

Chapter 17

Health, Risk, Toxicology

- Risk
- Risk Perception
- Risk Assessment
- Risk Management:
 - process of determining how to bring toxins to acceptable levels and at what cost.

Distorted perception of risk

- We fear:
 - What we can't control (would rather drive our own car than fly in a plane)
 - What we don't understand (nuclear power, new technology)
 - What is not voluntary (driving is OK, someone building a power plant next door is not)
 - What is catastrophic/played up by media (Chernobyl, terrorist attack is more worrisome than death from smoking)
 - What is "unfair." (Living by a power plant has risk of 1 in 100,000, but can upset people because their risk is higher than others)

Hazards

- 4 Main Types:
- Cultural
 - Unsafe working conditions, smoking, poor diet, drugs, unsafe sex, poverty, criminal assault...etc.
- Chemical
 - Harmful chemicals in the air, water, soil and food
- Physical
 - Radioactivity, fire, earthquakes, floods...etc.
- Biological
 - Pathogens, pollen, bees (stings), snakes...etc.

Hazards (Chemical)

- Neurotoxins- chemicals that disrupt the nervous system
 - Aspartame
 - Monosodium glutamate (MSG)
 - Sucralose
- Carcinogens:
 - Radon
 - Formaldehyde
 - Tobacco smoke

Hazards (Chemical)

- Teratogens- agents and conditions, including viruses, drugs, chemicals, stressors, and malnutrition, which can impair prenatal development and lead to birth defects or even death
- Allergens- chemicals that cause allergic reactions

How much is too much?

- **Toxicity:** how harmful something is. Depends on:
 - Dose
 - Frequency
 - Genetic make up of those exposed
 - Health of those exposed
- **Other factors include:**
 - Solubility (water or oil/fat)
 - Persistence
 - Bioaccumulation (small dose build up in individuals over time)
 - Biomagnification (build up as passes through food chain)
 - Chemical interactions (antagonistic or synergistic)
- **Effects:**
 - Acute effects: immediate/rapid effect of exposure.
 - Chronic effects: long-lasting effects from one or repeated exposures

Measuring Toxicity

- LD 50: Median lethal dose: amount in 1 dose that kills 50% of the test animals within a 14 day period.
- Most toxic chemicals from EPA:
 - Arsenic, lead, mercury, vinyl chloride, and PCB'S.

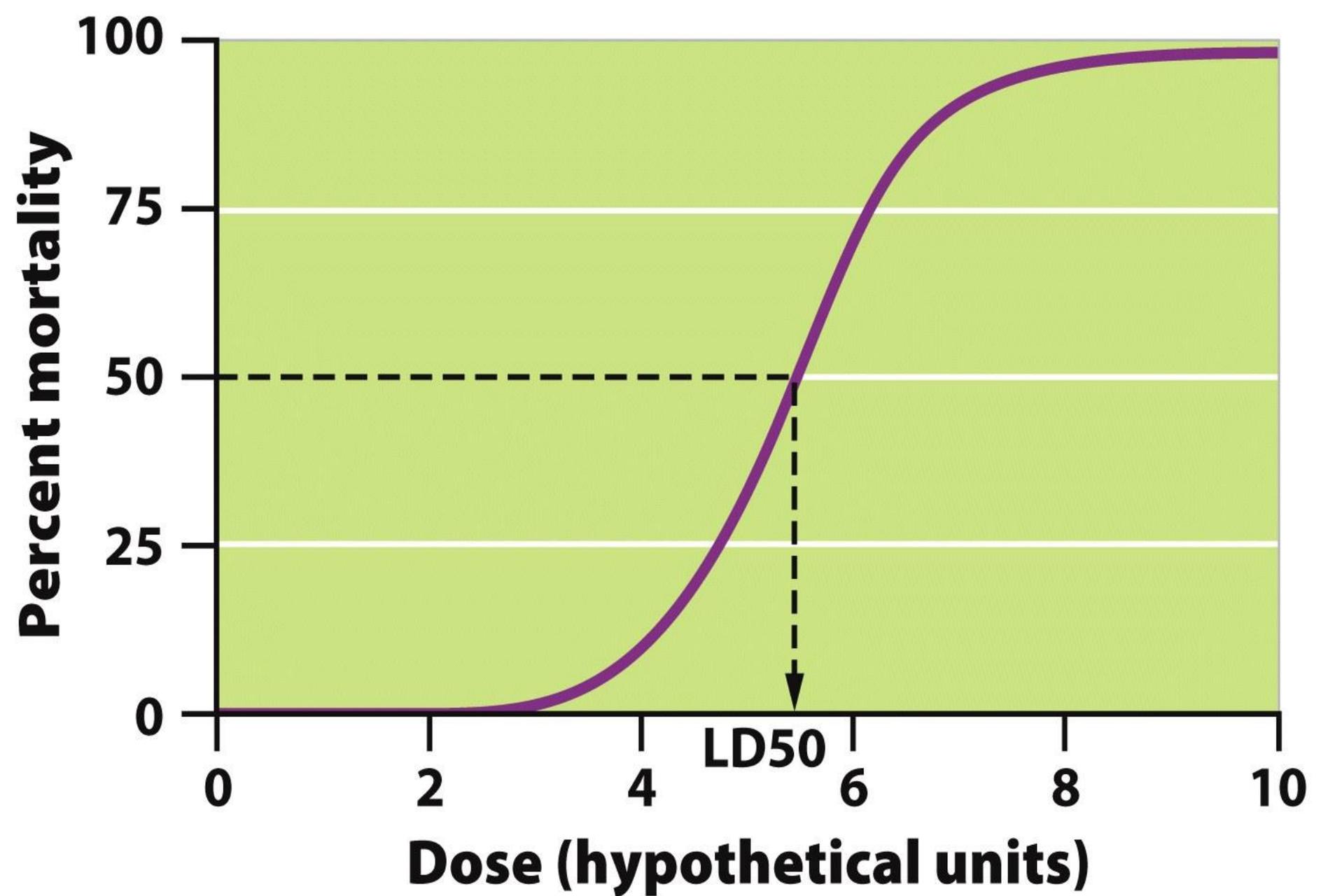
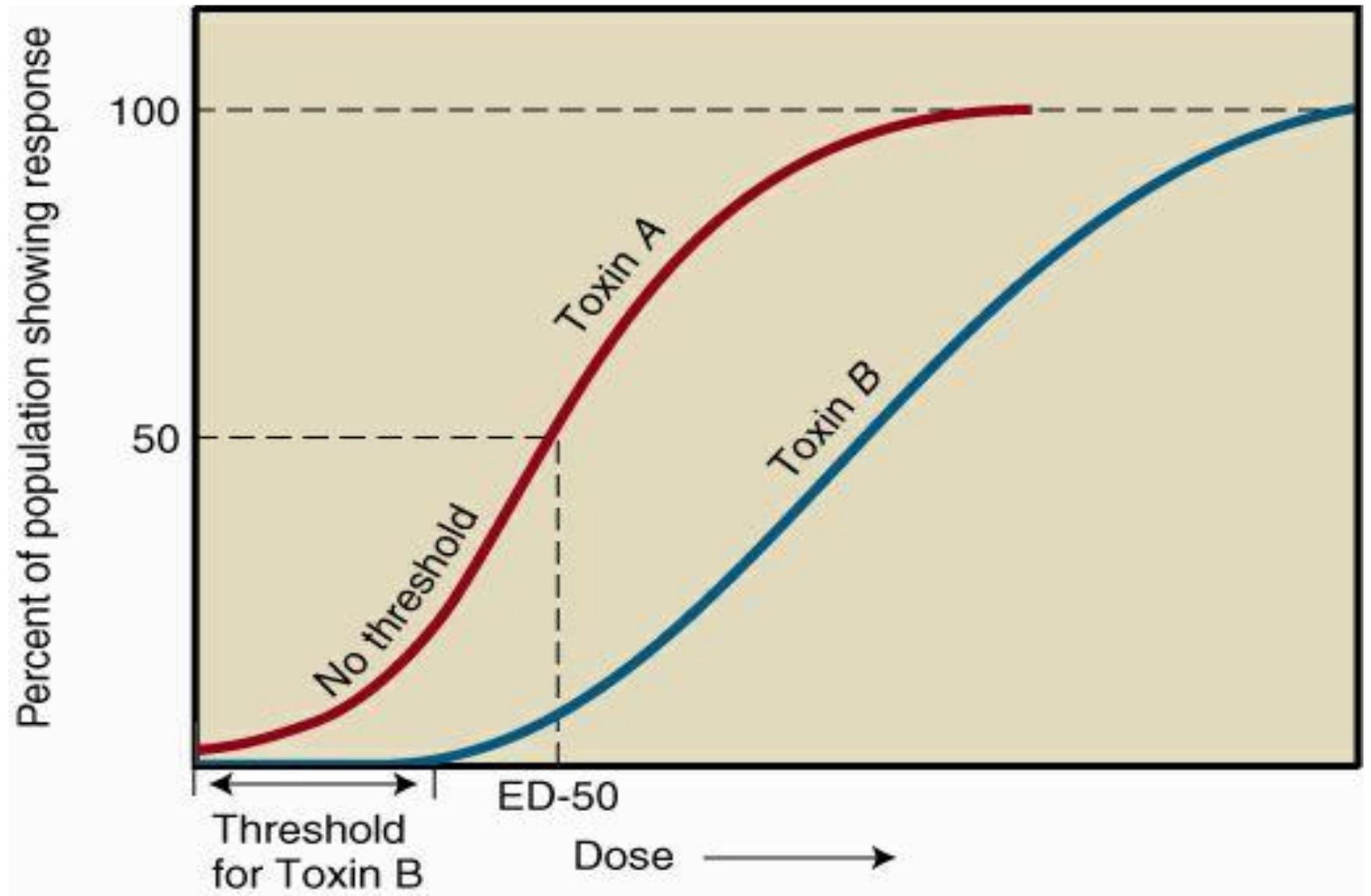


Figure 17.16
Environmental Science
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Threshold Effects:

- the level below which effects are not observable and above which effects become apparent



Bhopal



- December 3, 1984
- Poisonous gas cloud released covering 30 sq. miles
- Killed 4,000 local residents instantly and caused health problems for as many as 500,000
- Cause was personnel error: ignored safety procedures
- Union Carbide denies responsibility
- Feb. 1989, Union Carbide settled and was ordered to pay 470 million dollars compensation
- Clean-up continues, but many chemicals such as mercury and hexachlorobenzene are in open barrels. Rainfall causes rinsing out of the pollution to local drinking sources

Core Case Study: Love Canal

- Between 1842-1953, Hooker Chemical sealed multiple chemical wastes into steel drums and dumped them into an old canal excavation (Love Canal).
- In 1953, the canal was filled and sold to Niagara Falls school board for \$1.
- The company inserted a disclaimer denying liability for the wastes.

Core Case Study: Love Canal

- In 1957, Hooker Chemical warned the school not to disturb the site because of the toxic waste.
 - In 1959 an elementary school, playing fields and homes were built disrupting the clay cap covering the wastes.
 - In 1976, residents complained of chemical smells and chemical burns from the site.

Core Case Study: Love Canal



- President Jimmy Carter declared Love Canal a federal disaster area.
 - The area was abandoned in 1980 (left).

Core Case Study: Love Canal

- Love Canal sparked creation of the Superfund law, which forced polluters to pay for cleaning up abandoned toxic waste dumps.

Chernobyl



- April 26, 1986: Tests were being conducted on reactor 4
- The test caused a meltdown and the resulting fire and explosion killed 31 people
- Radioactive cloud blew northwest covering a large area in Europe
- 135,000 evacuated in a 30 km radius
- Reactor sealed in concrete sarcophagus
- Eventual death toll could be as high as 400,00, up to 7 million affected
- Dramatic increase in thyroid cancer and leukemia

The 1952 London smog disaster



- December, 1952 – March 1953 a heavy smog engulfed London killing 12,000 people, mostly children
- 900 deaths/day on December 8 and 9
- Unusual cold caused citizens to use more coal
- Particulate matter reached 56 times normal
- Visibility just a few meters
- Lung disease, tuberculosis, heart failure, bronchitis and pneumonia

The Baia Mare cyanide spill



<http://www.ehponline.org/docs/2001/109-10/romania.jpg>

- Background: workers in gold mines use cyanide to purify gold from rocks
- Jan 4,2000, cyanide used in a gold mine in Baia Mare (Rumania) overflowed into a major river
- Cause was a break in the dam that surrounded a settling basin
- 100,00 cubic meters of water with high concentrations of cyanide was released
- 100 people treated for eating fish
- Flexible environmental regulation in poorer countries contributed to the disaster

The Three Mile Island nuclear disaster



- March 28, 1979, main feed water pumps in reactor 2 failed resulting in a partial melting of the reactor core
- Operator errors, a stuck valve, faulty sensors and design errors were contributing factors
- Children and pregnant women in 8km radius were evacuated as a precaution
- Clean-up started in Aug. 1979 and ended in December 1993 at a cost of about 975 million dollars
- Reactor 2 is permanently closed
- Reactor 1 was restarted in 1985