

Environmental Health & Toxicology

- Infectious diseases
- Toxicology
- Movement and fate of toxins
- Measuring toxicity
- Risk assessment
- Minimizing effects

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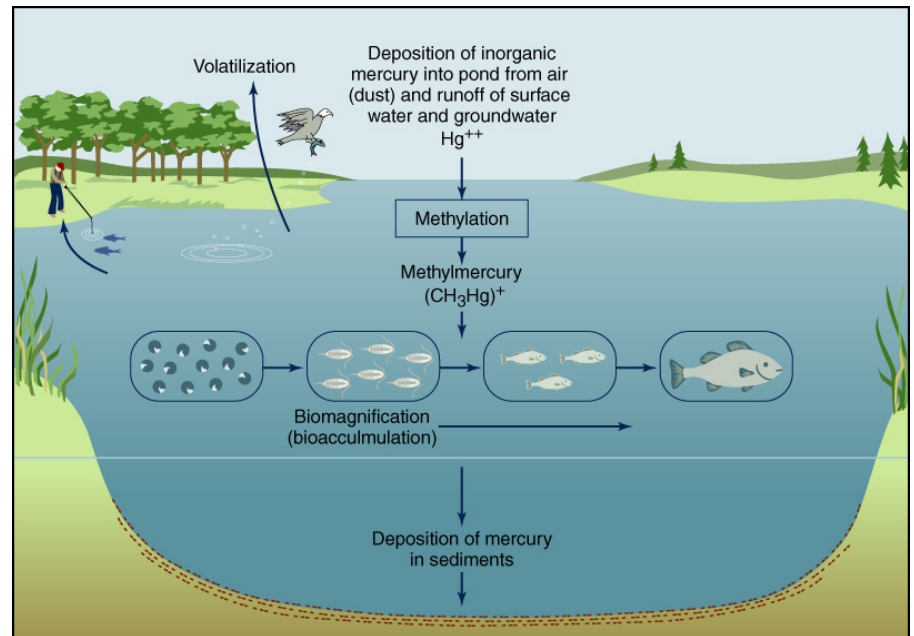


Do you want to stop reading those
Ingredients while we're trying to eat?

Mercury and Minamata

- **Lessons**

1. Individuals vary in their response
2. Pollutants may have a threshold
3. Some effects are reversible
4. Chemical form may be altered by ecological and biological processes



Env Health

- External factors that cause disease
- Many different types of environmental agents

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Disease

- Acute
- Chronic
- Change from 1900s to present.
- Future projections

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TABLE 8.1

Leading Causes of Global Disease Burden

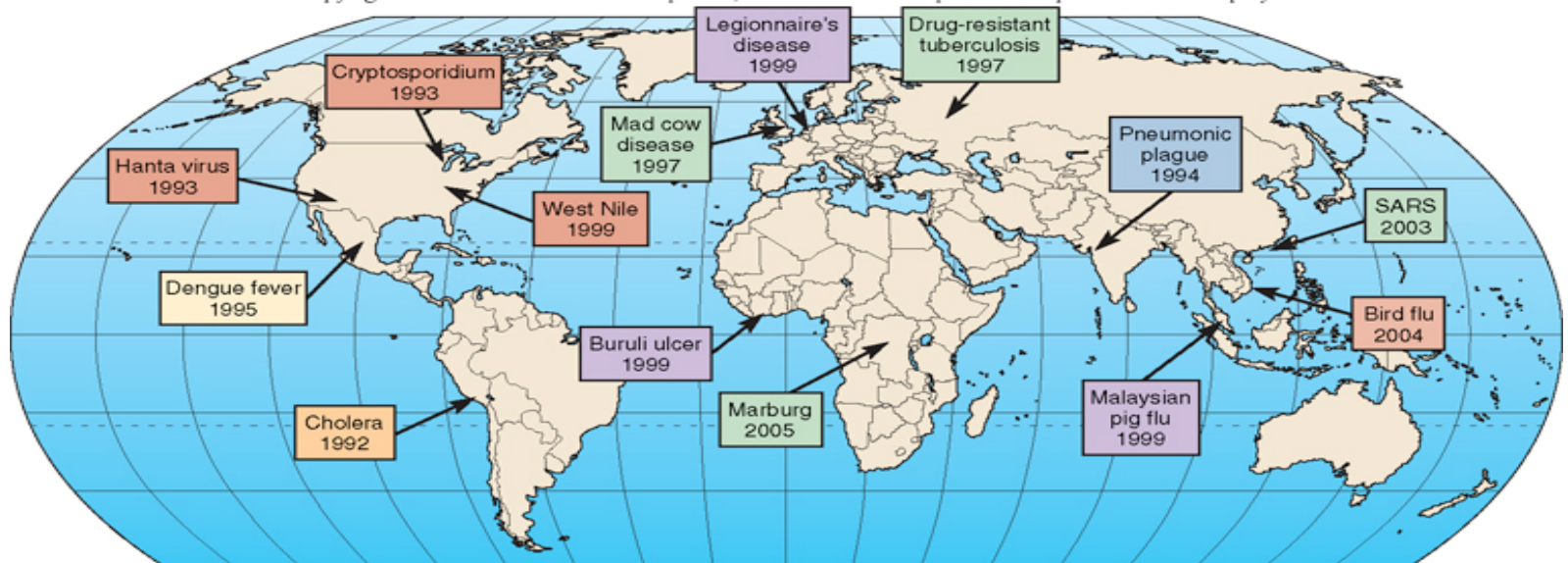
Rank	1990	Rank	2020
1	Pneumonia	1	Heart disease
2	Diarrhea	2	Depression
3	Perinatal conditions	3	Traffic accidents
4	Depression	4	Stroke
5	Heart disease	5	Chronic lung disease
6	Stroke	6	Pneumonia
7	Tuberculosis	7	Tuberculosis
8	Measles	8	War
9	Traffic accidents	9	Diarrhea
10	Birth defects	10	HIV/AIDS
11	Chronic lung disease	11	Perinatal conditions
12	Malaria	12	Violence
13	Falls	13	Birth defects
14	Iron anemia	14	Self-inflicted injuries
15	Malnutrition	15	Respiratory cancer

Source: World Health Organization, 2002.

Infectious Diseases

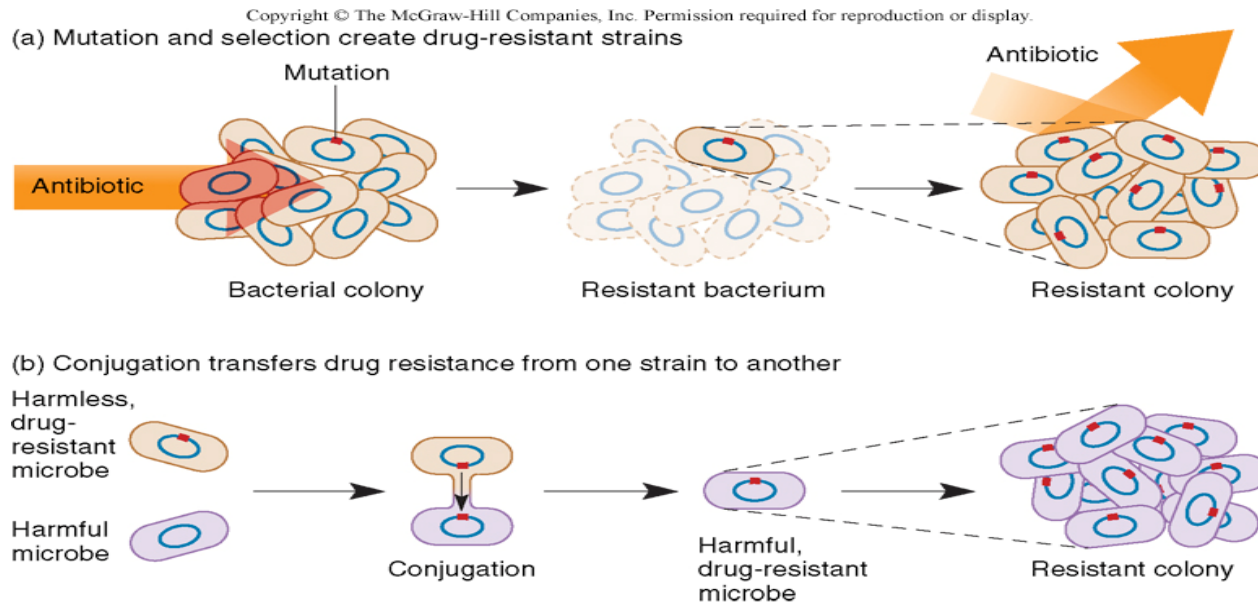
- Diseases still a major problem
- Diarrhea, measles, flu, tetanus, malaria
- Kill 11 million children in developing countries

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Resistance

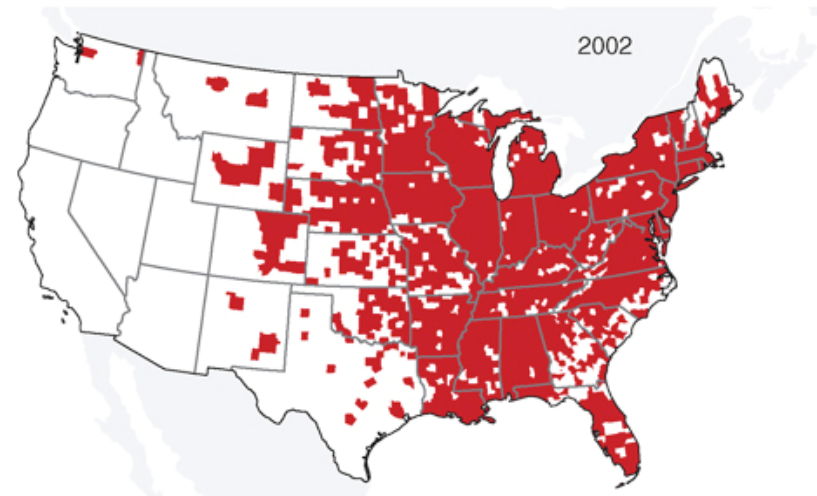
- Antibiotic
- Pesticide
- Herbicides



Emergent Diseases

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- SARS
- HIV/Aids
- West Nile virus
- Bird flu



Toxicology

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- Types of toxins
- Allergens
- Endocrine disrupters
- Neurotoxins
- Mutagens
- Teratogens
- Carcinogens

TABLE 8.2

Top 20 Toxic and Hazardous Substances

1. Arsenic
2. Lead
3. Mercury
4. Vinyl Chloride
5. Polychlorinated Biphenyls (PCBs)
6. Benzene
7. Cadmium
8. Benzo(a)pyrene
9. Polycyclic aromatic hydrocarbons
10. Benzo(b)fluoranthene
11. Chloroform
12. DDT
13. Aroclor 1254
14. Aroclor 1260
15. Trichloroethylene
16. Dibenz(a,h)anthracene
17. Dieldrin
18. Chromium, Hexavalent
19. Chlordane
20. Hexachlorobutadiene

Source: U.S. EPA, 2003.

Examples: Physiological effects

- **Organophosphates** = irreversibly inactivate acetylcholinesterase, which is essential to nerve function in insects, humans, and many other animals (ie; malathion, diazinon)
- **Mercury** = loss of peripheral sensation and restriction of the visual field. Patients in advanced stages of the condition show considerable atrophy of brain
- **Lead** = Lead is able to bind to and interact with the same proteins and molecules as these metals, but after displacement, those molecules function differently and fail to carry out the same reactions
- **PCBs** = affect the immune system
- **Arsenic** = kills by allosteric inhibition of essential metabolic enzymes. The LD50 for pure arsenic is 763 mg/kg (by ingestion)
- **Herbicides** = cause a variety of health effects ranging from skin rashes to death

Factors

- Chemical composition
- Solubility
- Chemical interactions
- Chemical changes
- Metabolic degradation
- Excretion
- Repair mechanisms

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TABLE 8.4

Factors in Environmental Toxicity

Factors Related to the Toxic Agent

1. Chemical composition and reactivity
2. Physical characteristics (such as solubility, state)
3. Presence of impurities or contaminants
4. Stability and storage characteristics of toxic agent
5. Availability of vehicle (such as solvent) to carry agent
6. Movement of agent through environment and into cells

Factors Related to Exposure

1. Dose (concentration and volume of exposure)
2. Route, rate, and site of exposure
3. Duration and frequency of exposure
4. Time of exposure (time of day, season, year)

Factors Related to Organism

1. Resistance to uptake, storage, or cell permeability of agent
2. Ability to metabolize, inactivate, sequester, or eliminate agent
3. Tendency to activate or alter nontoxic substances so they become toxic
4. Concurrent infections or physical or chemical stress
5. Species and genetic characteristics of organism
6. Nutritional status of subject
7. Age, sex, body weight, immunological status, and maturity

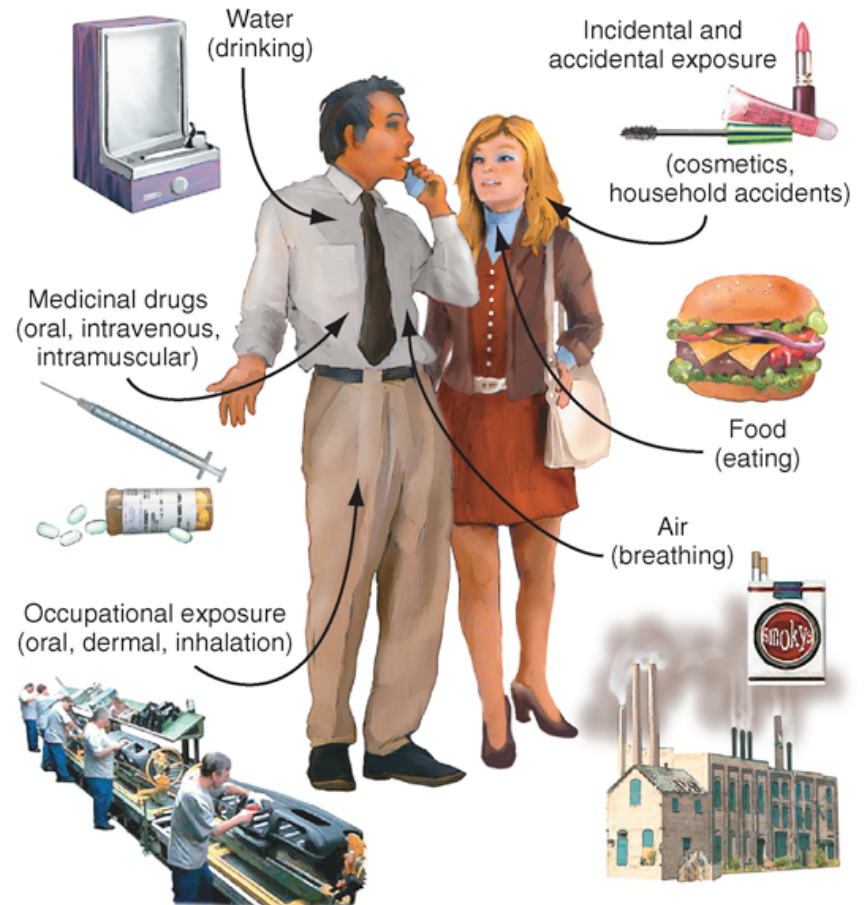
Source: U.S. Department of Health and Human Services, 1995

Movement and exposure

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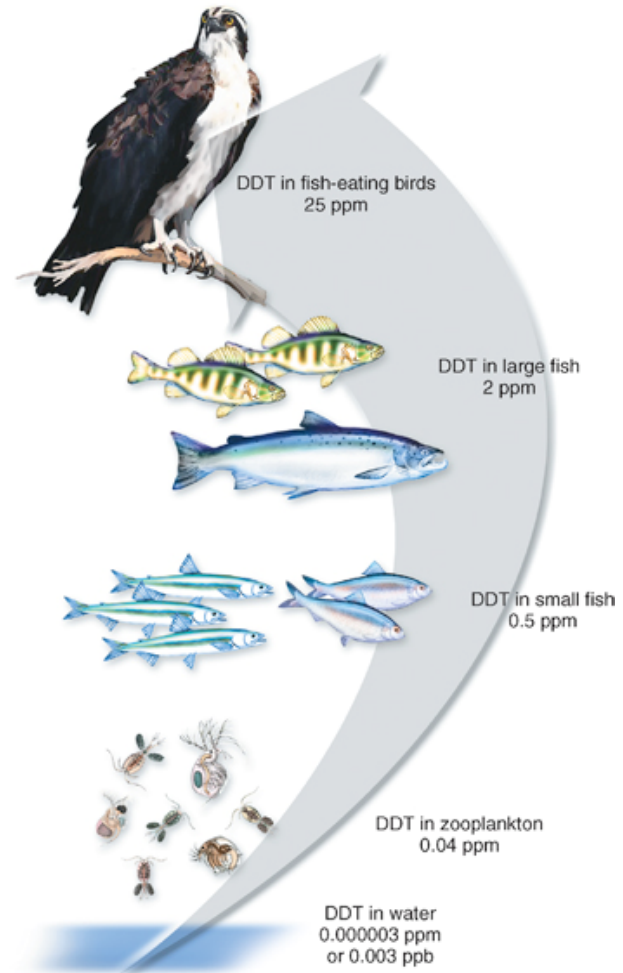
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Bioaccumulation/ magnification

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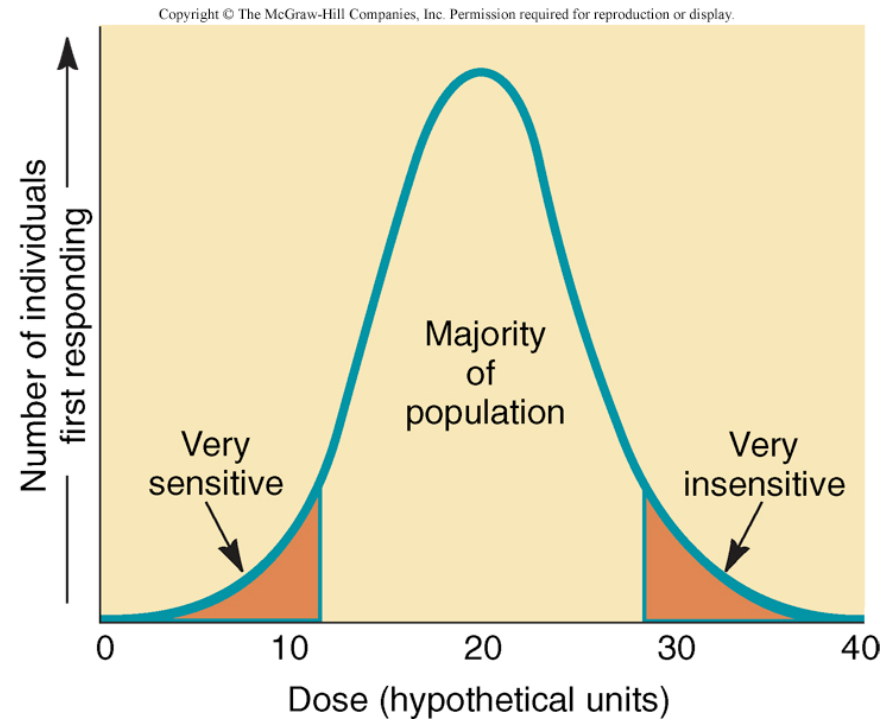
- Absorption from environment
- Increase in tissues
- Movement to higher trophic level



Factors affecting toxicity

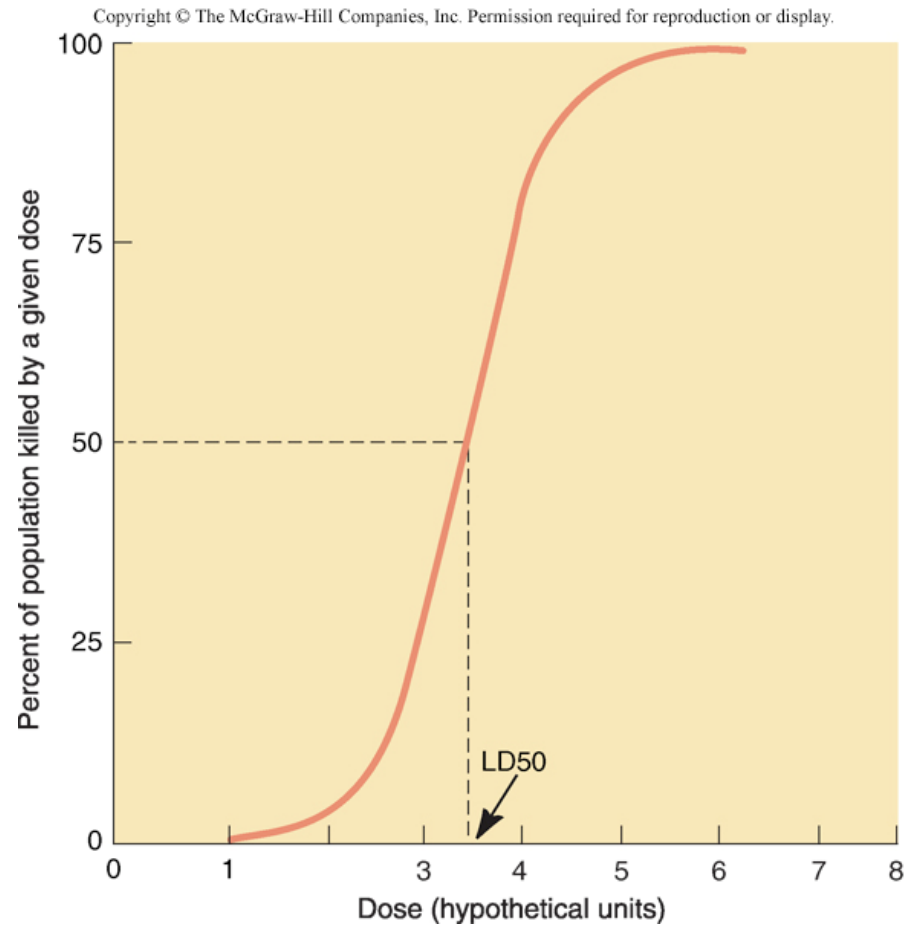
- Genetic basis
- Dose
- Rate
- Route of entry

- Acute vs Chronic effects



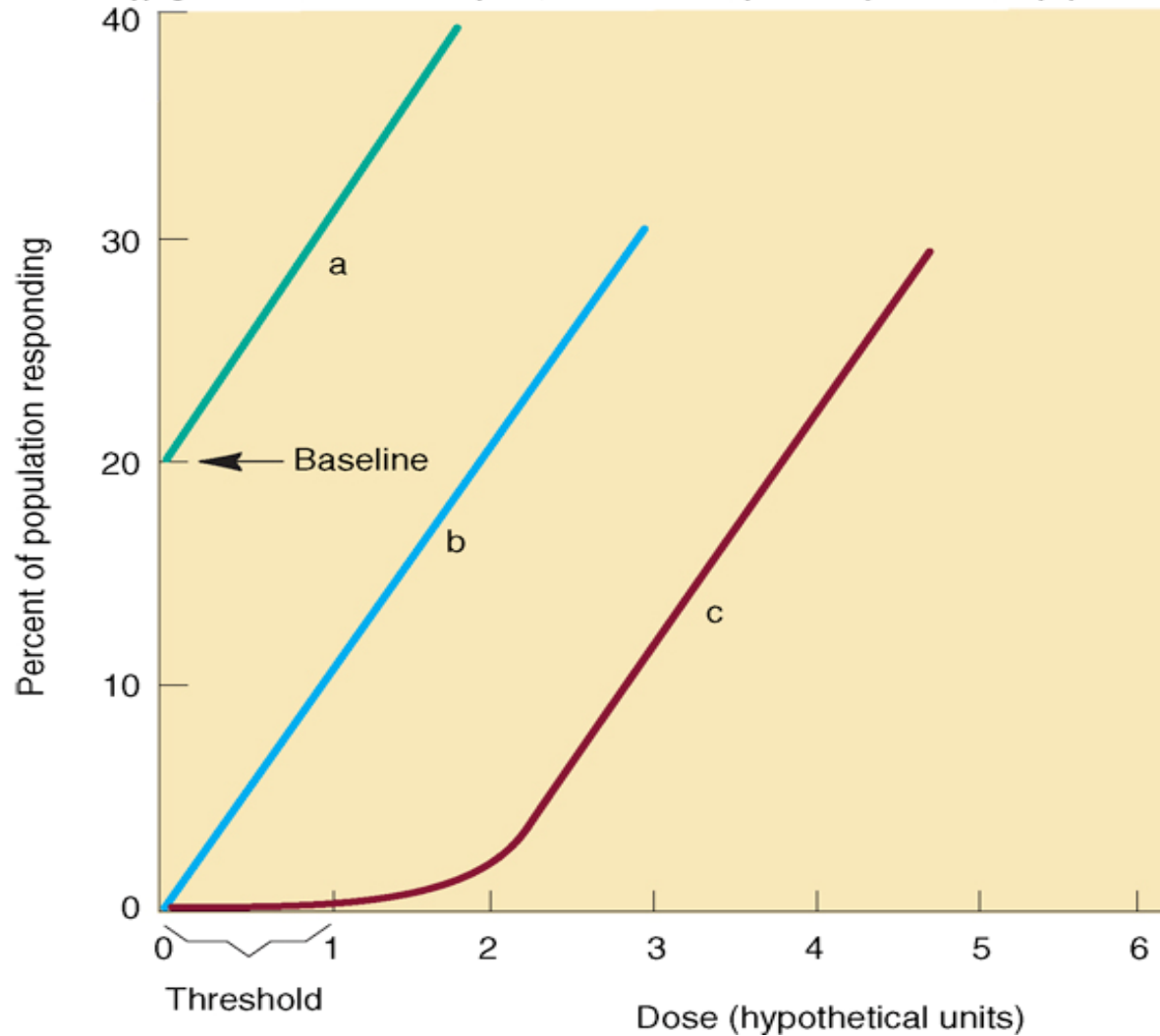
Measuring toxicity

- LD50: dose which kills 50%
- ED50: effective dose that causes an effect
- TD50: toxic dose to 50% of population



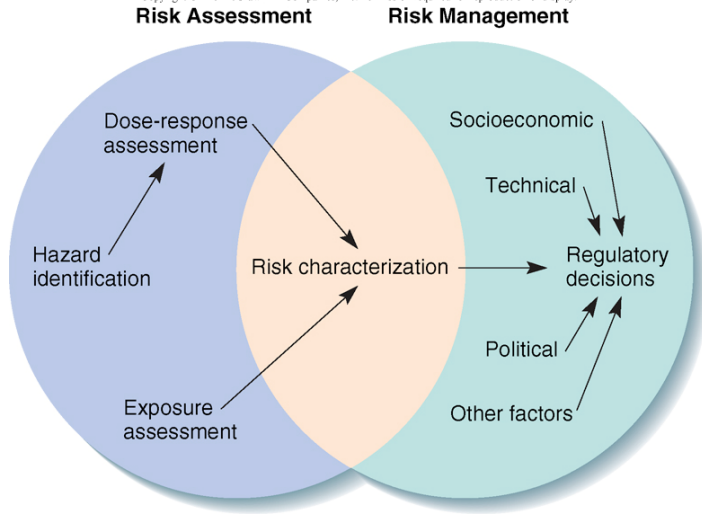
Dose-Response curves

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Risk

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TABLE 8.5

Lifetime Chances of Dying in the U.S.

Source	Odds (1 in x)
Heart disease	2
Cancer	3
Smoking	4
Lung disease	15
Pneumonia	30
Automobile accident	100
Suicide	100
Falls	200
Firearms	200
Fires	1,000
Airplane accident	5,000
Jumping from high places	6,000
Drowning	10,000
Lightning	56,000
Hornets, wasps, bees	76,000
Dog bite	230,000
Poisonous snakes, spiders	700,000
Botulism	1 million
Falling space debris	5 million
Drinking water with EPA limit of trichloroethylene	10 million

Source: U.S. National Safety Council, 2003.

- Perception
- Acceptance

TABLE 8.6

Relative Risks to Human Welfare

Relatively High-Risk Problems

Habitat alteration and destruction

Species extinction and loss of biological diversity

Stratospheric ozone depletion

Global climate change

Relatively Medium-Risk Problems

Herbicides/pesticides

Toxics and pollutants in surface waters

Acid deposition

Airborne toxics

Relatively Low-Risk Problems

Oil spills

Groundwater pollution

Radionuclides

Thermal pollution

Source: Environmental Protection Agency.