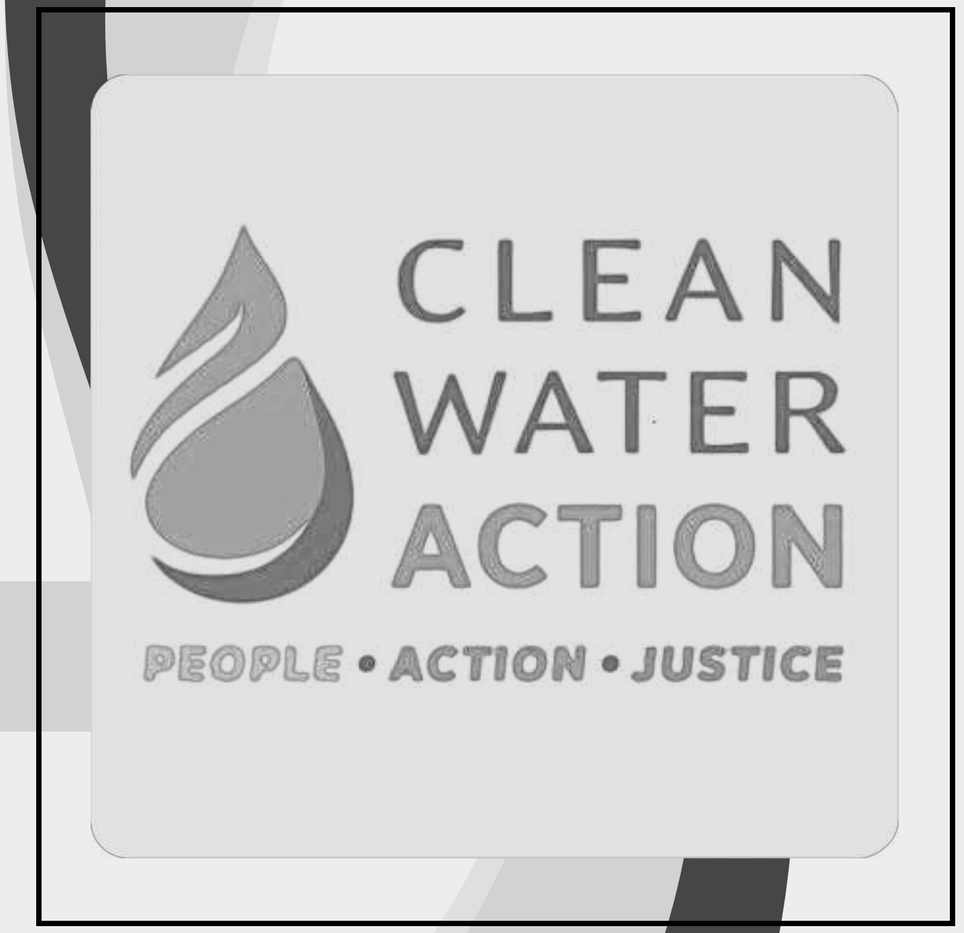
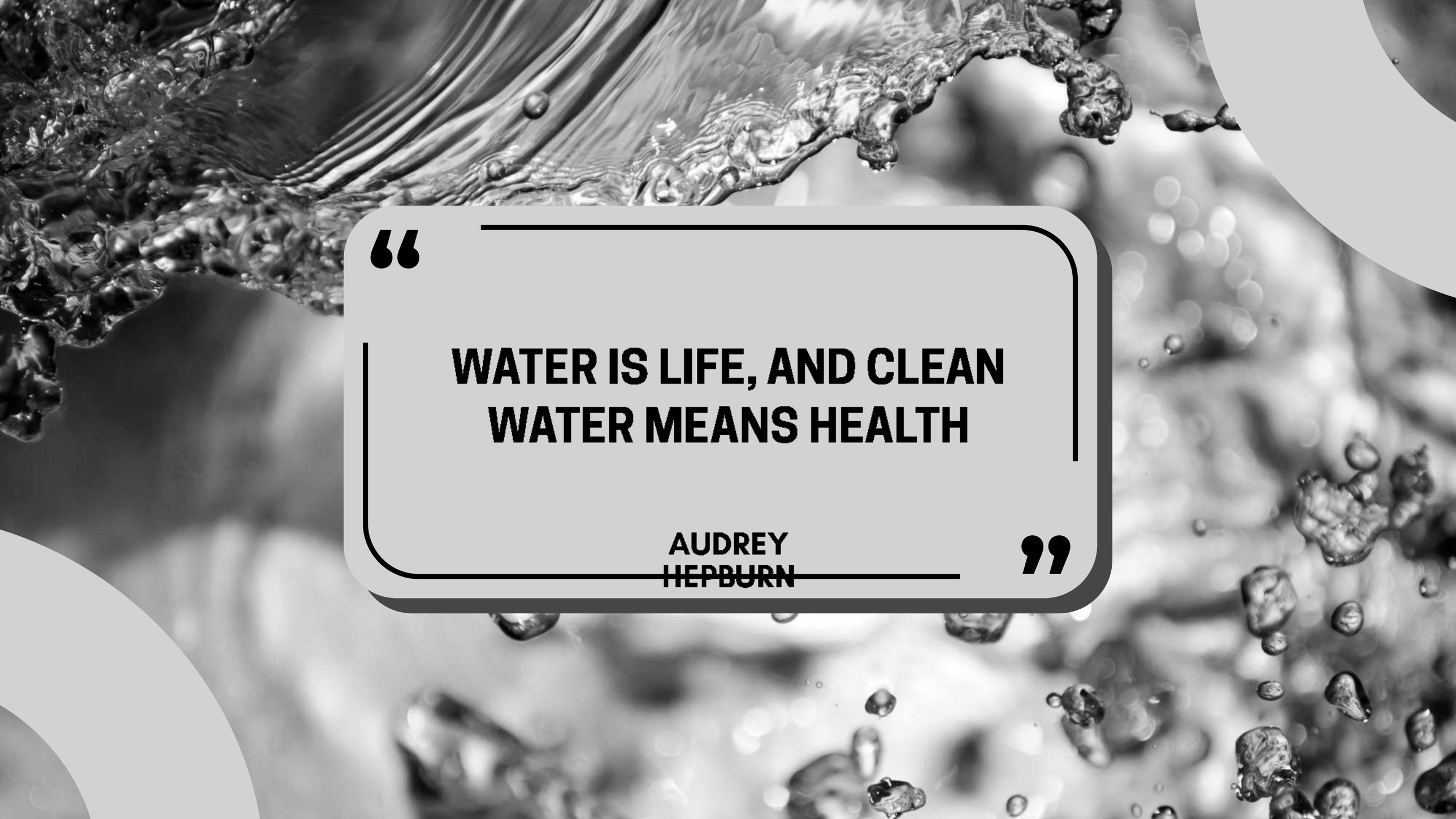
THANK YOU

Q&A
LET'S WORK TOGETHER TO
MAINTAIN POLLUTION FREE AIR
FOR A BETTER FUTURE

BIO 424 – Policy

CLEAN WATER ACT




“
WATER IS LIFE, AND CLEAN WATER MEANS HEALTH
AUDREY HEPBURN
”

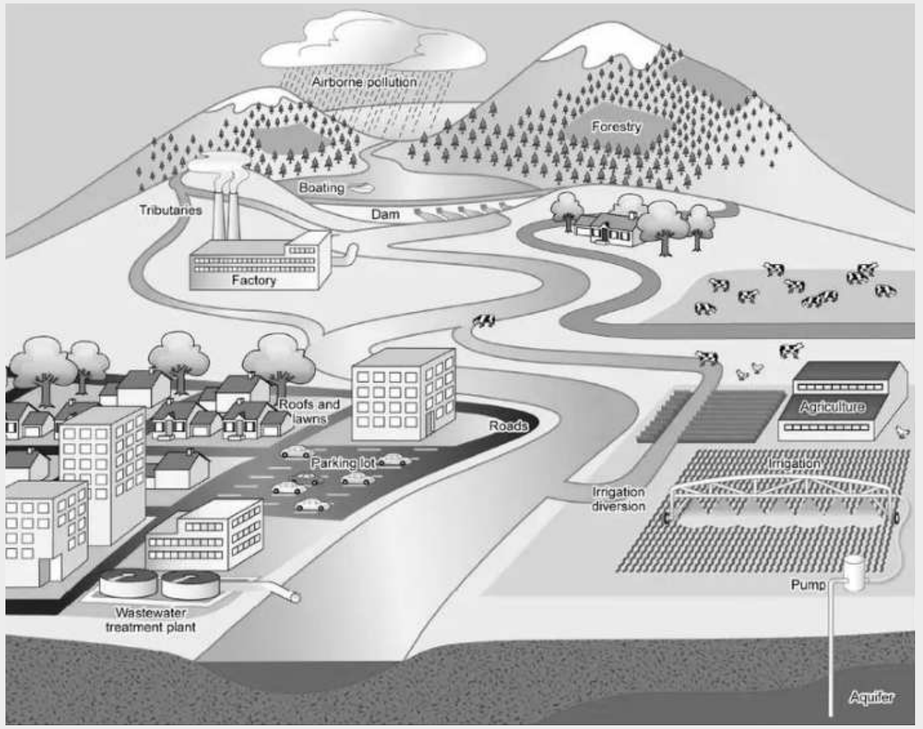
INTRODUCTION

Clean Water Act:

- Primary federal mechanism of water protection.
- Established in 1972.
- US lakes, ponds, and oceans used to be open dumping grounds for waste and sewage
- Drastic change for public and environmental health

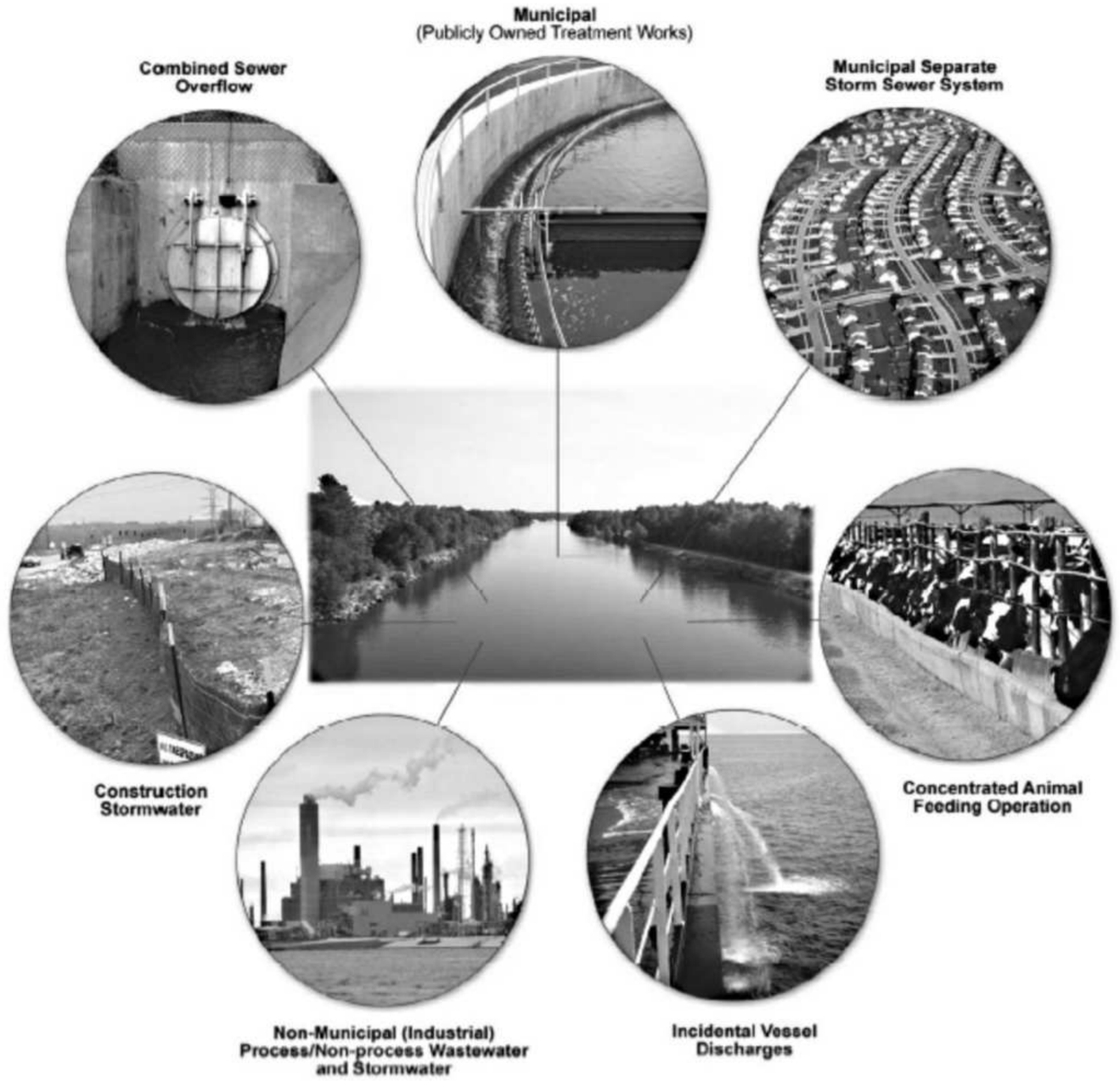
- Confussion and legal issues ⟶ “navigable waters”
- Considerable evolutions of CWA ⟶ legislative actions, court decisions, and agency rules

OPERATION OF THE CLEAN WATER ACT

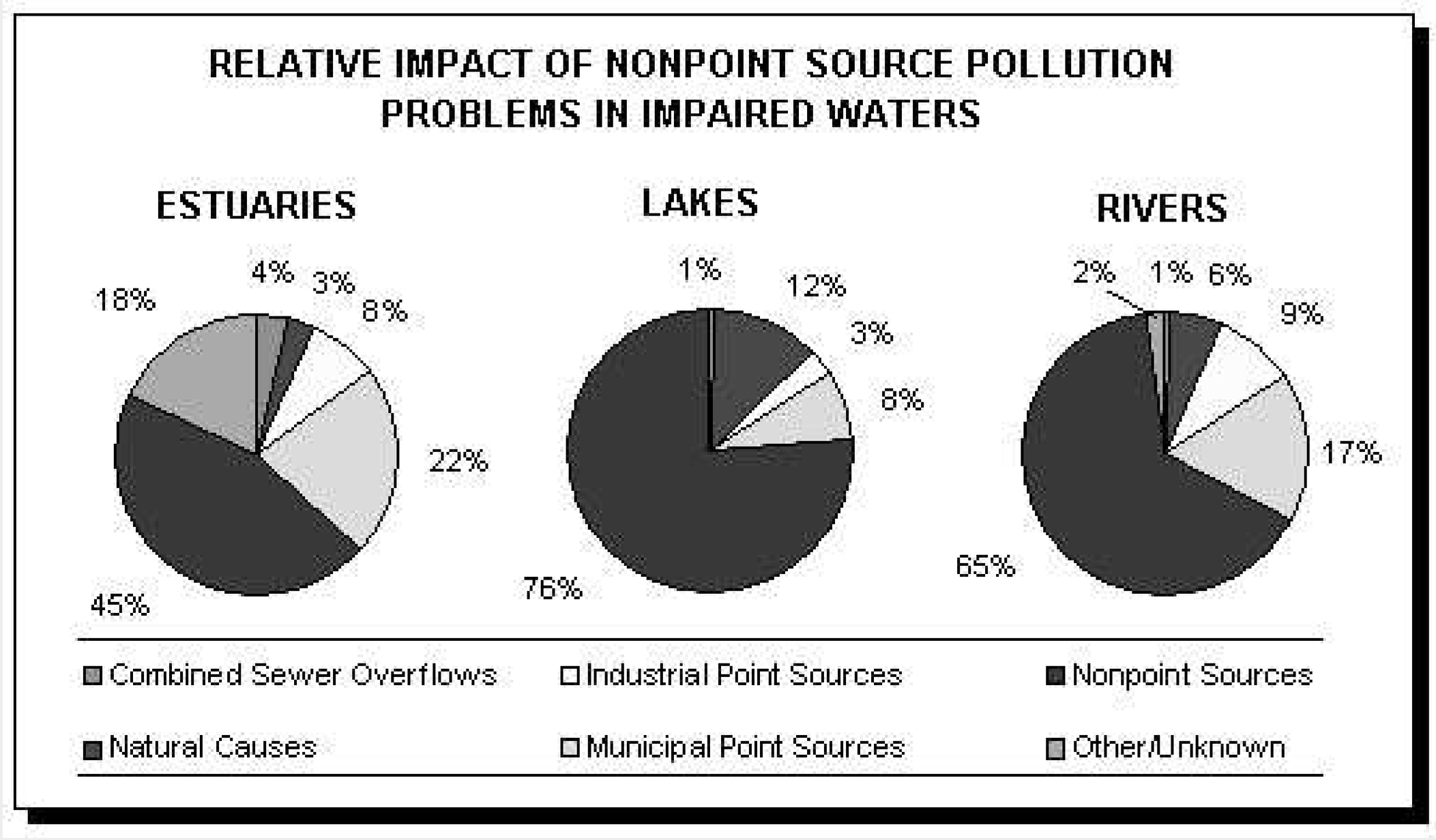


- Regulates the source point of pollution
- Licensing system
- Establishes water quality standards for water bodies in the US
- CWA controls point sources and nonpoint sources of pollution
- The EPA is responsible for enforcing the CWA

Exhibit 1-2 Common point source discharges of pollutants to waters of the United States



(US EPA,


RELATIVE IMPACT OF NONPOINT SOURCE POLLUTION PROBLEMS IN IMPAIRED WATERS
ESTUARIES
4%
3%
8%
18%
22%
45%
LAKES
1%
12%
3%
8%
76%
RIVERS
2%
1%
6%
9%
17%
65%
Combined Sewer Overflows
Industrial Point Sources
Nonpoint Sources
Natural Causes
Municipal Point Sources
Other/Unknown

(Welsch,

WHAT WOULD HAPPEN IF THE CWA DID NOT EXIST?

By the 1960s, many water bodies were on the brink of ecological collapse:

- **240 million gallons of raw sewage** were dumped into the Potomac River every day
- Massive oil spill off Santa Barbara: **100,000 barrels of oil** spilled into the Pacific Ocean.
- The Cuyahoga River in Ohio **caughed on fire** because of oil and industrial waste

HEALTH EFFECTS

- Increased waterborne diseases
- Toxic exposure to heavy metals, pesticides, and industrial chemicals
- Higher cancer risk
- Developmental and reproductive issues

CASE STUDY: PUEBLO OF ISLETA

Conflict: The Isleta Pueblo set water quality standards for a river running through their land, which affected Albuquerque's wastewater treatment plant upstream. Albuquerque opposed stricter rules, arguing they were too costly.

Resolution: EPA had the final authority. Only tribes and states can request the EPA's intervention in such disputes.

CHALLENGES OF THE CWA

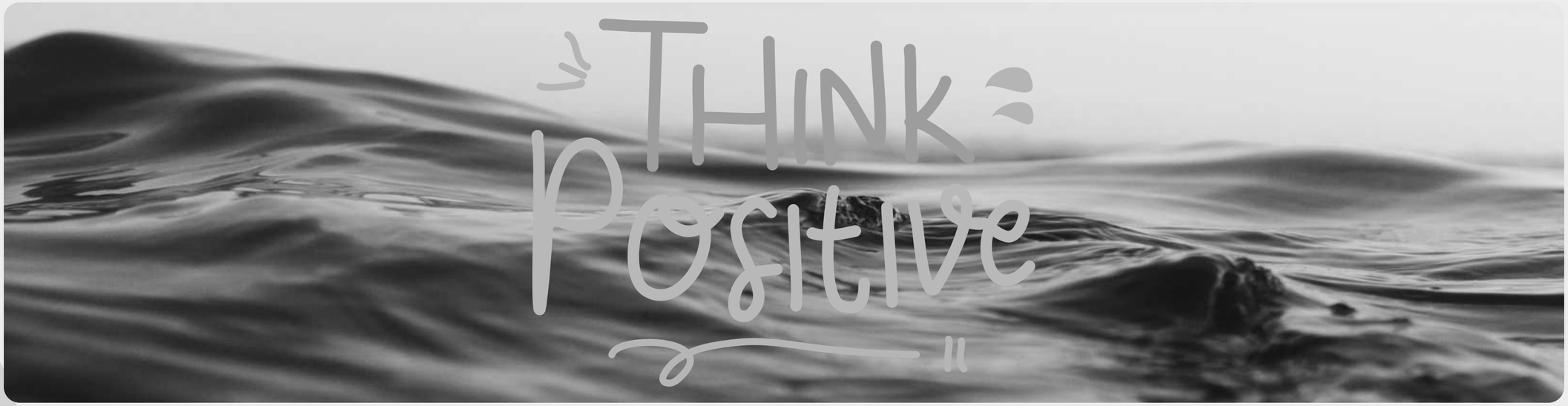
- Falling Short of Its Goals
- Weak Enforcement & Monitoring
- New and Emerging Pollutants
- Legal & Political Attacks

POTENTIAL SOLUTIONS

- Clarify and Expand Definitions
- Update the Law to Address Modern Threats
- Invest in Monitoring and Enforcement
- Restore Scientific Authority
- Public Engagement and Education

The Clean Water Act has had a powerful and lasting impact on water quality and public health in the U.S.

It isn’t perfect, but it’s one of the most important environmental laws in U.S. history. With stronger protections, we can build on its success and ensure clean water for future generations.



QUESTIONS?

Thank you!

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[redacted]

Toxic Substances Control Act (TSCA)

Addressing its importance to environmental protection and health

Introduction.

Chemicals are deeply present in our lifes

Exposure to certain chemicals are linked to health effects

TSCA purpose: ensure that chemicals manufactured, imported, and used in the United States do not put at risk human health and the environment

TSCA

What is the Toxic Substances Control Act?

Enacted in 1976 and administred by the EPA. Authority to regulate the production, importation, use and disposal of chemicals

2016: TSCA revised under the Lautenbers Chemical Safety Act

How TSCA works?

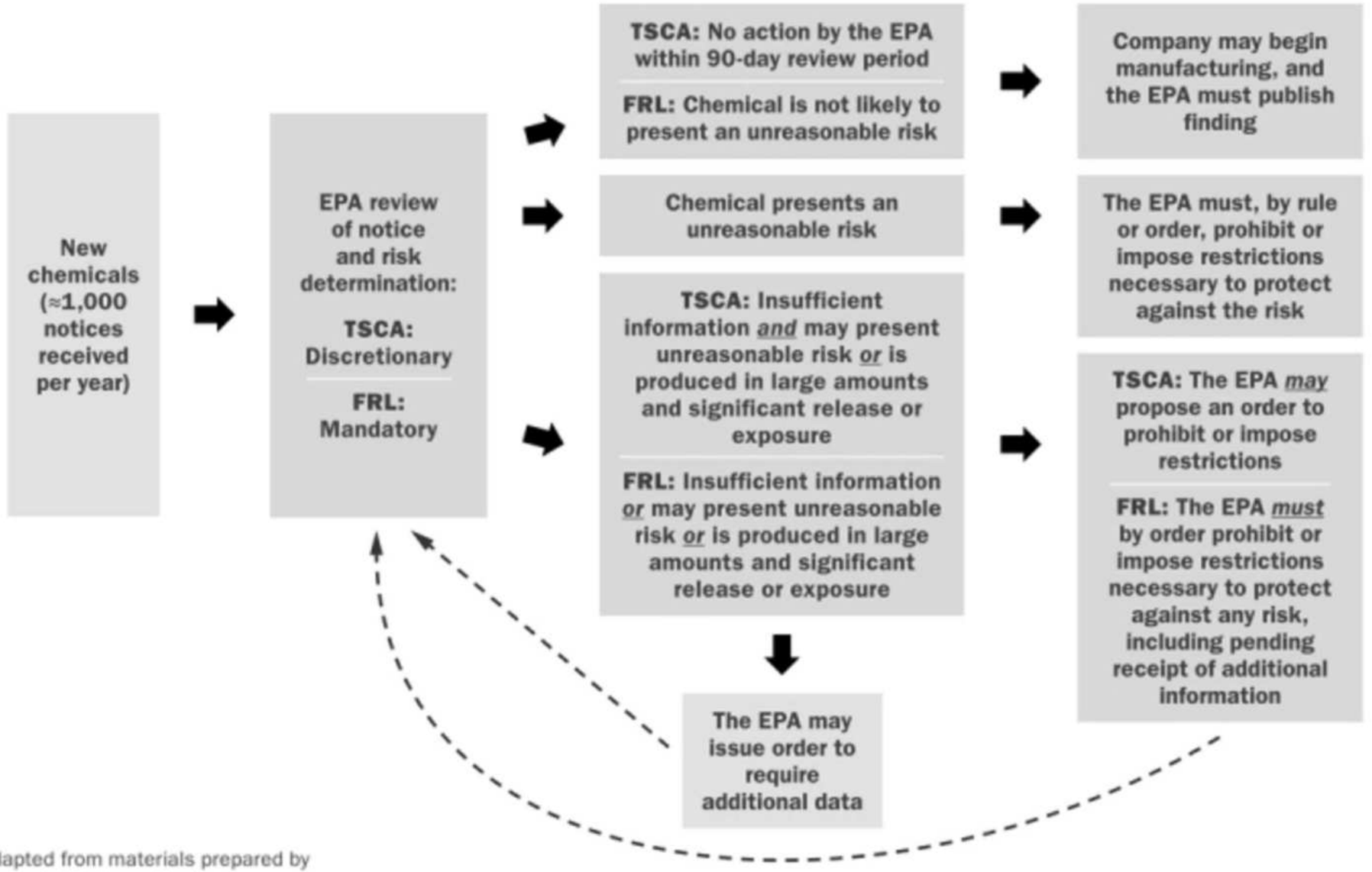
NEW CHEMICALS

- **PMNs:** pre-manufacture notices
- **EPA:** reviews data to find unreasonable risk

CHEMICALS ALREADY IN THE MARKET

- Chemical is unsafe: EPA impose restrictions or ban it.
- Companies need to maintain records.

Toxic Substances Control Act (TSCA) vs. Lautenberg Act (FRL)



Source: Adapted from materials prepared by the Environmental Defense Fund

STRENGTHS

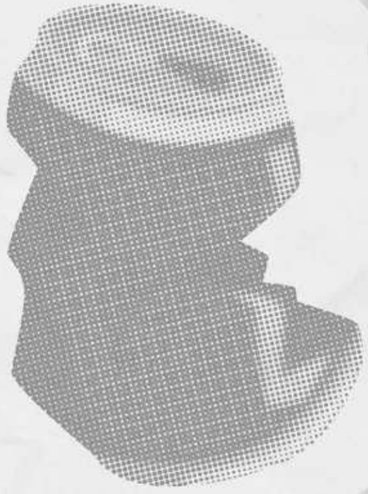
EPA has Stronger Authority

Mandatory Risk Evaluation

Clear Deadlines

Transparency Improvements

Focus on Vulnerable Populations



WEAKNESSES

Slow Review Process

Limited funding and Staff

Legacy Chemicals Loophole

Industry Influence

Transparency Gaps

CASE STUDY:

landfill

Kettleman Hills Facility, a hazardous-waste landfill owned and operated by Chemical Waste Management, Inc

TSCA violations, including in 2004, missing of PCBs monitoring for 8 years

Lab instruments to analyze PCBs were not calibrated correctly

Relation with TSCA Act

CONSEQUENCES IN HUMAN HEALTH

A study conducted by the California Department of Public Health (CDPH) in 2010 identified 11 babies with structural birth defects

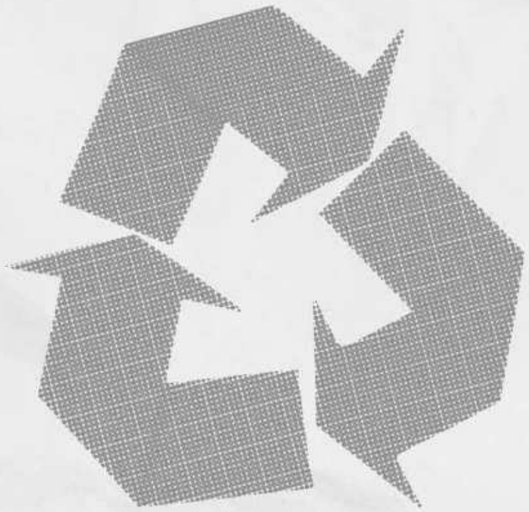
Born to mothers who had lived in Kettleman City either during their pregnancy or at the time of birth

WAYS TO IMPROVE

TSCA Act, often lacks enforcement in low-income areas.

- Increase transparency
- Updating on new chemical mixtures and subtances

Efficiently addressing the large number of existing chemicals already in commerce



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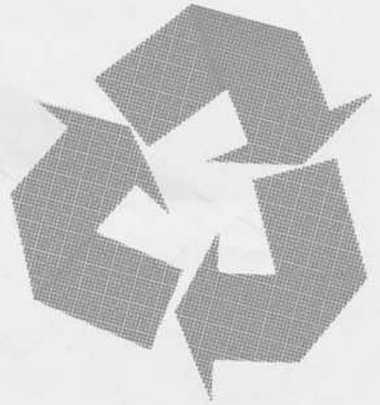

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SUSTAINABLE AGRICULTURE

Policy and Regulation

INTRODUCTION

- Sustainable Agriculture
- Environmental Impacts
- Policy
- Challenges in Implementation
- Case Study
- Future Directions

"Sustainable agriculture is not a luxury — it’s a necessity to ensure food security, protect our environment, and support farmers for generations to come."
— UN Food and Agriculture Organization (paraphrased)

SUSTAINABLE AGRICULTURE

"Farming in a certain way to help protect the environment and expand natural resources, to make the best use out of nonrenewable resources."

EXAMPLES

Organic Farming
Crop Rotation
Water Management
Soil Health

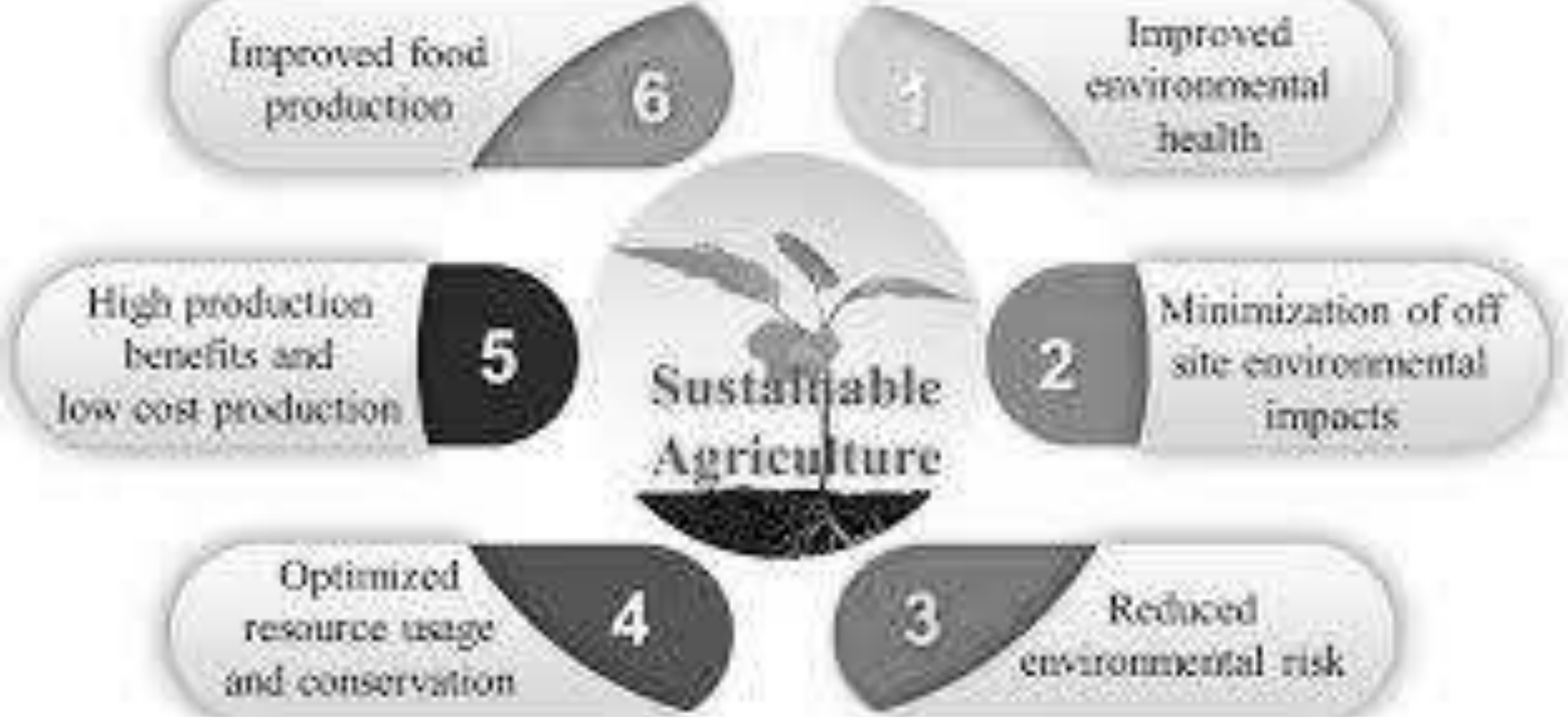
BENEFITS

Improved Soil Fertility
Reduced Environmental Impact
Economic Benefits

ENVIRONMENTAL IMPACT

- Lowers Carbon Footprint
- Improved Water Quality
- Reduces Natural Resource Usage

- Policy Gaps
- Consumer Behavior
- Climate Change
- Biodiversity Loss



POLICY

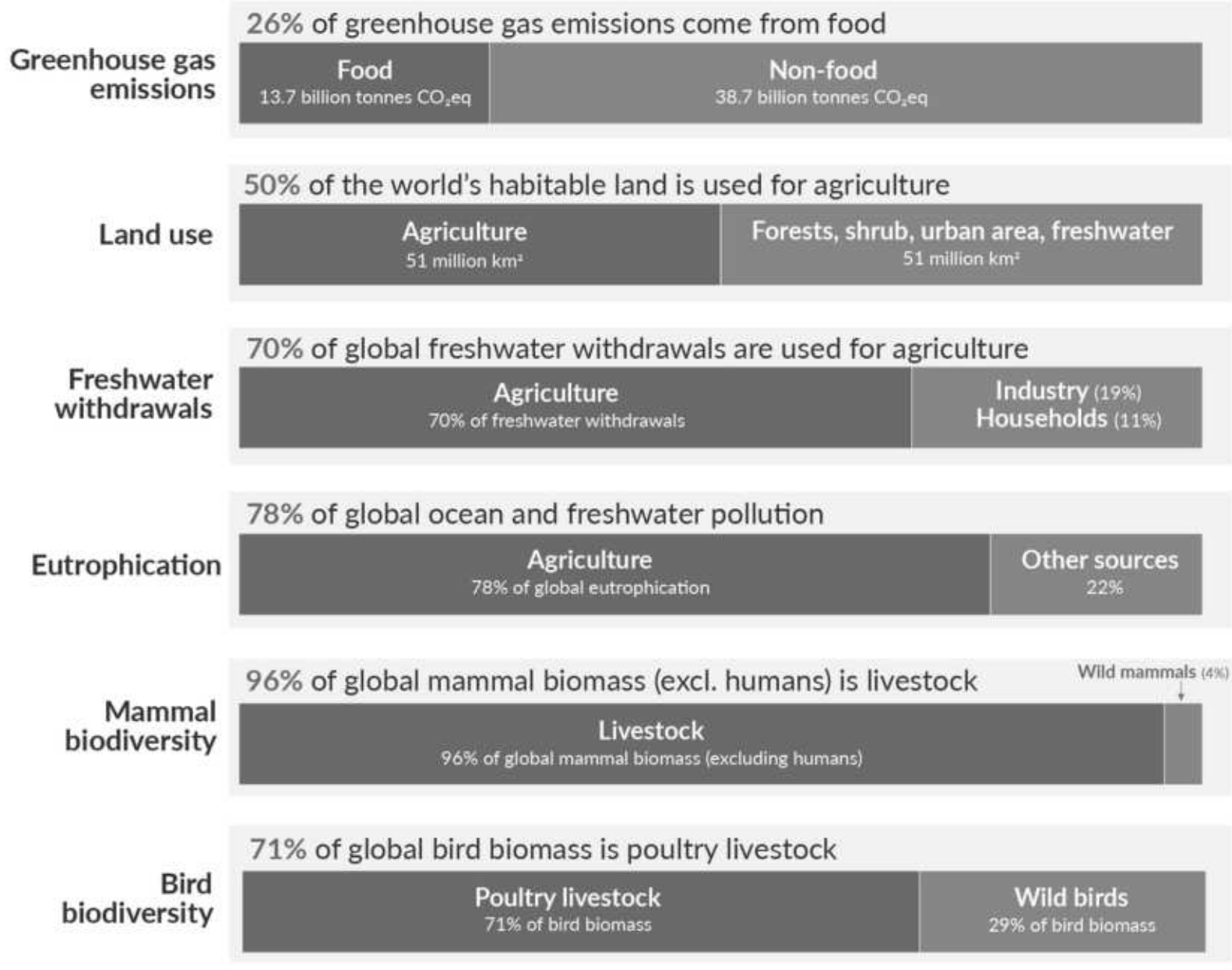
Farm Bill: includes different programs that support the practice of sustainable agriculture.

PROGRAMS

EQIP and CRP are two programs that are included within this bill.

The environmental impacts of food and agriculture

Our World in Data



Data sources: Poore & Nemecek (2018); UN FAO; UN AQUASTAT; Bar-On et al. (2018).
OurWorldinData.org – Research and data to make progress against the world's largest problems.

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Date published: November 2022.

CHALLENGES IN IMPLEMENTATION

- High Initial Costs
- Lack of Education and Training
- Weak Policy Enforcement
- Limited Access to Resources
- Market Pressures
- Fragmented Support Systems
- Cultural Resistance to Change

"Sustainability is easy to promise, but hard to practice."
— Unknown

CASE STUDY: “IS THERE A NEED FOR MORE SUSTAINABLE AGRICULTURE?”

“The world will need 70 to 100% more food by 2050.”
(Gomiero et al., 2011)

KEY POINTS

- Current Agriculture is Environmentally Unsustainable
- Resource Depletion
- Food Security at Risk
- Ecological Farming Alternatives
- Need for Policy & Research
- Systemic Change Required

FUTURE DIRECTIONS

- Smart Farming Technology
- Policy Innovation
- Climate-Resilient Crops
- Urban & Vertical Farming
- Farmer Education & Collaboration
- Consumer Awareness

RESOURCES

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THANK YOU

A Call to Action:

ADDRESING AN EMERGING CONTAMINANT

1,4-DIOXANE

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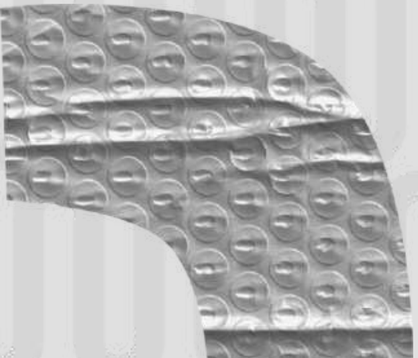
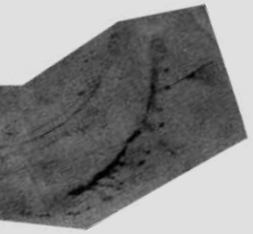
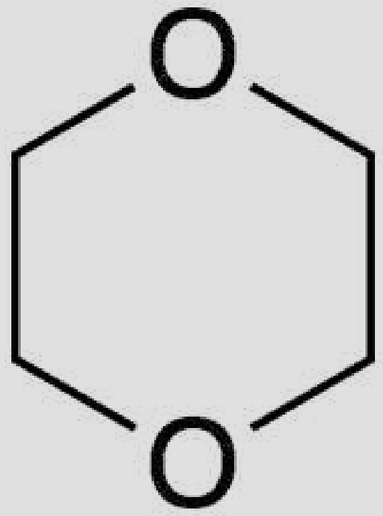




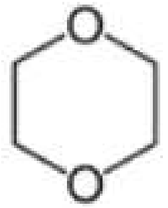
WHAT IS 1,4 - DIOXANE?



A synthetic chemical used as a solvent for a variety of organic chemicals found in paints, dyes, antifreeze, shampoos, deodorants, cosmetics, etc.; listed as #214 on the ATSDR's Substance Priority List and is the second most prevalent prior contaminant in public water supplies.

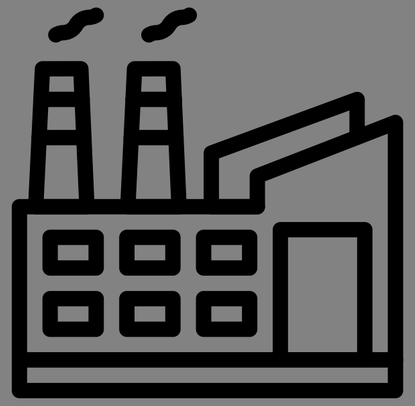
The U.S. Environmental Protection Agency classifies 1,4-dioxane as a likely human carcinogen, making its environmental impact and remediation a growing concern.

Table 1. Physical properties of 1,4-dioxane *.

Property	Value	Structure
Molecular weight	88.11 g mol^{-1}	
Density (25 °C)	1.033 g cm^{-3}	
Boiling point	101.1 °C	
Water solubility	Miscible	
Henry's law constant at 25 °C	4.80×10^{-6} atm-m^3 mol^{-1}	
Octanol-water partition coefficient (log K_{ow})	−0.27	
Organic carbon partition coefficient (log K_{oc})	1.23	

Note: * Data acquired from [18,19].

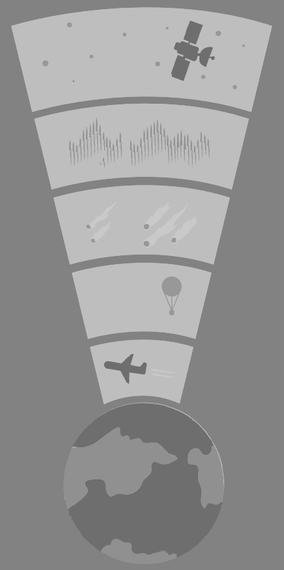
PRIMARY SOURCES



Industrial solvent stabilization

Manufacturing by-product in the production of detergents, shampoos, cosmetics

Improper Waste Disposal including the use of unlined lagoons, ponds, and septic systems

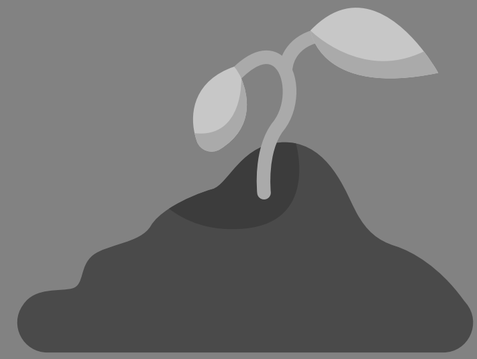


ATMOSPHERIC

1,4-Dioxane can evaporate into the air. Relatively short atmospheric lifetime of 1 to 3 days.

SOIL

Low adsorption due to its low affinity for soil particles, 1,4-dioxane can easily leach from soil into groundwater



SPREAD PATHWAYS

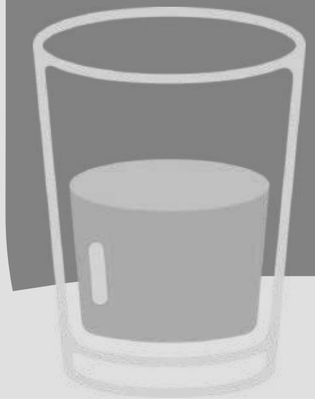
GROUNDWATER CONTAMINATION

- High solubility
- Limited Degradation

SURFACE WATER CONTAMINATION

- Effluent Discharge
- Runoff

ROUTES OF EXPOSURE

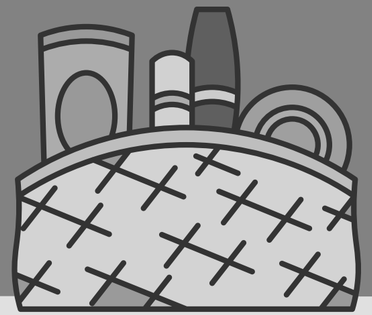


DRINKING WATER

Exposure through ingestion; excessive levels of 1,4-dioxane (>federal health risk guideline level of 0.35μg/L) expose people to higher cancer risks in US

FOOD

Exposure through ingestion; 1,4-dioxane found in adhesive materials for food packaging, pesticides that treat crops, and manufactured food additives



CONSUMER PRODUCTS

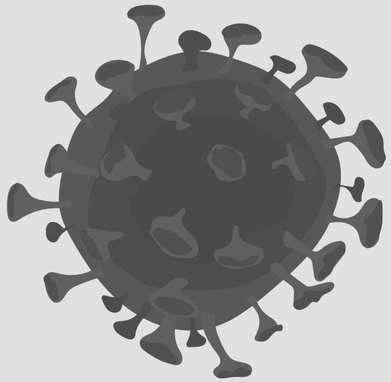
Elevated concentrations found in cosmetic products; higher exposure in women compared to men and children; exposure attributed to inhalation and, to a lesser extent, dermal absorption

BATHING/SHOWERING

Along with contaminated consumer products used in the shower, the water that we bathe/shower with is contaminated itself; exposure through inhalation and dermal contact

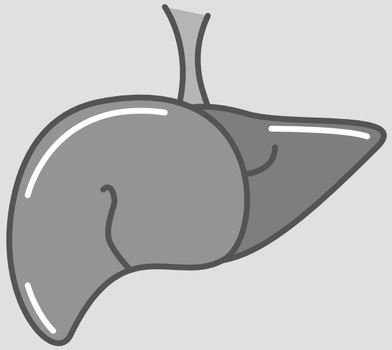
**Data based on mouse/rat experimentation; new medical developments needed to prove effects of 1,4-dioxane on humans

HUMAN HEALTH IMPACTS



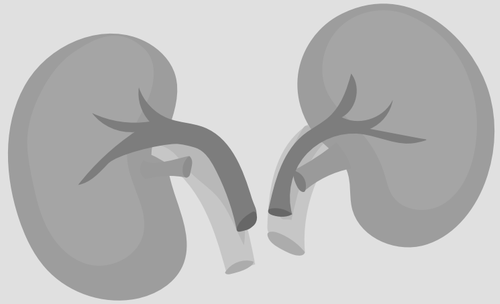
CARCINOGENIC EFFECTS

1,4-dioxane-induced tumors in liver and nasal cavities after long-term exposure through inhalation and ingestion



OTHER EFFECTS ON LIVER

Degeneration of hepatic cells, development of preneoplastic lesions, increased liver to body weight, centrilobular swelling, necrosis, increased DNA synthesis, and chromosomal damage

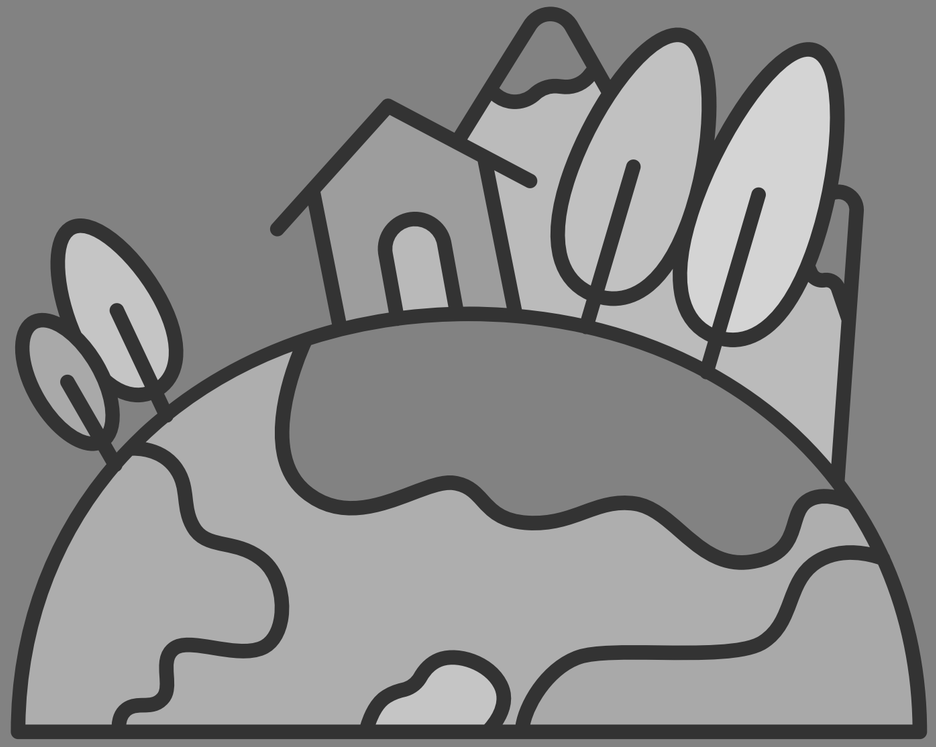


EFFECTS ON KIDNEYS

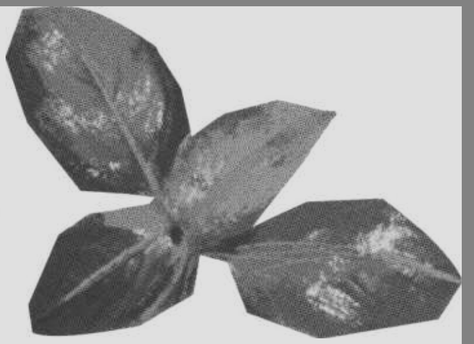
Long-term exposure to 1,4-dioxane through drinking contaminated water can cause cortical tubule cell degeneration, tubular necrosis, and glomerulonephritis (inflammation of kidney filters)

ENVIRONMENTAL IPACTS

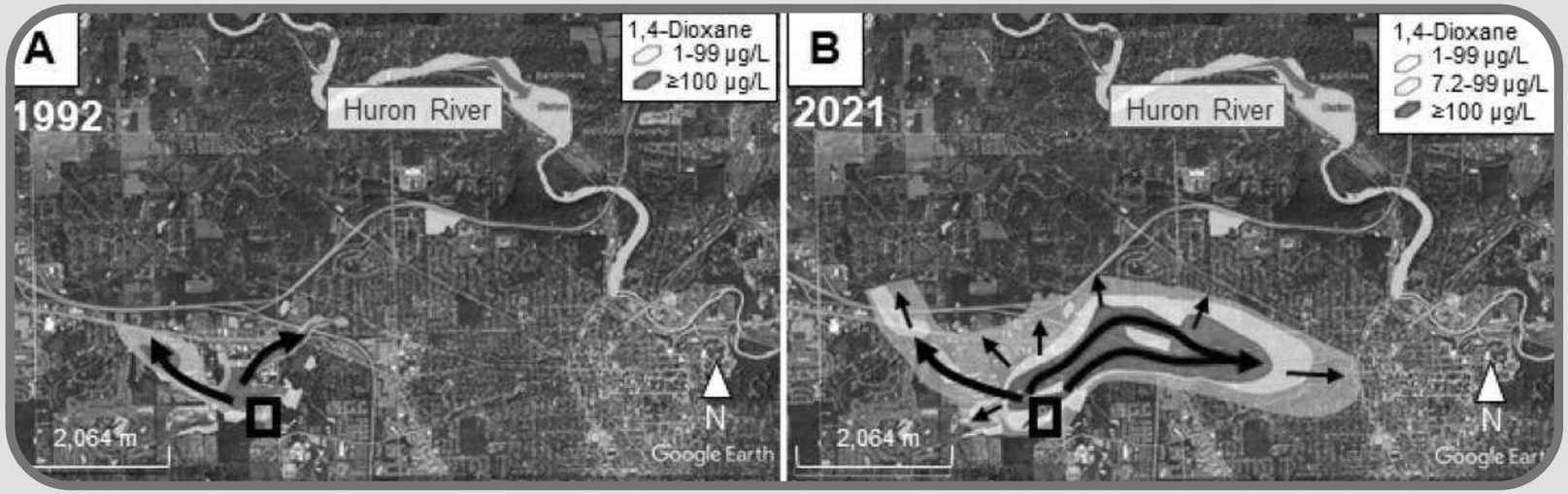
1. Aquatic Ecosystems
2. Water Pollution
3. Soil Pollution
4. Atmospheric Degradation

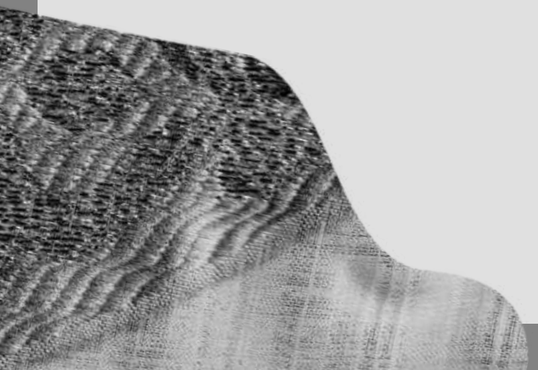


CASE STUDY: MICHIGAN'S GELMAN SITE



- Gelman Sciences Inc. used 1,4-dioxane as a solvent for cellulose triacetate for medical/scientific filters
- Filters had better thermal/chemical properties, increasing demand
- discharged 1,4-dioxane-contaminated wastewater into unlined manmade ponds (1967-1972)
- Estimated 1,4-dioxane groundwater plumes went from 1.4km² (1992) to 10km² (2021)





"There are no US federal drinking water standards for 1,4-dioxane despite recognition for over 40 years that 1,4-dioxane is an emerging drinking water contaminant" (Loch-Caruso et al., 2022)

LAWS AND REGULATIONS

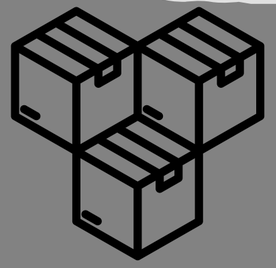
<u>Drinking Water & Groundwater</u>

Federal criteria

- EPA published drinking water health advisory levels for specific exposure durations for noncancer health effects and cancer risk

State-specific criteria

PREVENTION



Reduce use of products containing 1,4-dioxane

Improve water treatment facilities to better filtrate for 1,4-dioxane

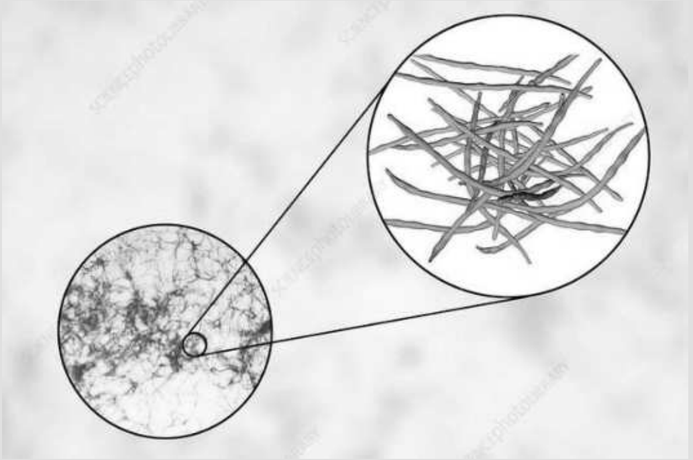
Increase public knowledge/awareness

Implement residential water purifiers

REMEDIATION: BIOREMEDIATION

Degradation of 1,4-dioxane by actinomycete

- Bacteria called CB 1190 can eat and breakdown 1,4-dioxane
- Actinomycete grows by consuming 1,4-dioxane.
- CB1190 growed by doubling its population every 30 hours.
- PH conditions of 6.0 which is slightly acidic and temperature of 30C
- Breaking down efficiency was counted at 0.33 milligrams of dioxane per minute for every milligarm of its own protein
- Around 59.5% of 1,4-dioxane was converted into CO2
- There are no harmful byproducts documented in the study; this means that the bacteria is fully cleaning 1,4-dioxane



IMPORTANCE:

Potential use of this bacteria in environmental cleanup projects to remove 1,4-dioxane from polluted water.

APPLIED AND ENVIRONMENTAL MICROBIOLOGY, Dec. 1994, p. 4527–4530 Vol. 60, No. 12
0099-2240/94/$04.00+0
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Degradation of 1,4-Dioxane by an Actinomycete in Pure Culture

R. E. PARALES,† J. E. ADAMUS,‡ N. WHITE,§ AND H. D. MAY*

Celgene Corporation, Warren, New Jersey 07059

Received 10 June 1994/Accepted 20 September 1994

An actinomycete capable of sustained aerobic growth on 1,4-dioxane was isolated from a dioxane-contaminated sludge sample. The actinomycete, CB1190, grows on 1,4-dioxane as the sole carbon and energy source with a generation time of approximately 30 h. CB1190 degrades 1,4-dioxane at a rate of 0.33 mg of dioxane min^{-1} mg of $protein^{-1}$ and mineralizes 59.5% of the dioxane to CO_2. CB1190 also grows with other cyclic and linear ethers as the sole carbon and energy sources, including 1,3-dioxane, 2-methyl-1,3-dioxolane, tetrahydrofuran, tetrahydropyran, diethyl ether, and butyl methyl ether. CB1190 is capable of aerobic autotrophic growth on H_2 and CO_2.

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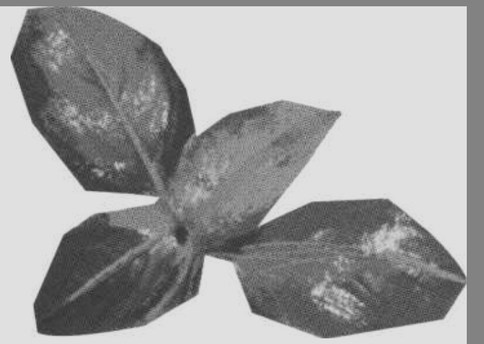
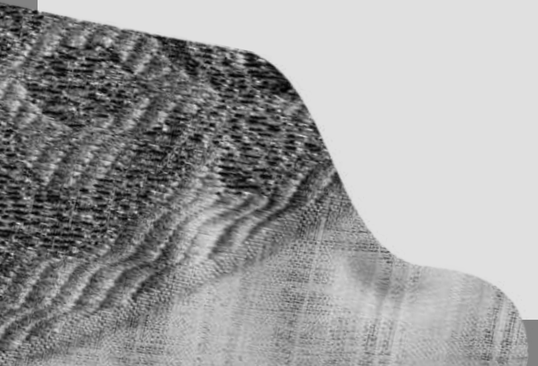
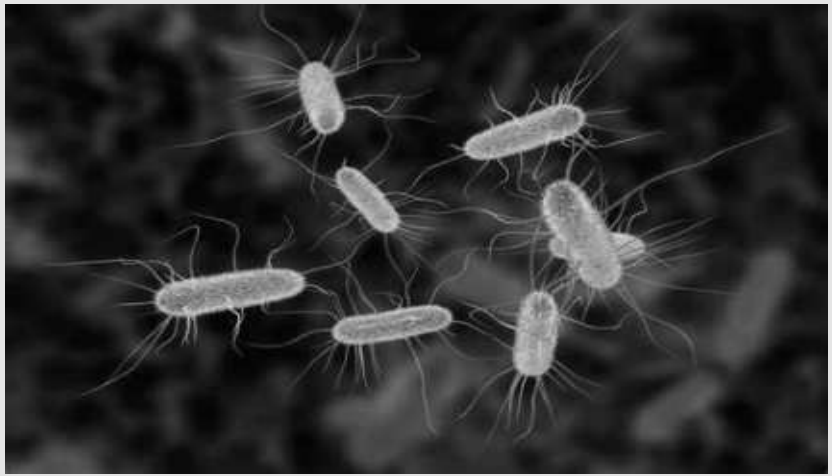


QUESTIONS?



Biological Hazards



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What is E.Coli?

- **Escherichia coli**
- The intestines, urinary tract and other body parts of healthy humans and animals are usually home to E.coli bacteria. (most of the time the bacteria lives in your gut)
- https://www.webmd.com/food-recipes/food-poisoning/what-is-e-coli

- **Types of E.coli:**
  - Enterotoxigenic E.coli
  - Enteropathogenic E.coli
  - Enteroaggregative E.coli
  - Enteroinvasive E.coli
  - Diffusely adherent E.coli
  - Enterohemorrhagic E.coli

Symptoms and Signs

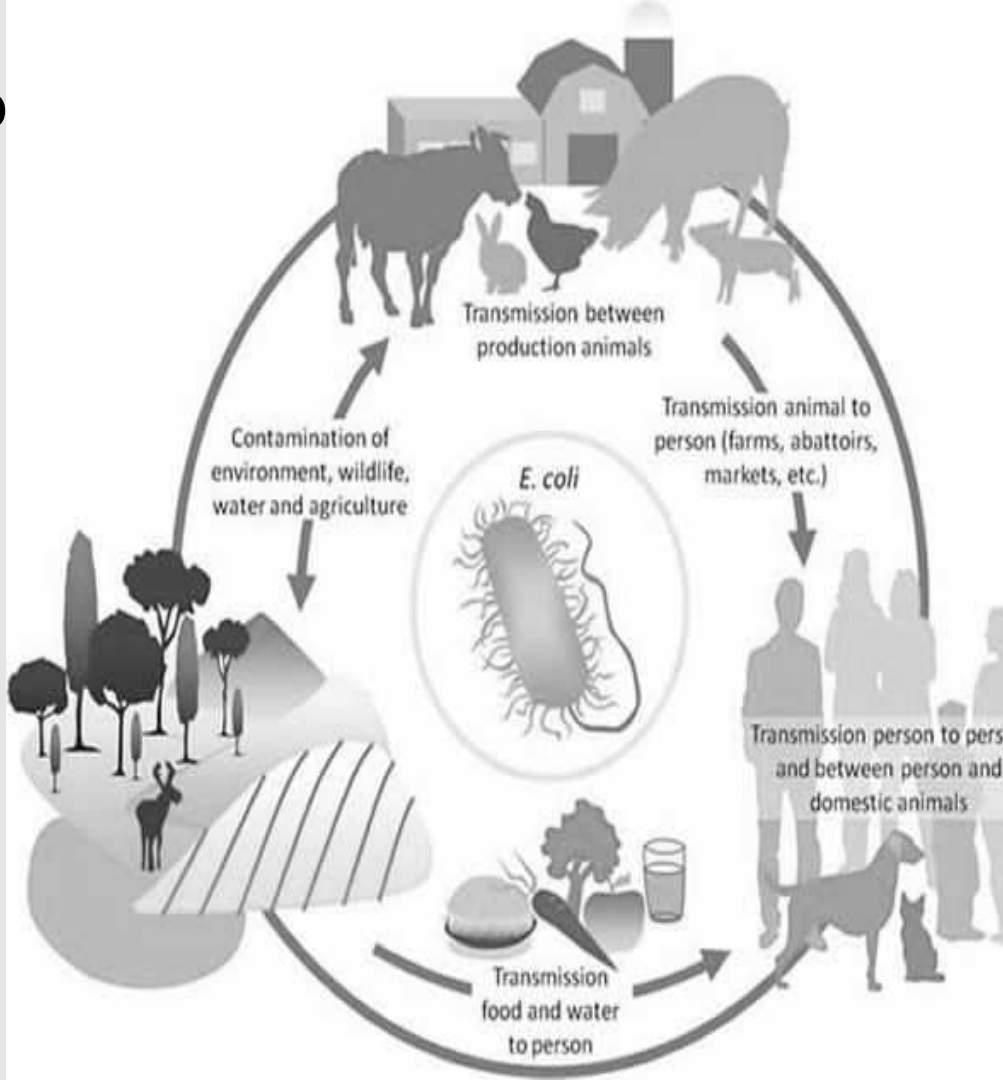
- “Some people sickened by *E. coli* O157:H7 (5-10%) may develop severe complications, including kidney failure or hemolytic uremic syndrome (HUS)”

Infection	Symptoms	Affected Groups	Sources	Common Locations
STEC	Bloody diarrhea, severe cramps, vomiting	Children <5, adults 65+	Contaminated food, water, animals, infected poop	High-income countries
ETEC	Watery diarrhea, cramps, vomiting	Younger adults (18–35), travelers	Contaminated food, water, or ice	Low-income countries
EPEC	Watery diarrhea, low fever, vomiting	Children <1	Infected poop	Low-income countries
EIEC	Watery or bloody diarrhea, fever	Children, travelers	Infected poop	Low-income countries
EAEC	Watery diarrhea (may have mucus), fever	Children, people with HIV, travelers	Uncertain	All income levels
DAEC	Watery diarrhea	Children (3–5 years)	Uncertain	Low-income countries

Sources/Pathways of E.co

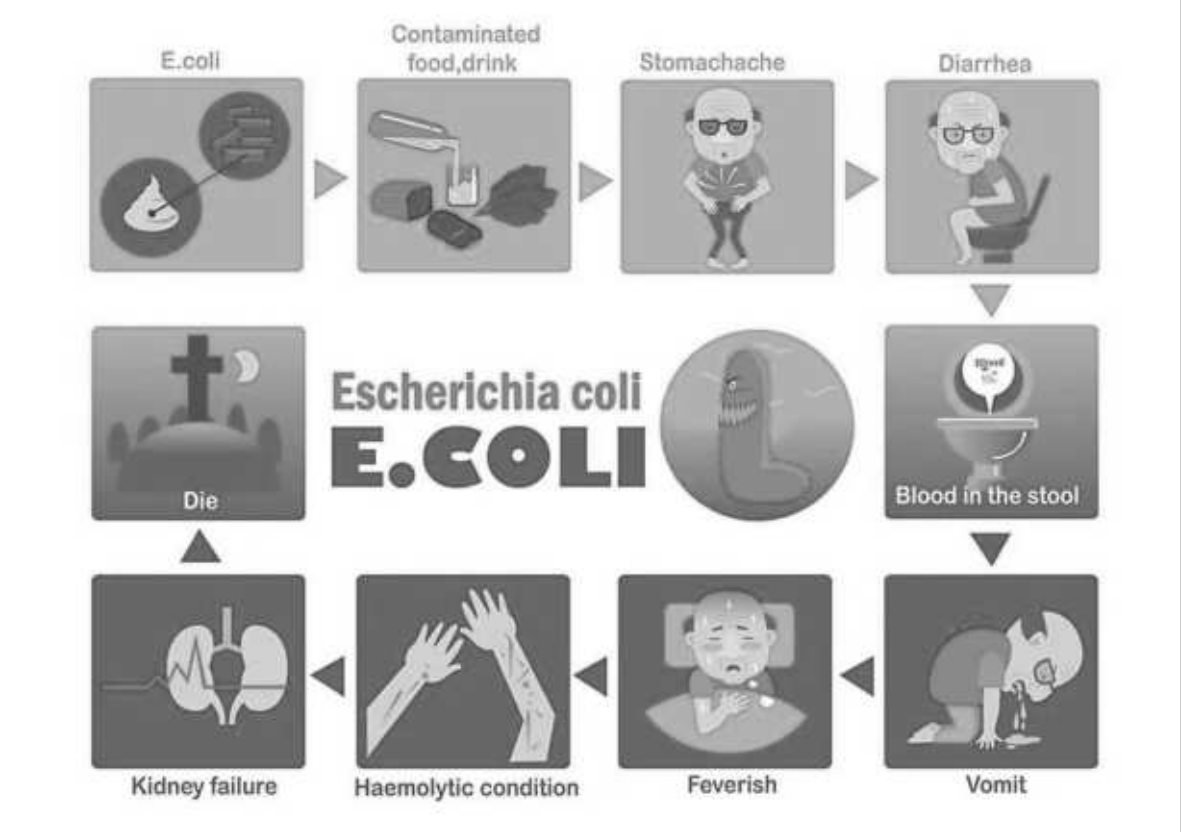
- Contaminated water
- Waste from animals and people
- Contaminated soil
- Untreated milk
- Vegetables/fruits
- Undercooked meat

PRIMARY ROUTE FOR HUMANS



Health risks: Diseases/illnesses

- UTIs
- Renal
- Diarrhea
- Pneumonia
- Travelers diarrhea
- Food poisoning
- Cholecystitis
- Meningitis
- Kidney Failure



Study in the UK: Health Risks in Humans

Infection with *E. coli* O157 can result in a wide spectrum of clinical symptoms, including haemorrhagic colitis (bloody diarrhoea), haemolytic-uraemic syndrome (HUS), non-bloody diarrhoea and thrombotic thrombocytopaenic purpura (TTP) (Su & Brandt, 1995). Haemorrhagic colitis is the commonest symptom typically appearing 1 to 5 days after oral ingestion with most patients recovering within 10 days. However, in a small percentage of susceptible patients (10%), and particularly young children, pregnant women and the elderly, the infection can result in life-threatening complications such as HUS and TTP. After oral consumption, *E. coli* O157 enters the intestines where it attaches firmly to the intestinal mucosa and produces Shiga-like toxins (also termed verocytotoxins). These toxins cause the walls of the intestines to become porous allowing further toxin to enter the bloodstream and induce the clinical manifestation known as HUS. The toxins subsequently damage red blood cells, and blood transfusions are required in more than 70% of HUS cases. In addition, kidney damage occurs from which about 50% of HUS patients suffer acute kidney failure and require dialysis (Siegler, 1995). The excretion of *E. coli* O157 in faeces of infected patients typically lasts for between 60 and 120 days after the onset of infection (Chapman *et al.*, 1997a).

The ramifications for the National Health Service in preventing this life-threatening infection are therefore very considerable, not least in relation to hospitalisation, dialysis and renal transplantation costs. Estimates from the USA indicate that human *E. coli* O157 infections costs the USA between $400 and $900 million annually in medical costs and lost productivity (Roberts & Buzby, 1998). Similar calculations using US health care data indicate that *E. coli* O157 may cost the UK around £30 million annually.

The primary route of *E. coli* O157 infection to humans has been associated with the consumption of contaminated foods and particularly inadequately cooked minced beef and milk either unpasteurised or contaminated post pasteurisation. However, other foodstuffs have also been implicated including fresh fruit and vegetables, unpasteurised fruit juices and water. Some UK cases have also been linked to the ingestion of soil contaminated with cattle manure (e.g. outbreak at the Glastonbury music festival). However, due to

E.Coli outbreak in NC, 2024

By Cassidy Johncox and Luke Tucker
Published: Nov. 14, 2024 at 12:09 PM EST

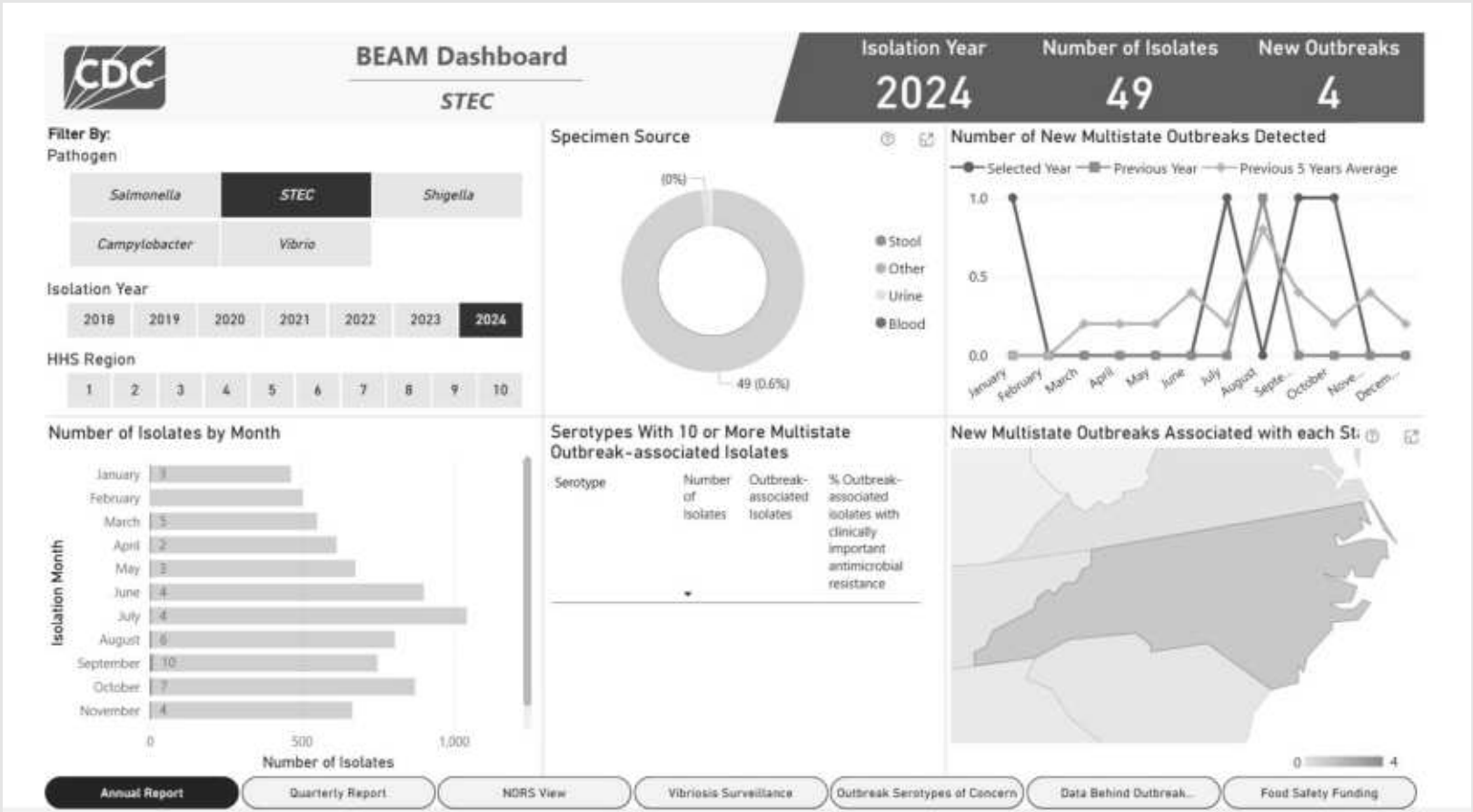
CHARLOTTE, N.C. (WBTV) - A person from North Carolina is among those who got sick from an ongoing E. coli outbreak linked to McDonald's, according to the CDC.

The total number of people across the U.S. sickened in the recent E. coli outbreak rose to 104, according to the CDC's update from Wednesday, Nov. 13. One of those cases was reported in North Carolina -- the state's first case connected with the outbreak.

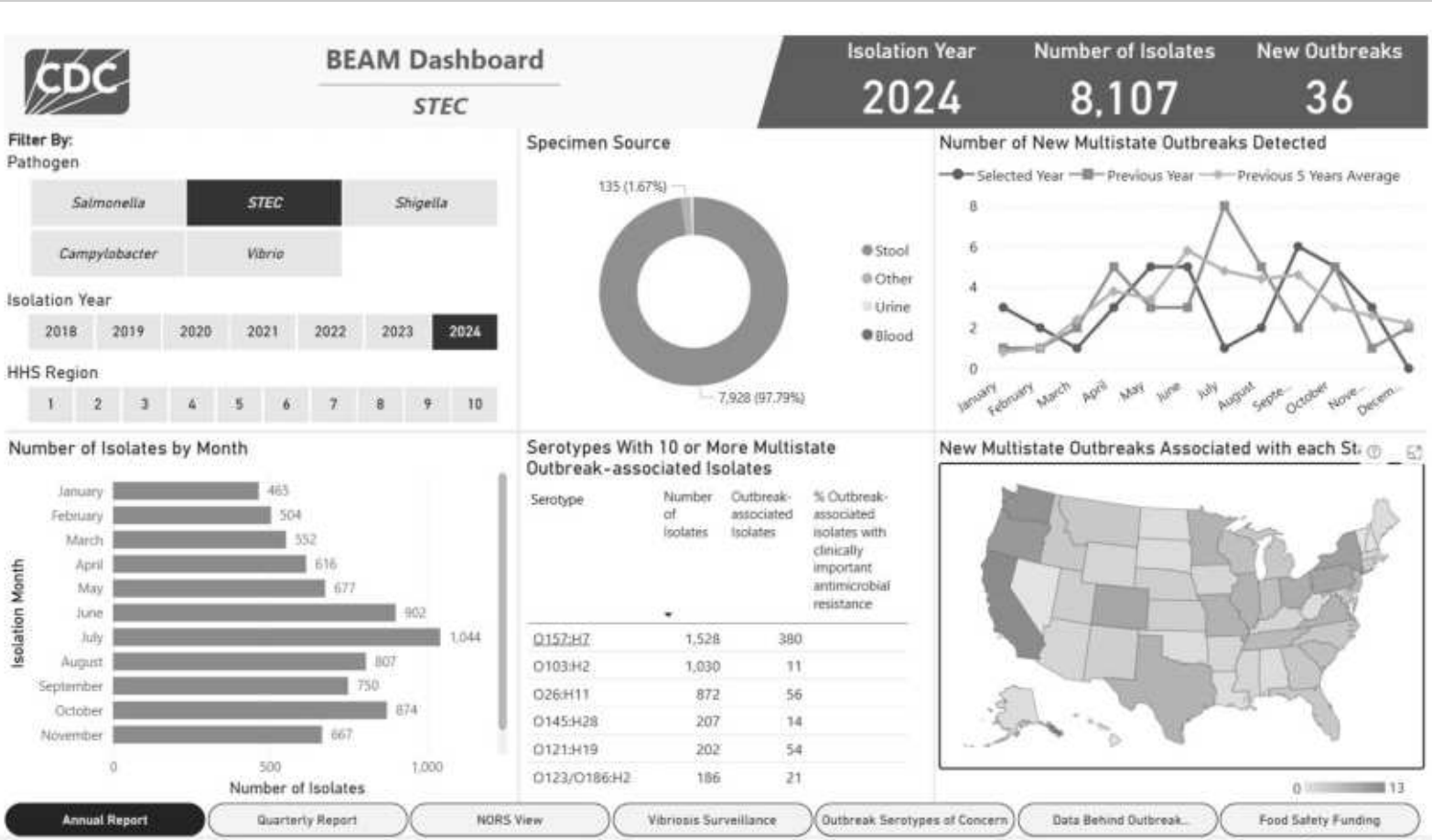
A McDonald's spokesperson says its restaurants in North Carolina are not impacted by the outbreak, however. The CDC counts where sickened people live, but not necessarily where they consumed the contaminated food -- meaning travel could be a factor.

Of the 104 cases of people sick with E. coli in the U.S., one person had died and 34 had required hospitalization. Four people developed HUS, which is a "serious condition that can cause kidney failure," the FDA reported. The older adult in Colorado who died was not among those who developed HUS.

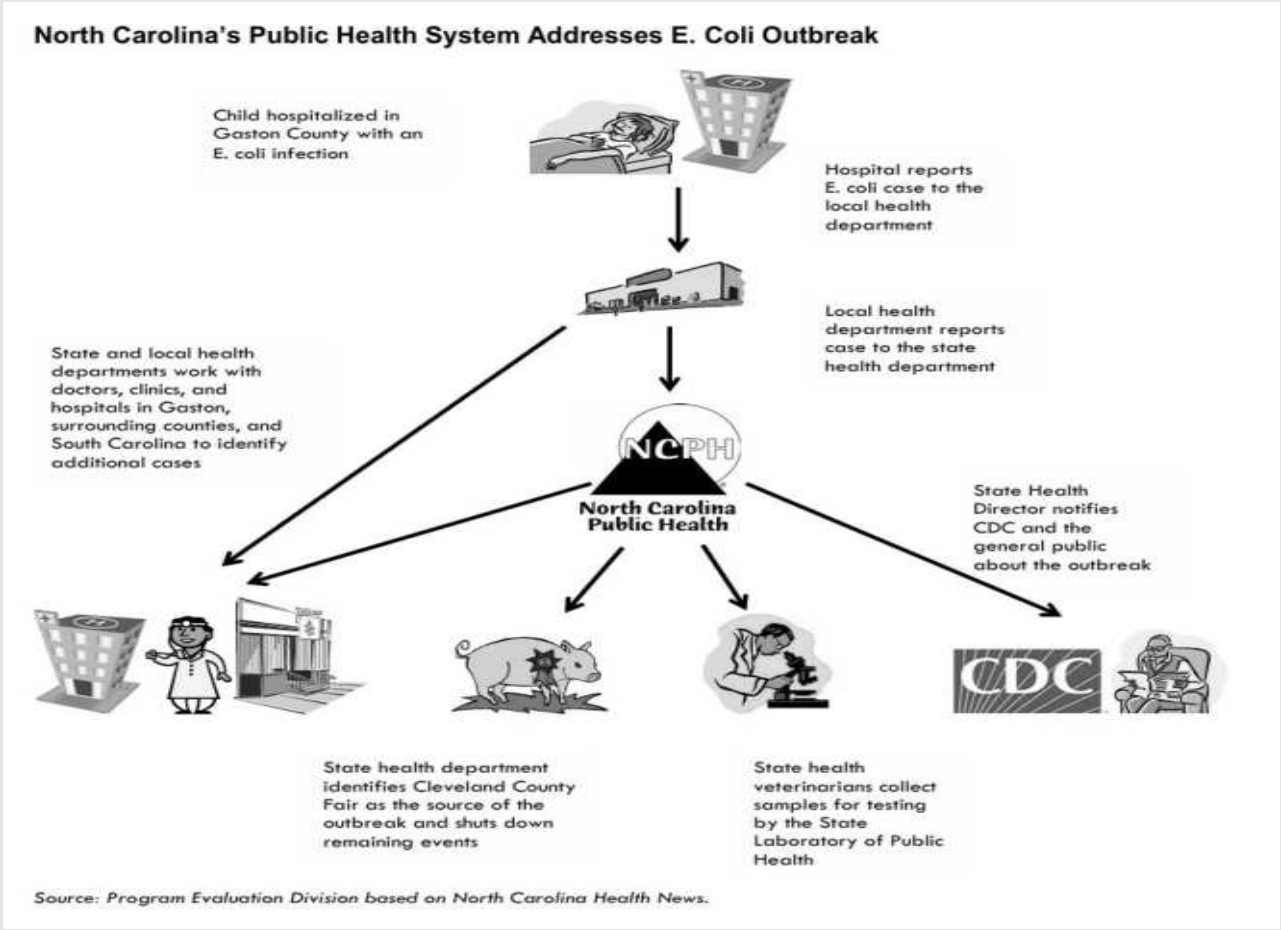
North Carolina STEC cases



STEC cases in the US



How E.coli outbreak is treated by public health?



Policy and regulations for E.coli

- Coliform testing, this is a required to see if there are positive test.
- Repeat sampling, to record the presence of e.coli
- Zero tolerance, there should be no detectable levels of e.coli
- States have to notify the authorities if there have been e.coli found.
- Industries must run a Hazard Analysis Critical Control Points (HACCP) to plan,monitor, and control the potential for a contamination.

1. Go through the proper sampling procedures
2. Taking corrective action(s)
3. If the violation is found, Public notification.

Conclusion

WAYS TO PREVENT E.COLI
WASH HANDS REGULARLY
AVOID PREPARING FOOD IF SICK
DISINFECT SURFACES
MONITOR SYMPTOMS

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EFFECTS OF NEONICOTINOIDS IN POLLINATORS

[redacted]

PESTICIDES OVERVIEW

Pesticides are substances used to prevent, control, or eliminate pests (insects, weeds, fungi, rodents, and bacteria) that can harm crops, humans, animals, or the environment.

Insecticides
Herbicides
Fungicides
Rodenticides
Bactericides
Nematicides
Miticides

NEONICOTINOIDS

A class of insecticides chemically similar to nicotine

Neonicotinoids are widely used in agriculture to protect crops from pests by targeting the insect nervous system. Neonics are absorbed by plants and distributed throughout their tissues, making them effective against insects that feed on leaves, stems, roots, and even pollen or nectar.

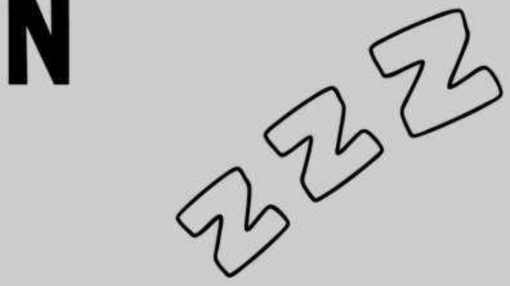
Often used in:

Agriculture
Horticulture
Veterinary Use
Structural Pest Control

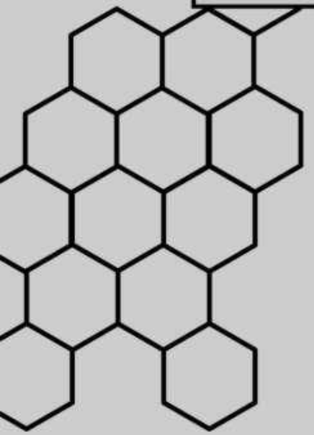
Common Compounds:

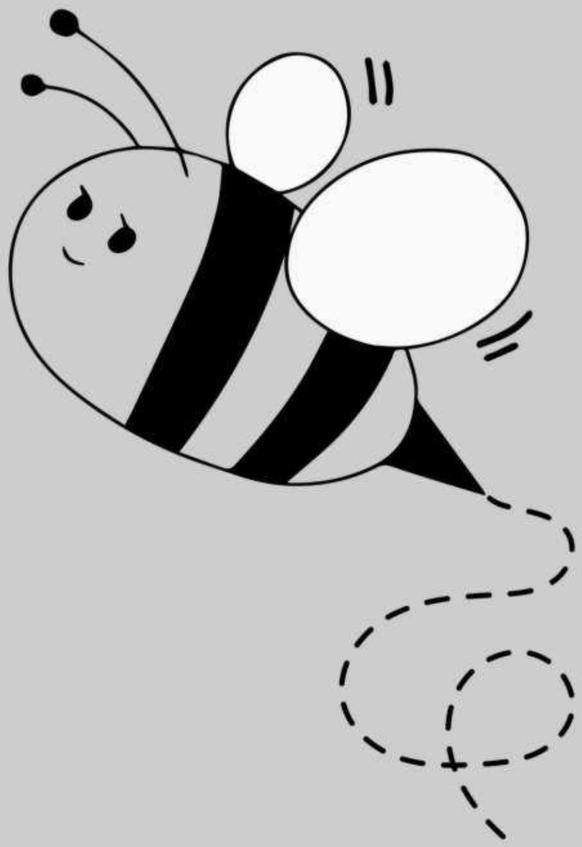
Imidacloprid
Clothianidin
Thiamethoxam
Acetamiprid
Dinotefuran
Nitenpyram

MECHANISM OF TOXICITY IN POLLINATORS



Neonicotinoids primarily affect pollinators like bees by interfering with their nervous system, leading to impaired behavior, reduced survival, and colony decline.





- Targeting the Nervous System
- Sublethal Effects on Pollinators
- Environmental Exposure in Pollinators
- Long-Term Colony Decline

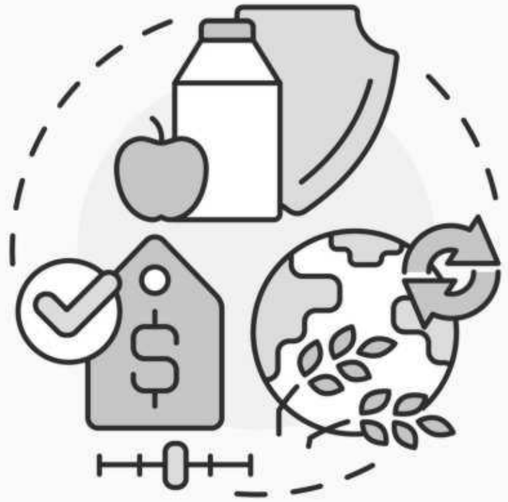
ENVIRONMENTAL CONSEQUENCES

Water Contamination and Aquatic Life

Soil Contamination and Non-targeted Organisms

Disruption of Ecosystem Services

HUMAN IMPACTS



Food security risks

Agricultural losses

Human health risks

Table 3: Summary of toxicity data for neonicotinoids

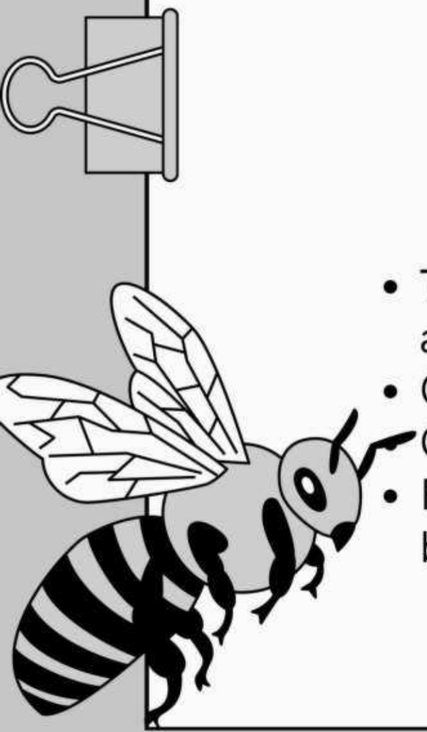
Health Issue	Acetamiprid	Clothianidin	Dinotefuran	Imidacloprid	Nitenpyram	Thiacloprid	Thiamethoxam
Carcinogen	No	No	No	No	No Data	Possible	No
Genotoxic							
Chromosome Aberration	No Data	No Data	No Data	Negative	No Data	Negative	Negative
DNA Damage/Repair	No Data	No Data	No Data	Negative	No Data	No Data	Negative
Gene Mutation	No Data	No Data	No Data	Negative	No Data	No Data	Negative
Genome Mutation	No Data	No Data	No Data	Negative	No Data	No Data	No Data
Unspecified Genotoxicity	Negative	Negative	No Data	Mixed	No Data	Negative	No Data
Endocrine Disruption	No Data	Possible	No Data	No Data	No Data	Yes	No
Reproduction/ Development Effects	No	Possible	Possible	Yes	No	Yes	No
Cholinesterase Inhibition	No	No	No	No	No Data	No	No
Neurotoxicant	No	Yes	No	Possible	No Data	Yes	No
Respiratory Tract Irritant	No	No	No Data	No	Yes	No	No
Skin Irritant	Yes	No	Possible	Possible	No	Yes	Possible
Skin Sensitizer	No Data	No Data	No Data	No Data	No Data	No	No Data
Eye Irritant	Possible	No	Yes	Possible	Yes	Yes	No
Phototoxicant	No Data	No Data	No Data	No Data	No Data	No	No Data
General Health Comments	N/A	Effects consistent with endocrine disruption noted in rodents / dogs. May cause low blood pressure, hypothermia, and impaired pupillary function	N/A	Moderately toxic. Potential liver, kidney, thyroid, heart and spleen toxicant	N/A	Possible liver and thyroid toxicant. Probable human carcinogen	Increased incidence of liver cell adenoma and adenocarcinoma in mice

Yes = Known to cause a problem; No = Known to not cause a problem; Possible = Status has not been identified

Table adapted from Kathleen A. Lewis, et al., *Human and Ecological Risk Assessment*, 2016. 22(4): p. 1050-1064.[17]

CASE STUDY: NEONICOTINOID PESTICIDES CAUSE MASS FATALITIES OF NATIVE BUMBLE BEES: A CASE STUDY FROM WILSONVILLE, OREGON, UNITED STATES

- June 2013 in Wilsonville Oregon
- 45,830-107,470 bumble bees from 289 - 596 colonies were killed.
- LC50 concentration exceeded by over 737%



METHODS

- Tissue samples for pesticide analysis.
- Genetic analysis.
GIS mapping.
- Pesticide concentration in bumble bees and flower tissues

RESULTS

- High concentrations of dinotefuran in both bumble bees and linden flowers
- Bumble bee = 0.92 ppm of dinotefuran
- Pesticide application violated state pesticide regulations

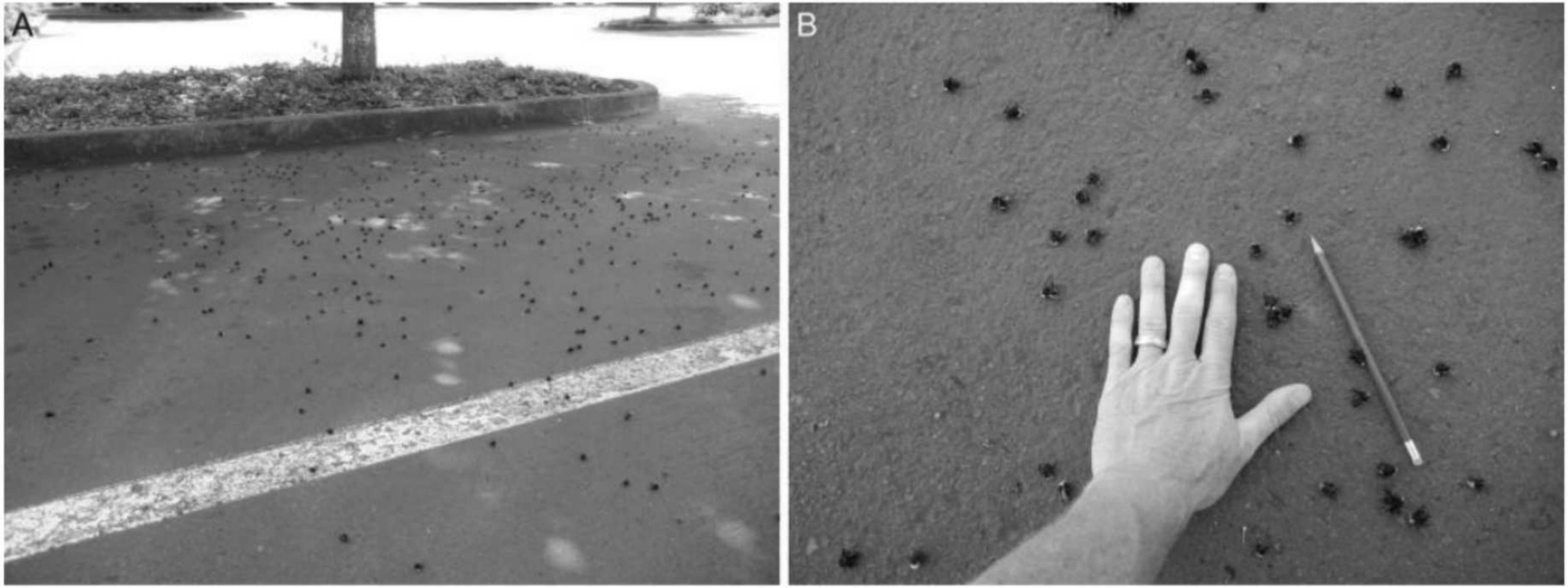


Fig. 2. Photographs of (A) *B. vosnesenskii* carcasses and (B) estimated density due to ingestion dinotefuran pesticide in a shopping center parking lot in Wilsonville, Oregon.

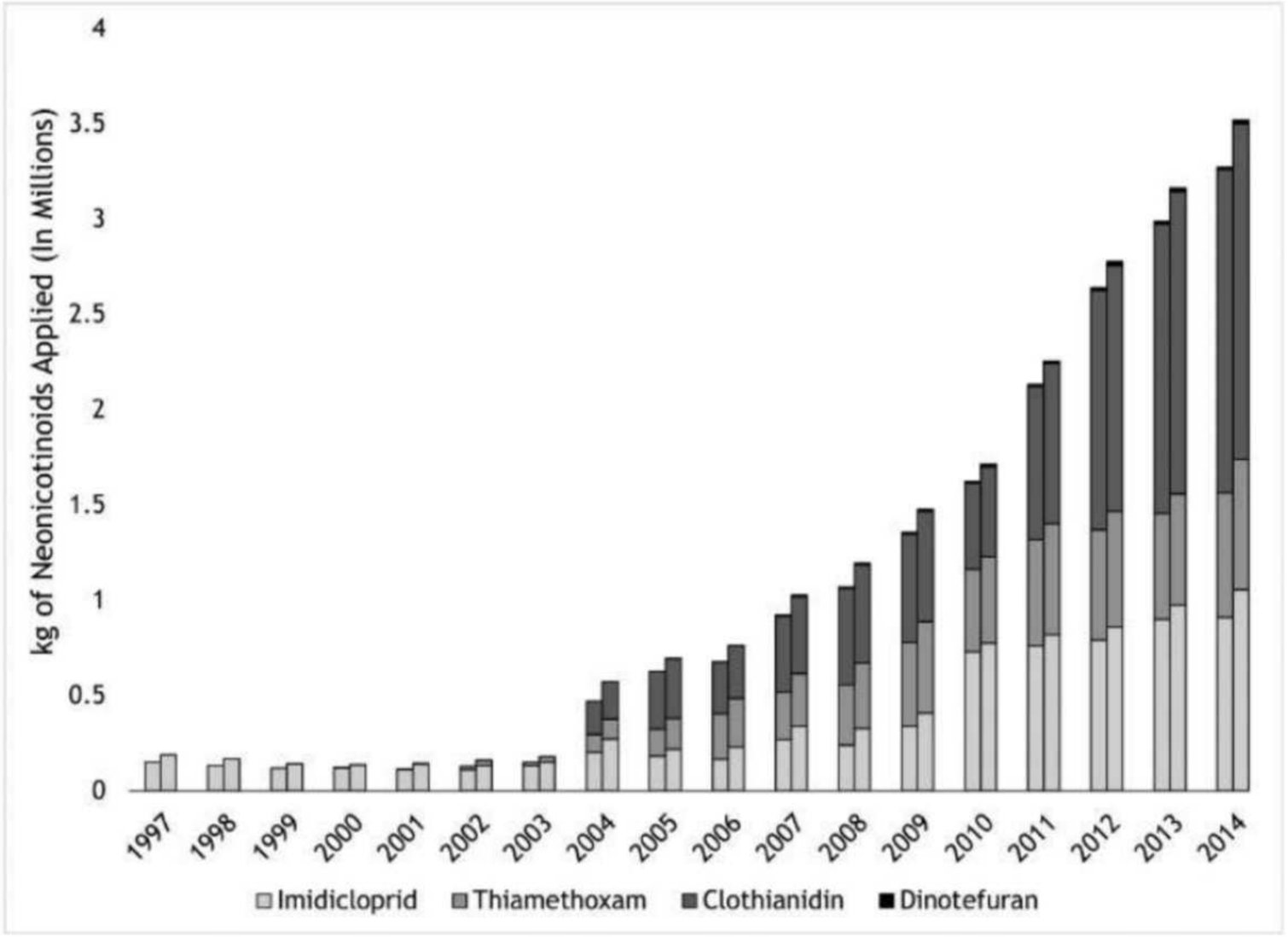


Fig. 1. Nitroguanidine neonicotinoid use in the United States by year in kg (Left: EPest-low, Right: Epest high) (Data: Baker and Stone 2015; Baker 2015, 2016; Thelin and Stone 2013).

REGULATIONS

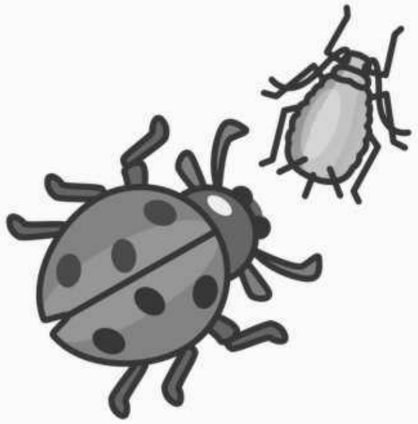
US REGULATIONS

Fast-tracking its review due to concerns about pollinators and human health.

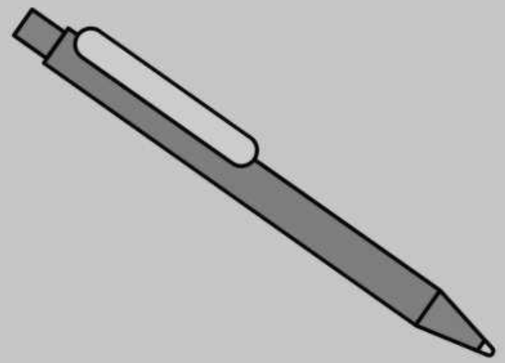
EU REGULATIONS

May 2018, EU completely banned the outdoor use of neonicotinoids

ALTERNATIVES

Integrated Pest Management (IPM)	Use of biological control agents	Development of pollinator-frinedly farming practices
		

QUESTIONS?



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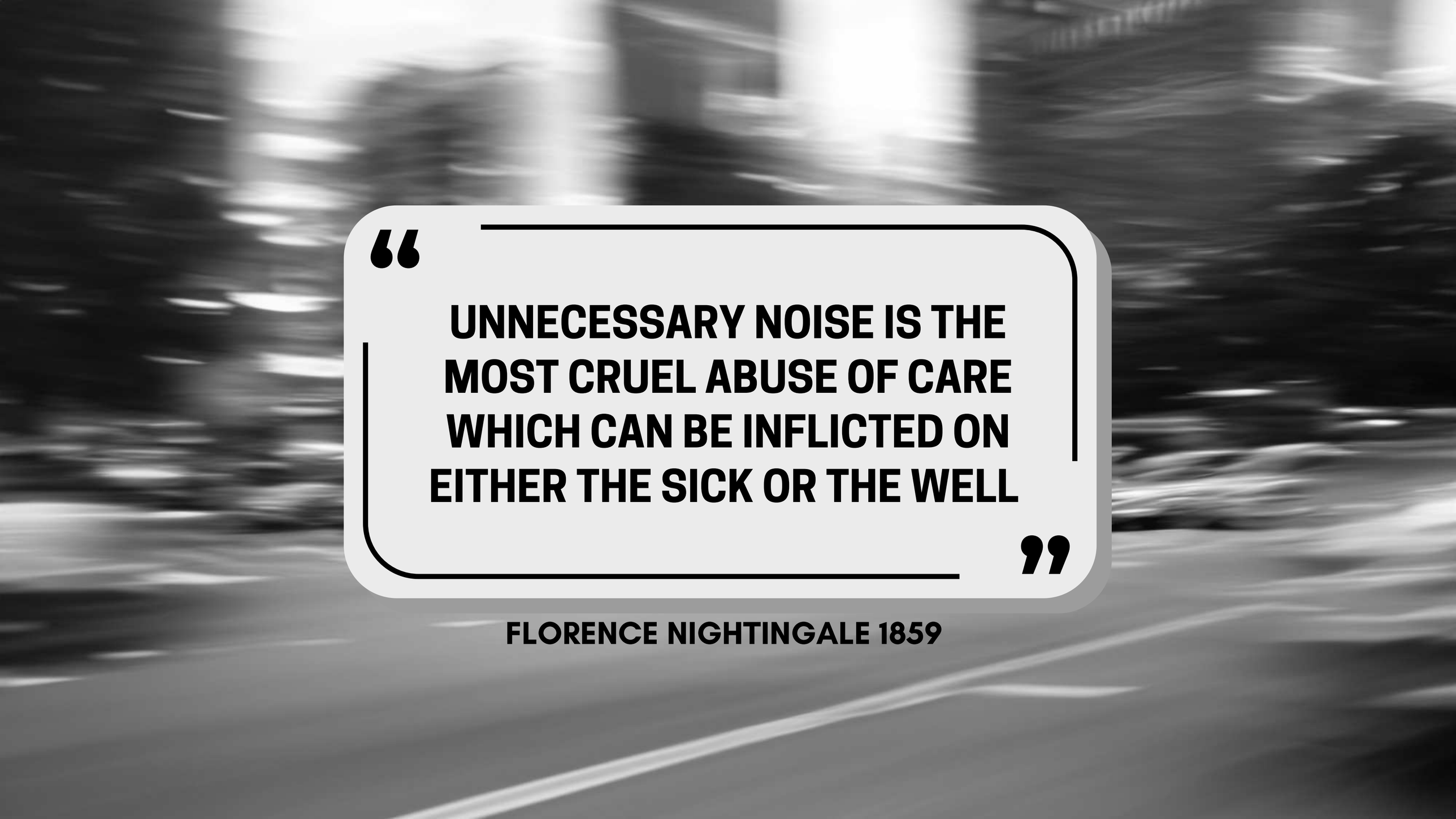
RISK ASSESAMENT & MANAGEMENT:
NOISE POLLUTION

BIO 424


“
UNNECESSARY NOISE IS THE MOST CRUEL ABUSE OF CARE WHICH CAN BE INFLICTED ON EITHER THE SICK OR THE WELL
”
FLORENCE NIGHTINGALE 1859

NOISE POLLUTION:

Unwanted or excessive sound that can negatively impact human health and the environment.

Sources:

- Traffic
- Construction
- Industrial activities

Air pollution

Major problem in cities around the world.

HEALTH EFFECTS:

Noise produces direct and cummulative adverse effects that impair health and degrade residential, social, and working environments:

- Economic losses
- Well-being losses

Similar effect as chronic stress

WHO categories of adverse health effects of noise pollution on humans:

HEARING IMPAIRMENT

NEGATIVE SOCIAL BEHAVIOR

INTERFERENCE WITH SPOKEN COMMUNICATION

SLEEP DISTURBANCES

CARDIO VASCULAR DISTURBANCES

MENTAL HEALTH DISTURBANCES

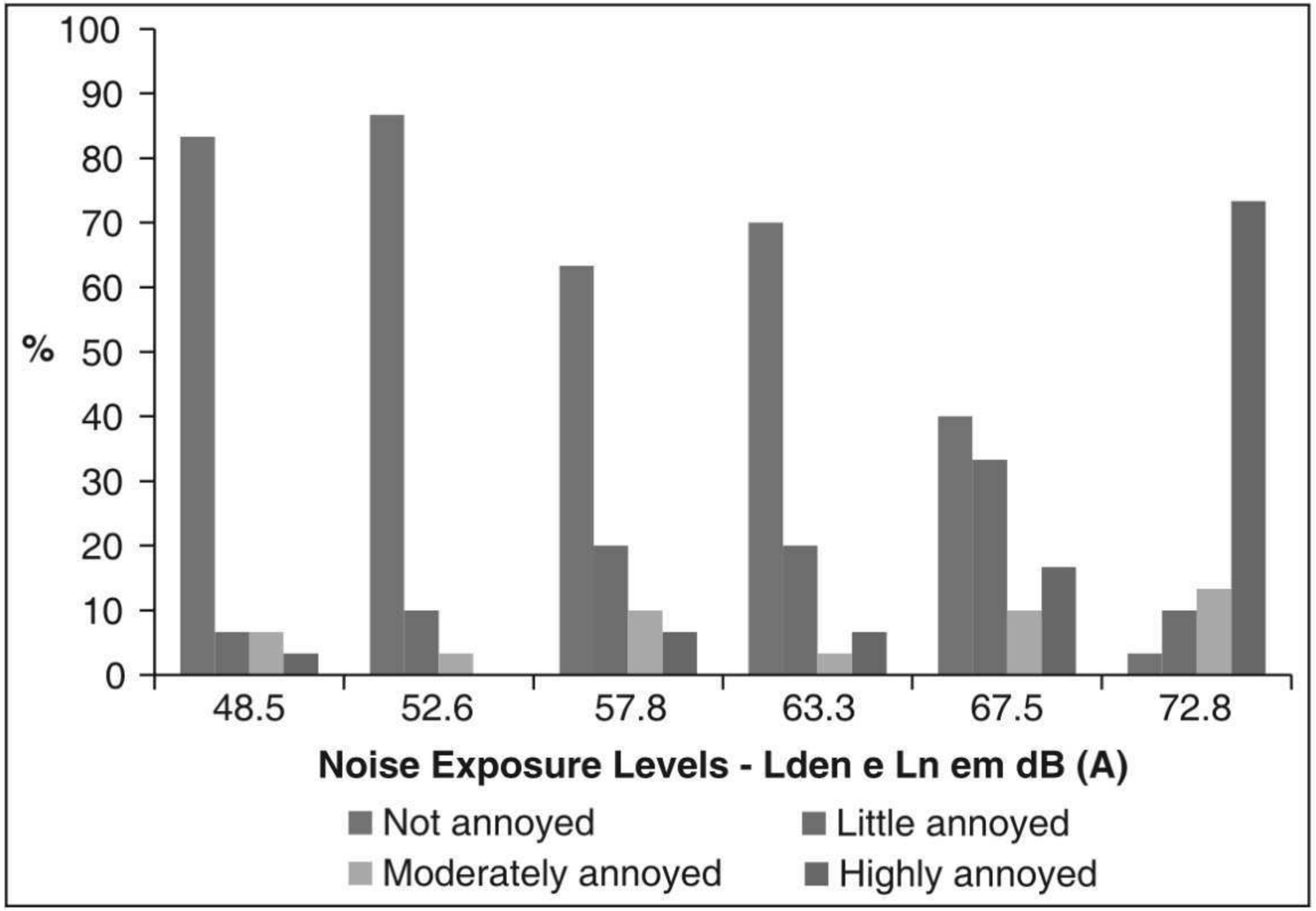


Figure 8: Annoyance in relation to noise exposure (Lden e Ln). Porto, Portugal, 2012

(DE PAIVA VIANNA ET AL., 2015)

CASE STUDY

RISK ASSESSMENT FOR PUBLIC HEALTH FOR TRANSPORTATION NOISE IN THE CITY OF BELGOROD (RUSSIA)

Growth of territory and population.

Federal Services for Surveillance on Consumer Rights Protection and Human Wellbeing has noted an increasing number of complaints from the public about road traffic noise.

Assessment, modelling, and calculation of risks study

(SEMEYKIN, 2018)

Risk Assessment

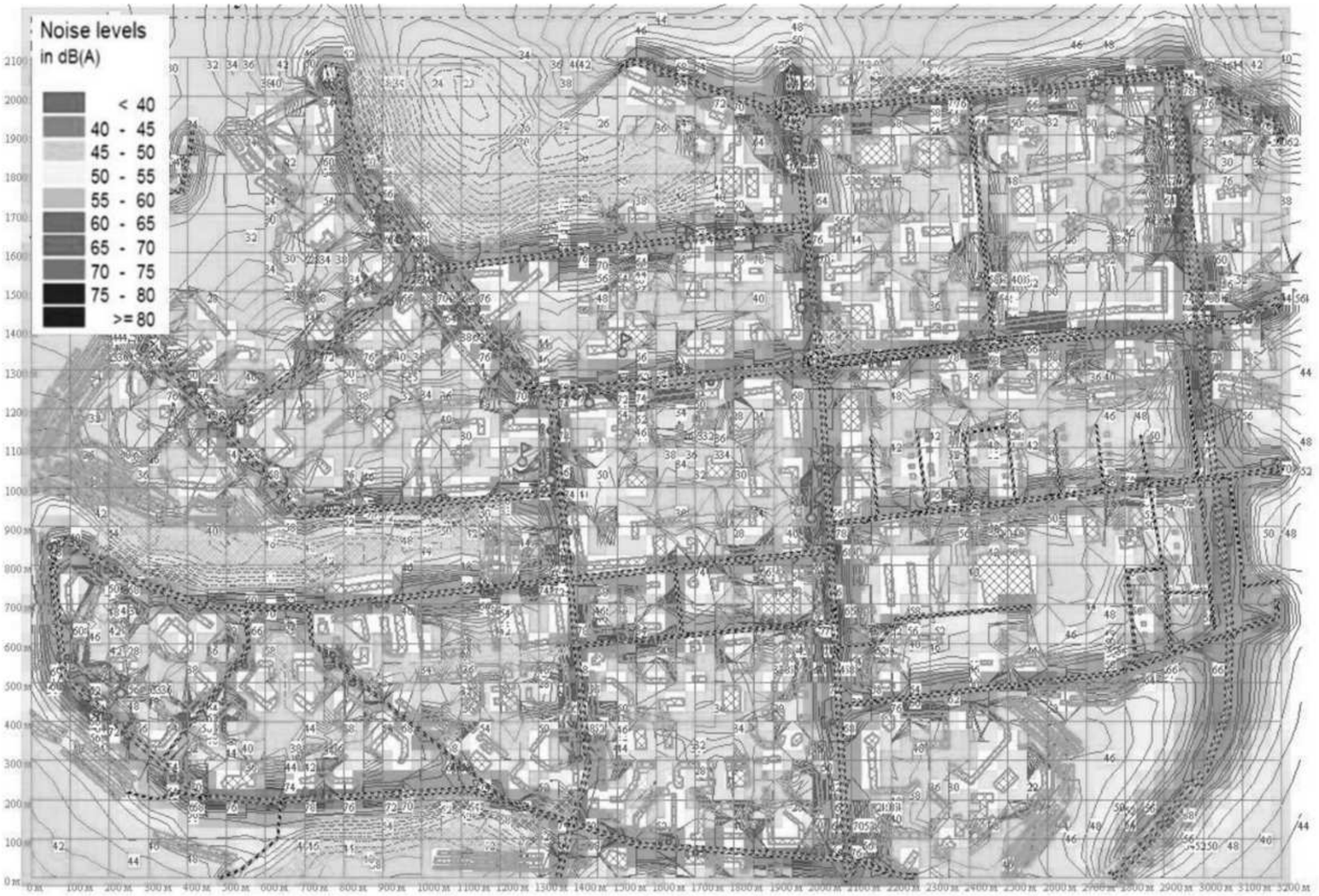
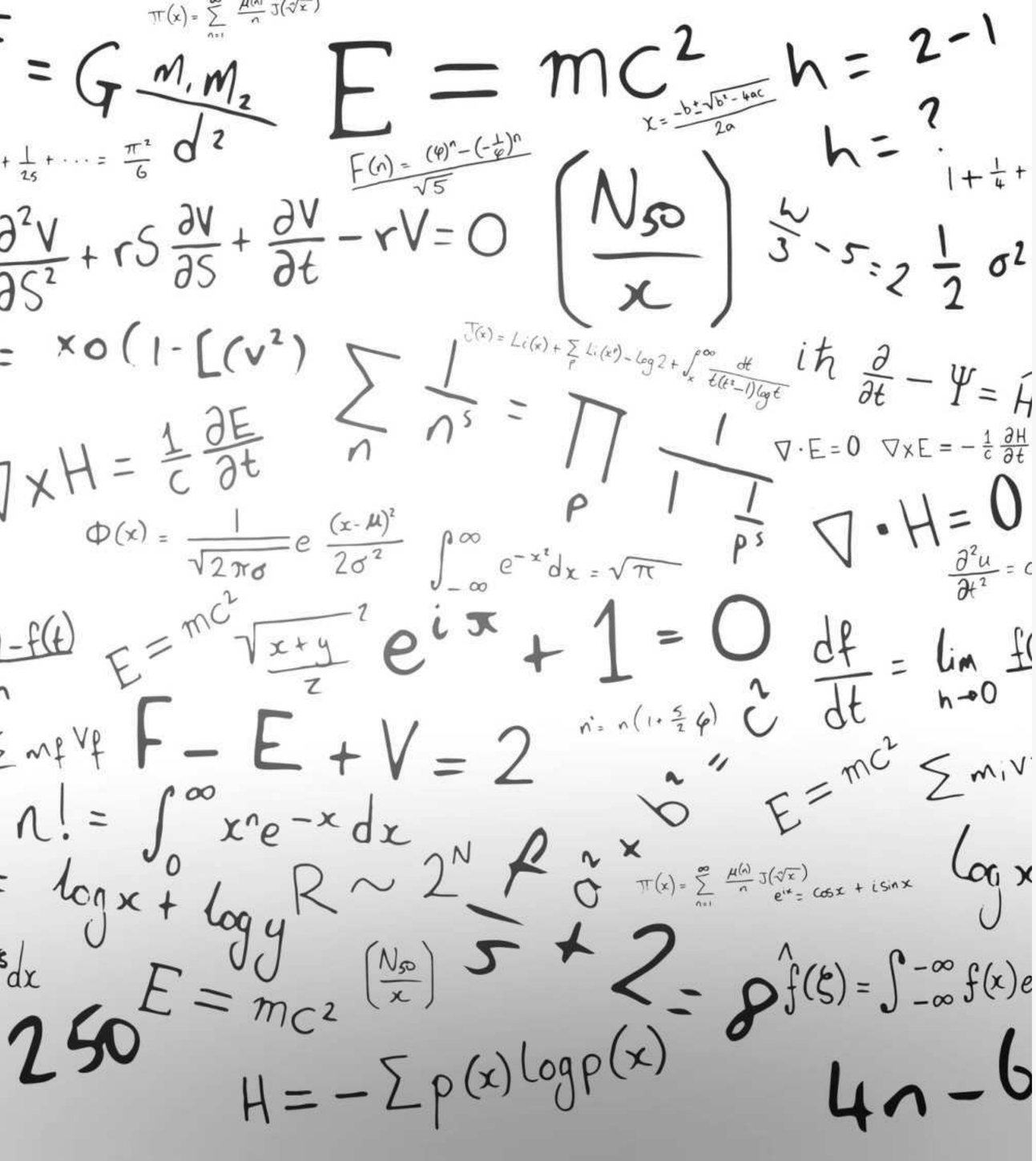


Figure 3. Noise map of the Southern district of Belgorod

Calculations followed MR 2.1.10.0059-12 guidelines.

Noise maps were constructed and high risk areas were identified.



With the use of mathematical models of risk, the trend of the formation of moderate and high risk was determined.

R values were calculated:

- R < 0.05 → low risk
- R 0.05 - 0.35 → moderate risk
- R 0.35 - 0.6 → high risk

Population:
26% → low risk
65% → moderate risk
9% → high risk

Measures to reduce noise polllution in the city are needed.

Policy
REGULATION

NOISE CONTROL ACT:1972

- Established a means for effective coordination of Federal research and activities in noise control
- Provided the establishment of Federal Nosie emission Standards for products that are distributed in commerce
- Provide information to the public respecting the noise emission and noise reduction characteristics of such products.

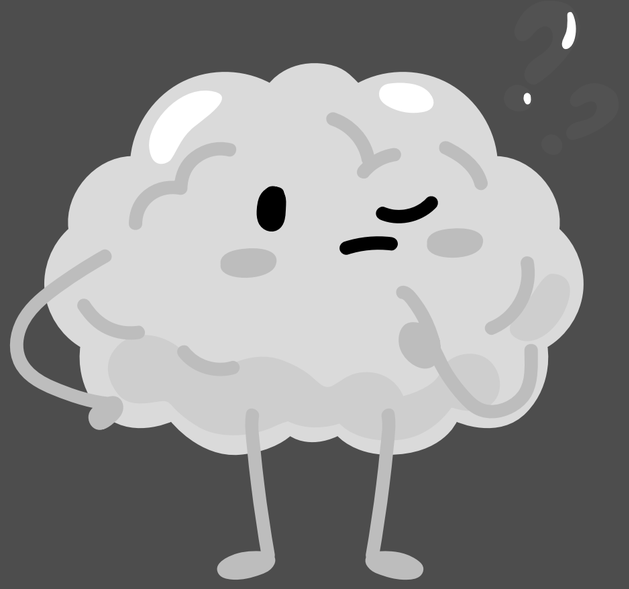
Possible

SOLUTIONS

- Smoother roads
- Use noise-absorbing materials
- Promoting quieter transportation
- Using loud devices responsibly
- Sound planning

THANK YOU!

QUESTIONS?



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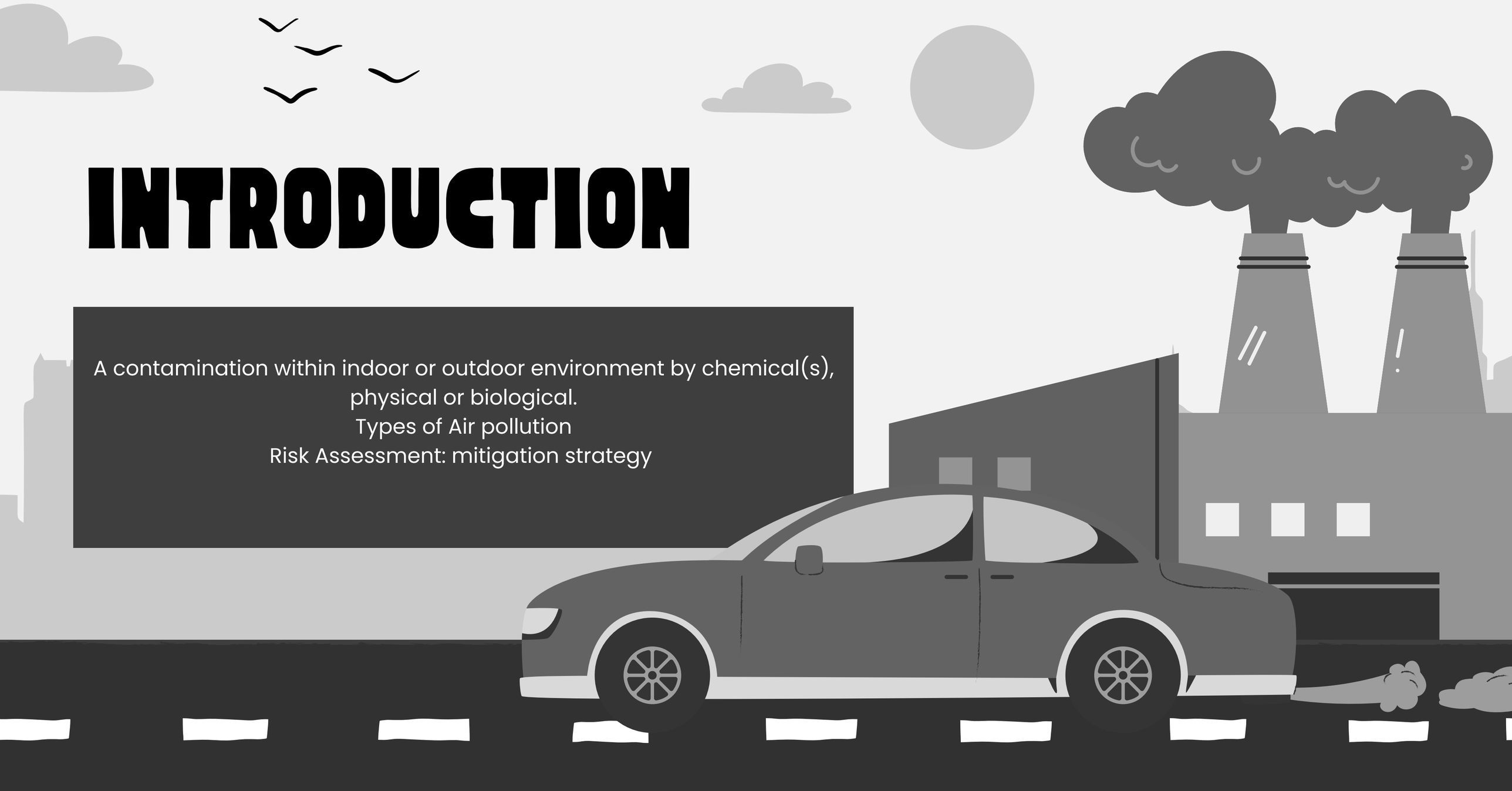
RISK ASSESSMENT OF AIR POLLUTION IN URBAN AREAS

INTRODUCTION

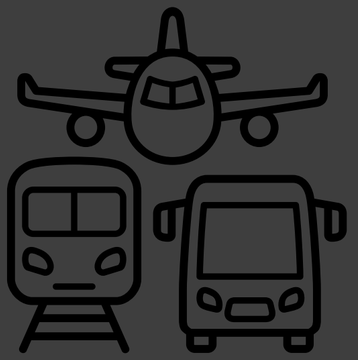
A contamination within indoor or outdoor environment by chemical(s), physical or biological.
Types of Air pollution
Risk Assessment: mitigation strategy



TYPES OF AIR POLLUTION

INDOOR

TRANSPORTATION



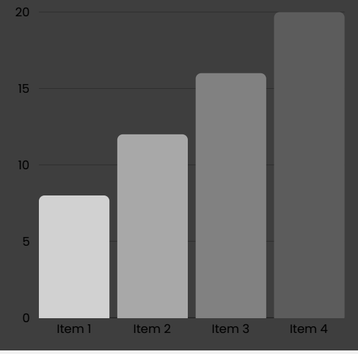
AGRICULTURE

INDUSTRIAL

STEPS OF RISK ASSESMENT

HAZARD IDENTIFICATION

EXPOSURE ASSESSMENT



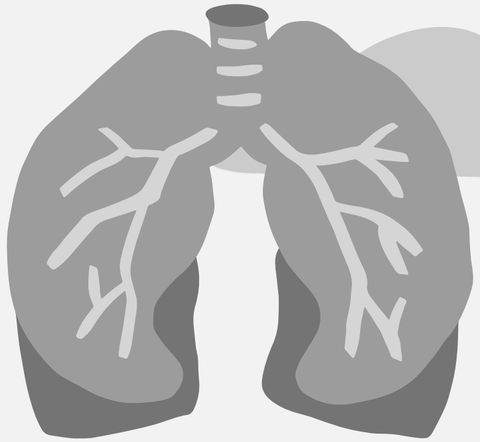
DOSE RESPONSE ASSESSMENT

RISK CHARACTERIZATION

HUMAN IMPACT

Exposure of air pollution

- respiratory issue
- development of cardio vascular disease
- premature death (babies or elderly)
- increased issuses of asthma



Chronic obstructive pulmonary disease: irreversible air flow obstruction which if exposed for a long time will increase

RISK MANAGEMENT STRATEGIES

MITIGATION STRATEGIES

+

PREVENTIVE MEASURES

IMPORTANCE OF RISK COMMUNICATION

IQAir

Technical knowledge is not helpful if people don’t understand it.

- Be transparent
- Use clear and simple language
- Address uncertainty

CASE STUDY: POWER PLANTS AND POPULATION SUSCEPTIBILITY IN WASHINGTON DC

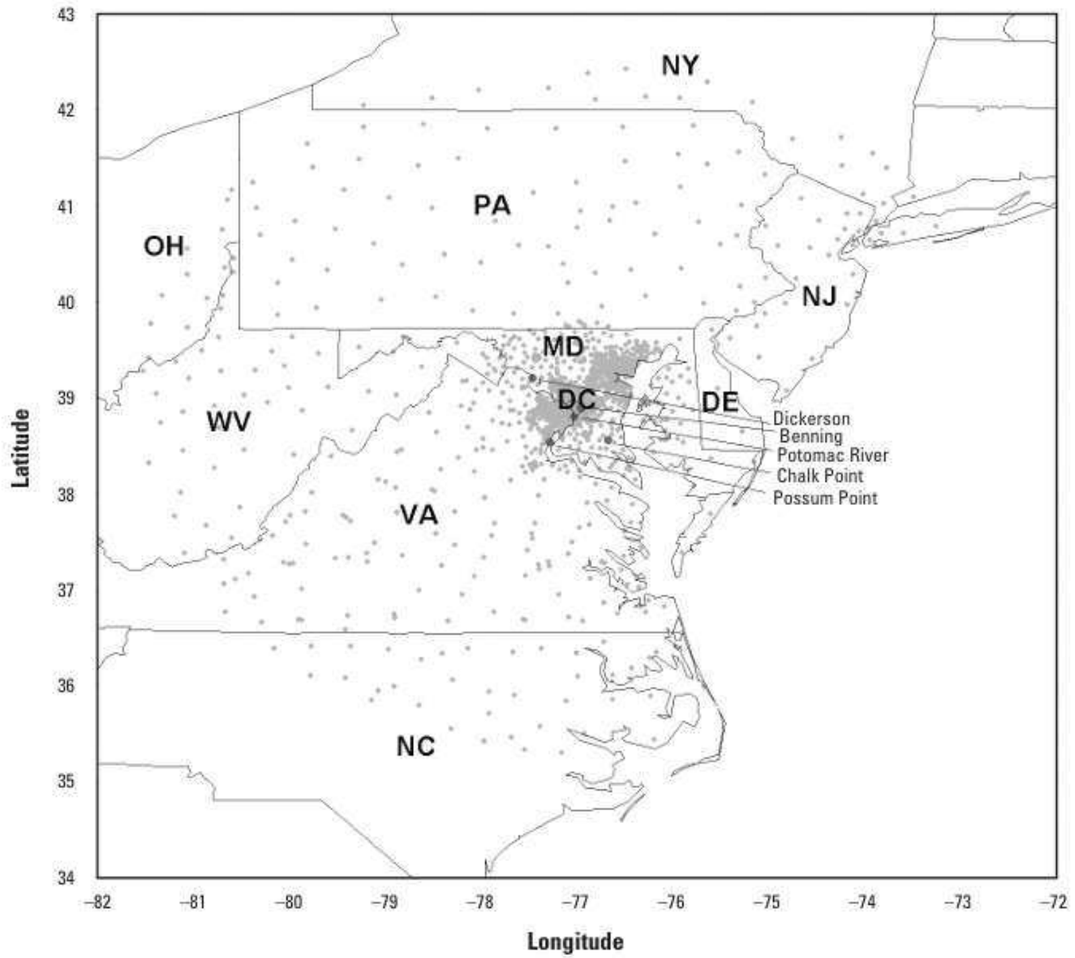


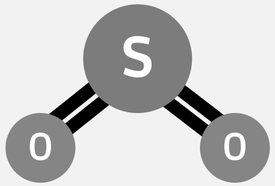
Figure 1. Receptor grid and power plant locations for Washington, DC, case study.

This case study focused at the health benefits of reducing air pollution from five older fossil-fueled power plants located within 50 miles of Washington, DC.

HEALTH IMPACTS MODELED

ROLE OF POPULATION SUSCEPTIBILITY

RESULTS



NO_2

Table 1. Characteristics of five power plants in Washington, DC, case study (1999 data).

Characteristics	Benning	Chalk Point	Dickerson	Possum Point	Potomac River
Initial year of commercial operation	1968	1964	1959	1948	1949
Nameplate capacity (megawatts)	580	2,046	588	1,373	514
Heat input (MMBTU)	3,304,107	85,352,274	33,592,811	28,930,805	32,100,184
Emissions, tons (% per quarter)					
SO_2	1,432 (2, 21, 76, 2)	57,630 (21, 25, 31, 23)	30,637 (30, 17, 34, 18)	19,497 (24, 22, 32, 23)	17,627 (22, 28, 29, 21)
NO_x	447 (2, 22, 74, 1)	25,222 (20, 24, 30, 26)	10,709 (30, 17, 34, 18)	5,116 (25, 22, 32, 21)	6,893 (21, 28, 30, 21)
$PM_{2.5}$	12 (2, 22, 74, 2)	304 (21, 27, 33, 20)	14 (30, 17, 34, 18)	156 (23, 20, 37, 20)	106 (21, 28, 29, 22)

Table 2. Magnitude and distribution of health benefits associated with modeled emission reductions at five power plants near Washington, DC.

Health outcome and stratification covariate	Baseline model (No stratification)	Full susceptibility model (Stratification by listed covariate)
Deaths/year		
Total	210	240
< High school education	52	120
≥ High school education	150	120
CHA/year		
Total	59	60
Diabetic	8	33
Nondiabetic	51	27
Asthma ERV/year		
Total	140	160
African American	38	100
Non-African American	100	57

Data presented are rounded to two significant figures; sums may not add because of rounding.

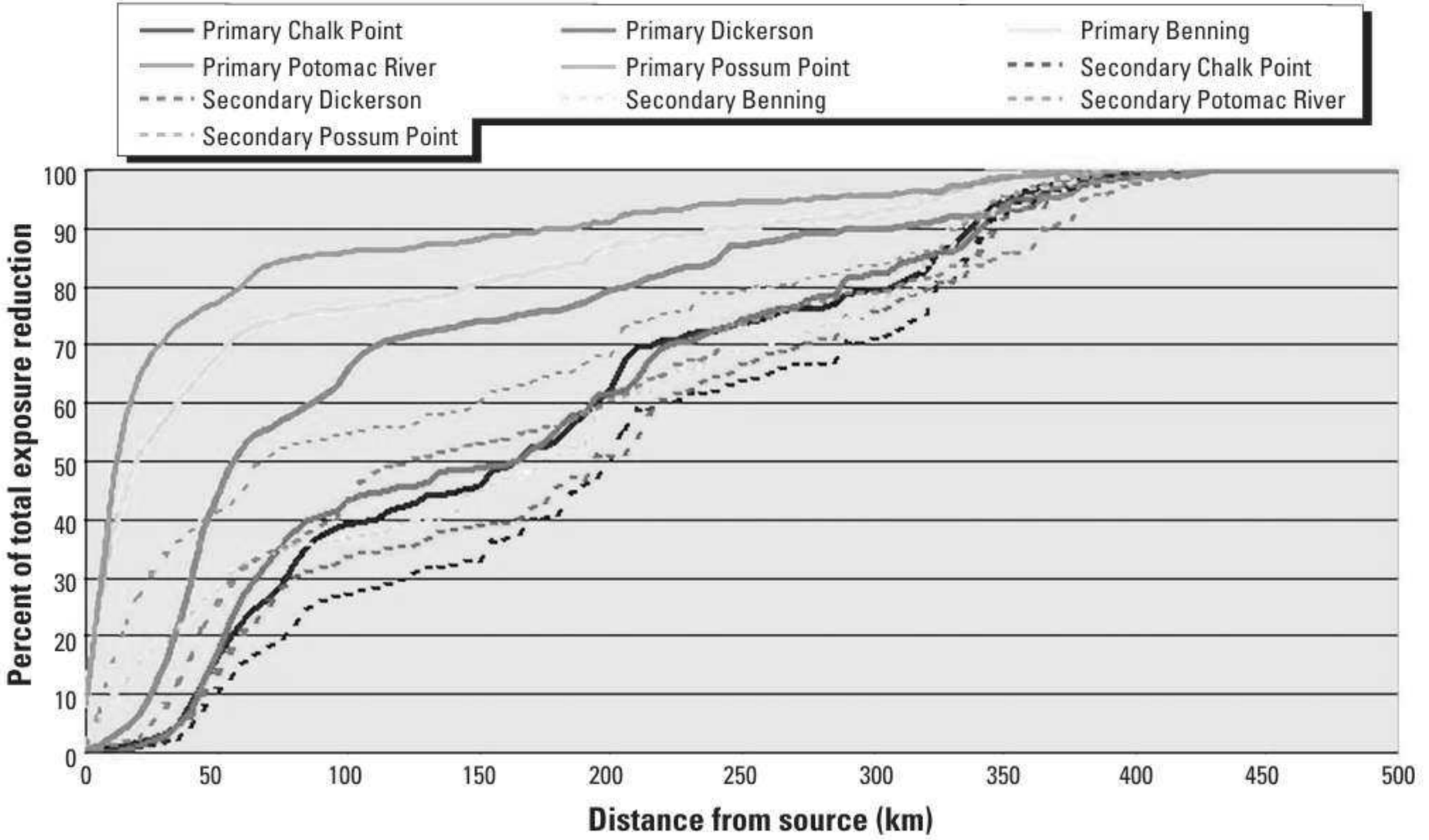


Figure 3. Cumulative distribution of total exposure reduction as a function of distance from the source, by power plant and pollutant type.

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https://www3.epa.gov/airtoxics/3_90_024.html https://oehha.ca.gov/air
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https://unisonenergy.dk/en/vedvarende-energy
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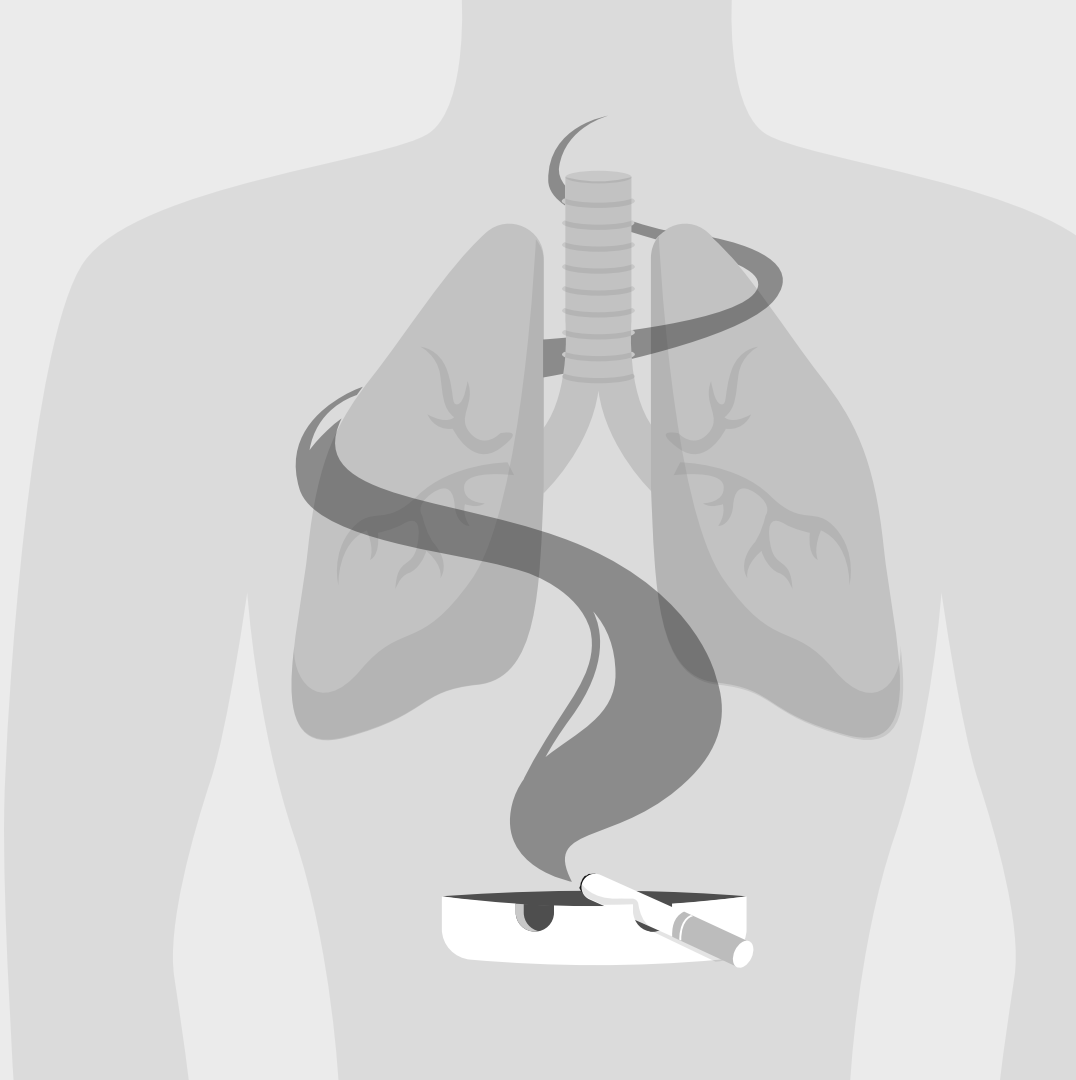
https://www.epa.gov/ghgemissions/overview-greenhouse-gases

QUESTIONS?

Tobacco Use: Environmental & Health Impact

BIO 424 [redacted]



Background Information

- Consumption of tobacco traces back to 600 AD (Thiruppathy et al., 2019)
- Native to the Americas
- Now cultivated most in China, followed by Brazil, India, the US, and Malawi (Riquinho and Hennington, 2012)
- Was brought to Europe by Columbus from the Caribbeans (Thiruppathy et al., 2019)
- WHO estimates 100 million premature deaths from tobacco in 20th century and 7 million/year (Thiruppathy et al., 2019)

Context: (Carli, 2022)
1 cigarette = ~1 g; 1 lb cigarettes = ~453 cigarettes

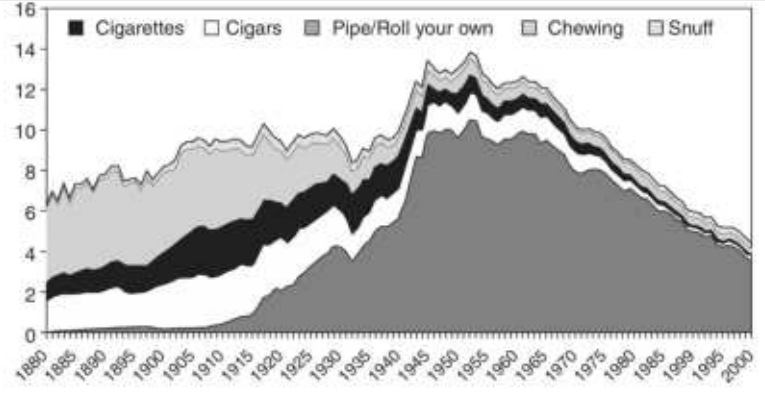
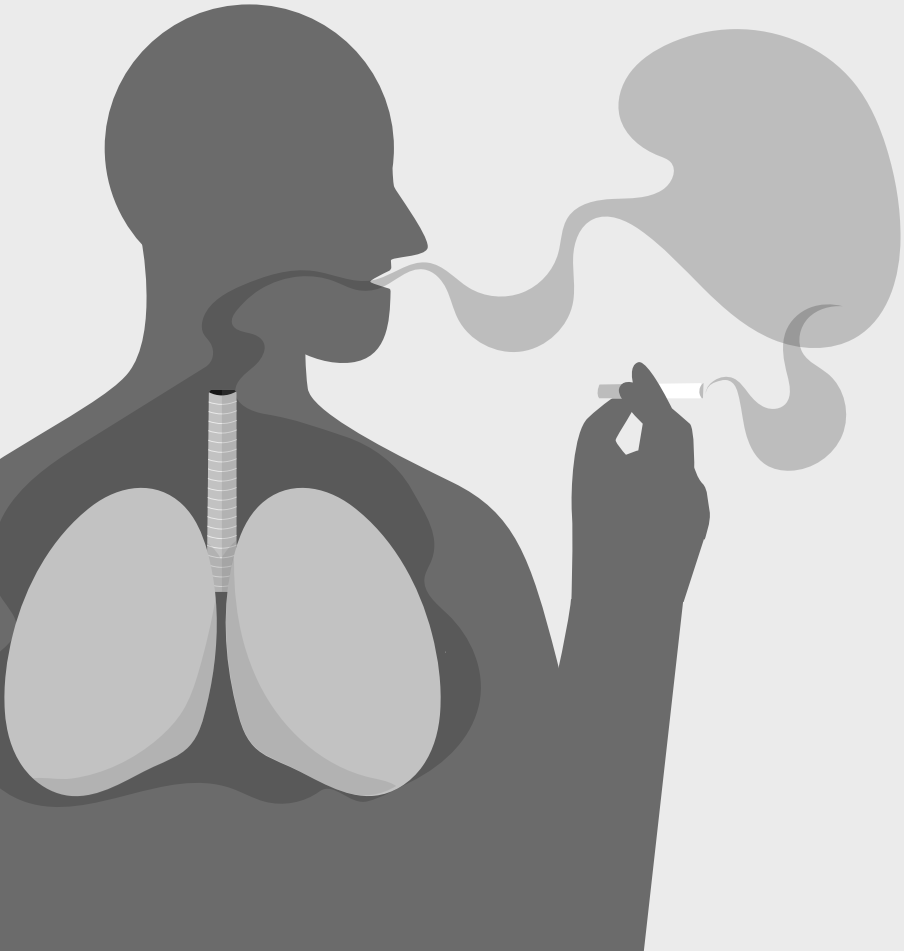


FIGURE 13.2. Per capita consumption of various tobacco products (in pounds)—United States, 1880-2000. *Source:* Tobacco Situation and Outlook Report, U.S. Department of Agriculture, U.S. Census. Adapted from Gerlach et al. (1998). Courtesy of Gary Giovino. *Note:* Among persons >18 years old. Beginning in 1982, fine-cut chewing tobacco was reclassified as snuff.

(Foulds et al., 2012)



“The continued popularity of tobacco smoking appears to defy rational explanation. Smokers mostly acknowledge the harm they are doing to themselves and many report that they do not enjoy it – yet they continue to smoke”
(West, 2017)

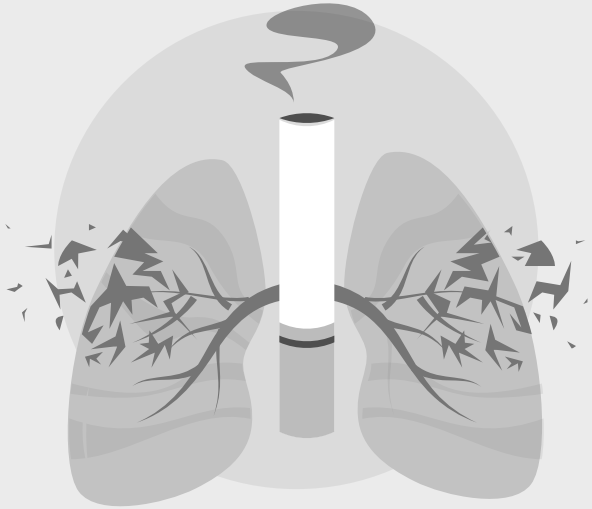
Health Impacts

Tobacco smoking increases the risk of contracting a wide range of diseases, many of which are fatal.

- Most smoking-related deaths arise from cancers → mainly lung cancer
- Respiratory disease → mainly chronic obstructive pulmonary disease
- Cardiovascular disease → mainly coronary heart disease

Risk factor for:

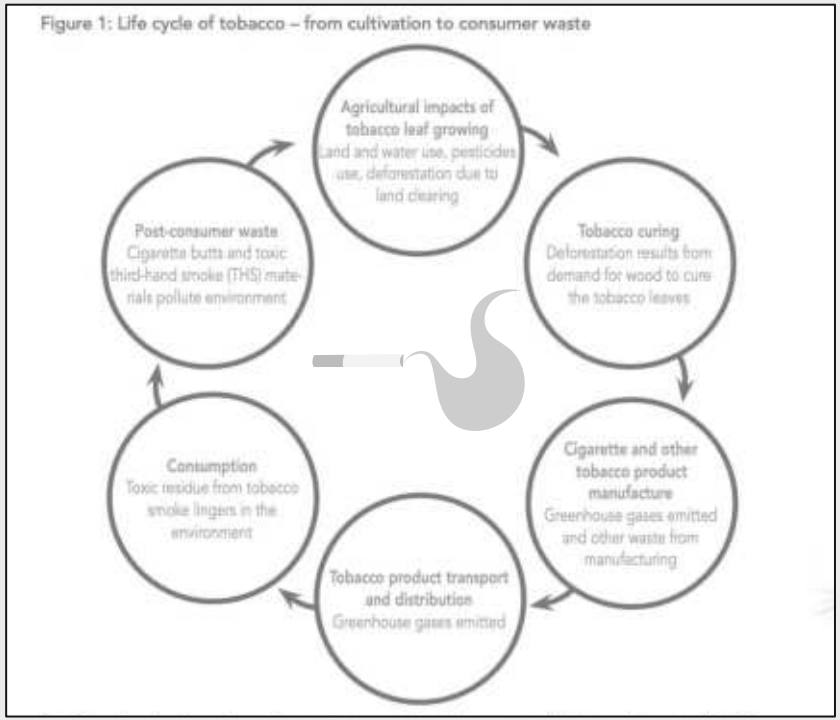
- Strokes
- Blindness
- Deafness
- Back pain
- Osteoporosis
- Peripheral vascular disease (leading to amputation)
- Miscarriage



(West, 2017)

Environmental Impacts

Tobacco threatens many of the Earth's resources. Its impact is felt in ways that extend far beyond the effects of the smoke released into the air by tobacco products when consumed (World Health Organization, 2017).



Policy & Regulations

Table 2. Global progress in the implementation of selected tobacco control policies at the highest level[a]. Change between 2007 and 2018 in the population living in countries with selected policy in billions and as a percentage of the world's population.

	2007		2018	
Policy achievement	Billion	%	Billion	%
Total tax on cigarettes ≥ 75% of retail price	0.5[b]	7.6[b]	1.0	13.2
Comprehensive ban of tobacco advertising, promotion, and sponsorship	0.2	3.0	1.3	17.1
Comprehensive smoke-free policy	0.2	3.0	1.6	21.1
Well-designed national antitobacco mass media campaigns	2.4[c]	36.4[c]	1.7	22.4
National quitline, and both NRT and some cessation services cost-covered	0.4	6.1	2.4	31.6
Strong and large graphic health warning on the package	0.4	6.1	3.9	51.3

[a]The highest level of implementation corresponds to a policy adopted with all the necessary features to make it as effective as possible in achieving its intended goals.
[b]Year corresponds to 2008.
[c]Year corresponds to 2010.Source: Reference [8] and own elaboration.

The health impact of smoke-free policies has been impressive.

The proportion of people protected by smoke-free legislations worldwide has increased from 3.0% in 2007 to 21.1% in 2018.

The largest countries in the world report significant decreases in the proportion of people exposed to secondhand smoke.

Evidence shows that countries that enact national legislative smoking bans reduce the population exposure and benefit from improved health outcomes, specifically of cardiovascular diseases.

(Peruga et al., 2021)

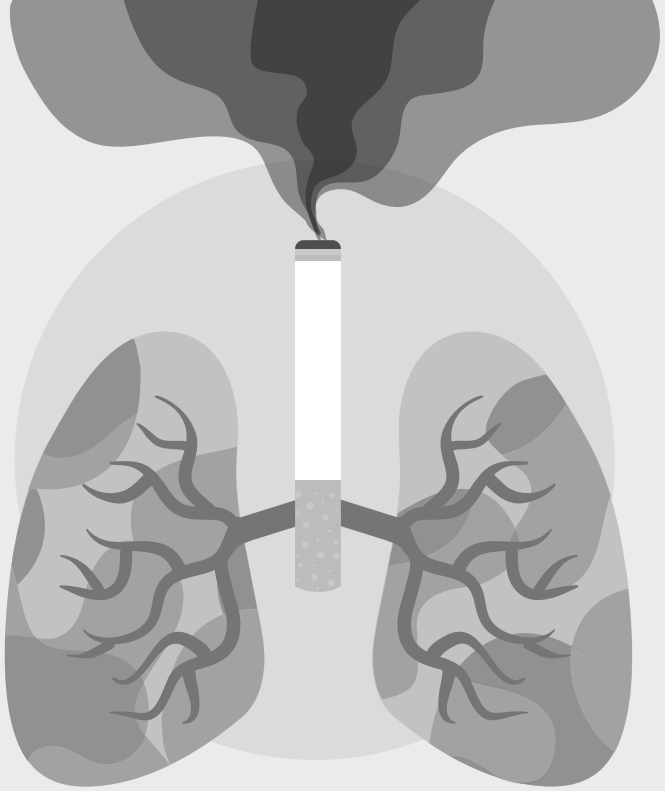
Solutions

Nicotine-replacement therapy

- Nicotine gum (Christen, 2001)
- Nicotine patch (Stapleton, 1999)
- Nasal spray (Shaik et al., 2016)
- Nicotine inhaler (Shaik et al., 2016)

NRT preparation	Proportion quitting	
	NRT	Control
Gum (n = 39)	1149/6328 (18·2%)	893/8380 (10·6%)
Patches (n = 9)	255/1245 (20·5%)	105/968 (10·8%)
Nasal spray (n = 1)	30/116 (25·9%)	11/111 (9·9%)
Inhaler (n = 1)	22/145 (15·2%)	7/141 (5·0%)
All NRT trials	1456/7834 (18·6%)	1016/9600 (10·6%)

Table 1: **Comparison of proportion of smokers who successfully quit with NRT versus control.** (Silagy et al., 1994)



Questions?

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ATRAZINE EXPOSURE IN CATTLE

AND ITS POSSIBLE HUMAN HEALTH CONSEQUENCES

[redacted]

WHAT IS ATRAZINE

Atrazine is a broad-spectrum herbicide that was introduced in the 1950's. It was created to control the annual grasses and broadleaf weeds that grew .

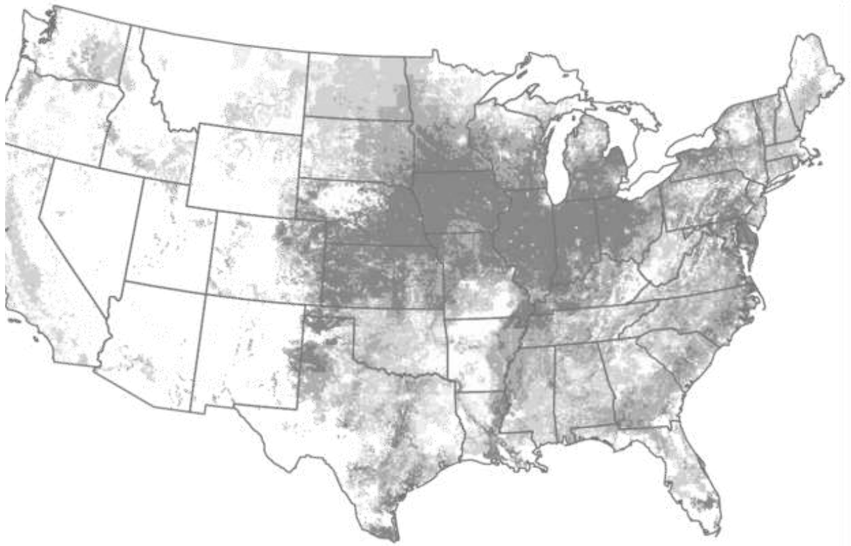
These are the most widely used crops ;

- Sugar Cane(76%)
- Corn(75%)
- Sorghum(59%)
- sweet corn(50-58%)

HOW MUCH ATRAZINE IS USED IN THE US?

An average of 72 million pounds applied annually: study in 2024

Atrazine use



EXPLANATION

Estimated atrazine use, in pounds per square mile per year

- Very low (< 0.09)
- Low (0.09 to 4.5)
- Medium (> 4.5 to 45)
- High (> 45)

Predicted atrazine and deethylatrazine in shallow groundwater beneath agricultural land

EXPLANATION

Predicted atrazine and deethylatrazine concentration, in micrograms per liter

- < 0.001
- 0.001 to 0.01
- 0.01 to 0.1
- > 0.1

Atrazine in Cattle

- Cattle can ingest atrazine through contaminated feed, potentially exposing humans via meat and milk.
- Atrazine is considered as a possible human carcinogen (Group C).

Article's Objective

Analyze atrazine levels in cattle serum and urine in order to determine bioaccumulation and possible human exposure from cattle industry

METHODS

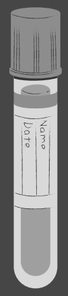
STUDY GROUP

45 Holstein cows from 3 dairy farms in Khuzestan, Iran, fed corn silage with atrazine (3 kg/ha).

CONTROL GROUP

5 cows with no atrazine exposure

URINE



SERUM

RESULTS

- Serum Samples:
  - Study Group: 0.739 ± 0.567 ppm
  - Control Group: 0.002 ± 0.005 ppm
- Urine Samples:
  - Study Group: 1.389 ± 0.633 ppm
  - Control Group: 0.012 ± 0.026 ppm
- Significant difference (P < 0.001) – Atrazine accumulates in cattle from contaminated feed.

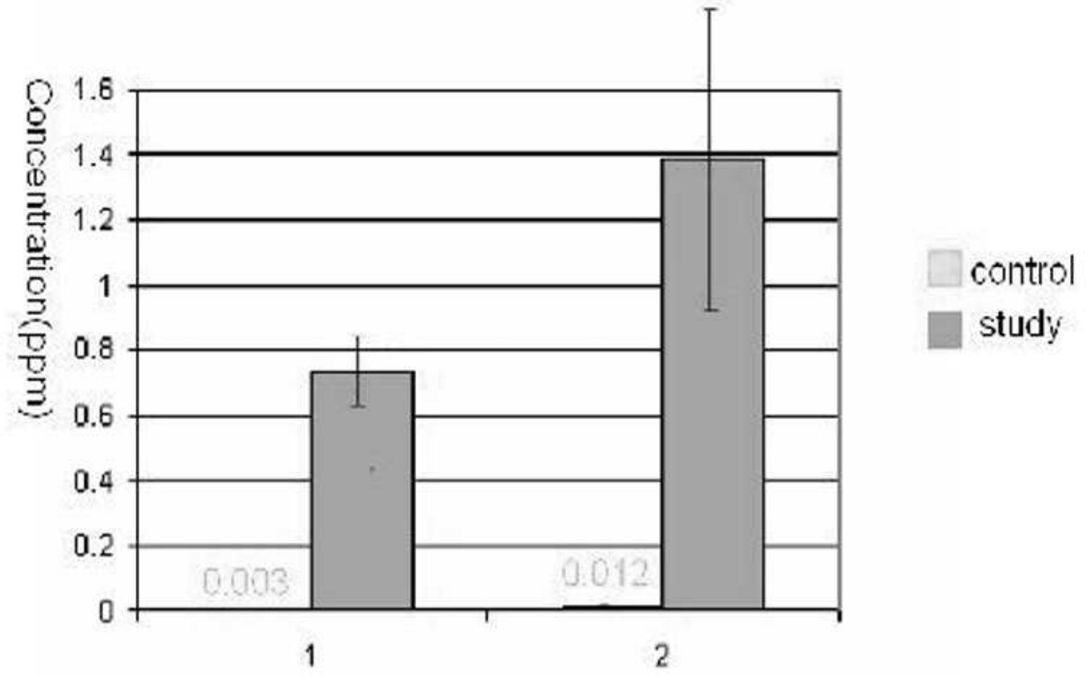


Fig. 8: Comparison of atrazine concentration in serum (1) and urine (2) samples of control and study groups

RESULTS BY AGE AND GENDER

- **Male vs. Female Cattle:**
  - Males had slightly higher atrazine levels, but the difference was not statistically significant.
- **Young (6 months) vs. Older (18 months) Cattle:**
  - Younger cattle had slightly higher atrazine levels, but age was not a significant factor.
- **Urine always had higher atrazine concentrations than serum**, indicating excretion through the urinary system.

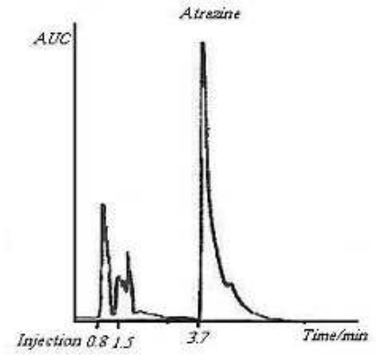


Fig. 7: The HPLC chromatogram of serum spiked atrazine at the concentration of 10 ppm after extraction. AUC: Area Under Curve

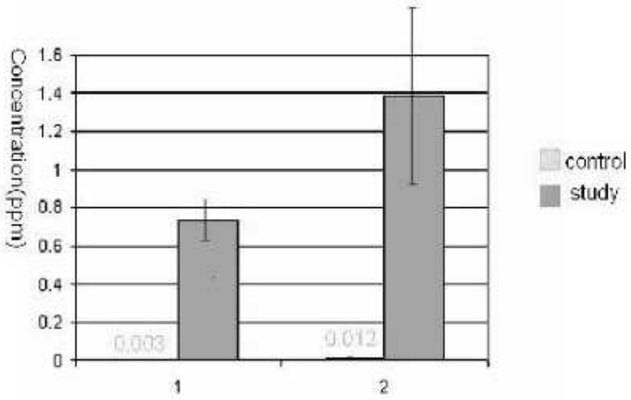


Fig. 8: Comparison of atrazine concentration in serum (1) and urine (2) samples of control and study groups

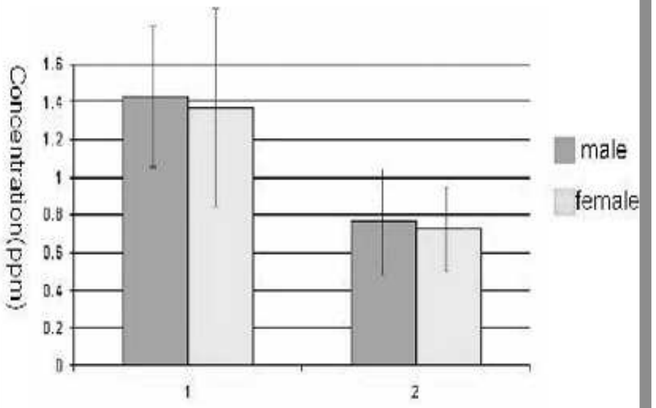


Fig. 9: Comparison of atrazine concentration in serum (2) and urine (1) samples of male and female groups

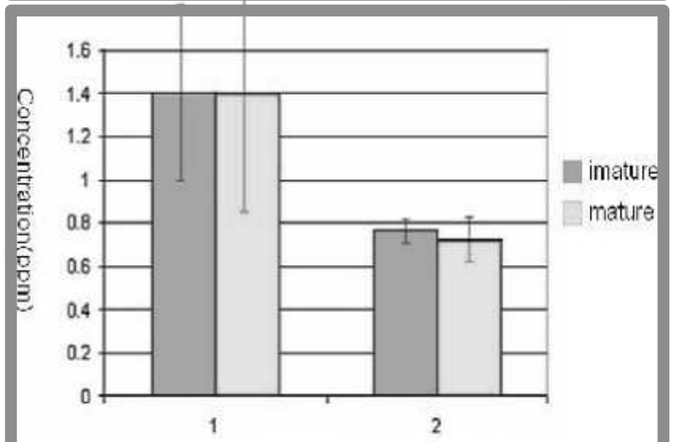


Fig. 10: Comparison of atrazine concentrations in serum (2) and urine (1) samples of 6-month and 18 month age groups

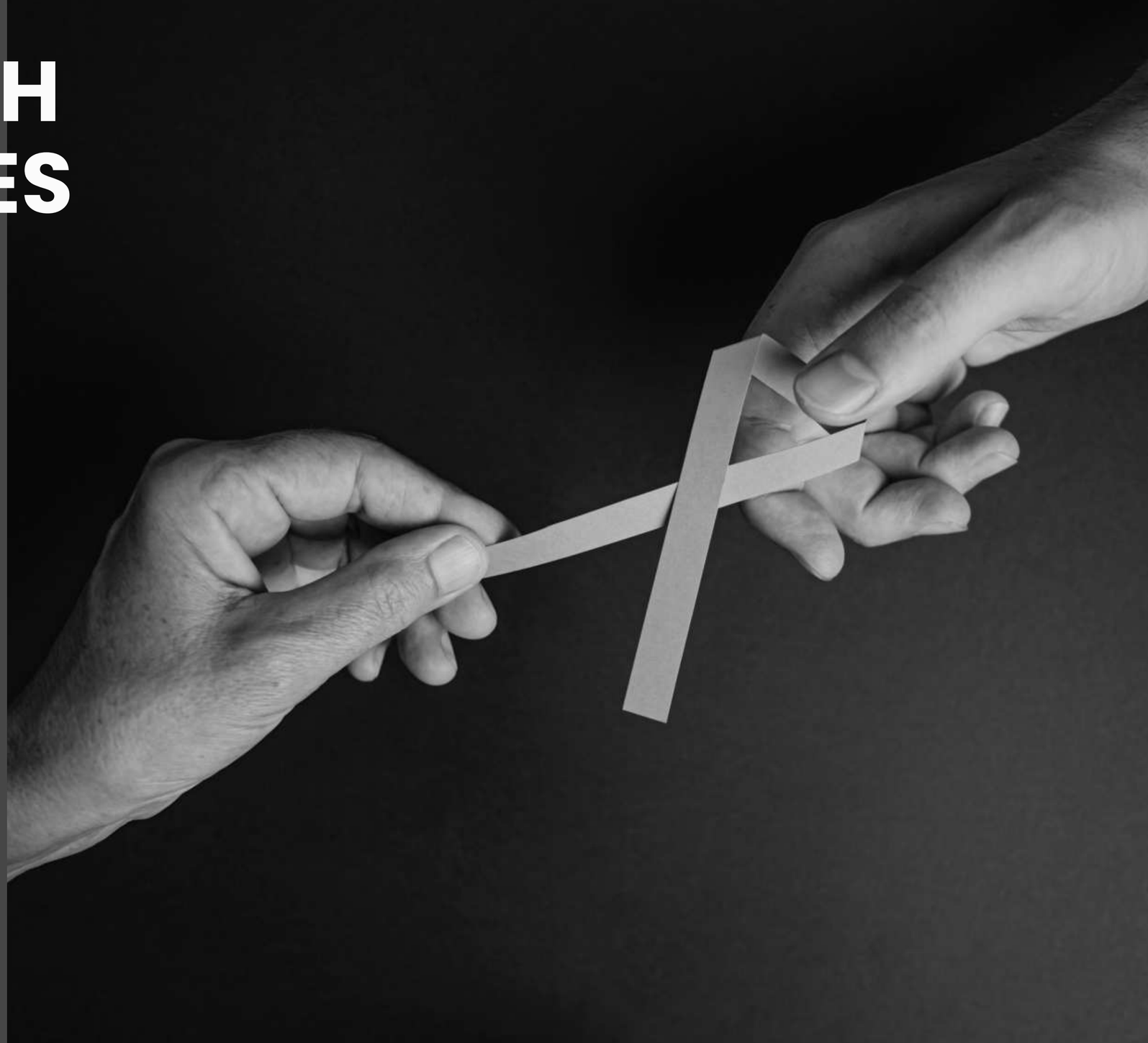
CONCLUSION

- Food exposed to atrazine accumulates in cattle serum and urine, posing a risk to human consumers.
- No significant effect of gender or age on atrazine accumulation.
- Findings support the need for monitoring pesticides in livestock and dairy products.
- Future studies should examine atrazine residues in meat, milk, and human health impacts.

HUMAN HEALTH CONSEQUENCES

CANCER

- Non-Hodgkins Lymphoma
- Prostate/Breast cancer
- multiple myeloma,
- leukemia,
- soft tissue sarcoma/carcinoma



HUMAN HEALTH CONSEQUENCES

Other health impacts:

- Liver damage
- Heart damage
- Kidney damage
- Weight loss
- Retinal and muscle degeneration
- Birth defects
- Changes in Blood Hormone levels

POLICIES AND REGULATIONS

- The EPA has set a maximum amount of atrazine that can be allowed in drinking water
- 0.003 milligrams of atrazine per liter of drinking water (0.003 mg/L)

- The Occupational Safety and Health Administration (OSHA) has set a limit of how much atrazine can be in the workplace
- 5 milligrams of atrazine per cubic meter of workplace air (5 mg/m3)
- The Epa has also deyermined the maximum levels that are allowed in food 0.02-15 parts atrazine per million parts of food (0.02-15 ppm).

QUESTIONS?

THANK YOU

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COAL MINING

Effects on aquatic organisms and human health

START

OVERVIEW

Introduction about mining, how they operate and minerals used.

COAL MINING and exposure pathways.

Case study.

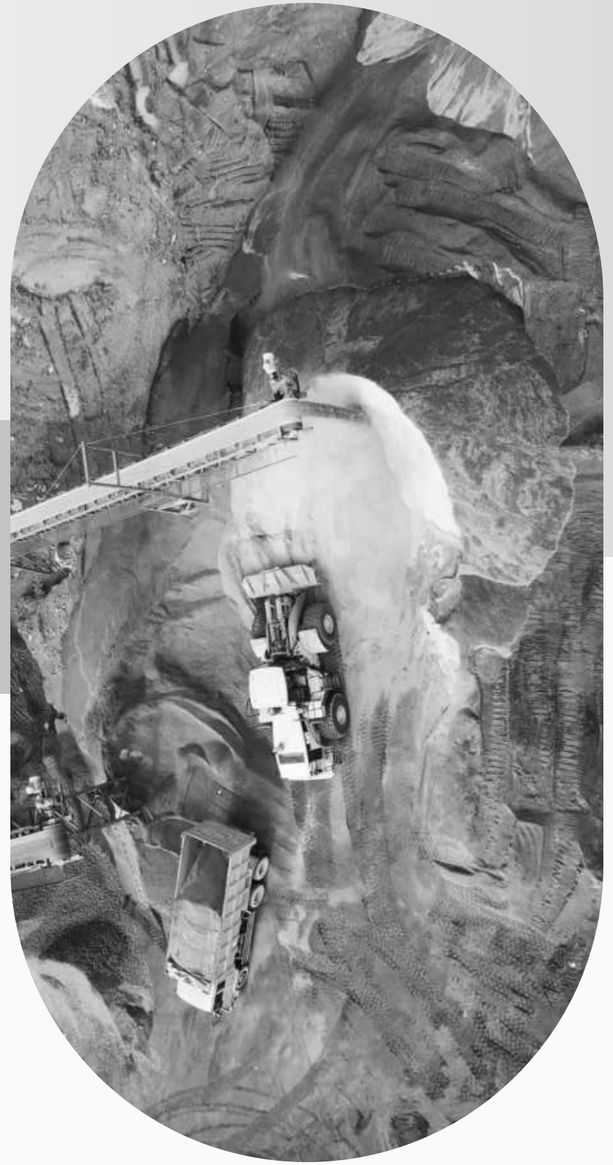
Effects on human health and the ecosystem.

Possible solutions.

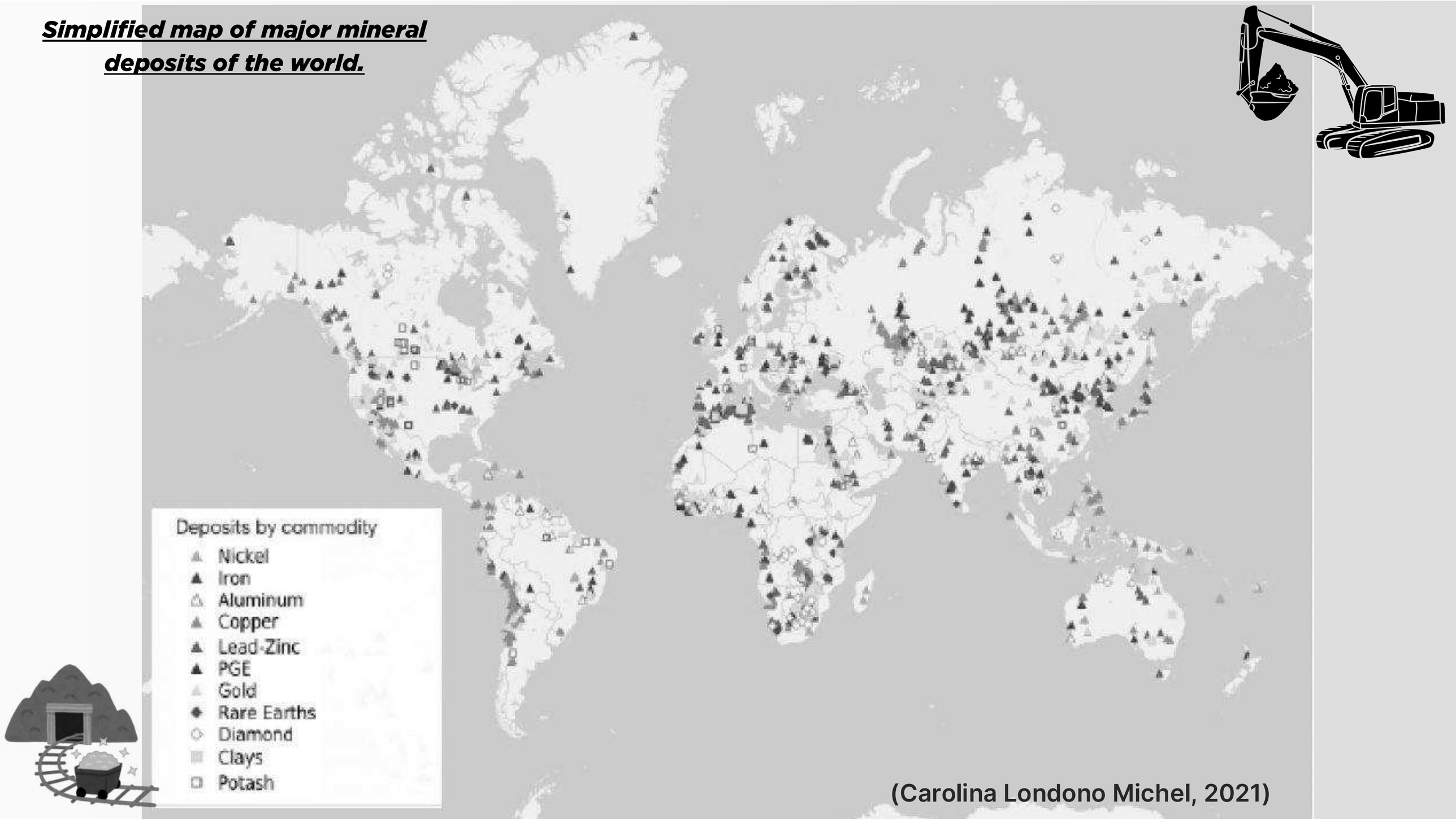
Individual actions.

Introduction

- Mining is one of the oldest and most important activities in the history of human civilization.
- Mining importance around the world.
- The use of minerals by countries worldwide.



Simplified map of major mineral deposits of the world.



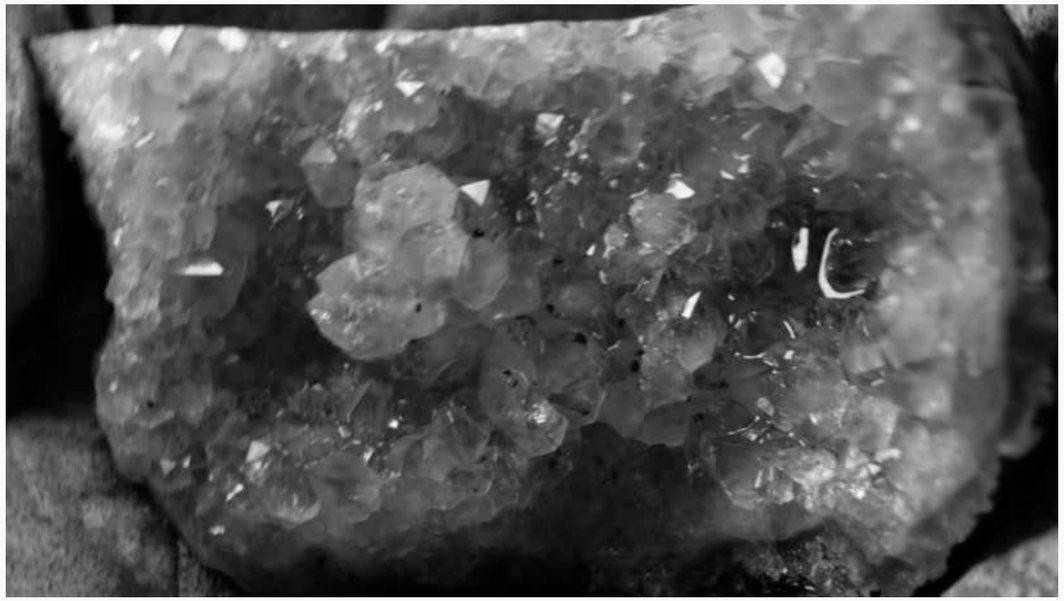
(Carolina Londono Michel, 2021)

Mining Operations

1. Prospecting or exploration.
2. Mining.
3. Mineral processing.
4. Metallurgic processing.
5. Closure.

Mineral commodities

- Metallic minerals.
- Nonmetallic or industrial minerals.
- Fuel minerals.

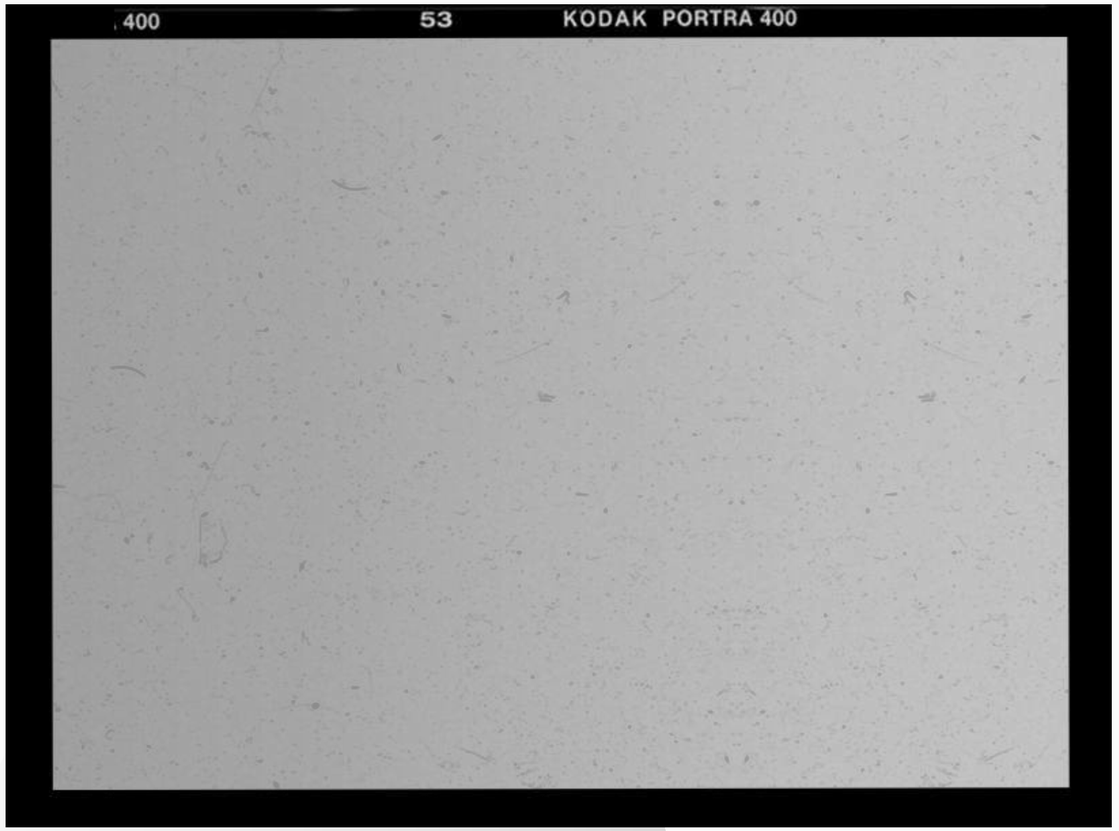


Several methods used to mine a specific mineral commodity.

Coal mining

- Coal mining.
- Preparation or processing.
- Energy generation.

Coal mining cycle



(BIAN et al., 2010)

Coal mining around the world.

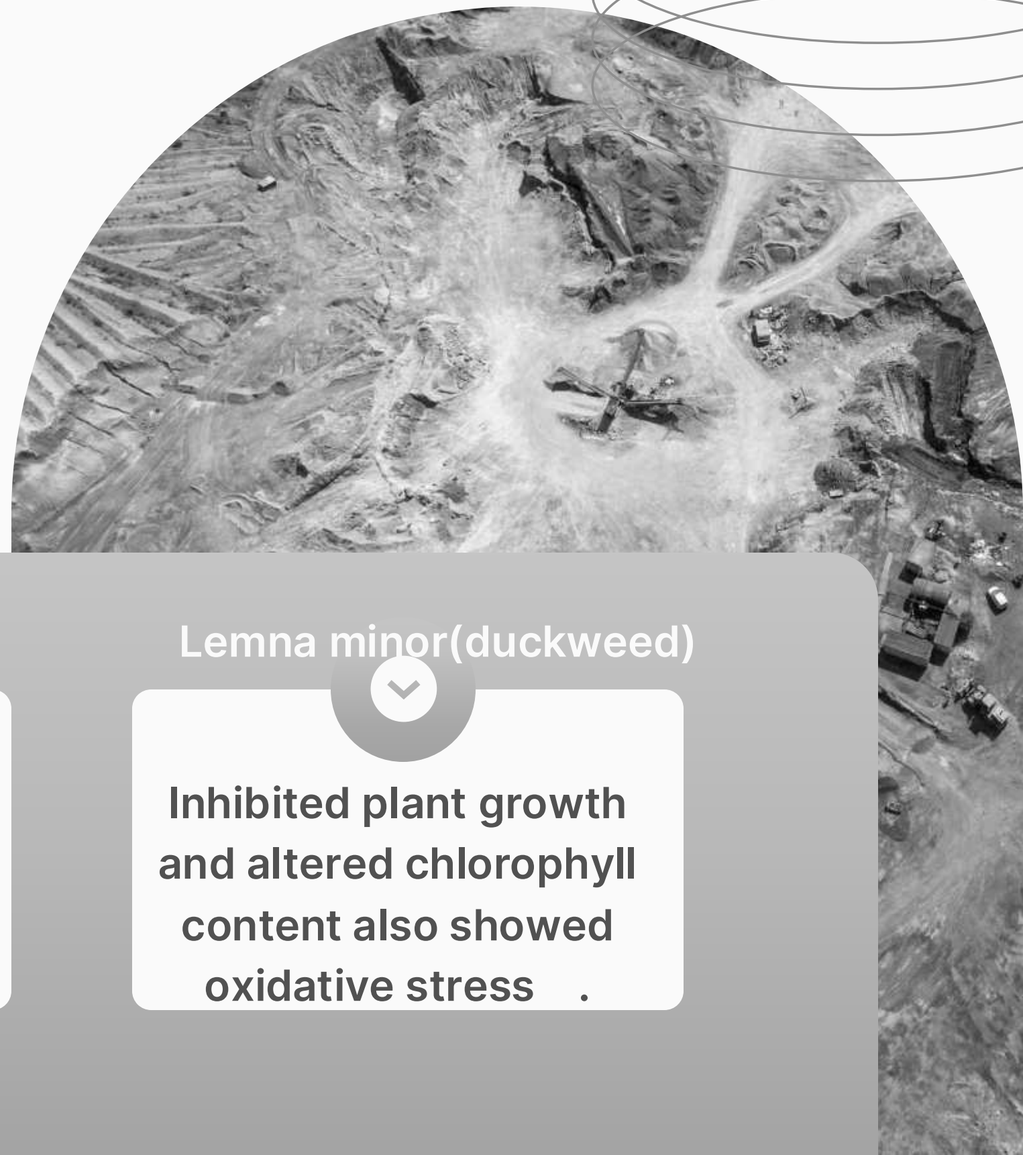
(Coal Mine Tracker Map - Global Energy Monitor, 2021)

Exposure pathways

- Gasses.
- Particulate matter.
- Water and soil contamination.
- Direct contamination to humans and the ecosystem.

Case Study

Assessment of ecotoxicological effects of Fojo coal mine waste elutriate in aquatic species (Douro Coalfield, North Portugal)



This paper discusses coal mining water pollution from the Fojo Coal Mine in Portugal and how its toxic elements affected multiple Aquatic Organisms.

Elements included:
Aluminum (Al), Lead (Pb)
Cadmium (Cd), nickel (Ni),
and Zinc (Zn)

Aliivibo Fischeri(Bacteria)

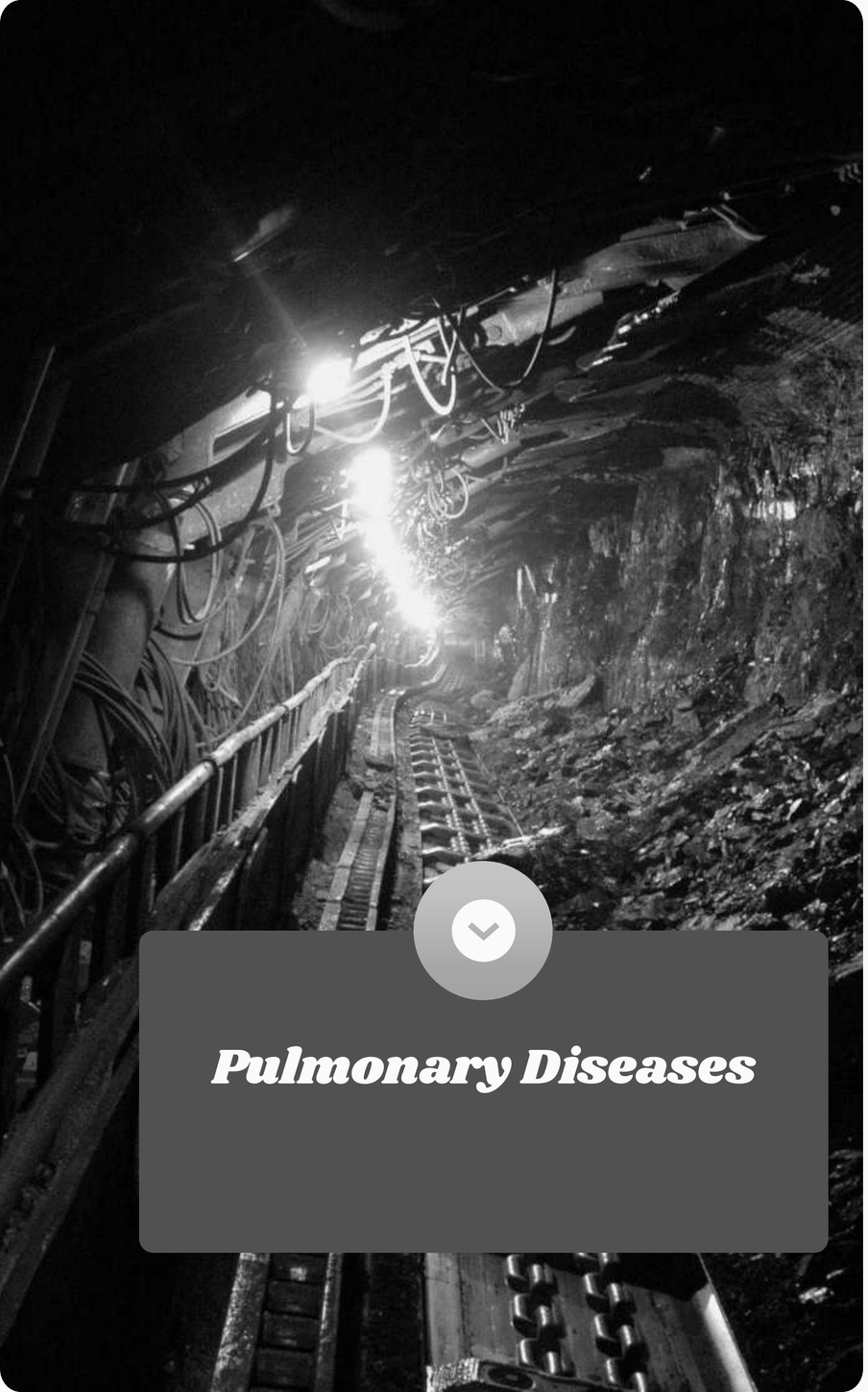
Light production was reduced due to the acidic conditions and presents of metal

Daphnia magna(water fleas)

100% mortality was seen

Lemna minor(duckweed)

Inhibited plant growth and altered chlorophyll content also showed oxidative stress .



Human Health Effects

Pulmonary Diseases

Lignite Water Syndrome

Heart Disease and Cancer

Table 1. Annual incidence and valuation of **human health** impacts resulting from coal-fired power plant emissions within the United States, 2010 (estimated; Clean Air Task Force, 2010).

Health Impact	Incidence (annual)	Valuation
Mortality	13,200	$ 96,300,000
Hospital Admissions	9,700	$ 230,000,000
ER Visits for Asthma	12,300	$ 5,000,000
Heart Attacks	20,400	$ 2,230,000
Chronic Bronchitis	8,000	$ 3,560,000
Asthma Attacks	217,600	$ 11,000,000
Lost Work Days	1,627,800	$150,000,000

(Finkelman et al., 2020)

Ecostytem effects

Surface mining causes a lot of land damage

Water quality degradation from mountaintop mines and valley fills can reach levels that can be fatally toxic

32% decline in the # of species present and 53% decline in inverdabrates and fish

Possible solutions

- Reclamation
- Soil treatment
- Water Treatment
- preventing acid rock drainage
- Controlling Gas emissions

- Closing of Coal fired power plants
- Sustinable mining practices
- New technologies

Individual Actions

- Reduce energy consumption.
- Support clean energies.
- Reduce fosil fuels use.
- Support restoration of damaged areas.

Conclusion

- Coal mining in energy generation.
- Exposure pathways.
- Effects on human health and the ecosystem.
- Solutions.

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THANK YOU!!

Q&A

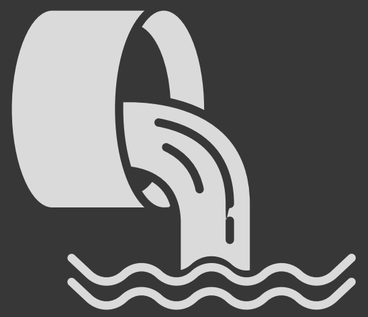
REMOVAL OF CONTAMINANTS IN WASTEWATER PLANTS

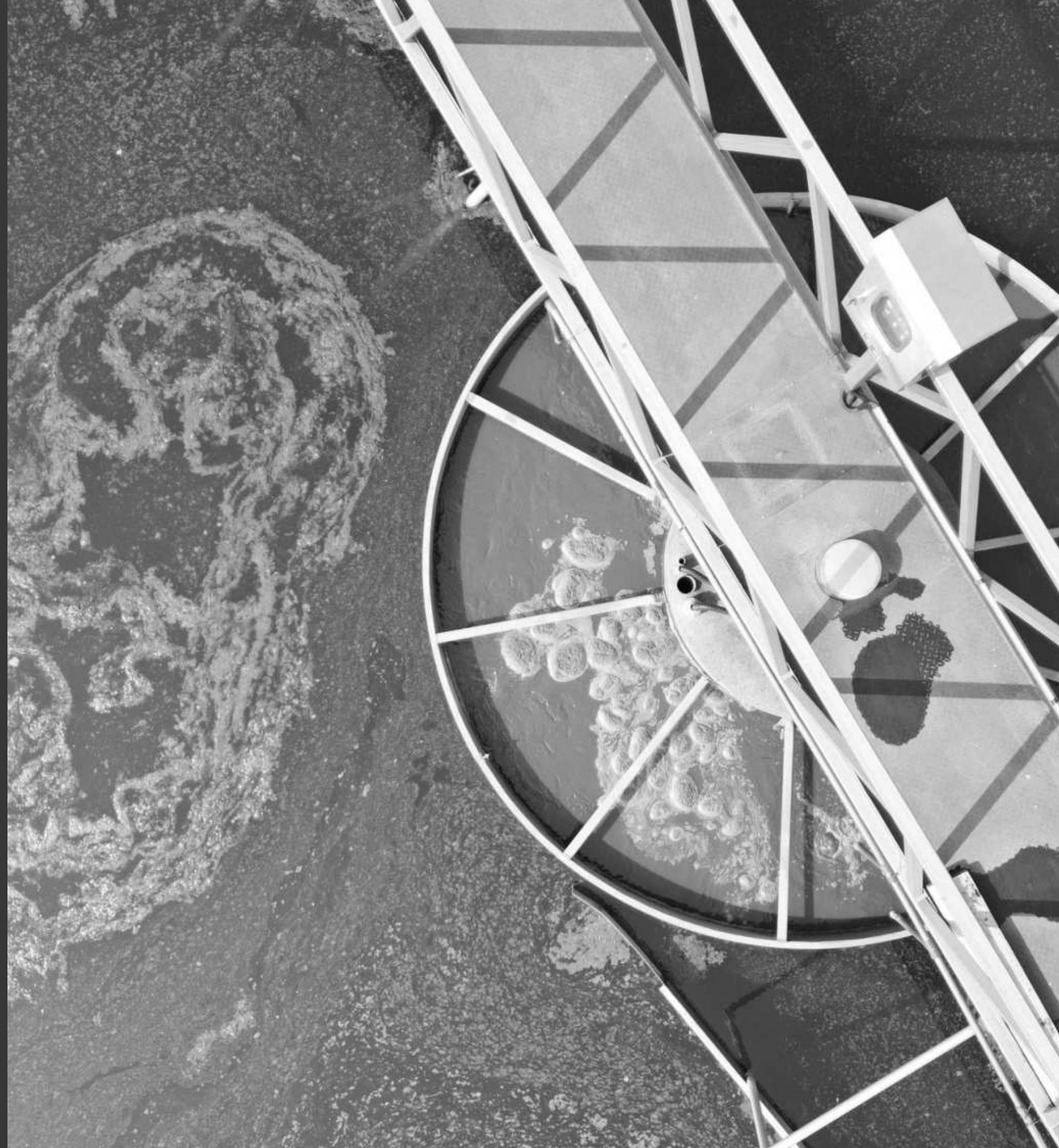
What are emerging contaminants?

- ECs include pharmaceuticals, personal care products (PPCPs), pesticides, and industrial chemicals.
- These contaminants are found in wastewater treatment plants and pose risks to human health and ecosystems.

Relevance to Wastewater Treatment Plants (WWTPs):

- WWTPs are a key barrier to preventing ECs from entering the environment.
- Inefficiencies in treatment can lead to human exposure and in the environment.





Sources of Emerging Contaminants in Wastewater

Hospital and Pharmaceutical Waste

Domestic wastewater

Industrial Discharges

Agricultural Runoff

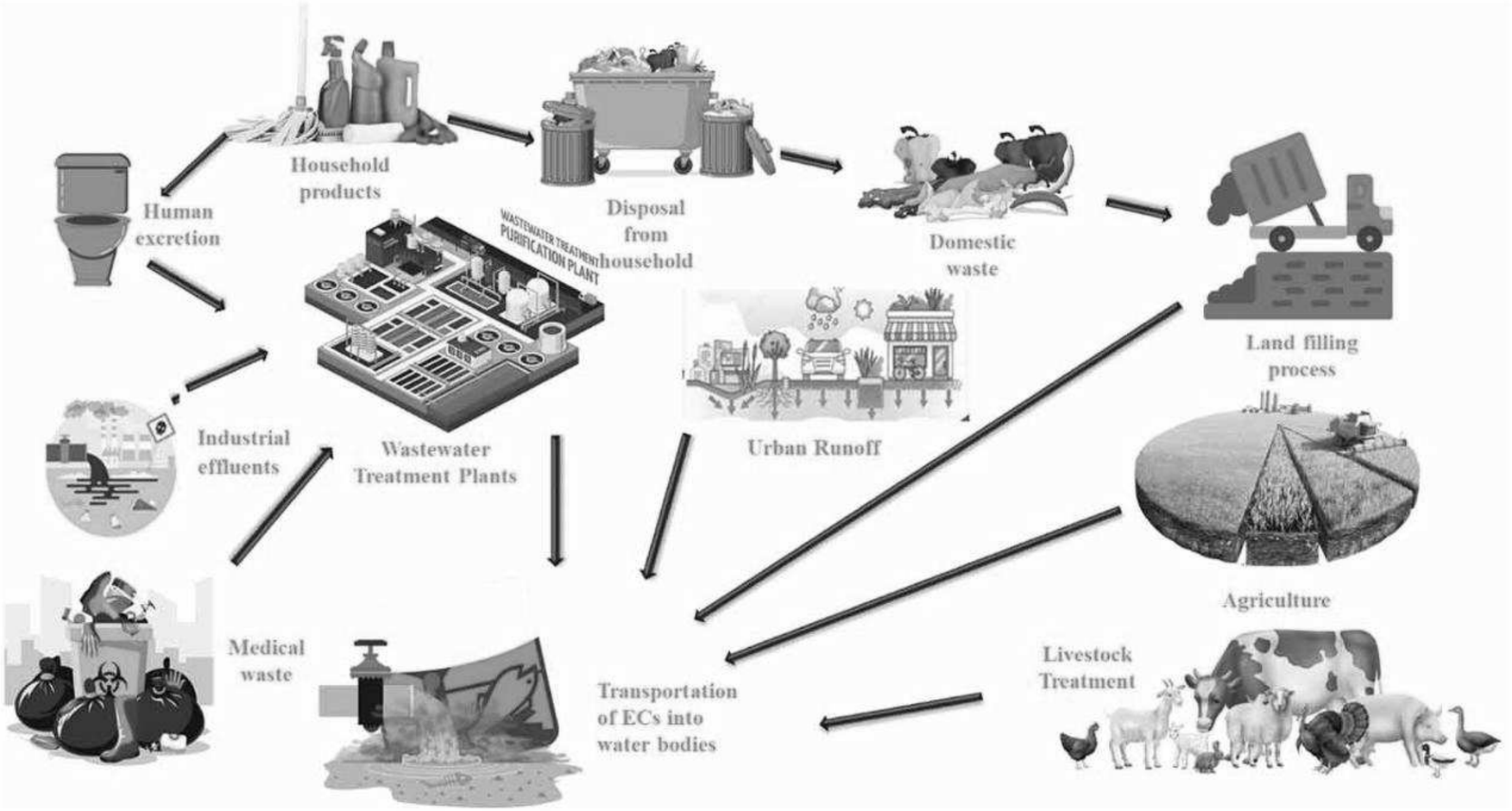
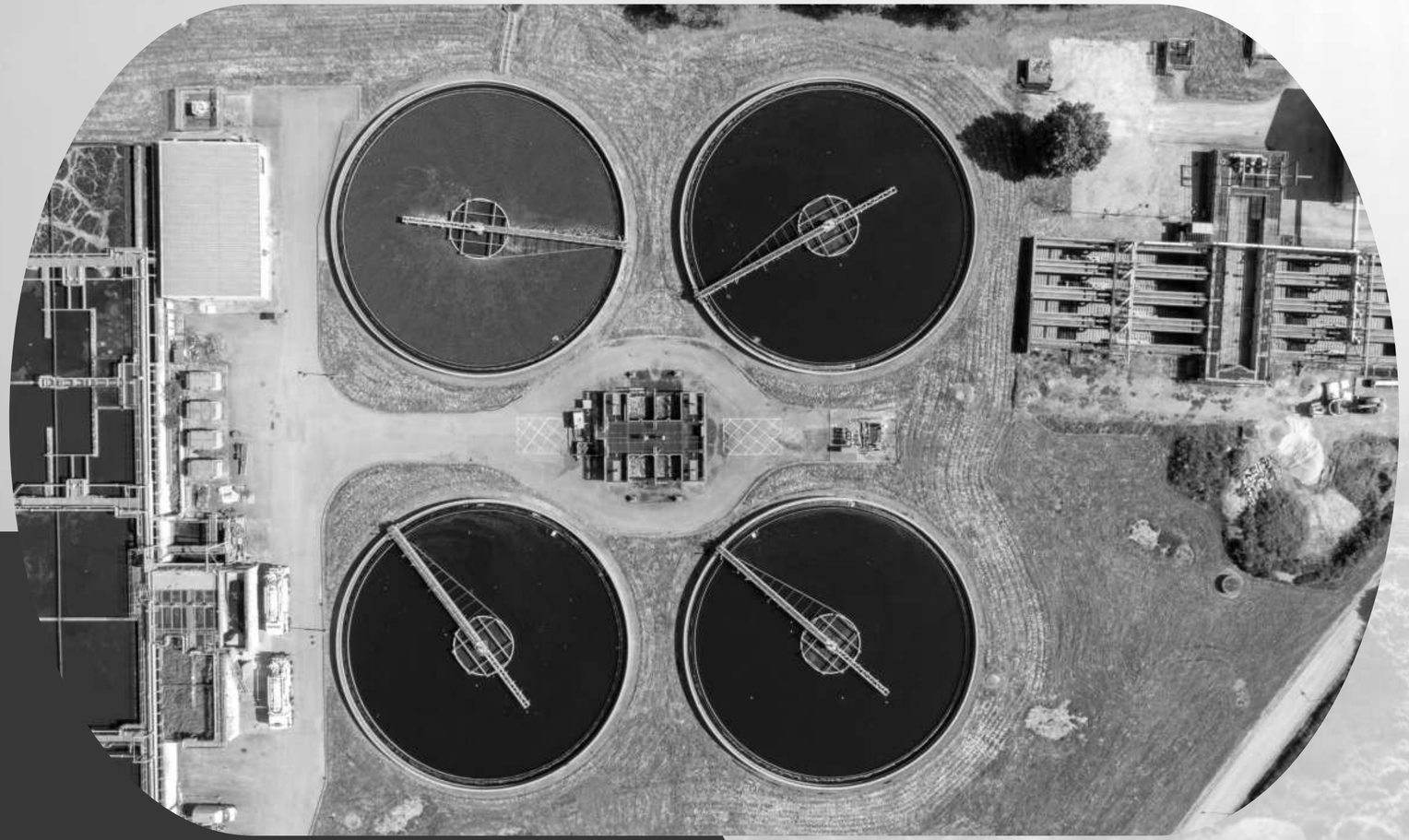


Figure 1 | Different pathways of ECs into water bodies.

Pathways of Exposure to ECs



- Direct Contact with Treated Water
- Drinking Water Contamination
- Airborne Exposure
- Food Chain Bioaccumulation

Inefficiencies in WWTPs Leading to Exposure

- Limitations of Conventional Treatment Methods
- Membrane Bioreactor (MBR) and Constructed Wetlands (CWs)
- Biosorption and Biodegradation

Health Risks Associated with EC Exposure

Cancer

Certain chemicals are linked to cancer

Endocrine Disruptions

Certain contaminants can cause hormone disruption

Antibiotic Resistance

Antibiotics found in wastewater can lead to resistant bacteria

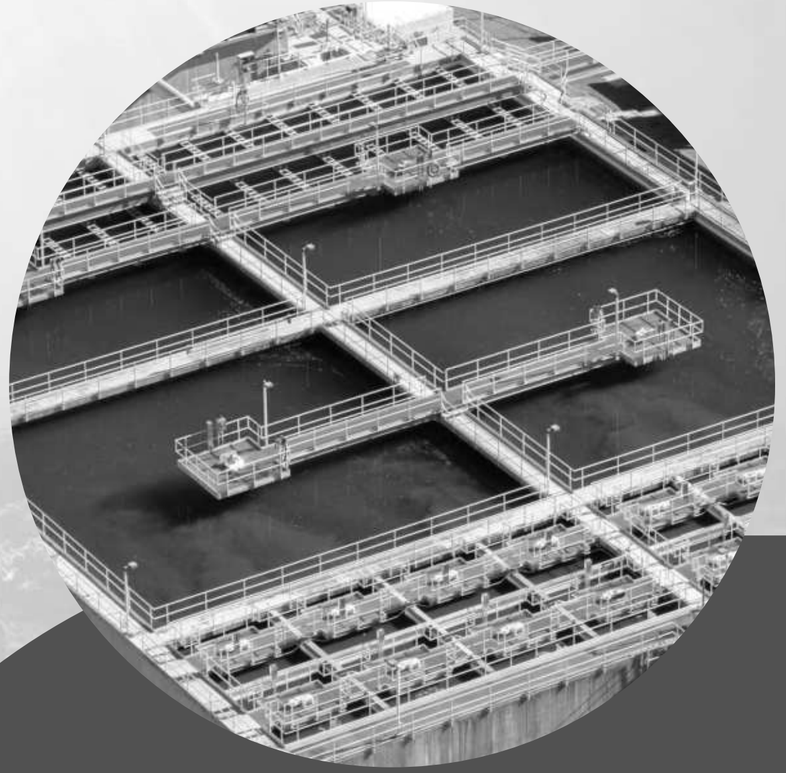
Mitigation Strategies to Reduce EC Exposure from WWTPs

Advanced treatment technologies

Wastewater treatment plants are not fully equipped to eliminate
emerging contaminates. Here are a few strategies:

Real-Time Monitoring and Risk Assessment

Source Control and Policy Regulations



Case Study:

“Risk assessment of contaminants of emerging concern in the context of wastewater reuse for irrigation: An integrated modelling approach”

Risk Assesment

Fate of EC

Risk Management

Conclusion

THANK YOU!

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PESTICIDES

HUMAN AND ENVIRONMENTAL HEALTH IMPACTS

[redacted]

WHAT IS A PESTICIDE?

Any substance or mixture intended for preventing, destroying, repelling, or mitigating any insects, rodents, nematodes, fungi, or weeds, or any other forms of life declared to be pests...

BACKGROUND INFO

Pesticides have been used widely for agricultural practices

- Can kill:
  - insects
  - fungi
  - bacteria
  - rodents

TYPES OF PESTICIDES

A

Insecticides

B

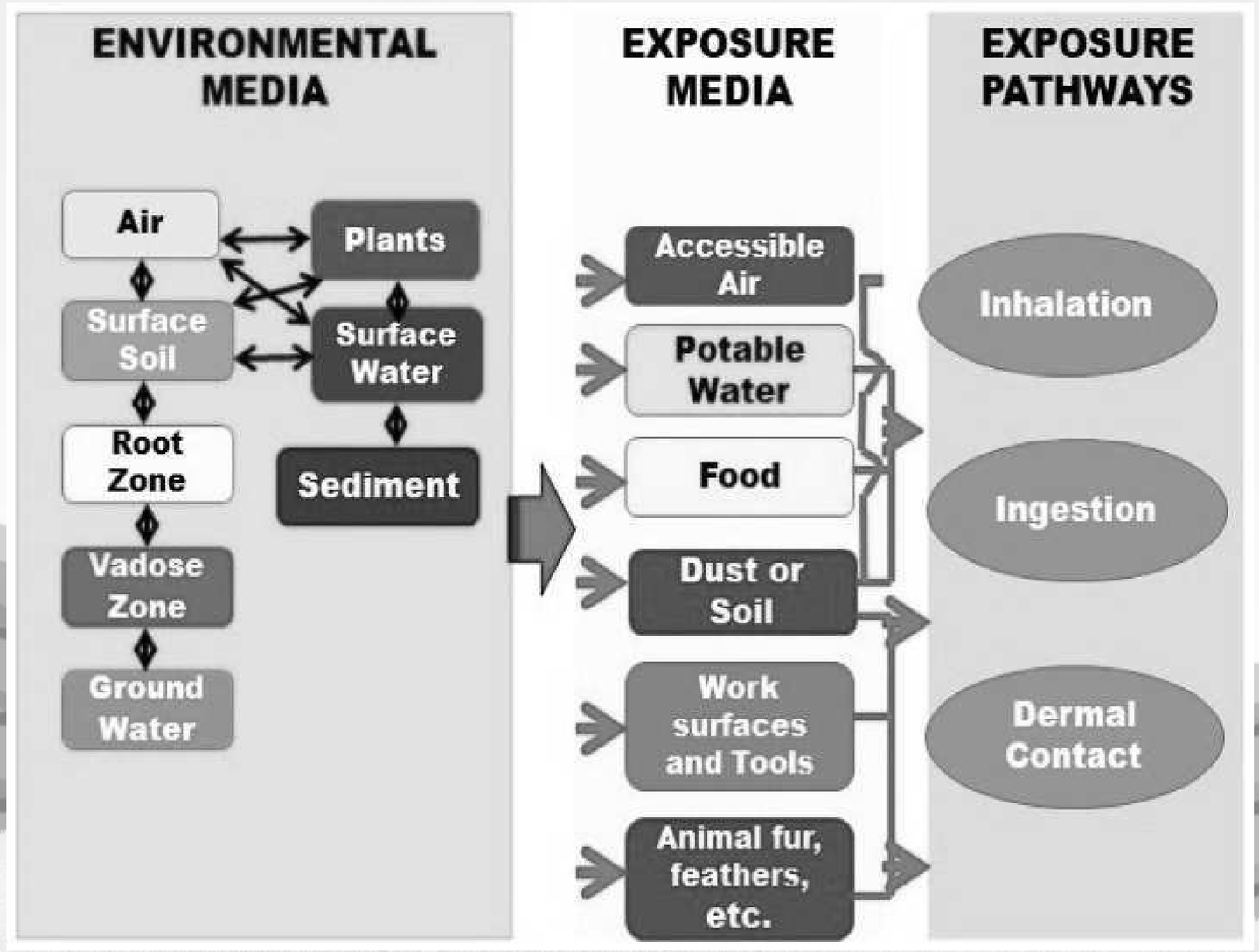
Fungicides

C

Rodenticides

ROUTES OF EXPOSURE

- Dermal — A
- Inhalation — B
- Ingestion — C


ENVIRONMENTAL MEDIA
Air
Plants
Surface Soil
Surface Water
Root Zone
Sediment
Vadose Zone
Ground Water
EXPOSURE MEDIA
Accessible Air
Potable Water
Food
Dust or Soil
Work surfaces and Tools
Animal fur, feathers, etc.
EXPOSURE PATHWAYS
Inhalation
Ingestion
Dermal Contact

EFFECTS ON HUMAN HEALTH

Skin Irritation

primary irritant dermatitis (PID)

Nervous system damage

difficulty breathing, involuntary urination, coma, and death.

Respiratory issues

coughing, wheezing, or sneezing upon exposure

Cancer and reproductive issues

interfere with hormone balance and reproductive functions,

ENVIRONMENTAL IMPACT

A

Contamination

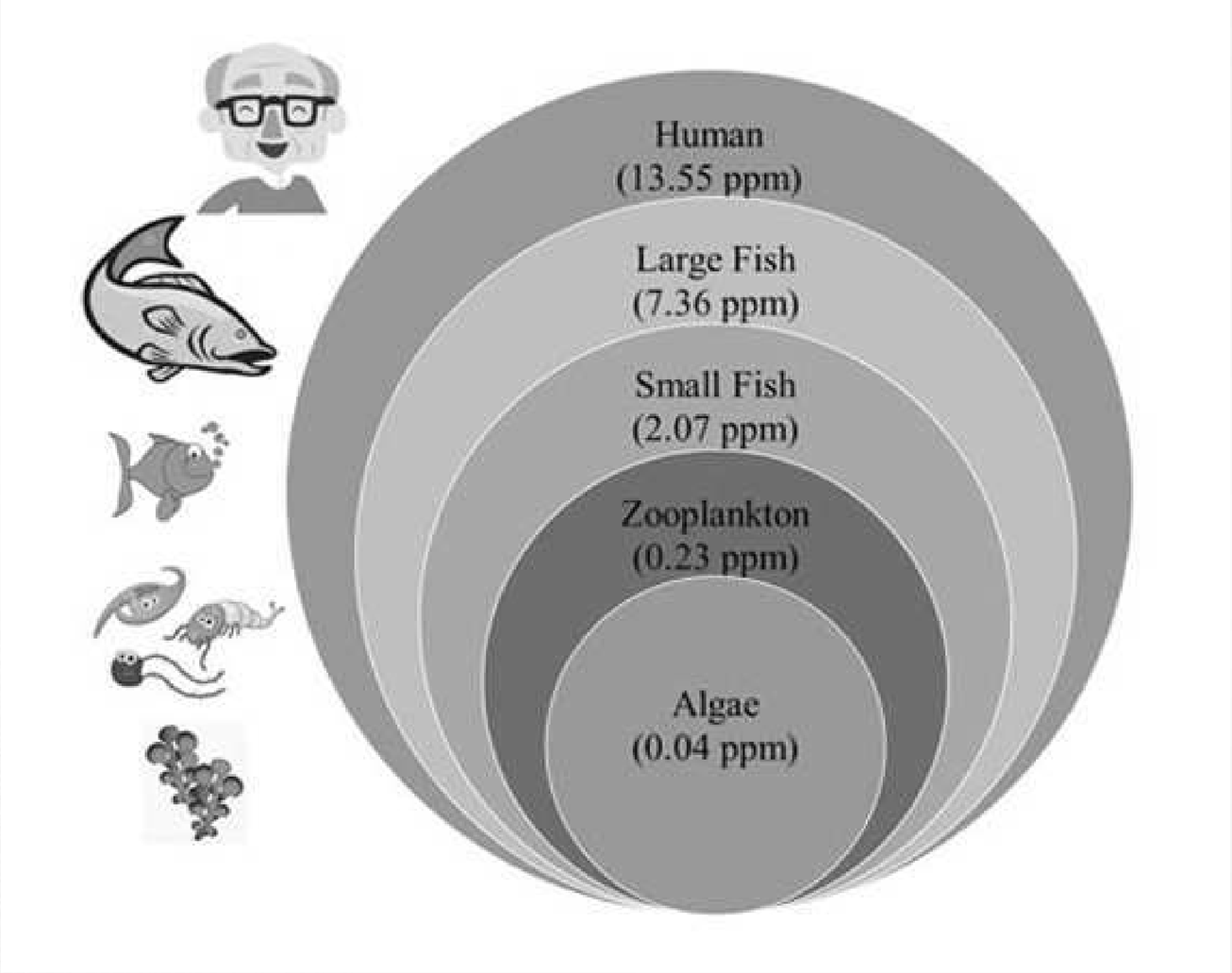
B

Threats to Biodiversity

C

Bioaccumulation & Biomagnification

Biomagnification of pesticides (DDT) at different trophic levels in a food chain



CASE STUDY: SOIL FUMIGATION IN FLORIDA TOMATO PRODUCTION

- **Methyl bromide (MeBr): used on crops worldwide**
- **Found to cause:**
  - Stratospheric ozone layer depletion
  - Poor soil biodiversity
  - Groundwater contamination
  - Serious health effects

- **Workers and beneficial arthropods most likely to be affected by fumigants**
- **Fish and consumers face lower relative risk**

- **MeBr placed under Clean Air Act in 1990 for regulation**
- **Alternative pesticides accessible**

CASE STUDY

Fumigant	Worker	Consumer + L	Fish	Birds	Bee	Beneficials
Midas@ 98:2	2,515	558	148	1,281	51	2,115
Midas@ EC Bronze	6,719	1,466	753	4,404	2,316	6,469
Midas@ 50:50	7,190	1,568	821	4,755	2,573	6,959
Midas@ EC Gold	11,292	2,454	1,417	7,817	4,816	11,220
Midas@ 33:67	12,005	2,608	1,520	8,349	5,204	11,961
Midas@ 25:75	16,631	3,607	2,190	11,796	7,721	16,761
Telone II + Pic	9,860	2,007	1,075	4,219	4,730	6,281
Telone C17 + Pic	10,781	2,203	1,202	4,855	5,221	7,173
Telone C35 + Pic	12,138	2,498	1,402	5,897	5,967	8,620
Pic Clor 60 + Pic	13,851	2,893	1,724	7,827	7,036	11,221
Telone II + Vapam	8,138	2,020	1,565	1,099	2,787	4,953
Telone C17 +Vapam	9,059	2,216	1,692	1,735	3,278	5,845
Telone C35 +Vapam	10,416	2,511	1,892	2,777	4,024	7,292
Pic Clor 60 +Vapam	12,129	2,906	2,214	4,707	5,093	9,893
MeBr	12,193	1,885	464	7,125	2,206	6,063
glyphosate (H)	6.56	2.46	4.1	4.92	7.38	12.3
paraquat (H)	24.38	4.23	2.44	7.31	2.44	4.06
halosulfuron methyl (H)	0.22	0.11	0.05	0.11	0.16	0.44
s-metachlor (H)	9.54	7.16	7.16	9.54	7.16	11.93
trifloxysulfuron methyl (H)	0	0.01	0.02	0.03	0.04	0.07
rimsulfuron (H)	0.25	0.09	0.03	0.19	0.32	0.6

Table 8. Field Use EIQ by environmental category.

FEDERAL INSECTICIDE, FUNGICIDE AND RODENTICIDE ACT

FIFRA: the standard for federal regulation of all pesticides

FIFRA RESPONSIBILITIES

A	Focuses on sale, distribution, and use of pesticides
B	Pesticides must be licensed with EPA
C	Defines the term “unreasonable adverse effects on the environment”

BIOPESTICIDES: AN ALTERNATIVE

- Neem-based pesticides
- Rotenone
- Pyrethrum
- Eucalyptus Essential Oil

Q & A

Thanks for listening!

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Heavy Metals:

Environmental & Health Impacts

Ecotoxicology
BIO 424

[redacted]

80 200.592
Hg
Mercury

Background Information

Environmental pollution worldwide is a concerning side effect of the growing demand for natural resources in modern society.

All of the world's environments suffer from some degree of contamination.

Aquatic environments, such as rivers, estuaries and coastal regions, are the most severely affected by contaminants.

Pollutants from industry and mining, include toxic substances such as heavy metals.

Heavy metals can affect the environment on a global scale.

Although their effects are less visible, their impact is far harder to remedy.

They are non-degradable and accumulate in nature --> continue to affect ecosystemic functioning over the course of decades or even centuries.

Mercury (Hg)

Of all contaminant metals, Hg is by far the most toxic and the only capable of biomagnification in almost all food chains.

It is a prevalent component of industrial and agricultural effluents.

It is naturally present in relatively high levels in a number of different regions.

Sources:

- Industrial emissions
- Mining
- Fossil fuel combustion

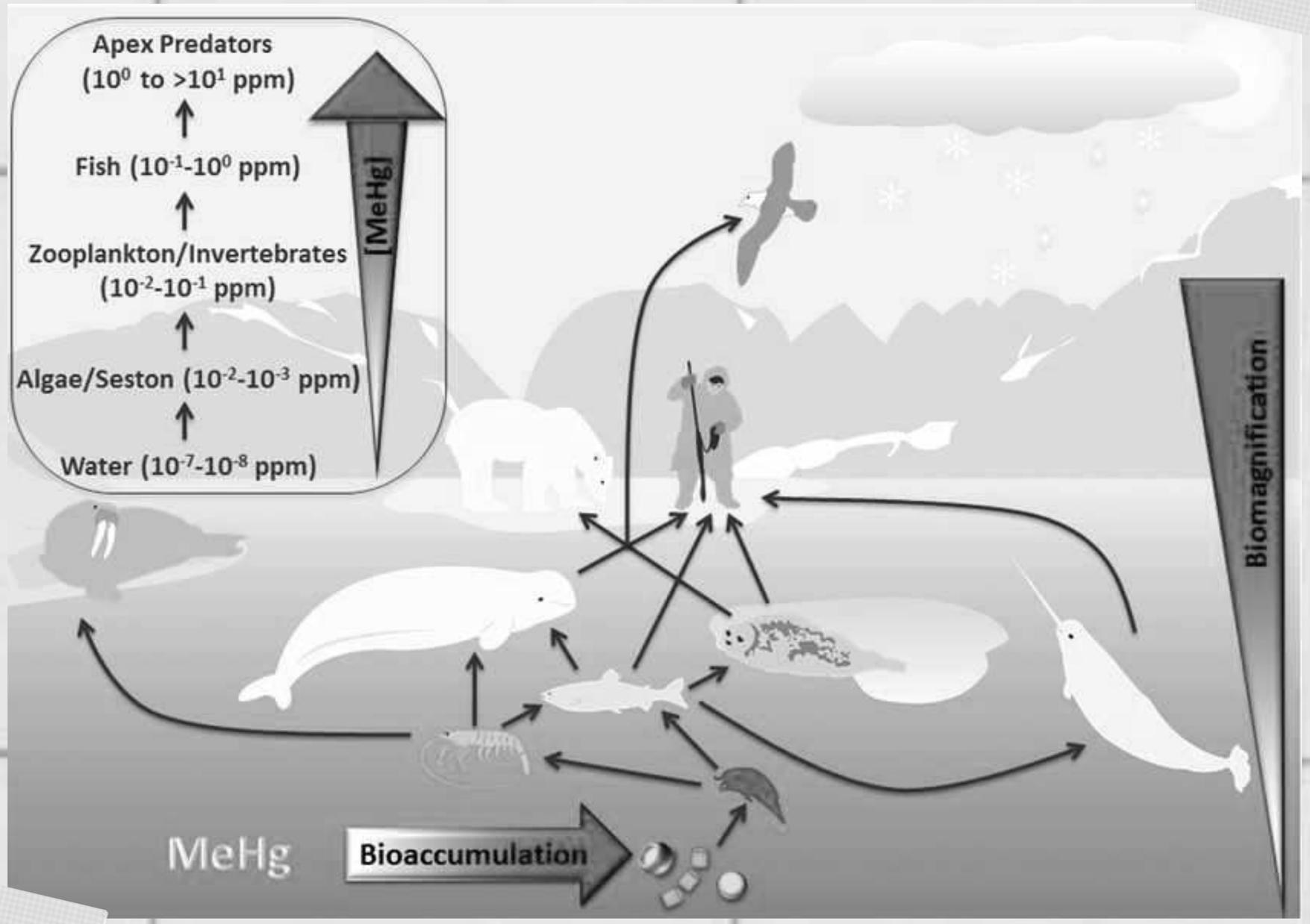
Release Hg into the atmosphere, which then deposits into aquatic systems.

Mercury enters water bodies as inorganic mercury (Hg^{2+}) and can be converted into methylmercury by bacteria.

Environmental Effects

Hg is the only metal known to biomagnify in food chains, increasing in concentration at higher trophic levels.

Methylmercury is absorbed by biological membranes and accumulates in fish, impacting neurological and reproductive health.



(Lehnherr, 2018)

Health Effects

Hg contamination in fish poses severe risks to human populations, particularly those relying on fish as a dietary staple.

Documented cases of Hg poisoning include Minamata disease (neurological disease), caused by consuming mercury-contaminated seafood

Signs and symptoms include ataxia, numbness in the hands and feet, general muscle weakness, loss of peripheral vision, and damage to hearing and speech.

Case Study: Tucuruí Dam – Mercury Contamination

(Arrifano et al., 2018)

Background:

Tucuruí Dam, one of the largest hydroelectric projects in the Amazon, flooded 2,430 km² of forest.

This region was not considered a major Hg contamination site before dam construction.

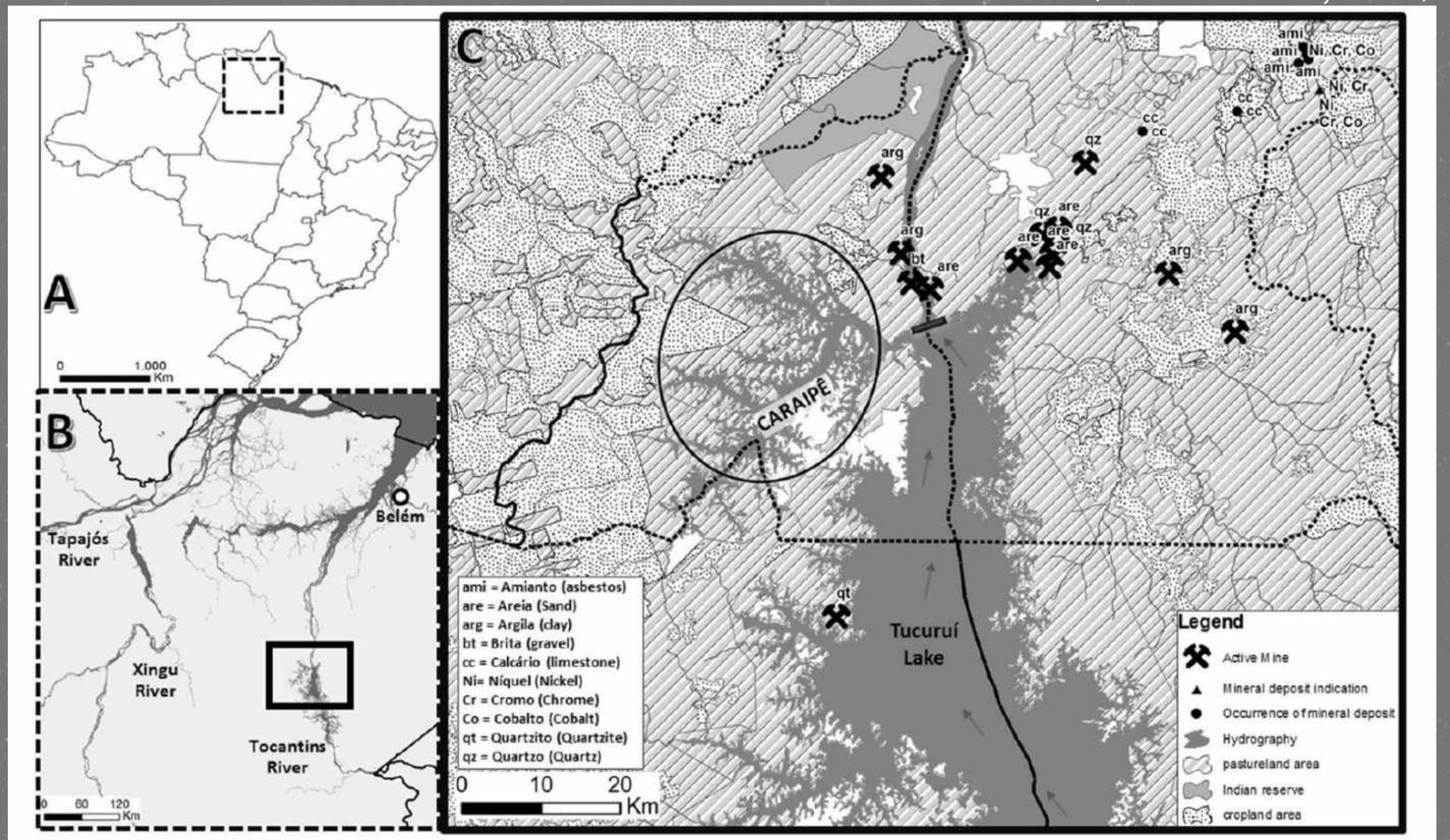


Fig. 1. Maps of Brazil (A), State of Pará (B) and Tucuruí (C). In C, the two communicated compartments (Caraipé and Lake) of the reservoir are shown in addition to the water flow, the dam (black bar), the land use and the present active mine points (note that none of these points are for gold extraction). Participants of the study were from Caraipé (area included in the circle). Maps were obtained from the Instituto Brasileiro de Geologia e Estatística (IBGE, Brazil), Departamento Nacional de Produção Mineral (DNPM, Brazil) and Ministério da Agricultura, Pecuária e Abastecimento (MAPA, Brazil).

Key Findings:

- The flooding of organic-rich areas created anoxic conditions, increasing the conversion of inorganic Hg into toxic methylmercury.
- High levels of mercury detected in predatory fish (Cichla sp.), often exceeding WHO's safety limit (0.5 µg/g).
- Human Exposure:
  - Hair samples showed median Hg levels of 12 µg/g (WHO limit: 10 µg/g).
  - Some individuals had levels as high as 75 µg/g
  - 57% of participants exceeded the WHO safety threshold.

Table 2
Methylmercury (MeHg) and total mercury (Hg) contents in hair and anthropometric data of participants of this study. All samples were analyzed for both MeHg and inorganic mercury, and total mercury was the sum of these two values.

		Total	Sex		Difference between sexes	
			Male	Female		
N (%)		37 (100)	18 (48.6)	19 (51.4)	Parametric Student *t*-test	Non-Parametric Mann-Whitney test
Age (years)		43.0 ± 2.4	46.1 ± 3.7	39.6 ± 2.8	P > 0.05	–
Weight (kg)		66.8 ± 2.8	77.2 ± 3.3	57.0 ± 3.2	***	–
Height (cm)		158.5 ± 1.7	166.7 ± 1.3	150.8 ± 1.9	**	–
BMI		26.30 ± 0.85	27.6 ± 1.4	25.03 ± 0.83	P > 0.05	–
Total Hg (µg/g)	Median (Interquartile)	12.0 (7.9–23.8)	19.7 (6.2 – 47.6)	11.0 (8.0 – 18.0)	–	P > 0.05
	Min - Max	1.1 – 75.8	1.1 – 75.8	3.6 – 42.9		
MeHg (µg/g)	Median (Interquartile)	10.9 (7.0–22.2)	18.2 (5.7 – 43.0)	10.0 (7.1 – 37.7)	–	P > 0.05
	Min - Max	0.93 – 69.2	0.93 – 69.2	3.2 – 37.7		

Data are showed as mean ± SEM except for mercury levels that are presented as median and interquartile intervals. BMI = Body Mass Index. ***P < 0.001 and **P < 0.01, male *vs* female.

(Arrifano et al., 2018)

Policy & Regulation

EPA set up a regulation, that explained the maximum amount of mercury within drinking water is 0.002 mg/ 2 ppb.

Exportation of metallic mercury is not allowed since 2013, Mercury Export Ban since 2008.

Emergency Planning and Community Right to know act (EPCRA), requires businesses/industries to report chemical emissions.

Solutions

Implementation of stronger regulations and policies.

Bioremediation (phytoremediation and microbial)

Dredging: the removal of contaminants within the sediment(s), disposing of chemicals properly.

Use of activated carbon filtration

Sources:

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ANTIDEPRESSANT DRUGS IN AQUATIC ECOSYSTEMS AND ITS EFFECTS ON HUMAN HEALTH

[redacted]

Date: Feb. 17, 2025

Environmental Health

OVERVIEW

- Antidepresant drugs and types.
- Sources of contamination.
- Transport and persistance of antidepresant drugs in aquatic ecosystems.
- Global use of antidepressants and consequently places with more water systems contamination.
- Effects on the ecosystem and human health.
- Case study.
- Solutions and individual actions.

ANTIDEPRESSANT DRUGS

- Group of organic compounds that are used to treat mental illness.
- TCA - First prescribed.
- SSRI - Most used now.

TYPES OF ANTIDEPRESANT DRUGS

TRICYCLIC ANTIDEPRESSANTS

Example: imipramine and clomipramine.

MONOAMINE OXIDASE INHIBITORS

Example: phenelzine and selegiline.

SELECTIVE SEROTONIN REUPTAKE INHIBITORS (SSRIs)

Example: Prozac and Zoloft.

SELECTIVE INHIBITORS OF SEROTONIN AND NOREPINEPHRINE RECUPTAGE (SNRI)

Example: Effexor and cymbalta.

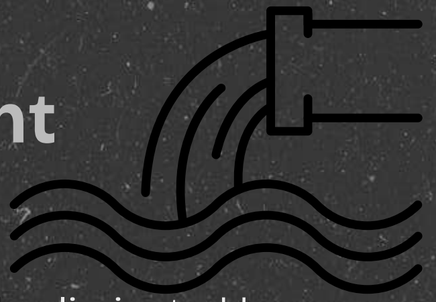
They are the most commonly found in water systems due to their increased use in recent years.

SOURCES OF CONTAMINATION

01 Human waste

After administration, pharmaceutical products can be eliminated from the body, mainly through urine and feces.

02 Water treatment plants



When waste is not effectively eliminated because it is resistant to degradation processes.

02 Livestock and agriculture

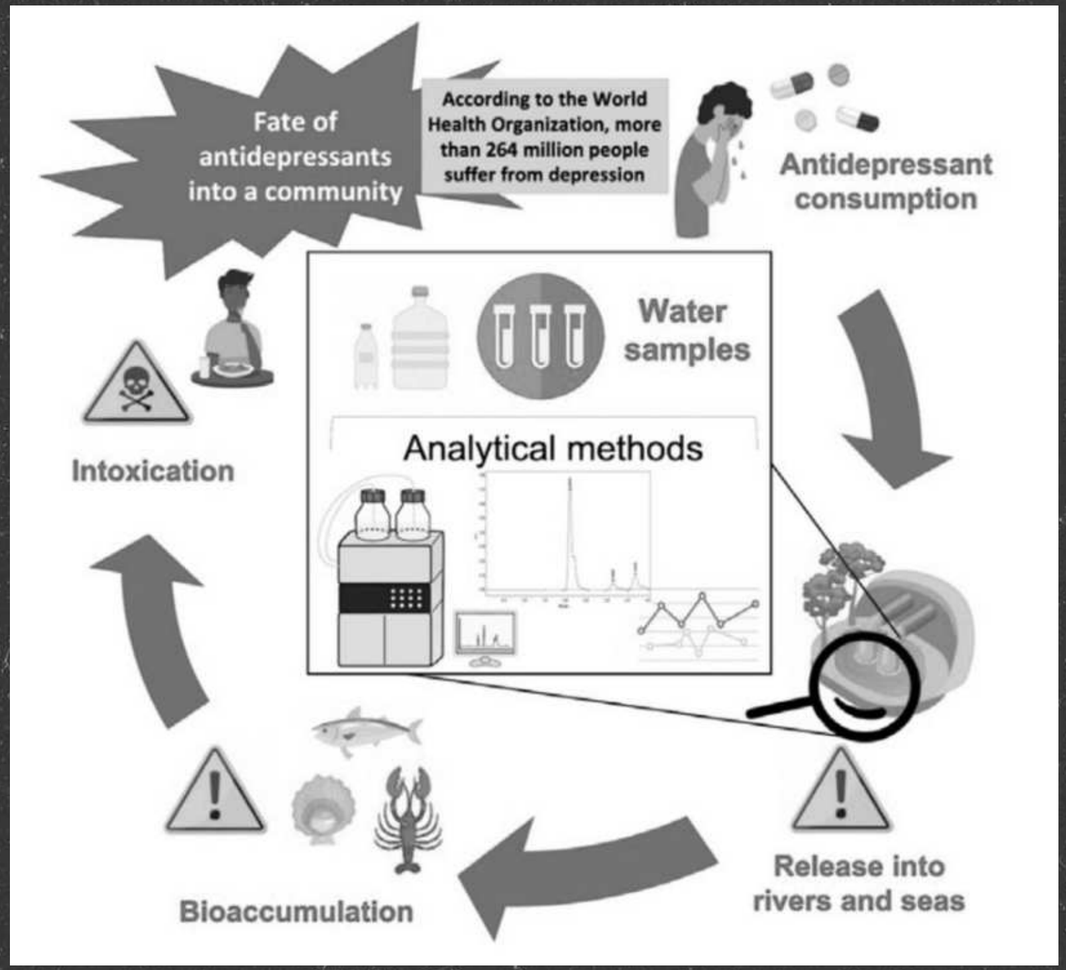
Antidepressant doses were found in some veterinary medicines.

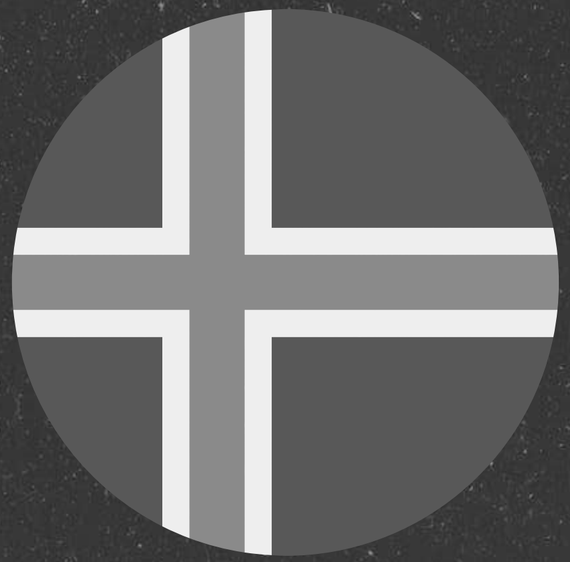
03 Disposal of medications

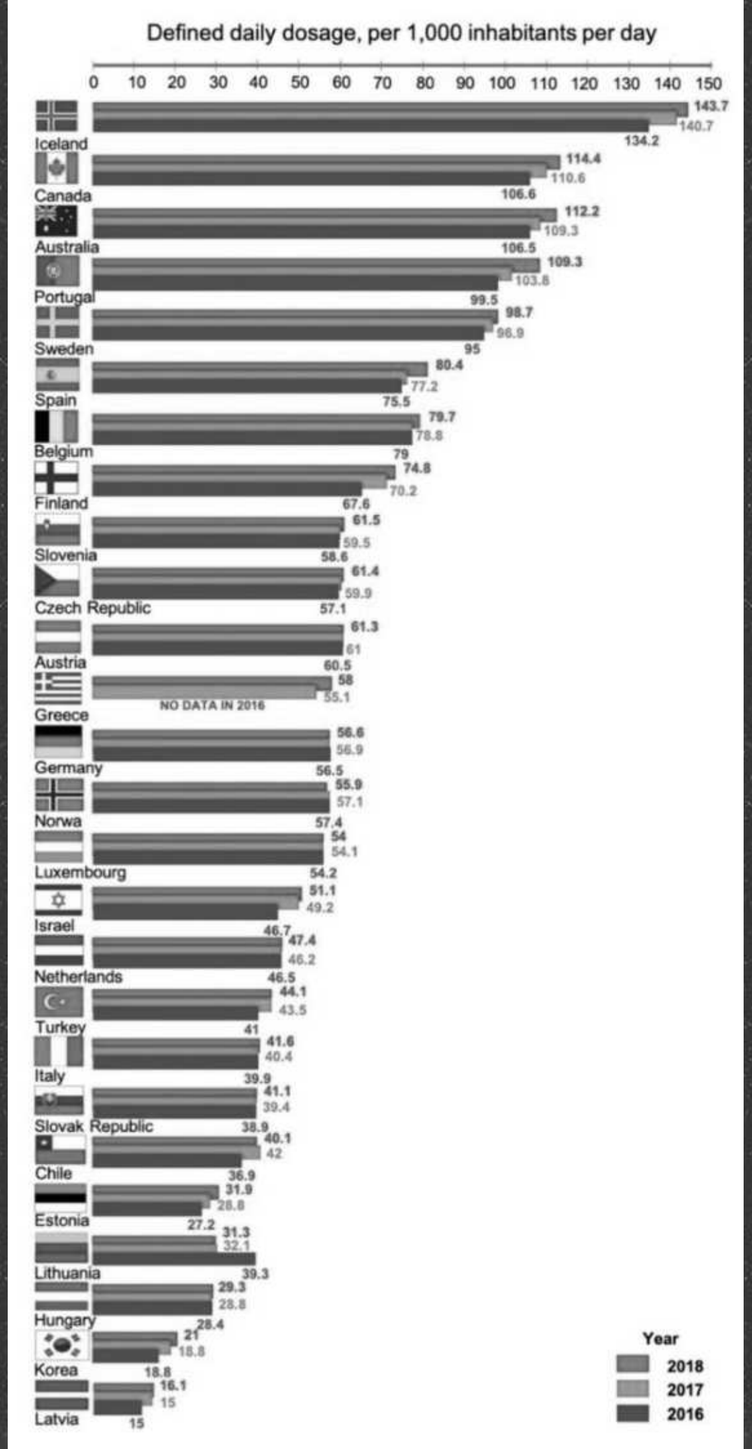
When you throw medication into the toilet or trash.

TRANSPORT AND PERSISTANCE IN THE ECOSYSTEM

- These drugs are persistent enough to reach their target before becoming inactive, making their degradation more difficult.
- Organisms environmentally exposed to pharmaceuticals may accumulate them in their organs and, consequently, pharmaceuticals may enter the food chain.

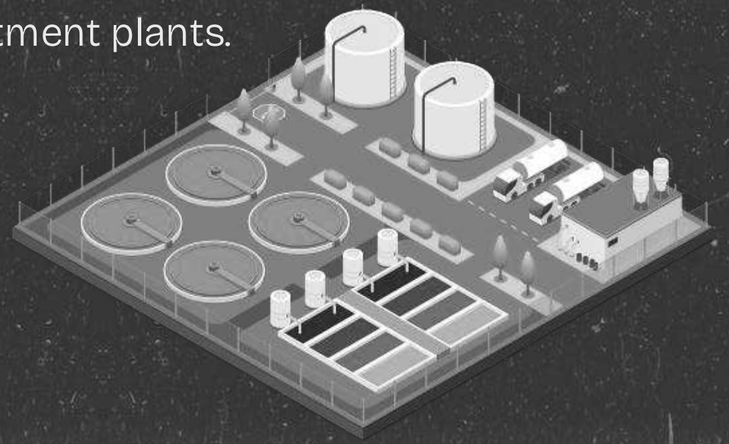





Defined daily dosage, per 1,000 inhabitants per day
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150
Iceland 143.7 140.7 134.2
Canada 114.4 110.6 106.6
Australia 112.2 109.3 106.5
Portugal 109.3 103.8 99.5
Sweden 98.7 96.9 95
Spain 80.4 77.2 75.5
Belgium 79.7 78.8 79
Finland 74.8 70.2 67.6
Slovenia 61.5 59.5 58.6
Czech Republic 61.4 59.9 57.1
Austria 61.3 61 60.5
Greece 58 55.1
NO DATA IN 2016
Germany 56.6 56.9 56.5
Norwa 55.9 57.1 57.4
Luxembourg 54 54.1 54.2
Israel 51.1 49.2 46.7
Netherlands 47.4 46.2 46.5
Turkey 44.1 43.5 41
Italy 41.6 40.4 39.9
Slovak Republic 41.1 39.4 38.9
Chile 40.1 42 36.9
Estonia 31.9 28.8 27.2
Lithuania 31.3 32.1 39.3
Hungary 29.3 28.8 28.4
Korea 21 18.8 18.8
Latvia 16.1 15 15
Year
2018
2017
2016

SOURCES OF CONTAMINATION TO THE ECOSYSTEM

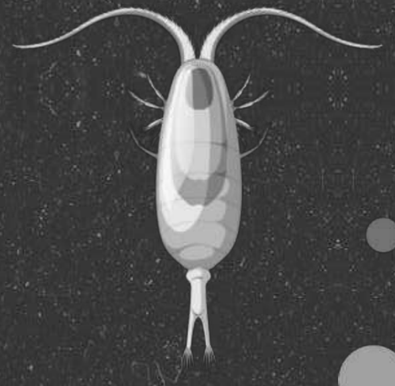
- Human excretory waste that goes into the water system.
- Poor medication waste.
- Waste water treatment plants.



EFFECTS ON THE ECOSYSTEM

- Water pollution system.
- Soil contamination.
- Changes in the reproduction and survival of Aquatic organisms.
- Changes in the food chain.
- Changes in the development of organisms.
- Effect on bacteria and algae.
- Antibiotic-resistant bacteria.

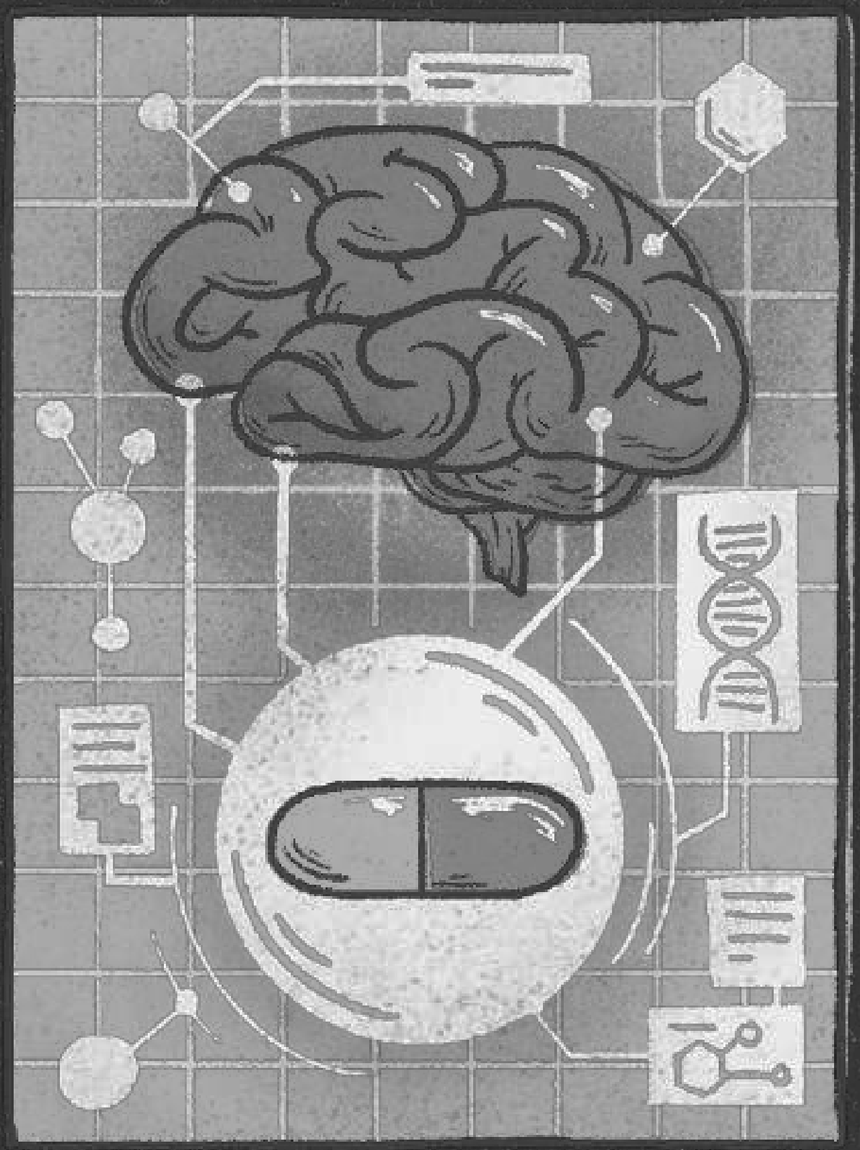
EFFCTS ON AQUATIC ORGANISMS

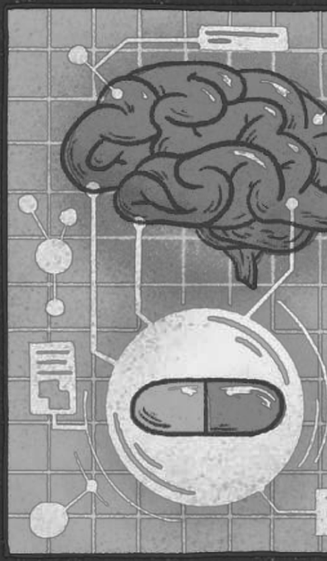


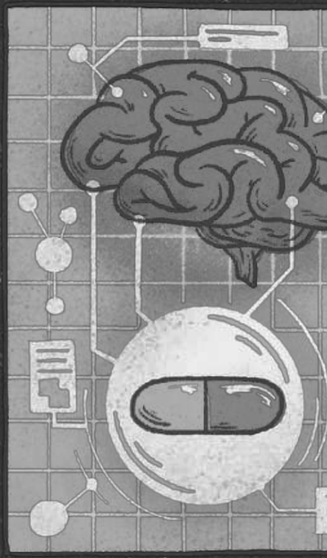
- Bioaccumulation.
- Alteration in food chains.
- Alters reproduction.
- Changes social behavior (more aggressive or less social).
- Alteration in feeding.
- Alteration in predator avoidance.
- Alteration in fertility.

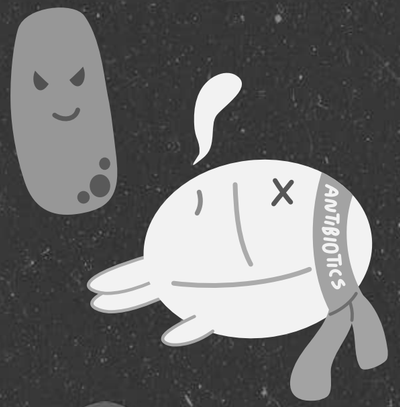
SOURCES OF HUMAN CONTAMINATION

- Contamination of drinking water.
- Consumption of contaminated fish or marine animals.
- Exposure due to working in drugstores, water treatment plants or making a living from fishing.
- Overconsumption or inadequate consumption.
- Contamination of water used to irrigate fruits and vegetables.





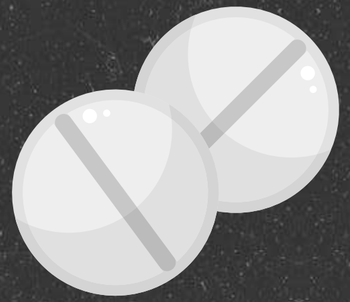




EFFECTS ON HUMAN HEALTH

- Endocrine system problems.
- Hormonal problems.
- Increased antibiotic resistance.
- Mental health effects if not prescribed.
- Stress response.
- Mood and metacognition effects.
- May interfere with medical prescriptions.
- Interfere with pre-existing illnesses.
- Fatigue and difficulty concentrating.
- Damage to the immune system.
- Gastrointestinal damage.
- Cardiovascular problems.
- Fertility and reproduction problems.
- Related to autism in children.

CASE STUDY

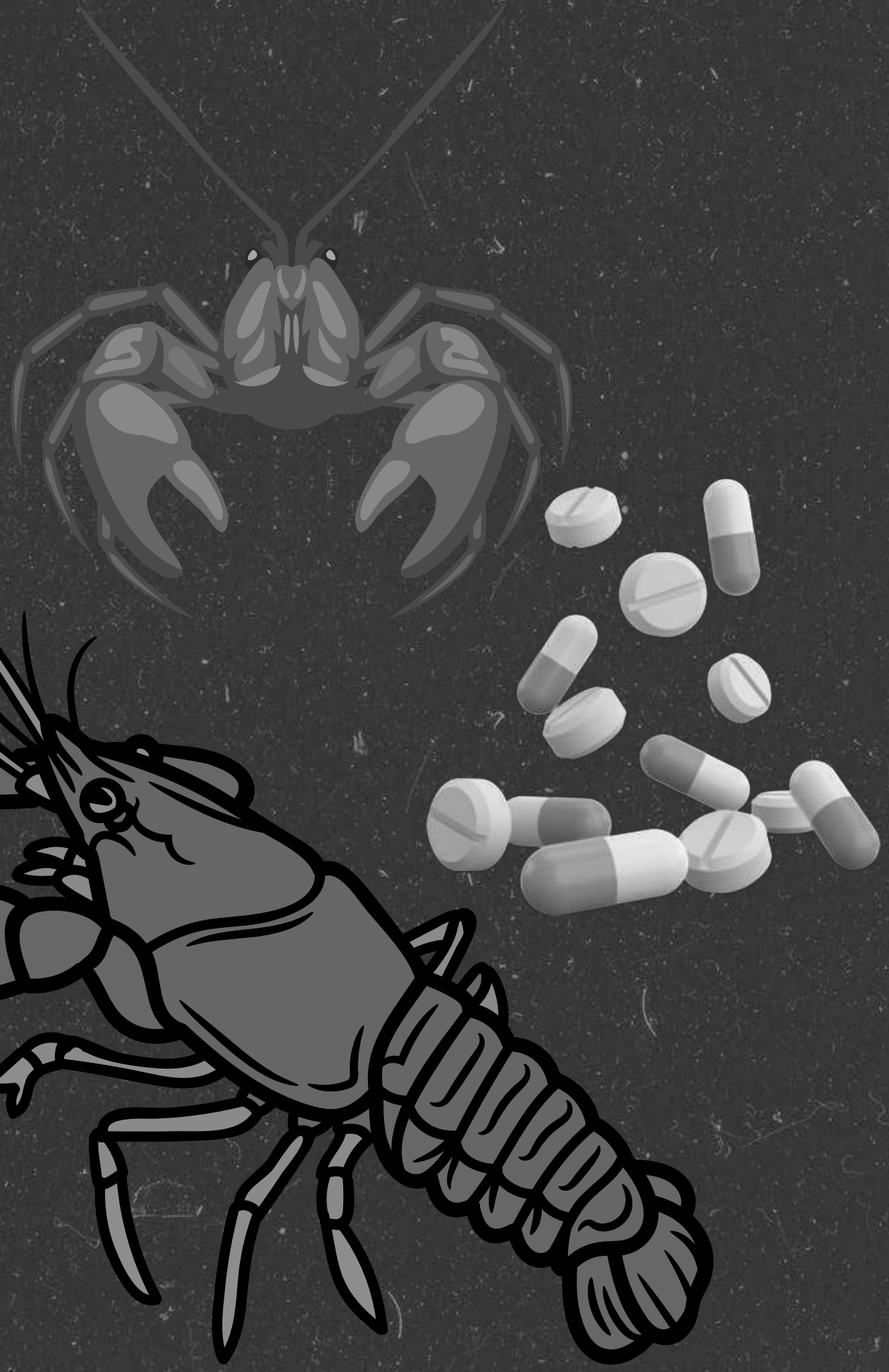


Exposure to a common antidepressant alters crayfish behavior and has potential subsequent ecosystem impacts.

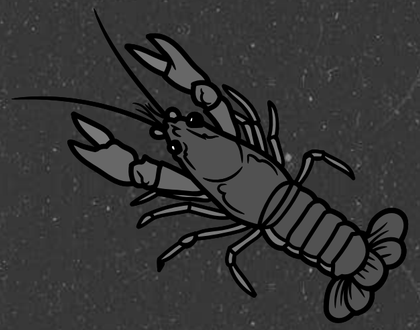
Alexander J Reisinger, Lindsey S Reisinger, Erinn K Richmond, Emma J Rosi

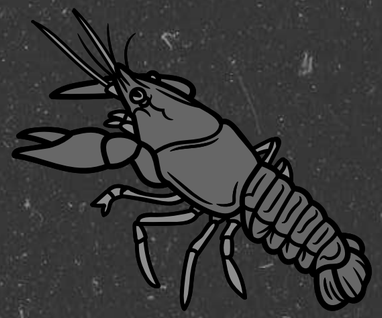
Examines the effects of citalopram, a type of SSRI antidepressant, on crayfish.

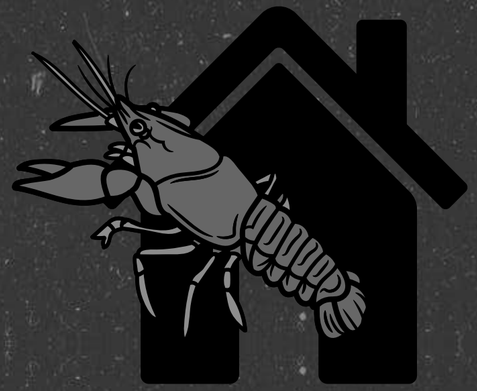
- Increased risk of predation because they emerged from their shells more quickly when stimulated.
- Reduced social interactions.
- More interested in chemical signals from food.
- Less nutrient absorption.

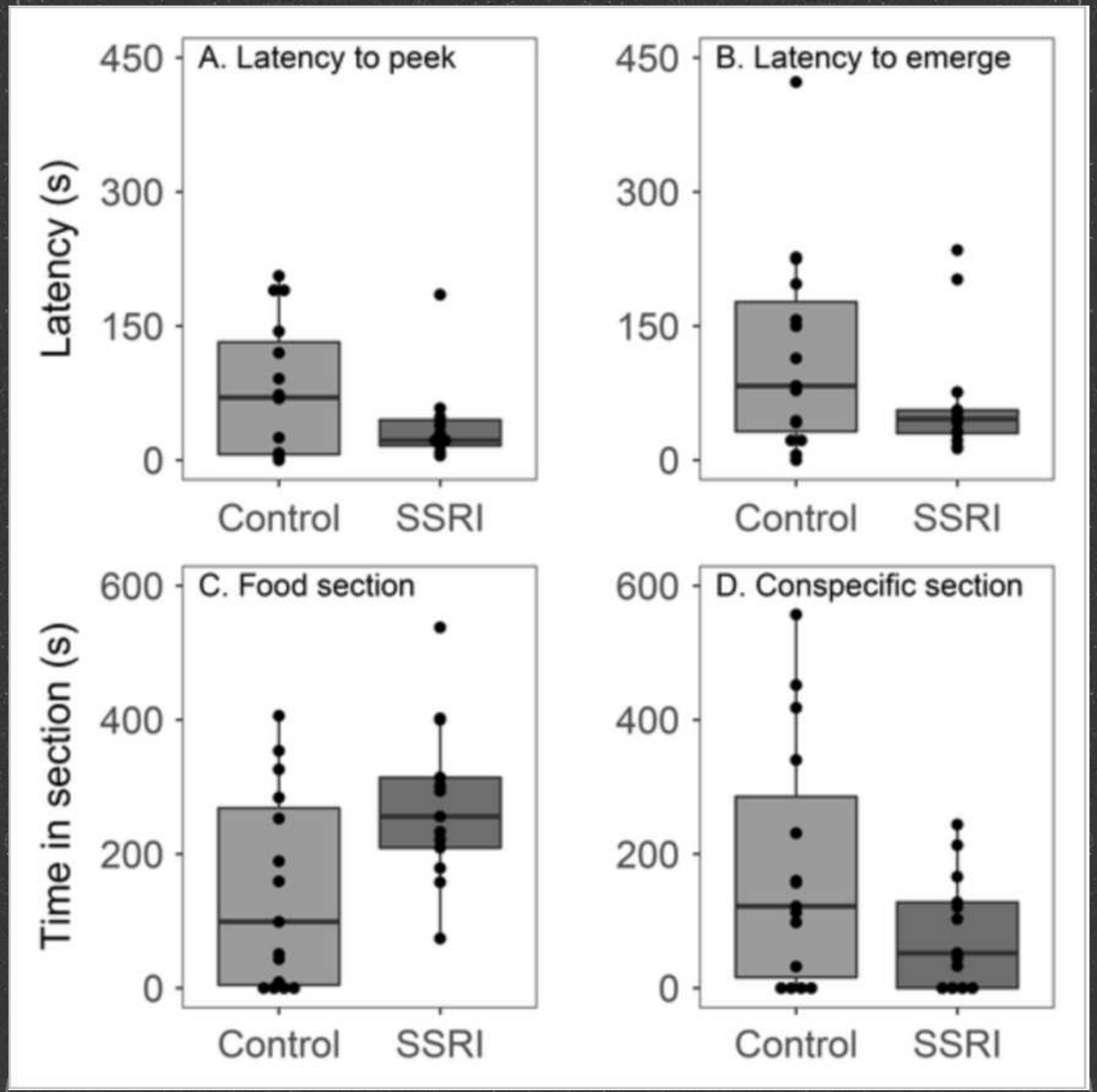


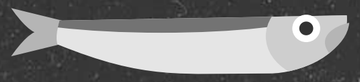
CASE STUDY





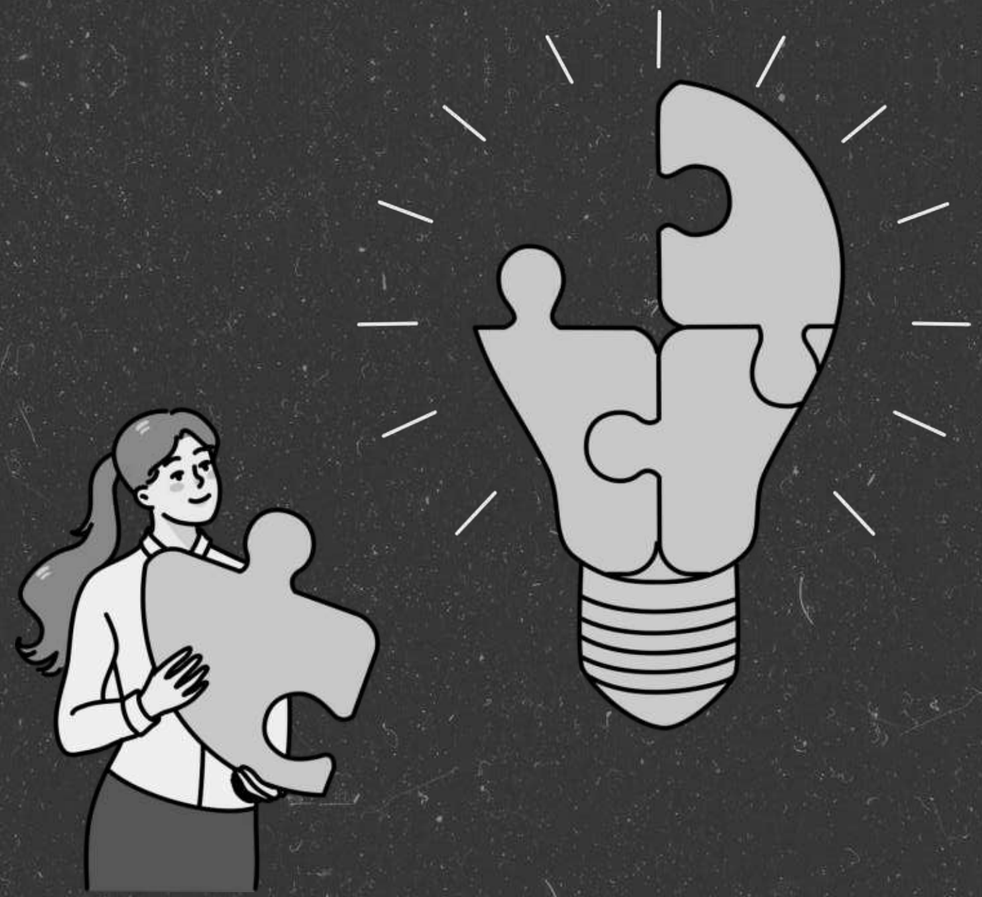


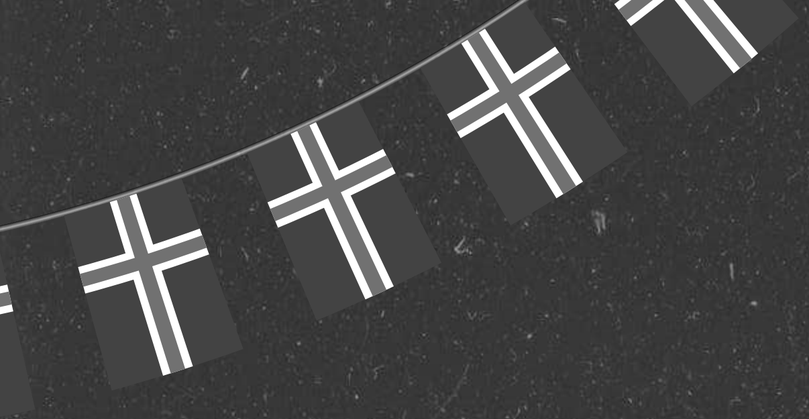

A. Latency to peek
B. Latency to emerge
C. Food section
D. Conspecific section
Latency (s)
Time in section (s)
0
150
300
450
0
200
400
600
Control
SSRI



SOLUTIONS AND INDIVIDUAL ACTIONS

- Clean water act: a federal law that regulates water pollution in the united states.
- Communicate with your local pharmacy to learn how to properly dispose of medications.
- Educate the public about how to properly dispose of the medication.
- Explain how medications in the water ways can negatively impact human health.





PERSIST

CONCLUSION

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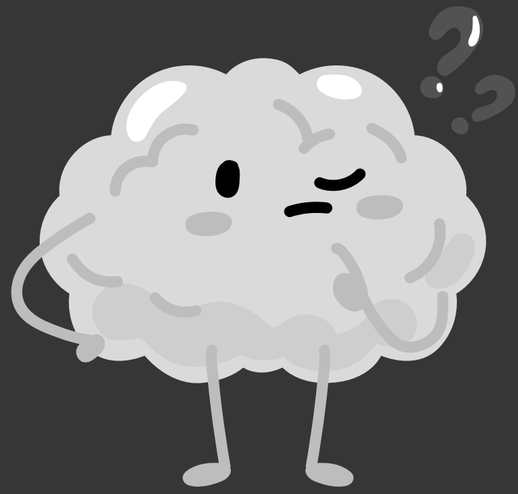
THANK YOU FOR LISTENING!



Q&A

LEAD CONTAMINATION AND FUTURE REMEDIATION

Examine lead contamination pathways in water, air, and soil, and the effects on human health and ecosystems.

WHAT IS LEAD

Lead is a very toxic heavy metaal that has a blusih grey hue. It is capable of existing in both organic and inorganic forms can be found in dust dirt and even old paint in both Organic and Inorganic forms . ead can be found in dust dirt and even old paint

LEAD POLLUTION

Lead pollution is a worldwide concern that can cause serious harm to both human health and environmental health. The consisitent bioaccumulation of lead can be highly poisonous yet industrially adaptable, Lead exposure is especially dangerous for pregnant women and children.

THREE MAIN LEAD FORMS

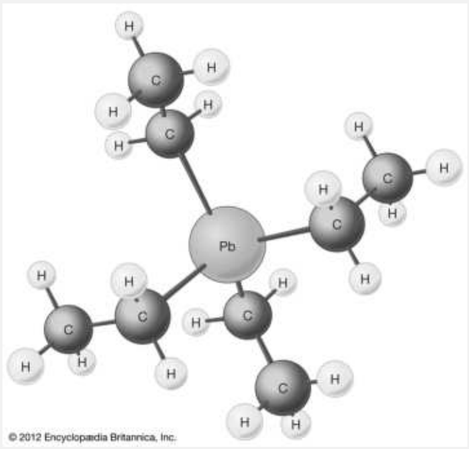
METALIC LEAD

It can corrode over time releasing lead ions into the soil and water

LEAD SALTS

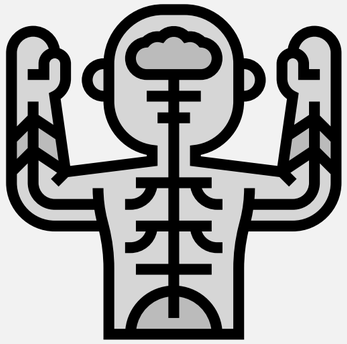
Salts are higly soluble in water, contaminate ground water and absorbed by plants and animals

ORGANIC LEAD



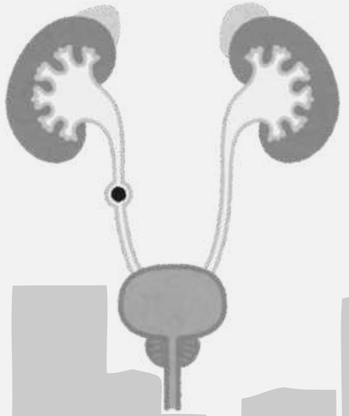
Highly toxic and can easily be absorbed through the skin, inhaled, or ingested. They can cross the blood-brain barrier

HEALTH IMPACTS

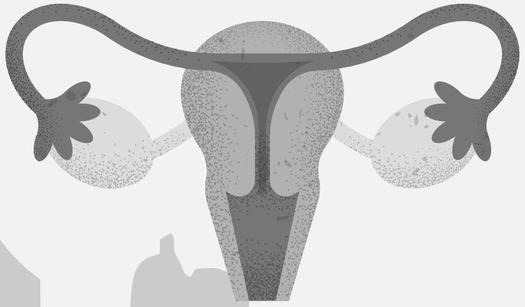


NERVOUS SYSTEM

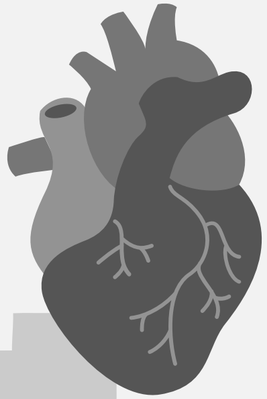
HEMATOPOIETIC SYSTEM



RENAL SYSTEM



ENDOCRINE AND REPRODUCTIVE SYSTEM



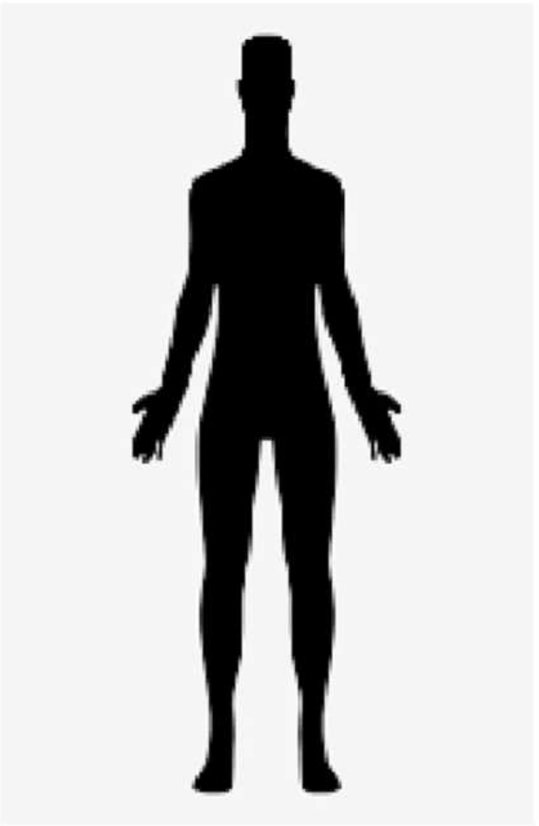
OXIDATIVE STRESS

Consequences of Lead Poisoning on Humans

BRAIN
Lower IQ
Hearing loss

BLOOD
Anemia

KIDNEY
Kidney failure



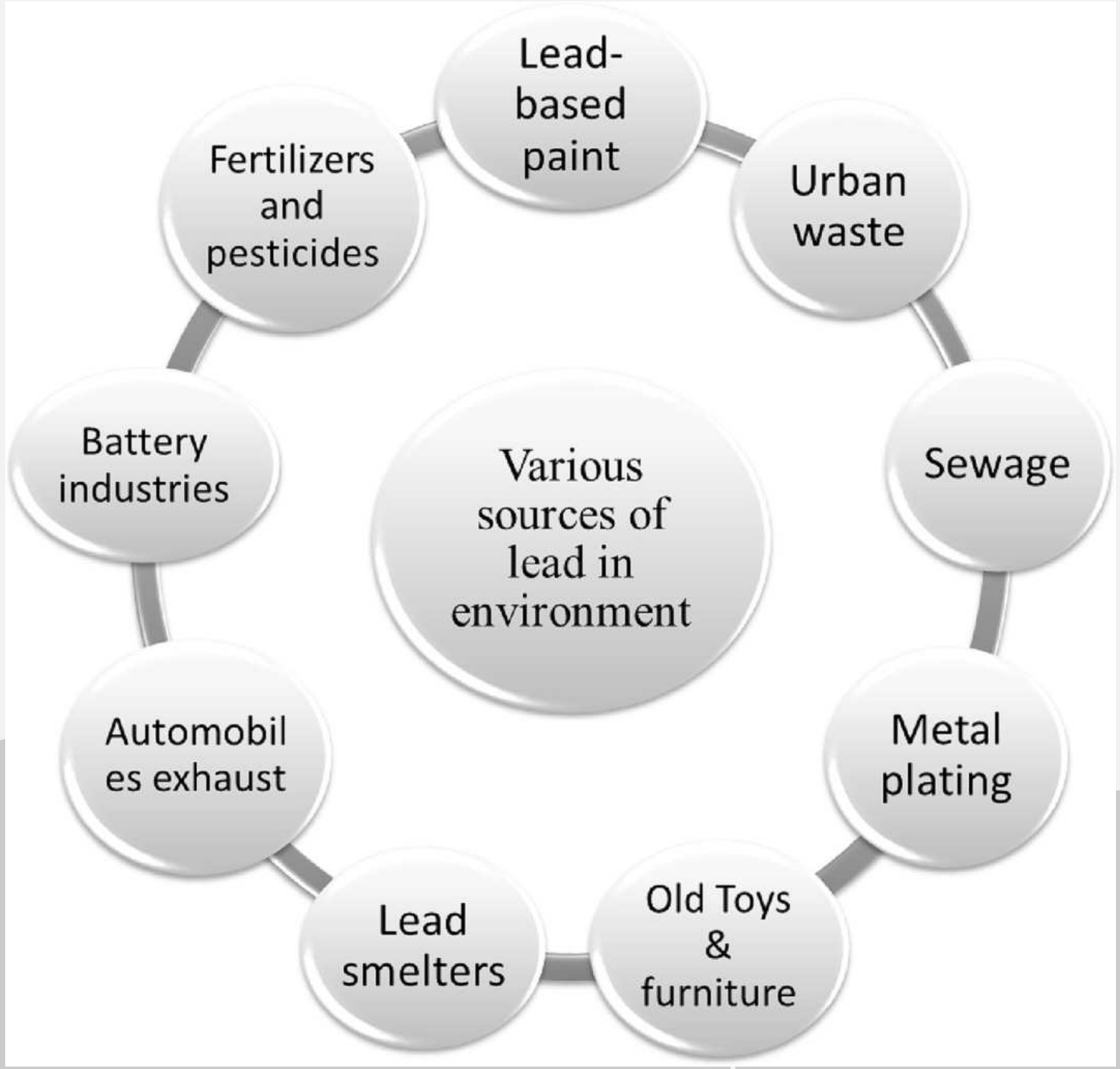
VISION
Blindness
Hallucination

HEART
Cardiovascular disorder

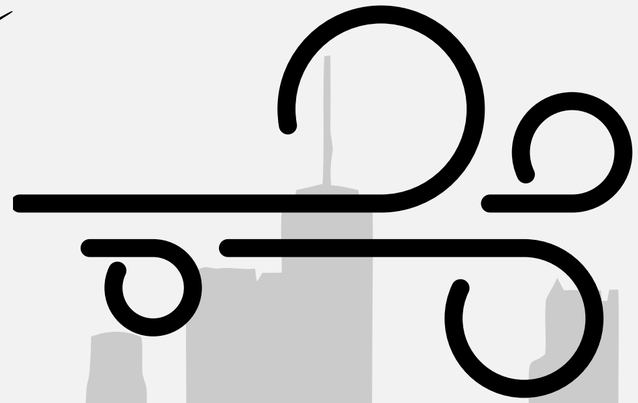
BONES
Impair deveploment

ENVIRONMENTAL IMPACTS

- Air Pollution
- Soil Contamination
- Water Contamination
- Wildlife and Biodiversity
- Ecosystem Imbalances


Various sources of lead in environment
Lead-based paint
Urban waste
Sewage
Metal plating
Old Toys & furniture
Lead smelters
Automobiles exhaust
Battery industries
Fertilizers and pesticides

SPREAD PATHWAYS



AIR

WATER

SOIL

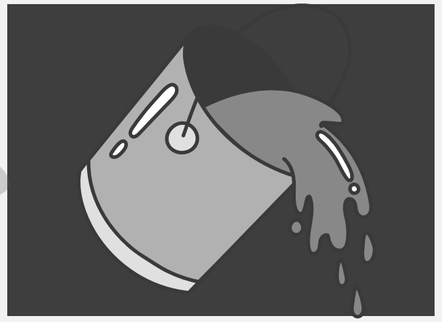
Air
Water
Dust
Pb
Soil
Food

SPREAD PATHWAYS: AIR

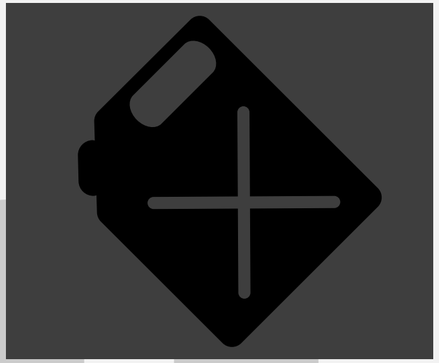
LEADED GASOLINE

SMELTING

SPREAD PATHWAYS: WATER + SOIL



LEAD PIPES, FAUCETS, FIXTURES



OLD PAINT CHIPS ,GASOLINE AND PESTICEDS

POLICES + REGULATIONS

THE SAFE DRINKING ACT

has reduced the maximum allowable lead content that is, content that is considered "lead-free"

One requirement of the LCR is corrosion control treatment to prevent lead and copper from contaminating drinking water.

LEAD COPPER RULE

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THANK YOU

QUESTIONS:

CLIMAT ECHANGE

UNDERSTANDING THE INFLUENCE ON HEALTH AND THE ECOSYSTEM

OVERVIEW

- Global climate change context
- Causes of global climate change
- Greenhouse gases
- Environmental risk and Mortality
- Disease and parasite spread.
- Impacts on human health and ecosystems.
- Ocean acidification
- Solutions

WHAT IS CLIMATE CHANGE?

- long-term change in temperature, precipitation, atmospheric pressure and humidity of the environment.
- Caused by human activities
- Negative effects.
- Industrial revolution.

CAUSES OF CLIMATE CHANGE

- Gas emissions from industry and transport.
- Deforestation.
- Agriculture.
- Burning fossil fuels.
- Human waste.
- Large volcanic eruptions.
- Sun radiation.
- Natural cycles (e.g “El niño)

ROLE OF GREENHOUSE GASES

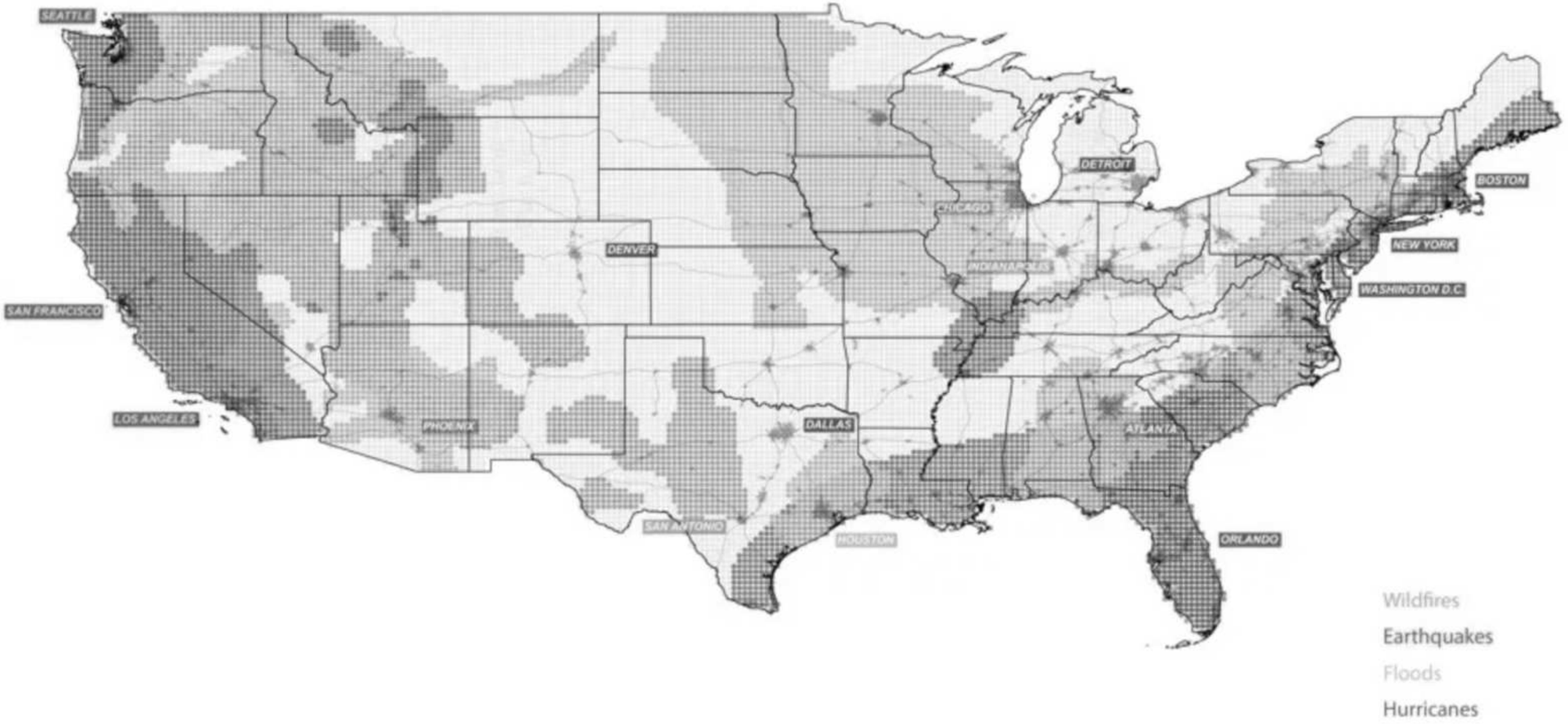
Greenhouse gases:

- Carbon dioxide (CO2)
- Methane (CH4)
- Nitrous Oxide (N2O)
- Water vapor

Greenhouse gases effect:

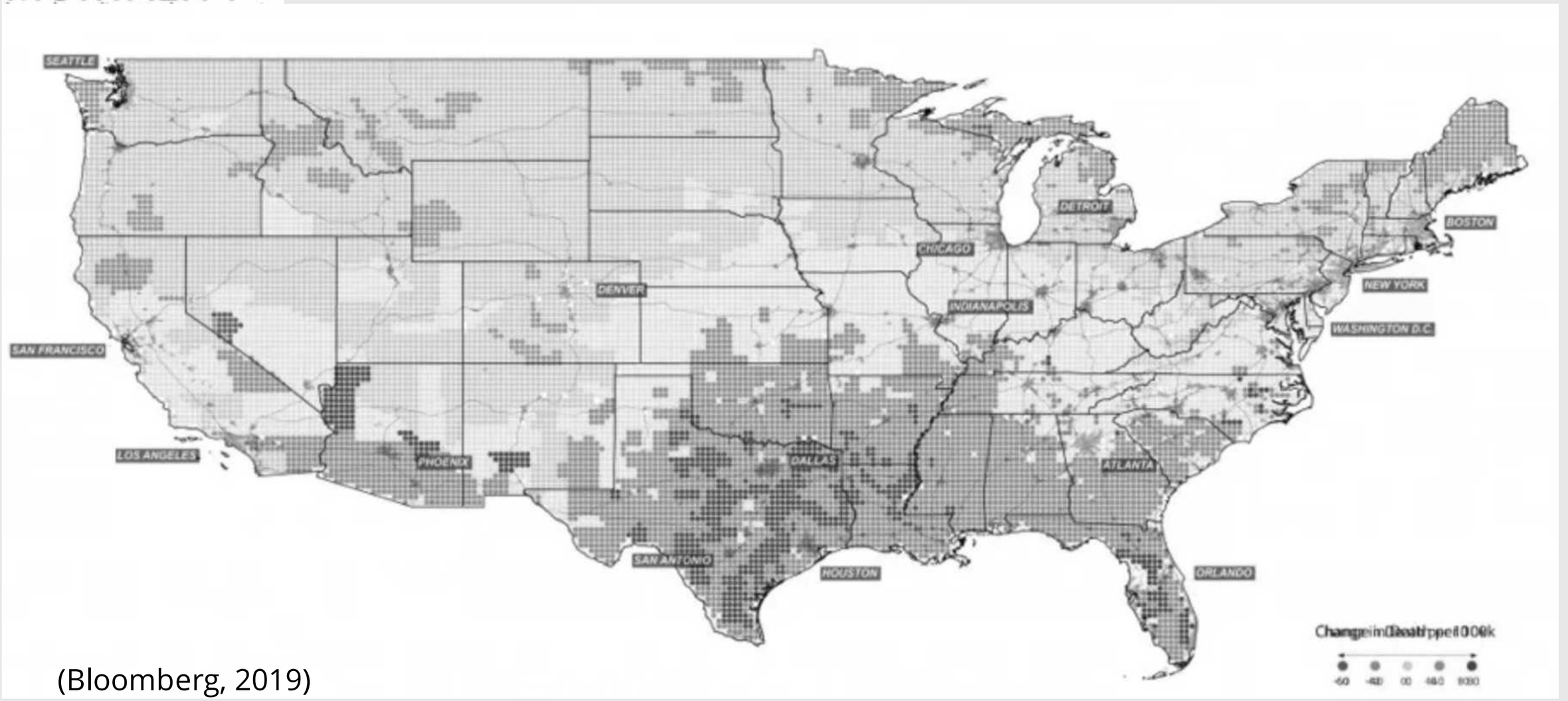
- Earth's radiative balance
- Composition and properties of the atmosphere.

ENVIRONMENTAL RISKS



(Bloomberg, 2019)

MORTALITY



(Bloomberg, 2019)

IMPACT ON HUMANS & HEALTH

- Respiratory Issues.
- Infectious Disease Spread.
- Waterborne Illnesses.
- Food Insecurity and Malnutrition.
- Mental Health Struggles.
- Cardiovascular Diseases.
- Developmental and Birth Defects.

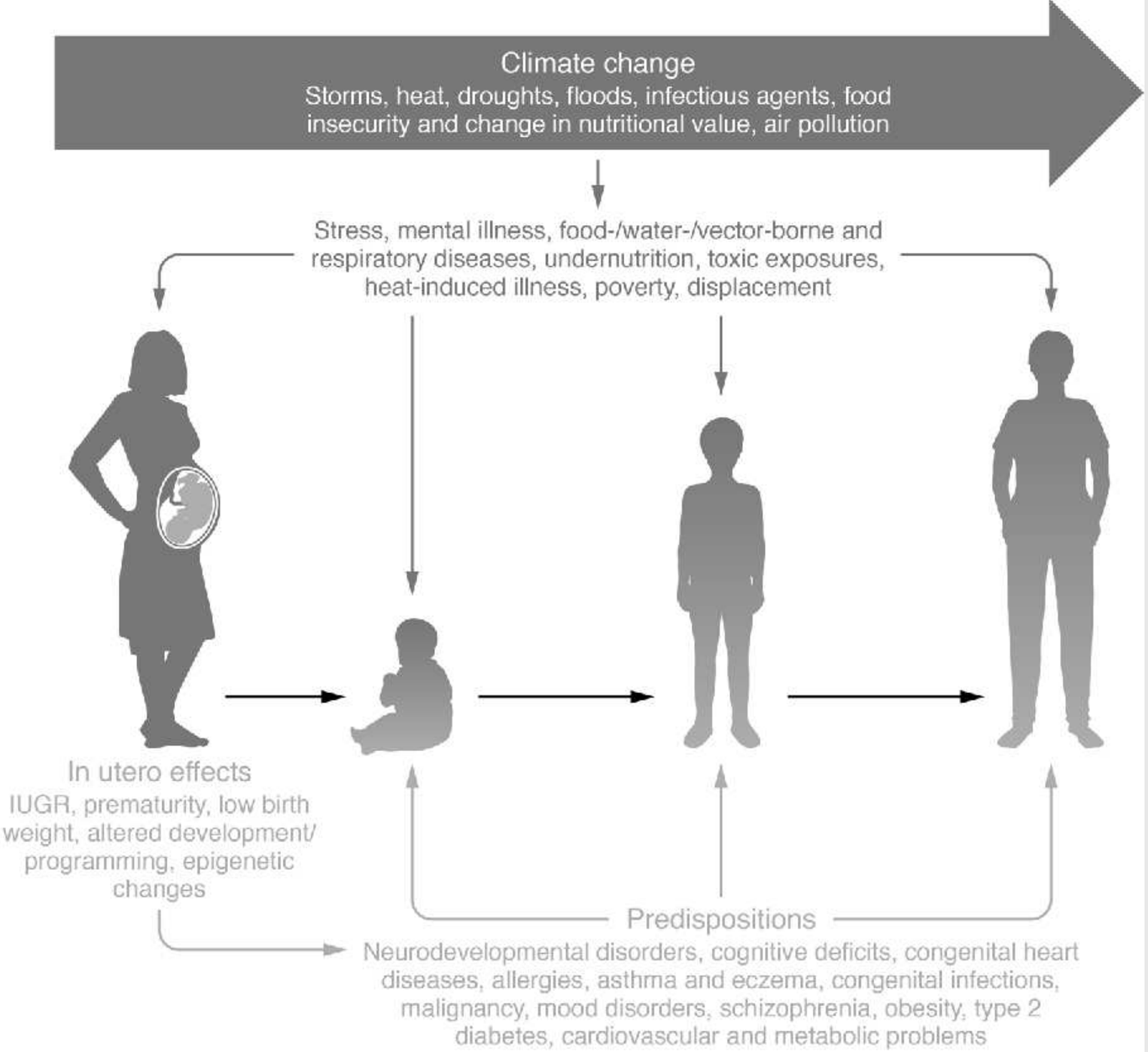
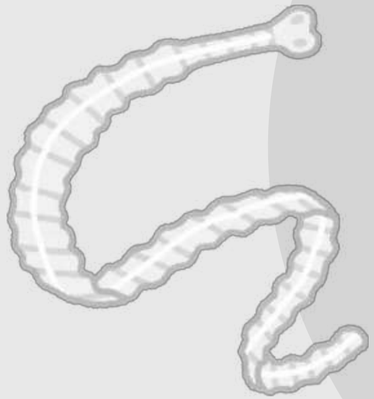


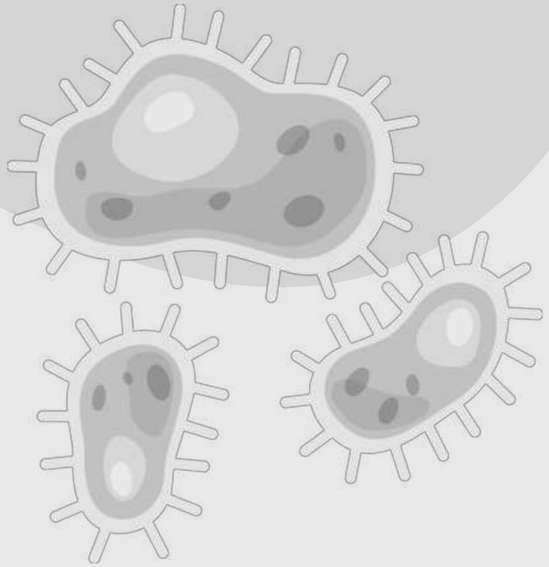
Figure 1. Adverse effects of climate change on children's health start before they are born

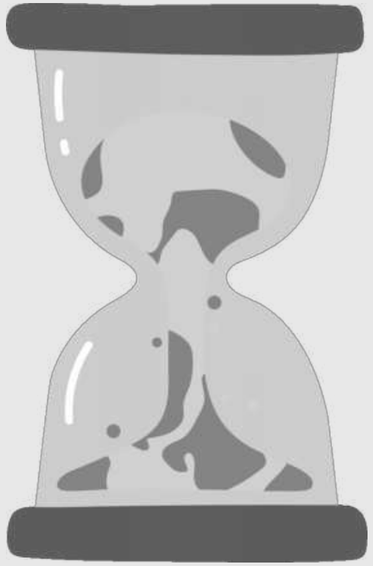


IMPACT

DISEASE AND PARASITE SPREAD

- Expanding Ranges of Pathogens.
- Weakened Immune Systems.





IMPACT

DISRUPTION OF ECOSYSTEMS AND WILDLIFE

- Rising Temperatures.
- Melting Ice and Rising Sea Levels.
- Desertification and Deforestation.
- Disruptions in Food Webs.
- Mismatched Seasonal Cycles.
- Loss of Prey.
- Biodiversity Decline.
- Wildfires.
- Hurricanes and Flooding.
- Droughts and Water Shortages

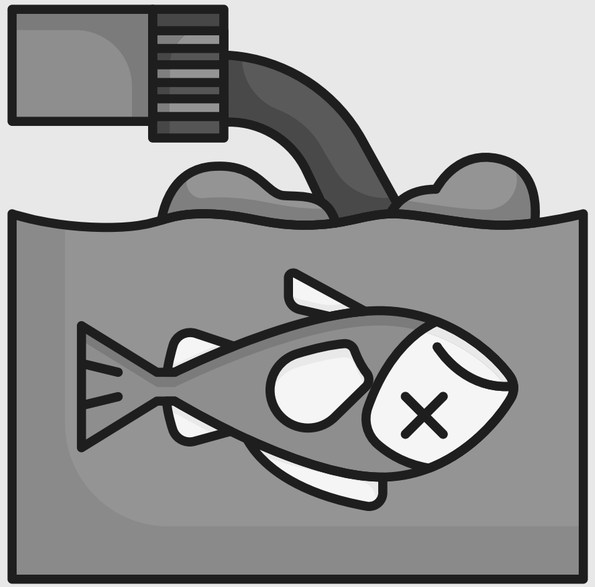
IMPACT

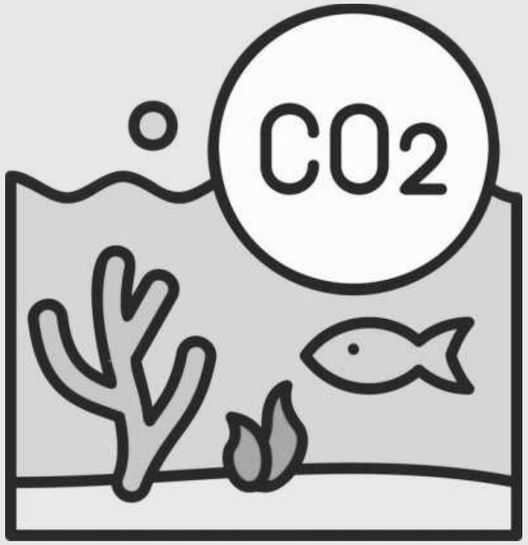
DISRUPTION OF ECOSYSTEMS AND WILDLIFE

- Temperature-Dependent Sex Determination.
- Endocrine Disruptions.
- Earlier Migrations.
- Failed Hibernation Cycles.

IMPACT

OCEAN ACIDIFICATION AND MARINE ECOSYSTEM COLLAPSE





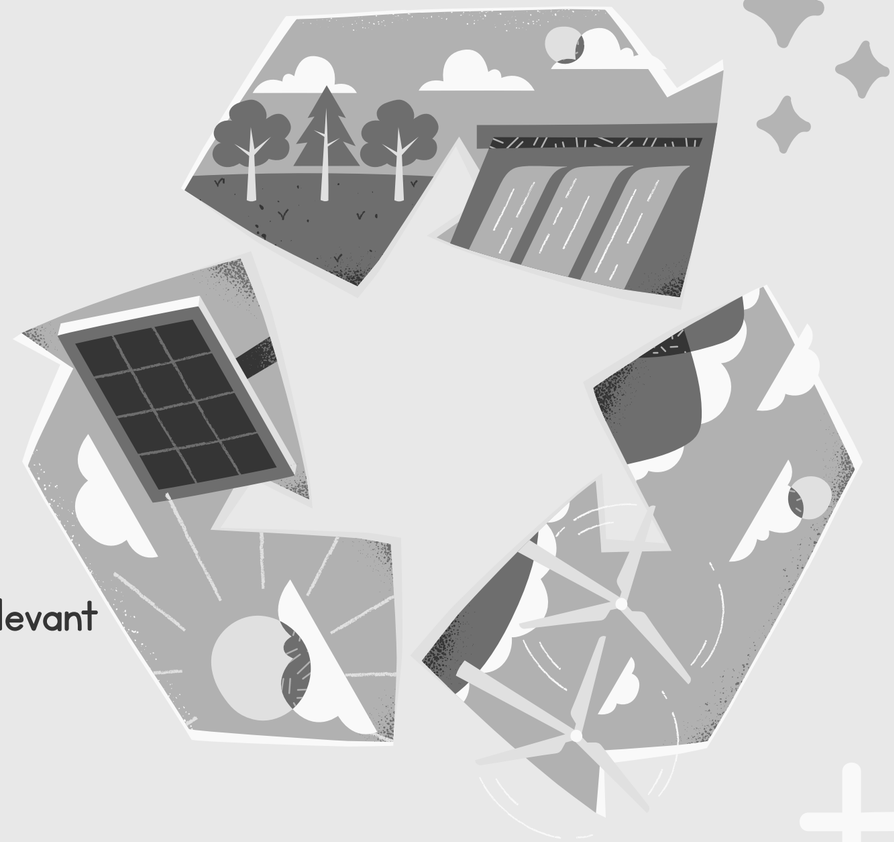
- Coral Bleaching.
- Shell Deformation in Marine Organisms.
- Declining Fish Populations

POSSIBLE SOLUTIONS

- International Agreements and Frameworks
- National and Regional Climate Policies
- Renewable Energy and Emission Reduction Policies
- Conservation and Land Protection Policies
- Adaptation and Resilience Strategies

INDIVIDUAL ACTIONS

- Reduce plastic use
- Save energy
- Save water
- Support eco-friendly products
- Use renewable means of transport
- Help in projects dedicated to reducing pollution
- Help raise awareness in the community about a topic as relevant as global climate change
- Encourage the community to make small changes
- Fight to always achieve the most sustainable option



CONCLUSION

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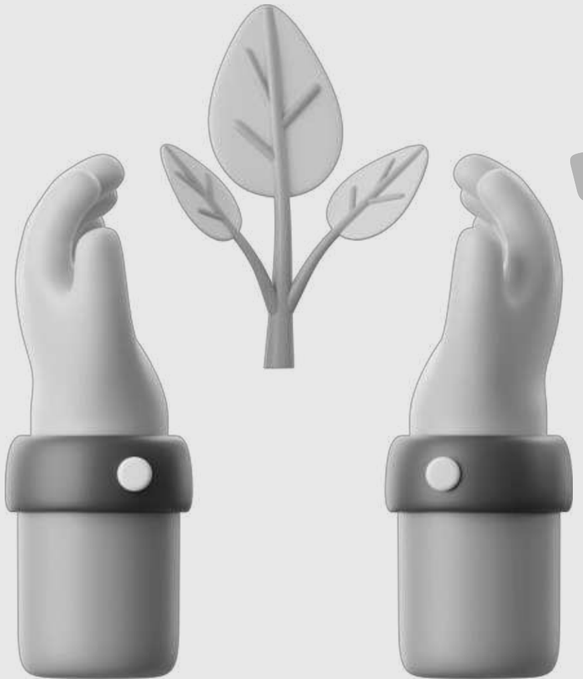
THANK YOU

FOR YOUR ATTENTION

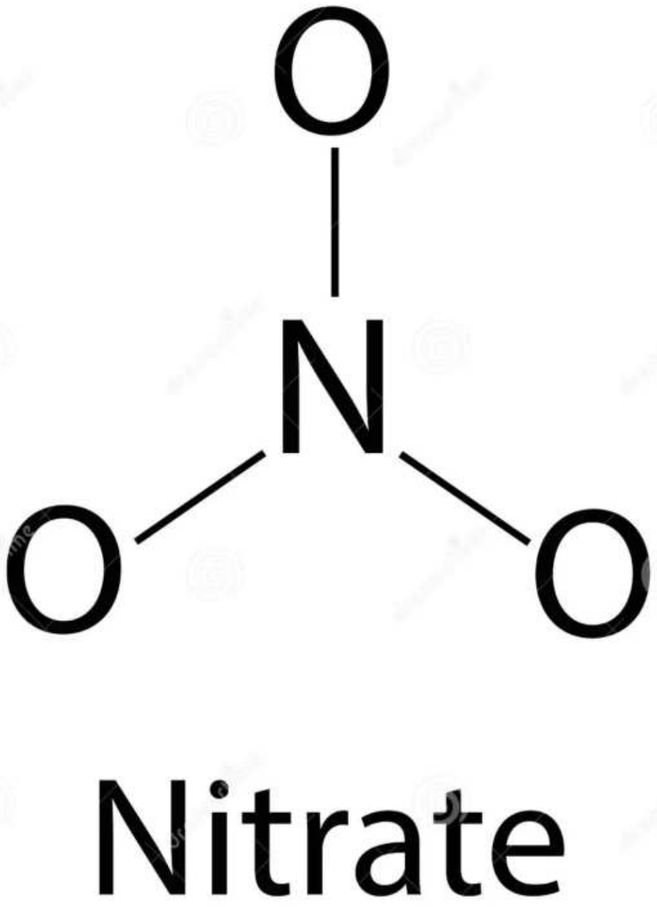
Save our planet



Q&A

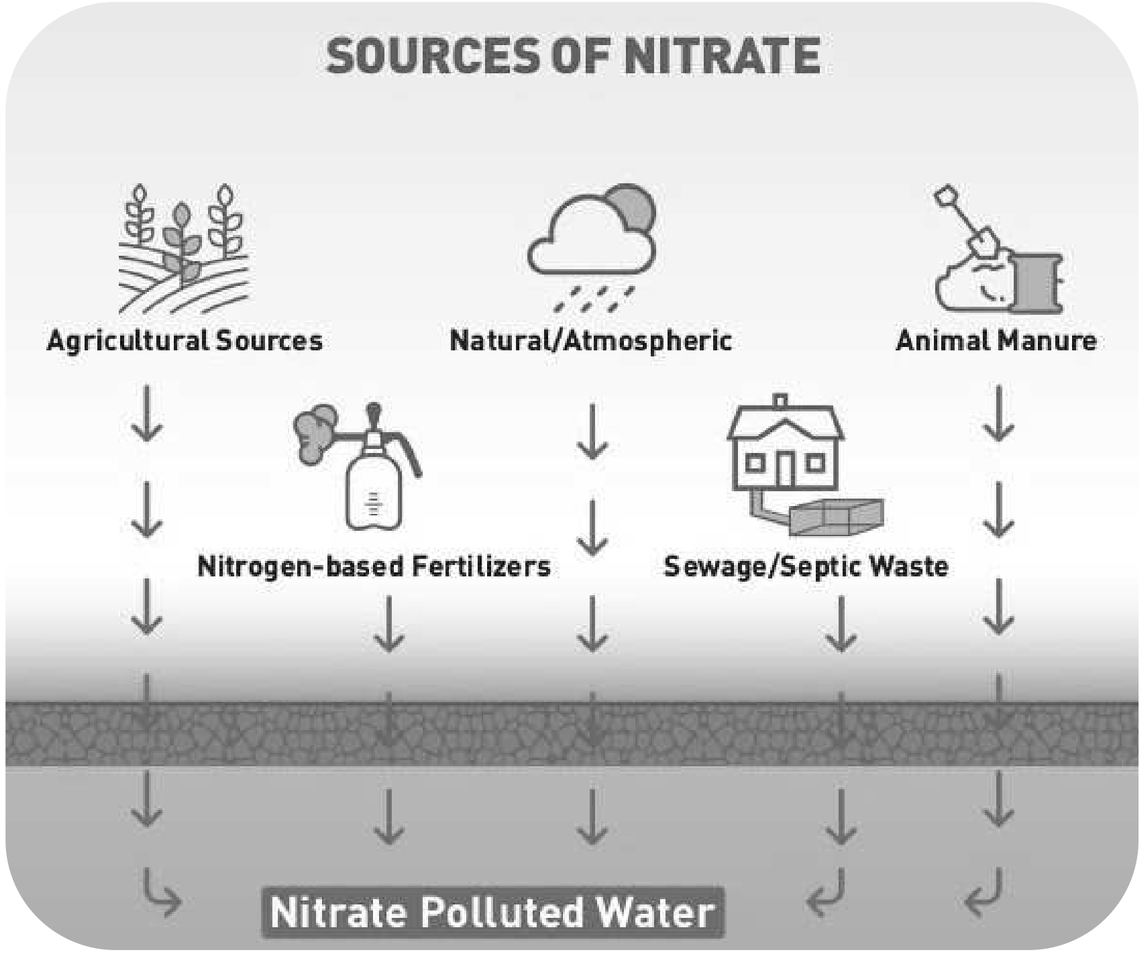
EXPOSURE OF NITRATES IN DRINKING WATER

AND ITS POSSIBLE HUMAN HEALTH CONSEQUENCES



WHAT ARE NITRATES?

- Nitrate (NO3–) is a common contaminant in drinking water worldwide.
- Nitrate contamination results primarily from the use of nitrogen fertilizers from cattle industry.
- Water Treatment Plants have to test for nitrates concentration.



HOW THEY CAN BE FOUND IN DRINKING WATER?

According to the EPA, nitrates can reach our drinking water through run off from agricultural lands, by erosion of natural deposits, and from a leak in septic tanks or sewage

PERMITTED CONCENTRATIONS OF NITRATES IN DRINKING WATER

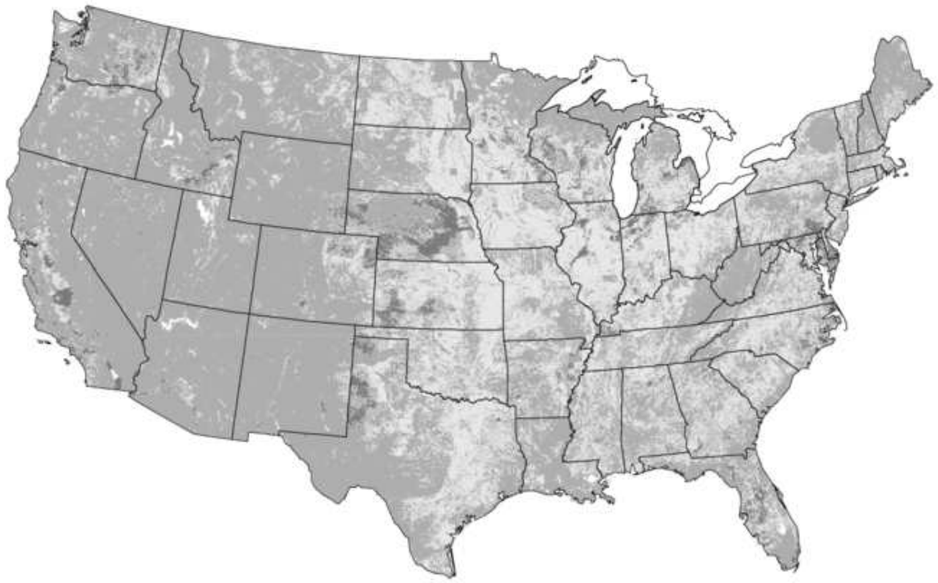
Mercury (inorganic)	0.002	0.002	Kidney damage	Erosion of natural deposits; discharge from refineries and factories; runoff from landfills and croplands
Nitrate (measured as Nitrogen)	10	10	Infants below the age of six months who drink water containing nitrate in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue-baby syndrome.	Runoff from fertilizer use; leaking from septic tanks, sewage; erosion of natural deposits
Nitrite (measured as Nitrogen)	1	1	Infants below the age of six months who drink water containing nitrite in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue-baby syndrome.	Runoff from fertilizer use; leaking from septic tanks, sewage; erosion of natural deposits
Selenium	0.05	0.05	Hair or fingernail loss; numbness in fingers or toes; circulatory problems	Discharge from petroleum refineries; erosion of natural deposits; discharge from mines

HTTPS://WWW.EPA.GOV/GROUND-WATER-AND-DRINKING-WATER/NATIONAL-PRIMARY-DRINKING-WATER-REGULATIONS

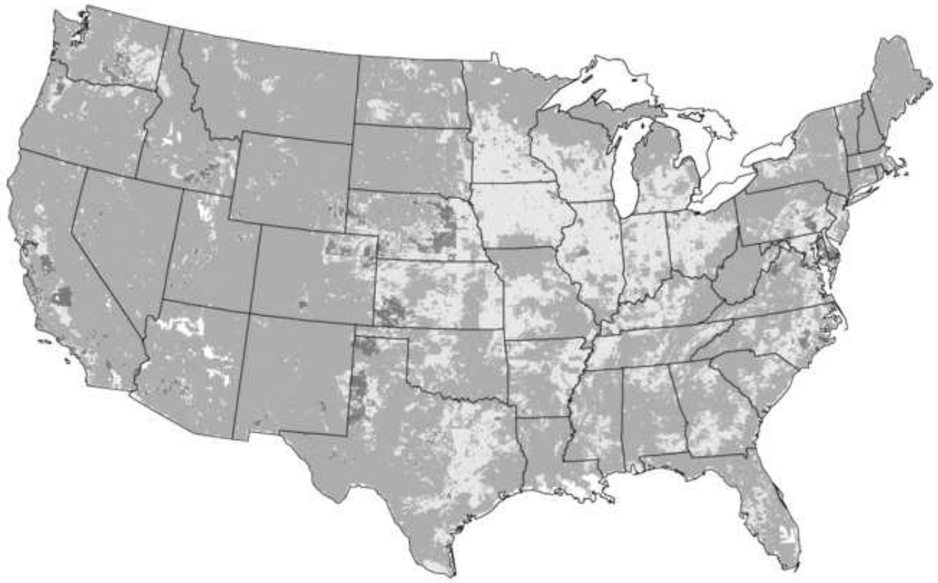
Predicted concentrations of nitrate in U.S. groundwater

By **Water Resources Mission Area** 2015 (approx.)

Predicted nitrate in shallow, recently recharged groundwater



Predicted nitrate in deeper groundwater used for drinking water



EXPLANATION

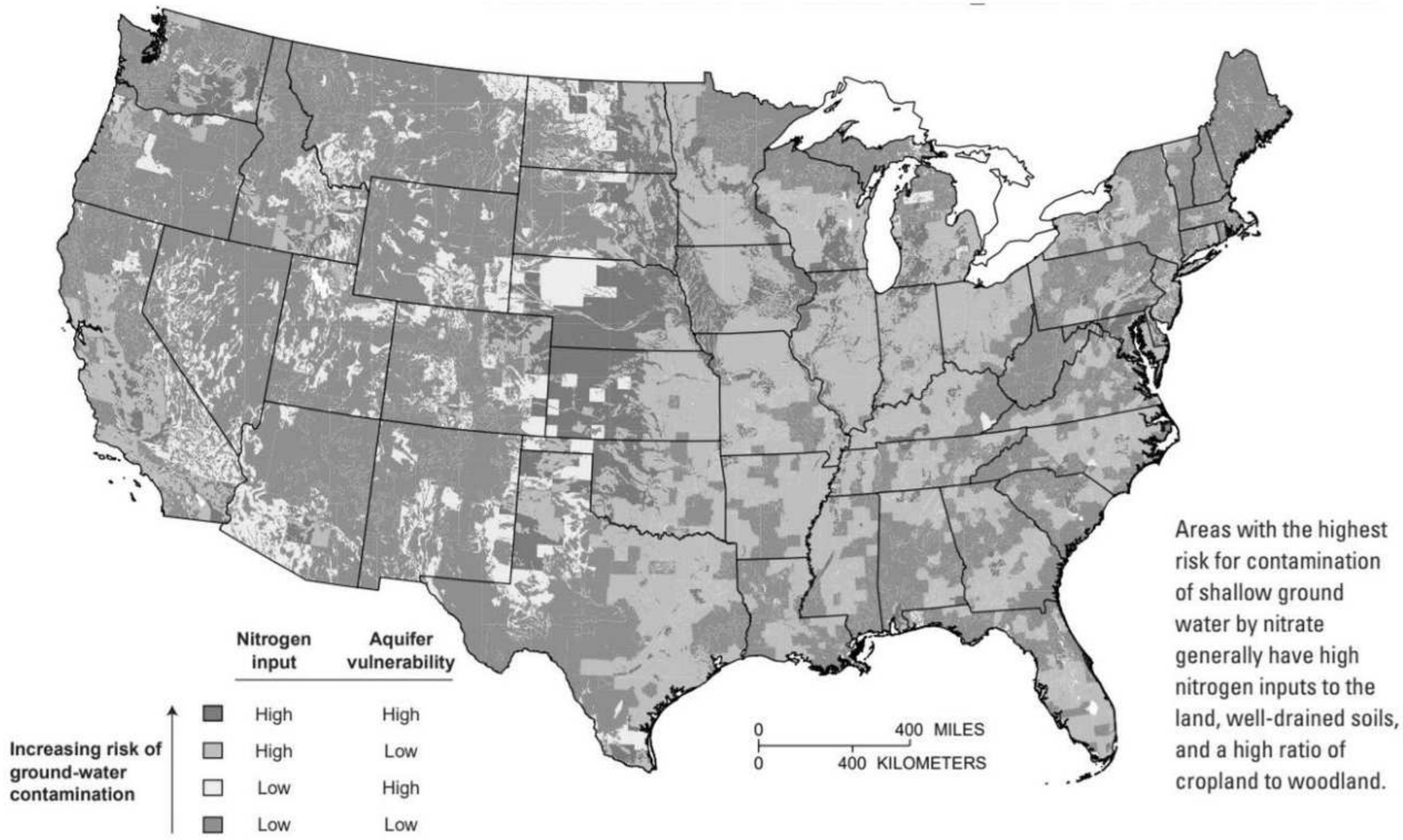
Predicted nitrogen concentration, in milligrams per liter as N

- < 1
- 1 to 5
- > 5 to 10
- > 10

KANSAS AND NEBRASKA SHOWING THE HIGHEST RISKS OF NITRATES CONTAMINATION IN GROUNDWATER

Areas at high risk of nitrogen contamination of groundwater

By Water Science School 1999 (approx.)



Areas with the highest risk for contamination of shallow ground water by nitrate generally have high nitrogen inputs to the land, well-drained soils, and a high ratio of cropland to woodland.

HUMAN HEALTH IMPACTS

CANCER

- COLORECTAL
- BLADDER
- BREAST
- KIDNEY
- BRAIN (CHILDHOOD)
- OVARY
- THYROID
- PANCREAS
- STOMACH/ ESOPHAGUS

PREGNANCY/CHILD HEALTH COMPLICATIONS

- METHEMOGLOBINEMIA
- PREMATURE BIRTH
- SMALL-FOR-GESTATIONAL AGE (SGA) BIRTHS
- CONGENITAL BODILY DEFECTS/ MALFORMATIONS
- TYPE 1 DIABETES
- ACUTE RESPIRATORY TRACT INFECTIONS
- GOITER

THYROID ISSUES

- THYROID DISEASE
- HYPOTHYROIDISM

CASE STUDY #1

EXPOSURE TO NITRATE FROM DRINKING WATER AND THE RISK OF CHILDHOOD CANCER IN DENMARK

INTRODUCTION

- BACKGROUND: NITRATE (NO_3^-) IS A COMMON DRINKING WATER CONTAMINANT, PRIMARILY FROM AGRICULTURAL FERTILIZERS AND ANIMAL MANURE.
- PUBLIC HEALTH CONCERN: NITRATE MAY CONVERT TO N-NITROSO COMPOUNDS, POTENTIAL CARCINOGENS.
- OBJECTIVE: INVESTIGATE THE ASSOCIATION BETWEEN NITRATE EXPOSURE AND CHILDHOOD CANCER, INCLUDING LEUKEMIA, LYMPHOMA, AND CENTRAL NERVOUS SYSTEM (CNC) CANCER.

METHODS

- **Study Type: Nationwide case-control study in Denmark.**
- **Population: 1,219,140 singleton live births (1991–2015).**
- **Cases: 596 leukemia, 180 lymphoma, 310 CNC identified from the Danish Cancer Registry.**
- **Control: sample of people exposed to minimal nitrate concentrations.**
- **Exposure Assessment: Nitrate concentrations estimated via public water records and linked to residential history.**
- **They calculated annual average nitrate ion concentrations from 130,944 drinking water samples in 3,907 public waterworks taken between 1991 and 2015**

RESULTS

- **No significant association between nitrate exposure and childhood leukemia or lymphoma.**
- **Increased risk observed for CNC in the highest exposure group (>25 mg/L nitrate): These findings were particularly strong for nitrate exposure during preconception and during the third trimester.**

HEALTH IMPACT OF NITRATE POLLUTION IN DRINKING WATER IN WISCONSIN

- 10% of private wells exceed drinking water standard of 10 mg/L; >20% of wells in agricultural areas exceed DWS
- Utilized a modified attributed fraction disease model, which additionally incorporated increasing risk with increasing nitrate concentrations
- Nitrate concentrations proved to have adverse pregnancy/birth effects, along with being carcinogenic (more details on next slide)

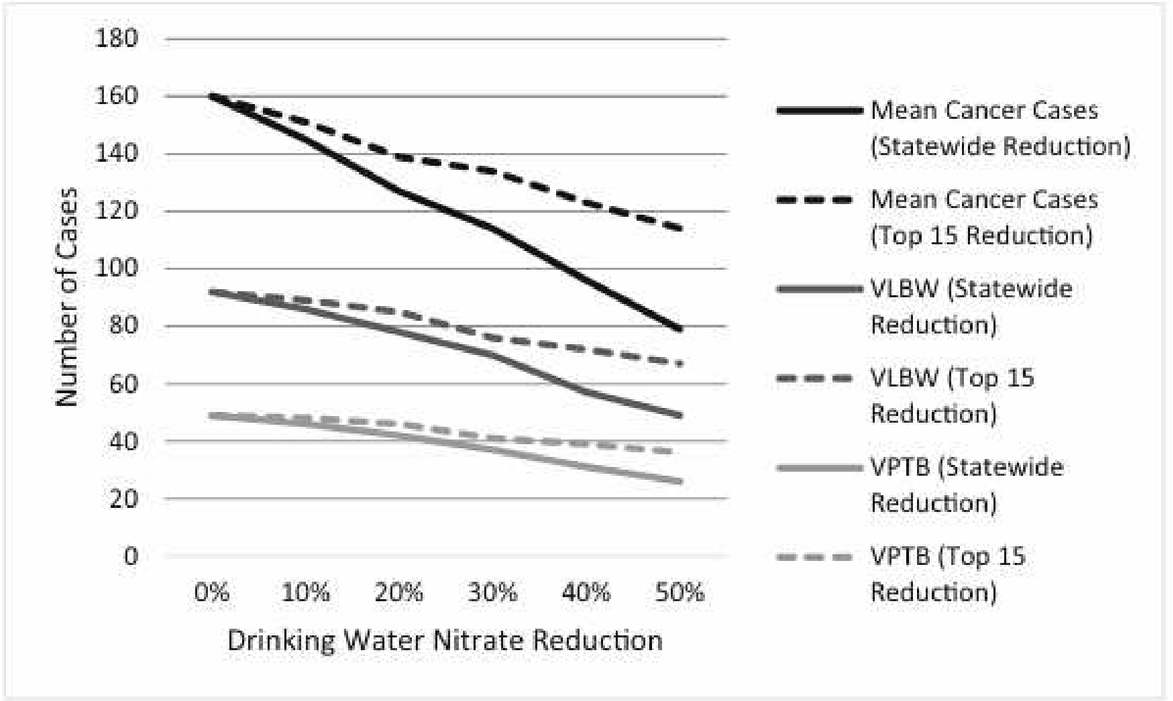


Fig. 3 Estimated declines in annual cases of cancers, very low birth weights (VLBW), and very low preterm births (VLPTB) attributable to nitrates in drinking water with increasing reductions in drinking water nitrate concentrations

HUMAN HEALTH IMPACTS

Adverse health outcome	At-risk population or births	Annual attributable cases due to nitrate exposure from community water systems	Annual attributable cases due to nitrate exposure from private wells	Total annual cases attributable to nitrate exposure
Colorectal cancer-1	1,314,000-1417, 000	116	102–118	218–233
Colorectal cancer-2	1,122,000-1,148,000	78	42–44	120–122
Colorectal cancer-3	1,973,000-2,039,000	49	30–32	79–81
Colorectal cancer-4	1,203,000-1,294,000	34	32–37	66–71
Colorectal cancer-5	227,000–277,000	21	45–59	66–80
Ovarian cancer-1	69,000-79,000	3	4–5	7–8
Ovarian cancer-2	36,000-44,000	1	2	2–3
Thyroid cancer-1	105,000–114,000	7	7–8	14–15
Thyroid cancer-2	45,000-55,000	3	6–8	9–11
Kidney cancer-1	227,000–277,000	9	19–25	28–34
Bladder cancer-1	45,000-55,000	2	4–5	6–7
Neural Tube Defect-1	6000-8000	0	1	1
Neural Tube Defect-2	22,000–23,000	1	1	2
Very preterm birth-single threshold	22,000–23,000	16	10–11	26–27
Very preterm birth-multiple thresh-old	22,000–23,000	36	36–43	72–79
Very low birthweight-single threshold	22,000–23,000	29	17–19	46–48
Very low birthweight-multiple threshold	22,000–23,000	66	69–83	137–149

Table 3 Estimated annual nitrate-attributable cases of cancers and adverse birth outcomes. The ranges reflect private well exposure using the WDNR data set (lower estimate) and the DATCP data set (upper estimate). Populations and births are all rounded to the nearest thousand.

SOLUTIONS: EFFECTIVE REMOVAL METHODS

FREEZING-MELTING PROCESS

Freezes nitrate-containing water and separating ice crystals from nitrate

NANO ALUMINA

Acts as an absorbent; is capable of extracting nitrate from water

PHYSICOCHEMICAL METHODS

Includes ion exchange, electrodialysis, reverse osmosis, and denitrification; used in water treatment plants to extract nitrate

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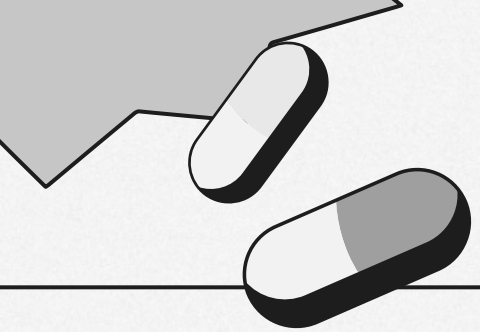

Emerging Contaminants: Antibiotics

BIO 424 [redacted]

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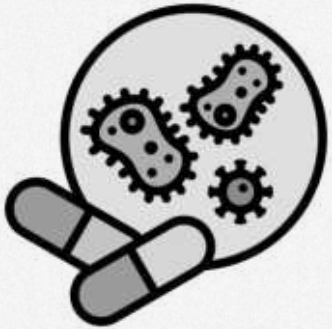
02 Health Risk

03 Case Study Analysis

04 Policy and Proposed Solutions

Background Information

- The presence of pharmaceutical residues in the environment are becoming a bigger concern
- Use of antibiotics has increased worldwide in both human and veterinary fields
- These contaminants usually enter the surface water through wastewater
- Continuous pollution can harm aquatic and land organisms over time
- Special attention is being paid to their presence in aquatic environments



(Milic et al., 2013)

- Wastewater treatments do not fully remove emerging contaminants, especially pharmaceuticals
- Pharmaceuticals are usually water soluble and poorly degradable
- They can pass through all natural filtrations, reach the groundwater, and end in drinking water
- Even small amounts of antibiotics can harm the environment and public health due to their bioactivity
- Common human antibiotics: fluoroquinolones, macrolides and aminoglycosides
- Common veterinary antibiotics: penicillins, tetracyclines and macrolides

(Milic et al., 2013)

Antibiotic Pathways

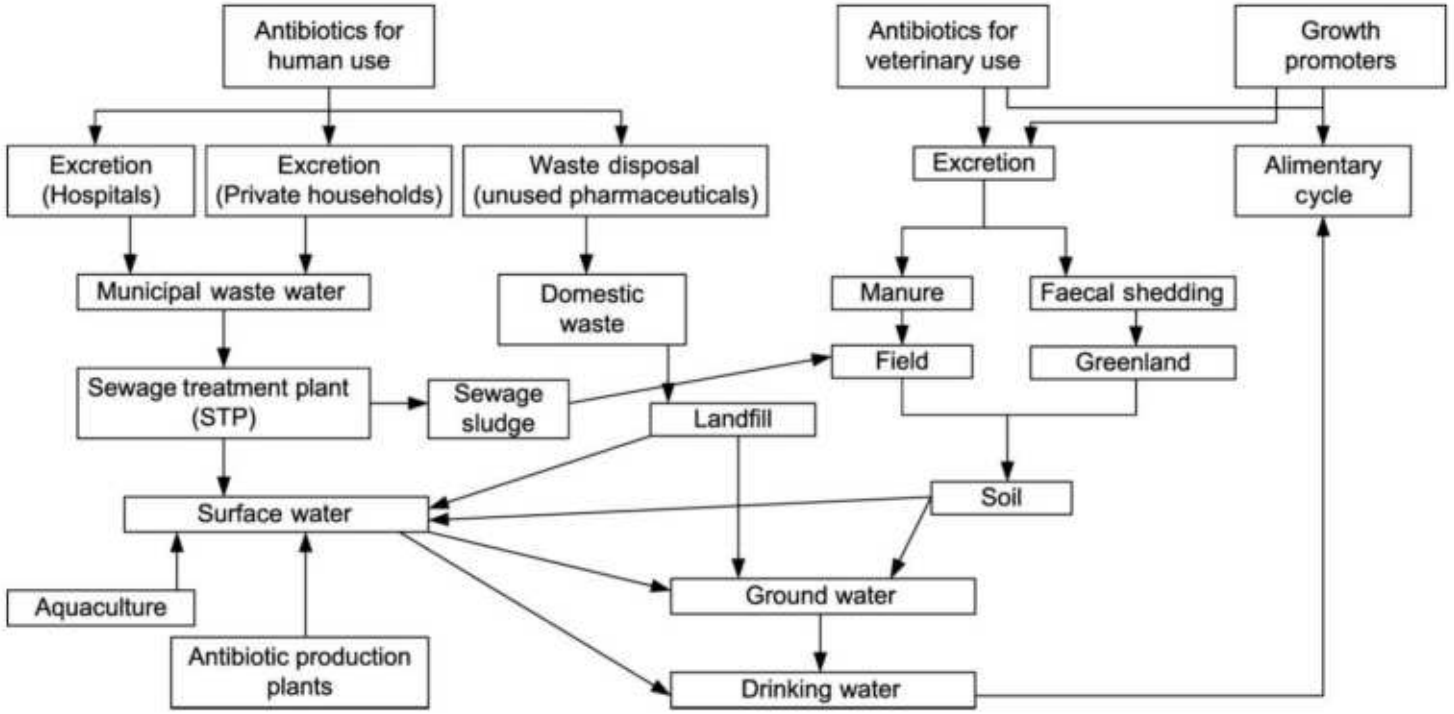


Figure 1. Sources and pathways for antibiotic presence in environment.

(Milic et al., 2013)

Human Health Risks

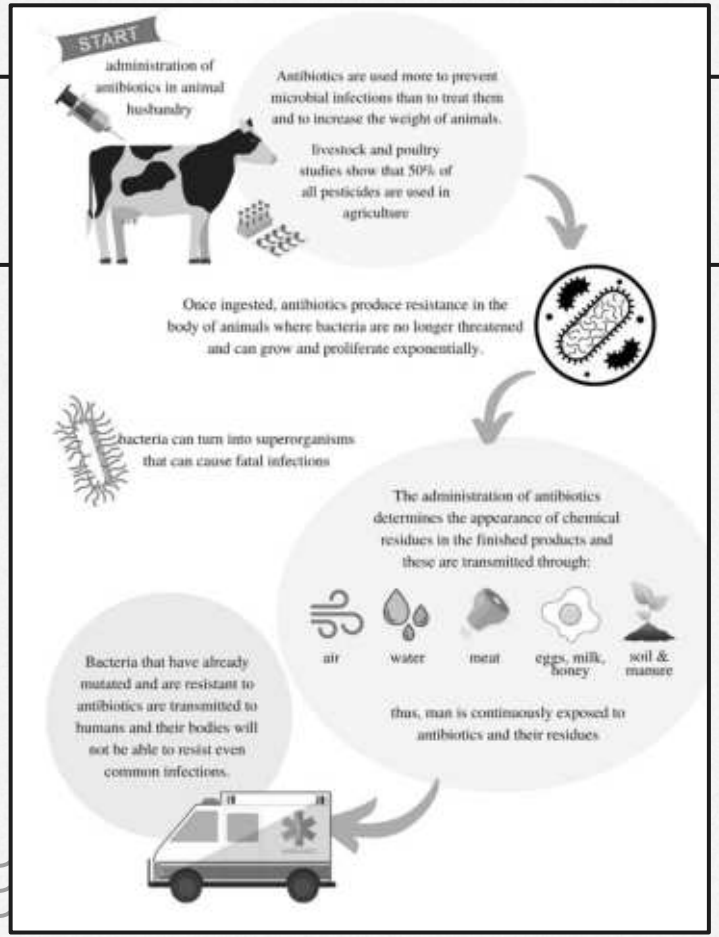
- Antibiotic resistant bacteria (ARB)
- Antibiotic resistant genes (ARG)

- Allergic Reactions
- Potential hormonal disruption (Long-term effect)

- Increased susceptibility to infections
- Digestive microbe imbalance

- Bioaccumulation
- Biomagnification

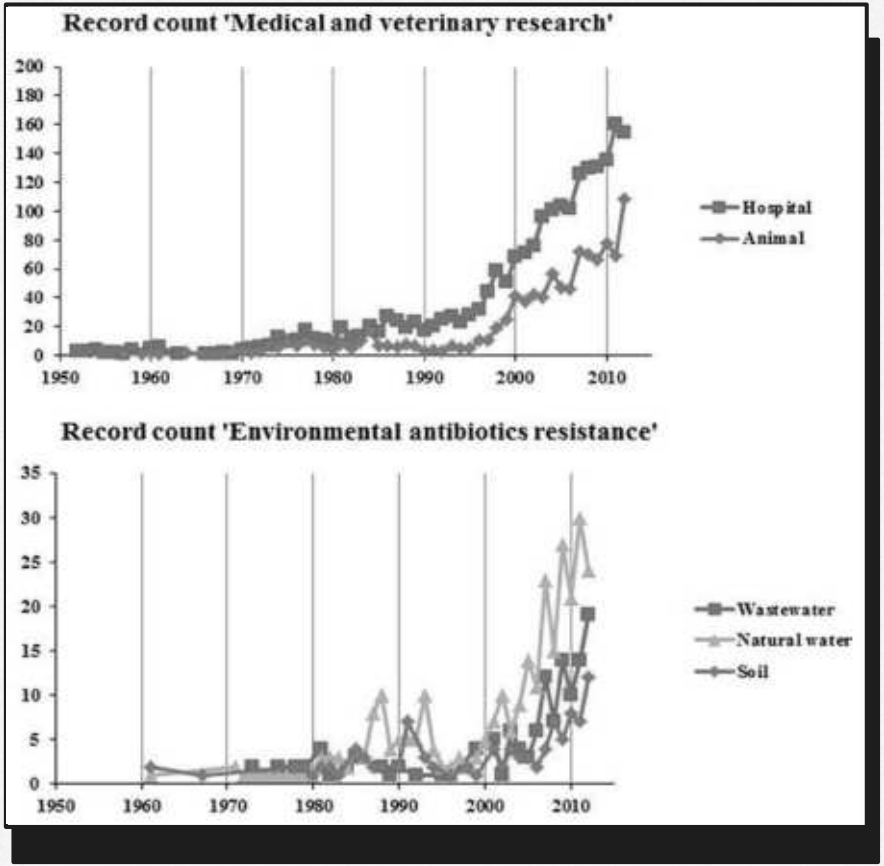
(Meng et al., 2019)



Antibiotics to Humans

How does antibiotic resistance happen?

The Number of Reported Antimicrobial Resistance Related Incidents



“Antibiotic Resistance Genes as Emerging Contaminants: Studies in Northern Colorado”

Case Study Summary

This study identifies antibiotic resistance genes (ARGs) as environmental contaminants in northern Colorado, concentrated in areas impacted by human and livestock antibiotic use. ARGs persist in water systems, potentially reaching human consumers through drinking water.

Relation to Environment

This study relates to antibiotic resistance and its environmental impact by showing how resistance genes can be transported through water systems, influenced by human and agricultural activities, and potentially reintroduced to human populations. The presence of ARGs in treated wastewater and drinking water underscores the need for improved water treatment strategies to mitigate their spread.

(Pruden et al., 2006)

Policy

- Issue often framed within "The One Health Model": links human, animal, and environmental health
- Address the misuse of antibiotics in the health and agricultural sectors
  - Lax policies and lack of regulation
  - Limited public awareness of antibiotic risk
  - Easy access to antibiotics without prescriptions (self-medication)
  - Inappropriate prescribing due to diagnostic uncertainty

(Kraemer et al., 2019)

- Countries like Canada have developed their own domestic action plan to combat antibiotic pollution, using the WHO Global Action Plan as a framework
- EU banned antibiotics as growth promoters in livestock and food animals:
  - Stronger controls on medicated feeds and antibiotic use
  - Encourages safer alternatives and better use practices
- Policy gaps & challenges: pharmaceutical industry pollution
  - No global regulations to prevent antibiotic waste
  - Lack of monitoring and enforcement on industrial discharges

(Kraemer et al., 2019)

Proposed Solutions

Use of techniques that can eliminate or reduce the concentration of antibiotics and do not affect environmental systems (Palacio et al., 2022):

Biological

Bioremediation and phytoremediation

↓

break down antibiotics

(Kaur Sodhi & Singh, 2022)

Chemical

Advanced oxidation

↓

a process that can safely remove antibiotic compounds

(Palacio et al. 2022)

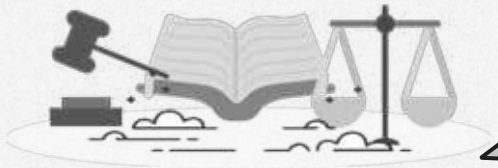
Physical

Adsorption

Membrane filtration

Reverse osmosis

(Pirsaheb et al., 2023)



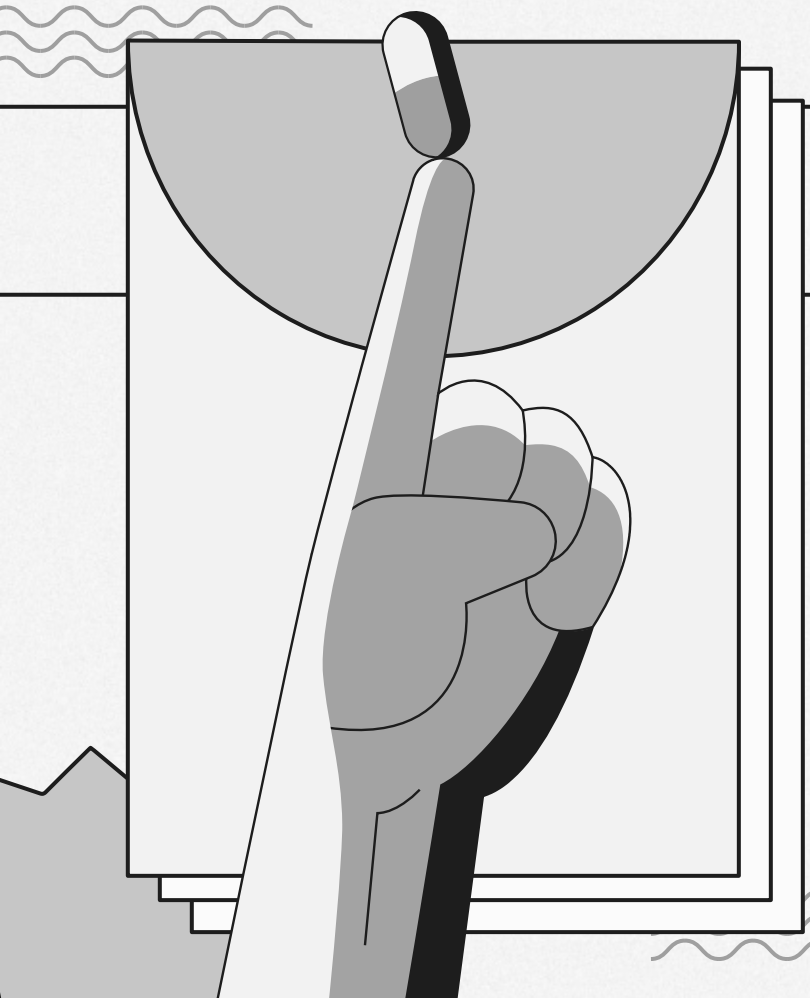
Legally:

- More rigorous control over the types and concentrations of antibiotics used
- Antibiotics should be marketed only by professionals who should sell them only with a prescription
- Prohibition of antibiotics whose toxicity is established and those more likely to induce direct or cross-resistance to antibiotics
- Permanent awareness of the dangers posed by antibiotic residues

Individually:

- Use antibiotics only when necessary and under the prescription
- Discard medications properly
- Stay informed, educated others, & advocate for better policies <3

(Arsène et al., 2022)



Conclusion

Antibiotic contamination in the environment poses significant risks to the ecosystem and to human health, with wastewater treatment often failing to remove these pollutants. To address the issue, biological, chemical and physical treatment methods, stronger regulations, and public awareness are needed. Collaboration among healthcare, agriculture, and policy makers are essential to mitigate the spread of antibiotic-resistant bacteria.

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Thank You

Questions?