



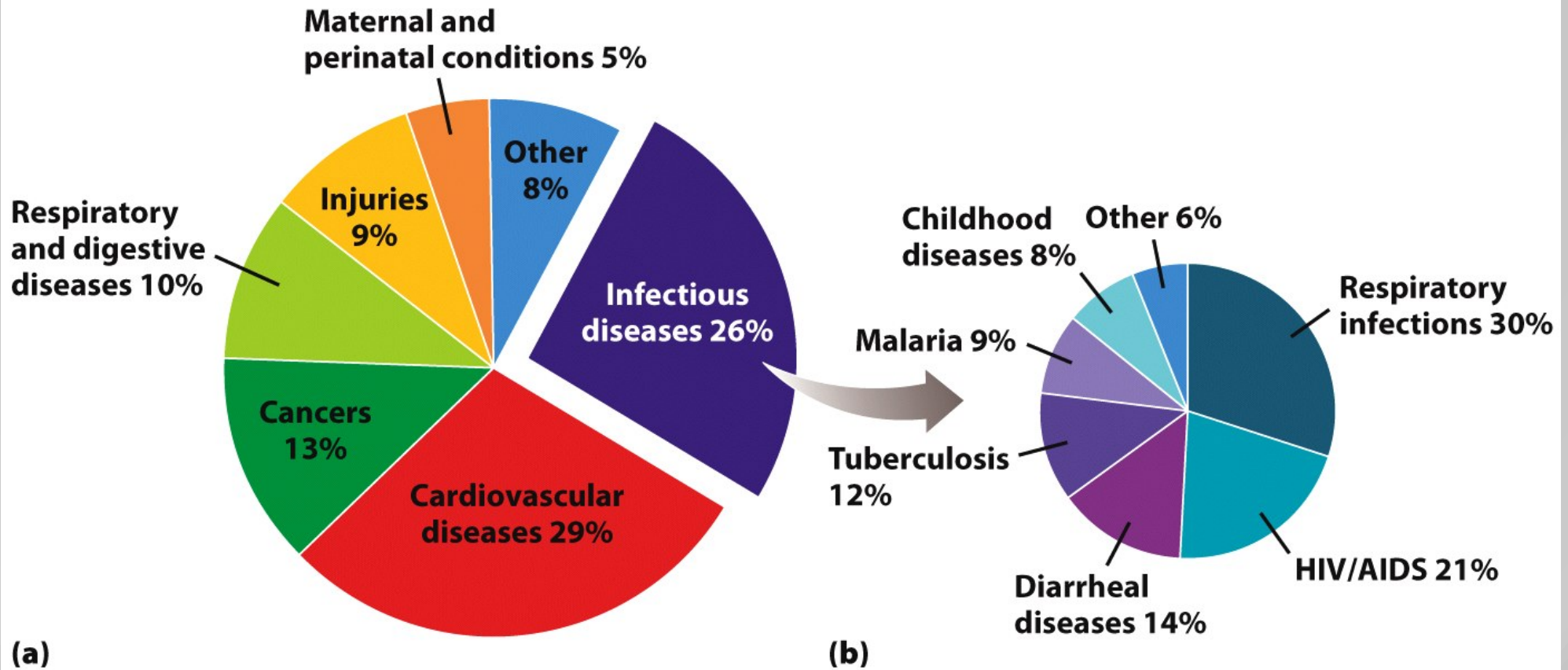
# Chapter 17

## Human Health and Environmental Risks

# Three categories of human health risks

- ▣ physical
- ▣ biological
- ▣ chemical

# Global Death Causes



**Figure 17.1**  
*Environmental Science*

© 2012 W. H. Freeman and Company

What % of deaths are caused by disease (biological factors)?  
What are the "big 6" infectious diseases?

# Biological Risks

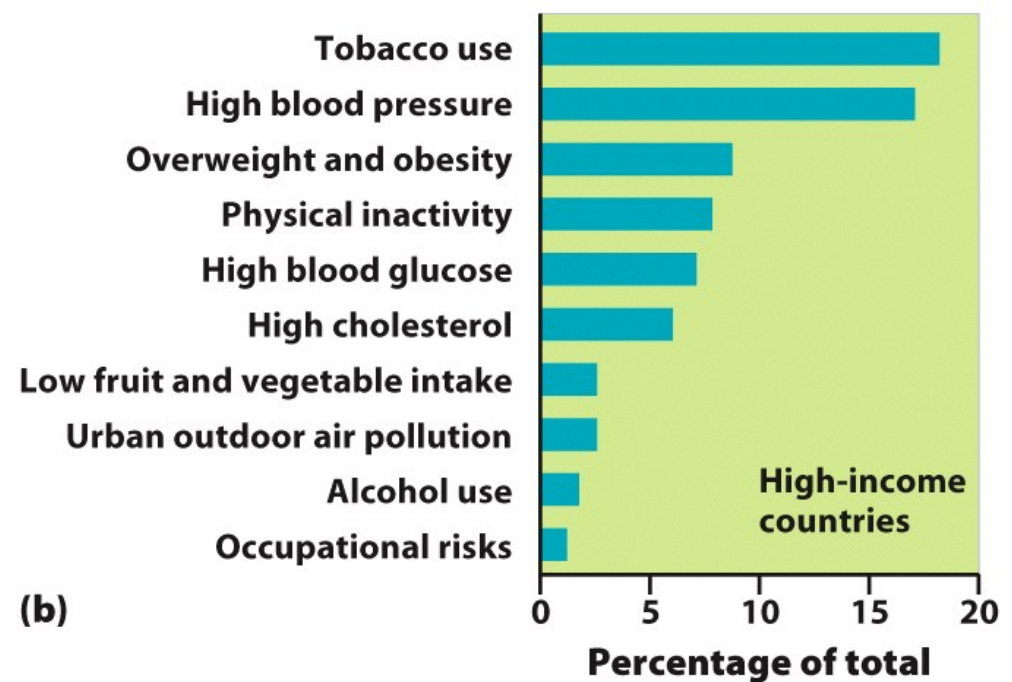
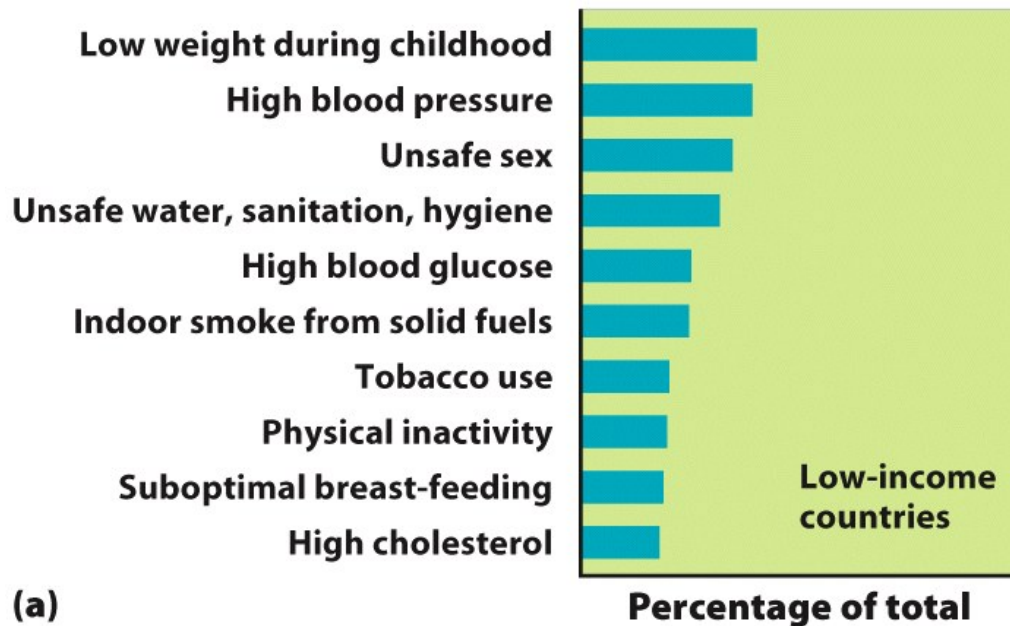
- ▣ Infectious diseases- those caused by infectious agents, known as pathogens.
  - ▣ Examples: pneumonia, diarrheal and venereal diseases, malaria, TB, Ebola
- ▣ Chronic disease- slowly impairs the functioning of a person's body.
  - ▣ Cancer, emphysema, heart disease, etc.
- ▣ Acute diseases- rapidly impair the functioning of a person's body.
  - ▣ Malaria, Ebola

Which of these would poverty exacerbate?

# Leading Health Risks

## Low Income Countries

## High Income Countries



**Figure 17.2**

*Environmental Science*

© 2012 W. H. Freeman and Company

Why do we see these trends?

# Infectious Disease

- Epidemic – rapid increase in disease
- Pandemic – rapid increase in disease over large geographic area (ex. a continent)

# Historical Diseases

- ▣ Plague
- ▣ Malaria
- ▣ Tuberculosis

# Plague – The Black Death



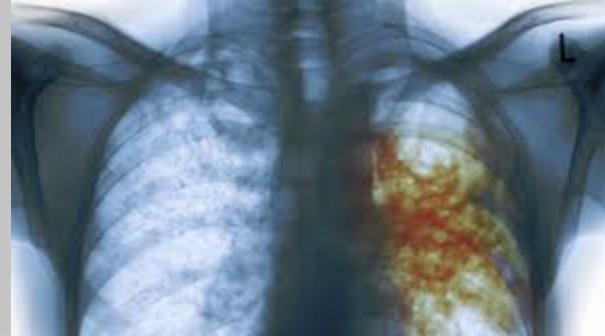
- Bubonic plague
- Fleas on rats bit and infected humans from a bacterium
- 1/4 of European population killed in 1300s
- Occasional small outbreaks, but antibiotics are effective





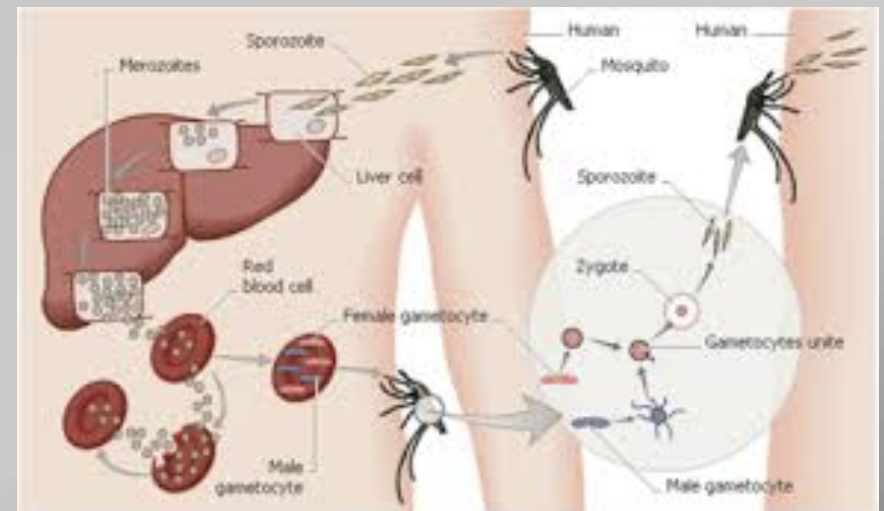
# Tuberculosis (TB)

- Highly contagious
- Caused by bacterium that affects lungs
- 1/3 population carry, but are not infected
- Treated with antibiotics, but resistance an issue



# Malaria

- Flulike symptoms...some die, esp. Children
- Caused by protist (Plasmodium); from mosquito
- 350-500 million each year contract
- DDT used at one time
- Bed nets in developing countries



# Decline of TB in US

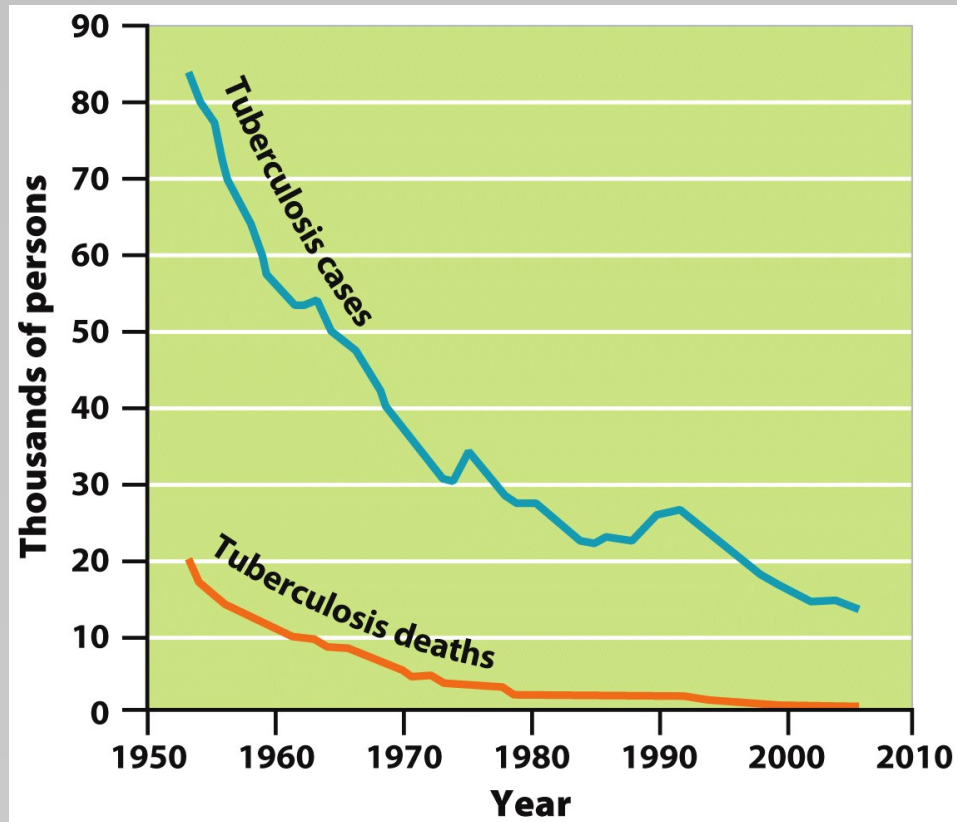
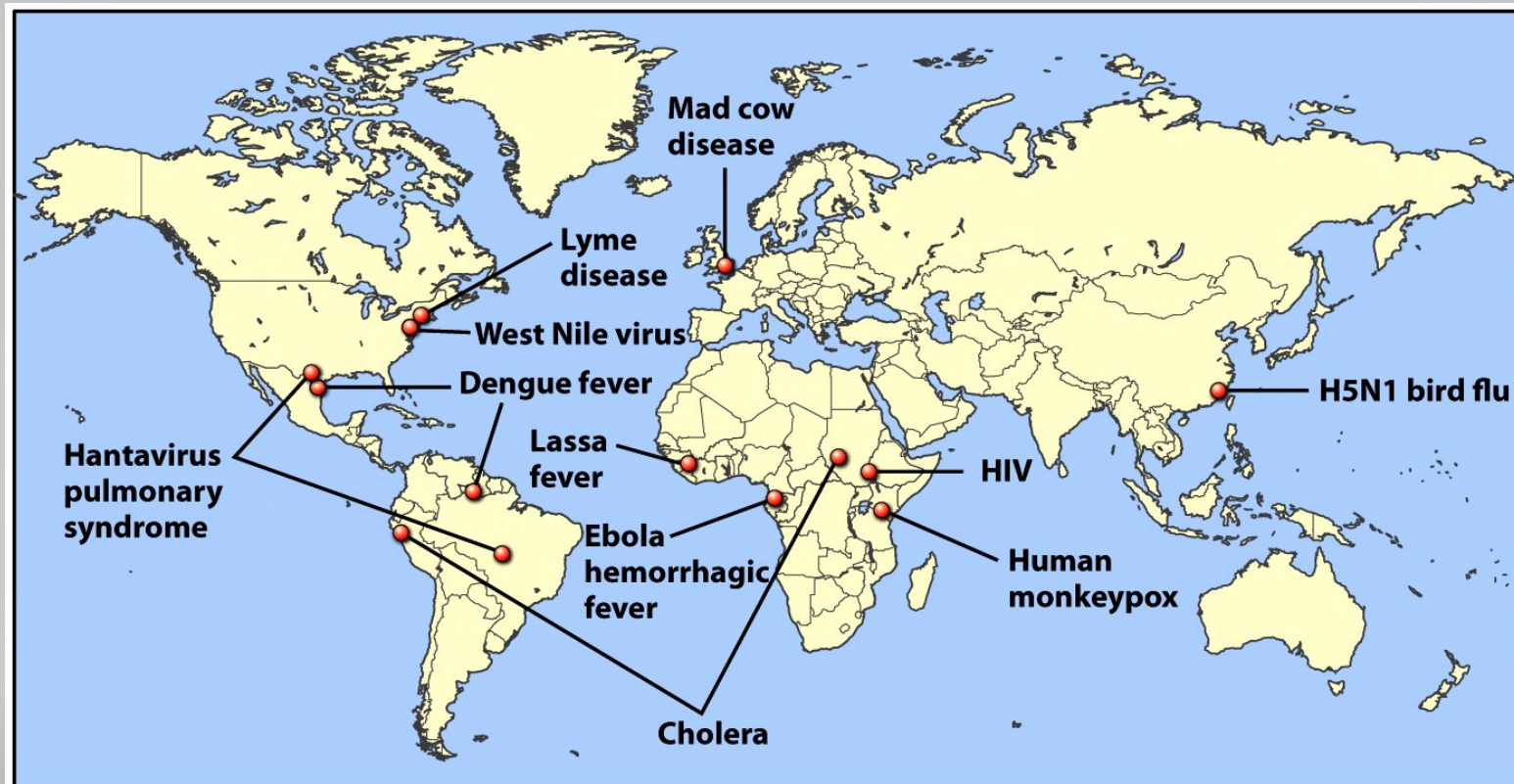


Figure 17.6  
Environmental Science  
© 2012 W. H. Freeman and Company

# Emergent Diseases (last 20 years)

- ▣ HIV/AIDS
- ▣ Ebola
- ▣ Mad Cow Disease
- ▣ Bird Flu
- ▣ West Nile Virus

# Emergence of New Diseases



**Figure 17.7**  
*Environmental Science*  
© 2012 W. H. Freeman and Company

# HIV/AIDS

- Weakened immune system
- Caused by virus transmitted through sex, drugs, and rock and roll (OK, not rock and roll)
- Anti-viral drugs helping
- Still a problem in developing countries



If it's wet and not yours; don't touch it.

# Ebola Hemorrhagic Fever

- Caused by virus
- Equator diseases
- Very deadly – 2 weeks; fever, vomiting, internal/external bleeding
- Cure/vaccines being worked on



# Mad Cow/Creutzfeldt-Jakob Disease

- Caused by prions (not living proteins that mutate)
- Neurological issues in cows
- Crosses species barrier to humans as Bovine Spongiform Encephalitis
- Have to eat nervous system of infected animal



Figure 17.10  
Environmental Science  
© 2012 W. H. Freeman and Company



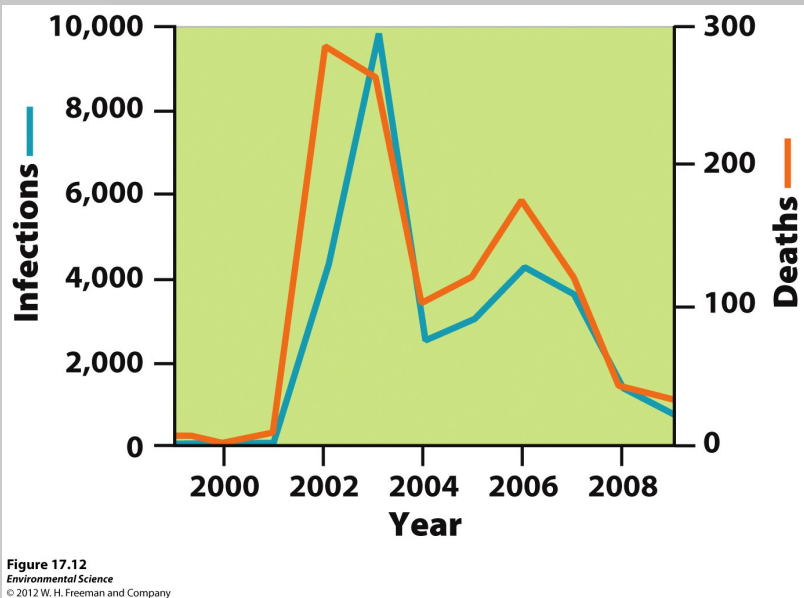
# Bird Flu/H5N1



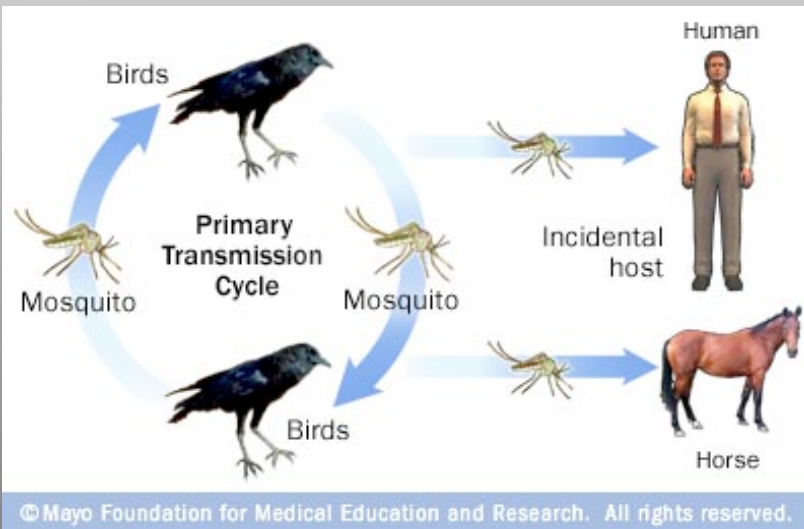
Figure 17.11  
Environmental Science  
© 2012 W. H. Freeman and Company

- Birds get H1N1
- Crosses species barrier to humans as H5N1
- Flu-like symptoms; low defenses
- Not very contagious....yet

# West Nile Virus (Mosquito-borne encephalitis)



- Transmitted among 100s species of birds and mosquitos
- Crossed species barrier in 1937
- Inflammation of brain causing illness and sometimes death



# Types of Harmful Chemicals

- ▣ Neurotoxins- chemicals that disrupt the nervous system
- ▣ Carcinogens- chemicals that cause cancer (genetic mat'l or processes, not organelles)
- ▣ Teratogens- chemicals that interfere with the normal development of embryos or fetuses
- ▣ Allergens- chemicals that cause allergic reactions
- ▣ Endocrine disruptors- chemicals that interfere with the normal functioning of hormones in an animal's body

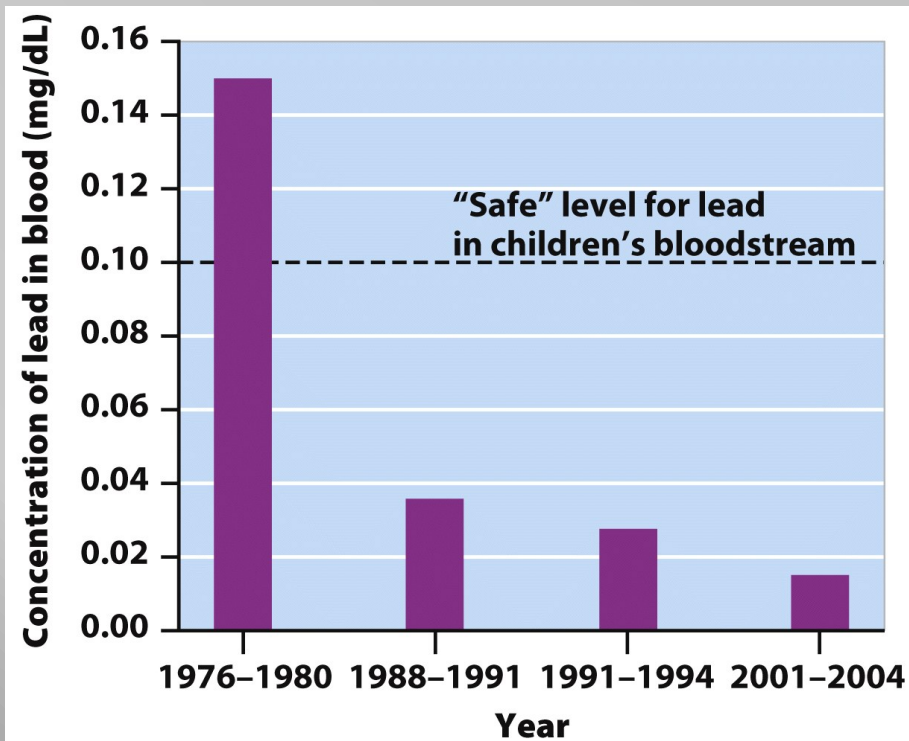
**TABLE 17.1**    **Some chemicals of major concern**

<b>Chemical</b>	<b>Sources</b>	<b>Type</b>	<b>Effects</b>
<b>Lead</b>	<b>Paint, gasoline</b>	<b>Neurotoxin</b>	<b>Impaired learning, nervous system disorders, death</b>
<b>Mercury</b>	<b>Coal burning, fish consumption</b>	<b>Neurotoxin</b>	<b>Damaged brain, kidneys, liver, and immune system</b>
<b>Arsenic</b>	<b>Mining, groundwater</b>	<b>Carcinogen</b>	<b>Cancer</b>
<b>Asbestos</b>	<b>Building materials</b>	<b>Carcinogen</b>	<b>Impaired breathing, lung cancer</b>
<b>Polychlorinated biphenyls (PCBs)</b>	<b>Industry</b>	<b>Carcinogen</b>	<b>Cancer, impaired learning, liver damage</b>
<b>Radon</b>	<b>Soil, water</b>	<b>Carcinogen</b>	<b>Lung cancer</b>
<b>Vinyl chloride</b>	<b>Industry, water from vinyl chloride pipes</b>	<b>Carcinogen</b>	<b>Cancer</b>
<b>Alcohol</b>	<b>Alcoholic beverages</b>	<b>Teratogen</b>	<b>Fetuses with reduced fetal growth, brain and nervous system damage</b>
<b>Atrazine</b>	<b>Herbicide</b>	<b>Endocrine disruptor</b>	<b>Feminization of males, low sperm counts</b>
<b>DDT</b>	<b>Insecticide</b>	<b>Endocrine disruptor</b>	<b>Feminization of males, thin eggshells of birds</b>
<b>Phthalates</b>	<b>Plastics, cosmetics</b>	<b>Endocrine disruptor</b>	<b>Feminization of males</b>

**Table 17.1**  
*Environmental Science*

# Hazardous Chemical Risks

**Neurotoxins...ex: Lead, Mercury, Arsenic**



**Figure 17.13**  
*Environmental Science*  
© 2012 W. H. Freeman and Company

**Teratogens...ex: Thalidomide, Alcohol**



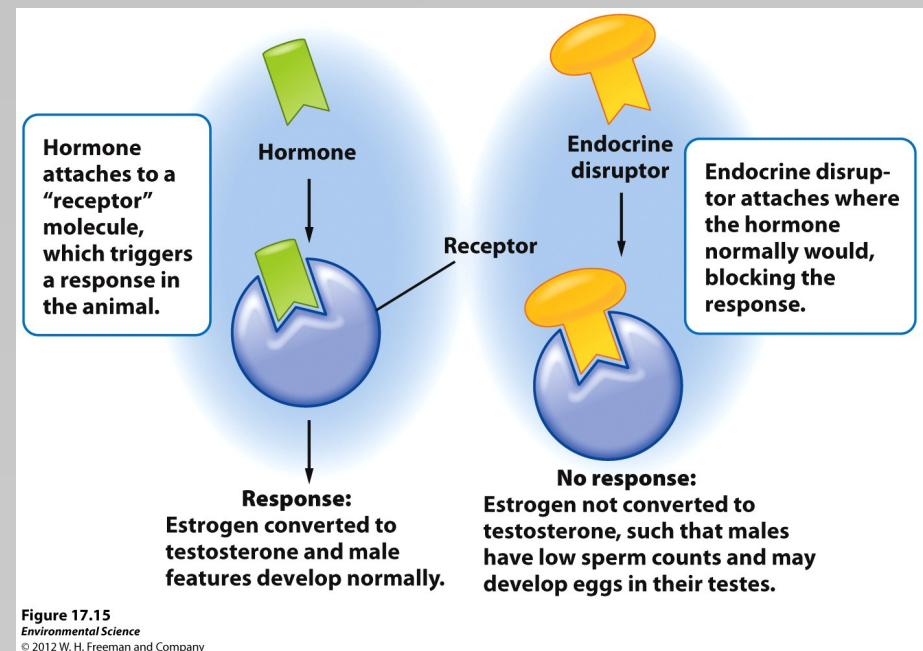
**Figure 17.14**  
*Environmental Science*  
© 2012 W. H. Freeman and Company

# Chemical Risks

**Allergens...ex: peanut and milk proteins, penicillin**



**Endocrine disruptors...hormone mimics and disruptors...ex: pharms and the herbicide Atrazine, Pthalates, DDT.**



# Dose-Response Studies

- ▣ Acute studies – 1-4 days; usually measure mortality
- ▣ Chronic studies – much longer
- ▣ Retrospective – track those already exposed for effects
- ▣ Prospective – track those not yet exposed for effects
  
- ▣ LD50- lethal dose that kills 50% of the individuals
- ▣ ED50- effective dose that causes 50% of the animals to display the harmful but nonlethal effect
- ▣ Threshold – dose at which an effect can be detected

# Mortality curve – Rats consuming pesticide

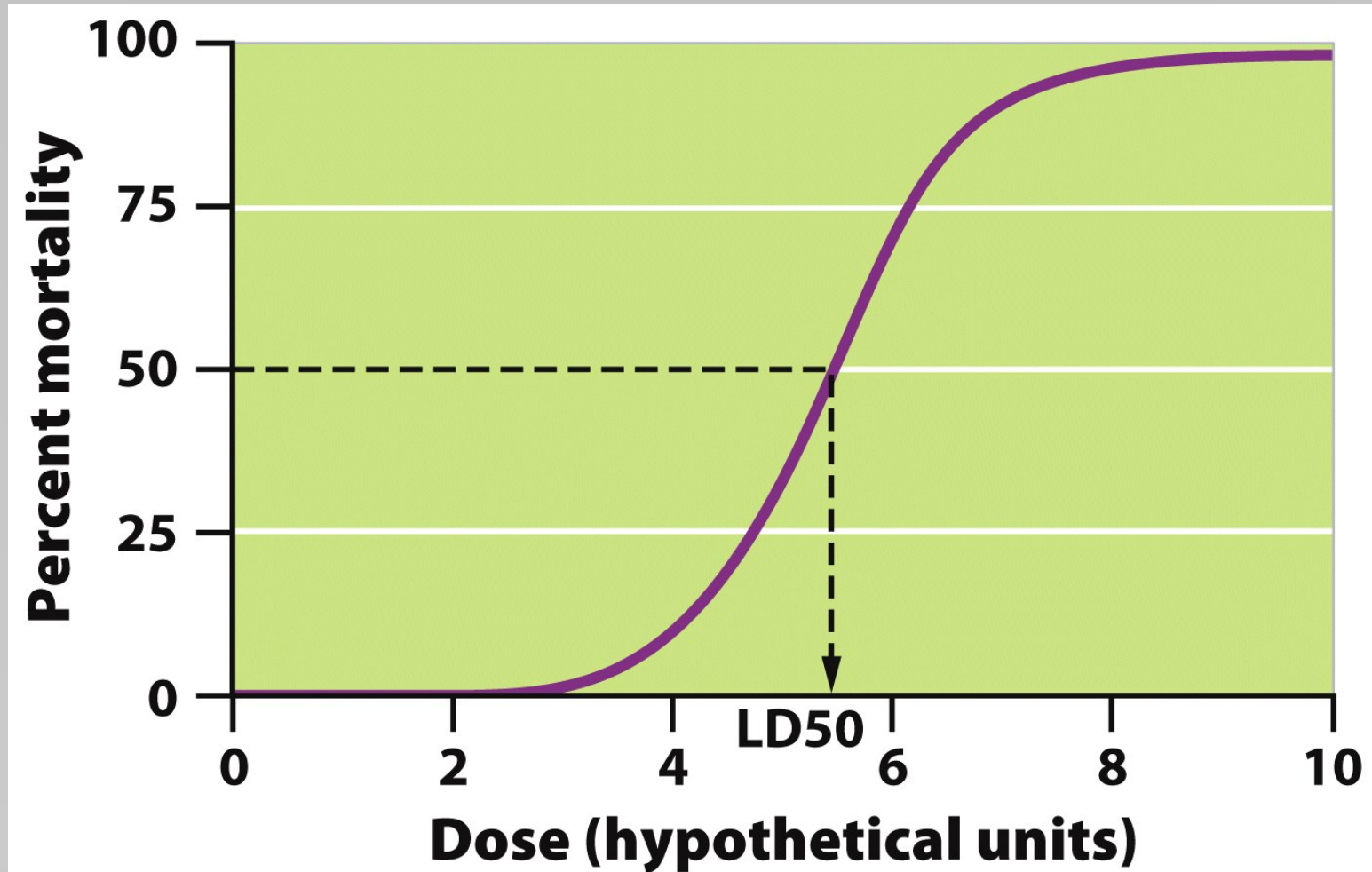


Figure 17.16  
*Environmental Science*  
© 2012 W. H. Freeman and Company

What dose is the LD50?



# What is SAFE?

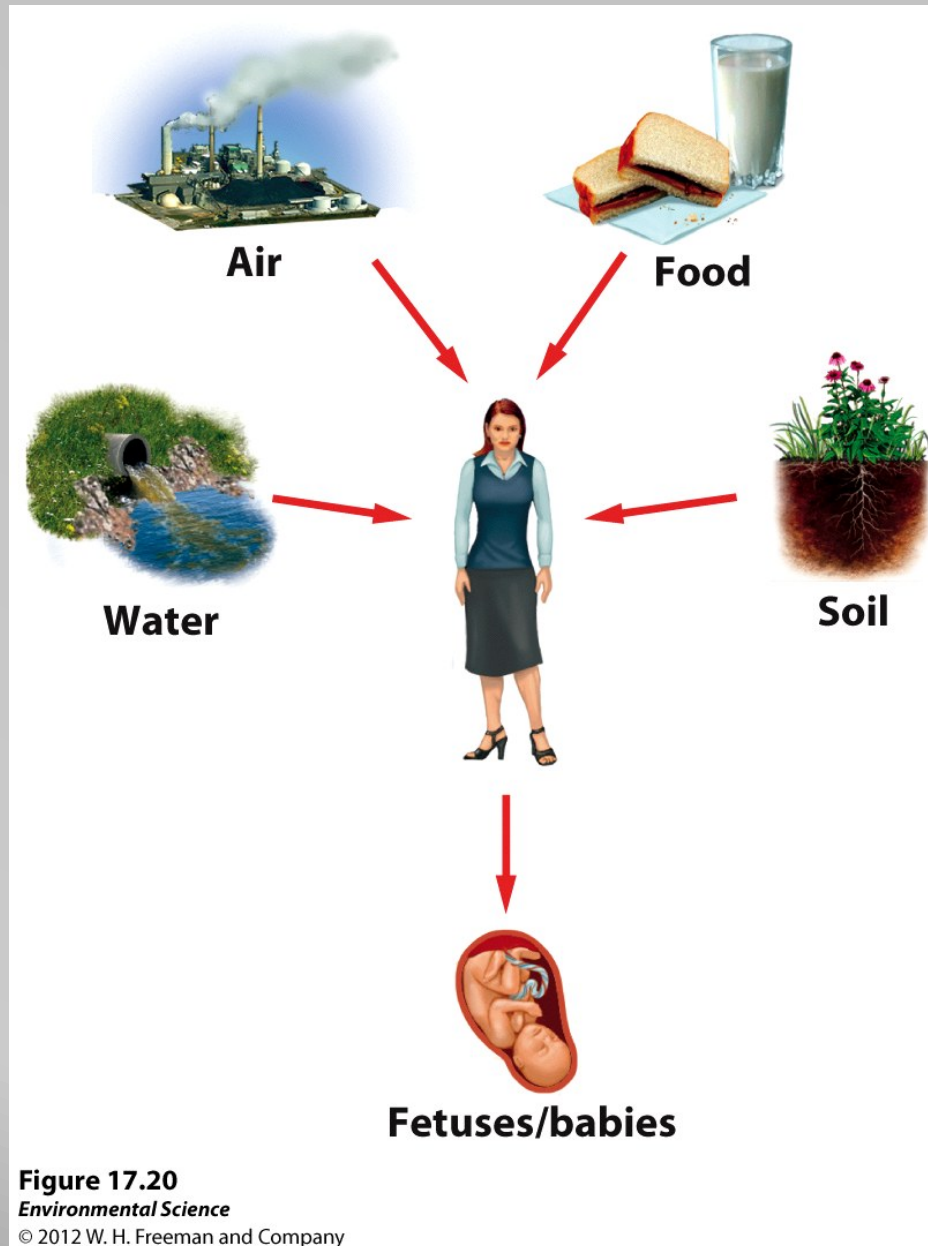
- Safe for most animals: LD50/10
- Safe for humans: LD50/1000
- EPA regulates through TSCA (Toxic Substances Control Act)

LD50 from last example was 5.4, so what level would be safe for the environment?  
For human exposure?

- ▣ Synergistic interactions- two risks come together and cause more harm than one would.
- ▣ For example, the health impact of a carcinogen such as asbestos can be much higher if an individual also smokes tobacco.



# Routes of Exposure



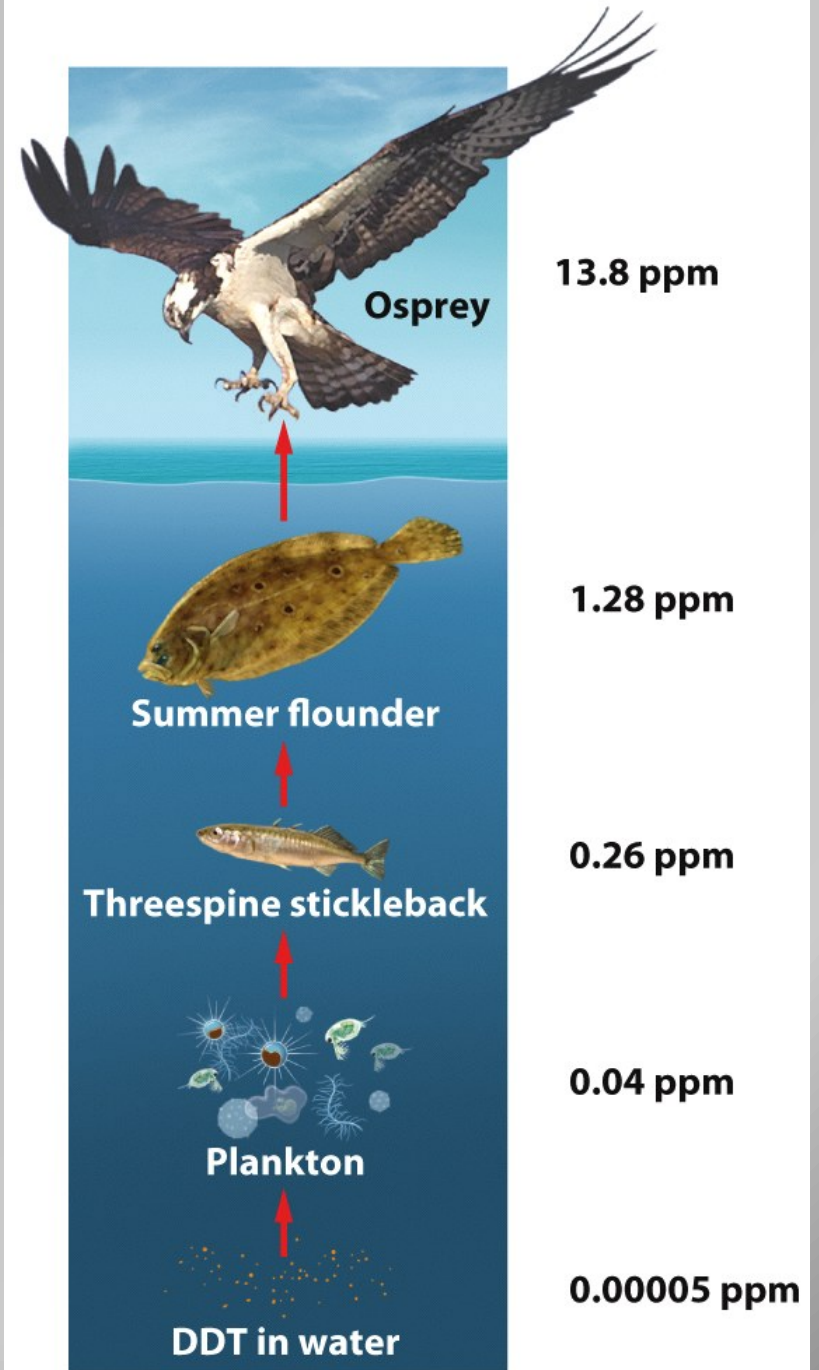
**Figure 17.20**  
*Environmental Science*  
© 2012 W. H. Freeman and Company

# Bioaccumulation

- ▣ bioaccumulation- an increased concentration of a chemical within an organism over time

# Biomagnification

- ▣ Biomagnification- the increase in a chemical concentration in animal tissues as the chemical moves up the food chain.



**Figure 17.21**

*Environmental Science*

© 2012 W. H. Freeman and Company

# Persistence

- ▣ Persistence- how long a chemical remains in the environment

<b>TABLE 17.2</b>	<b>The persistence of various chemicals in the environment, measured in terms of their half-life</b>
<b>Chemical</b>	<b>Half-life</b>
Malathion insecticide	1 day
Radon	4 days in air
Vinyl chloride	4.5 days in air
Phthalates	4.5 days in water
Roundup herbicide	7 to 70 days in water
Atrazine herbicide	224 days in wetland soils
Polychlorinated biphenyls (PCBs)	8 to 15 years in water
DDT	30 years in soil

**Source:** Hazardous Substances Data Bank, <http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB/>.

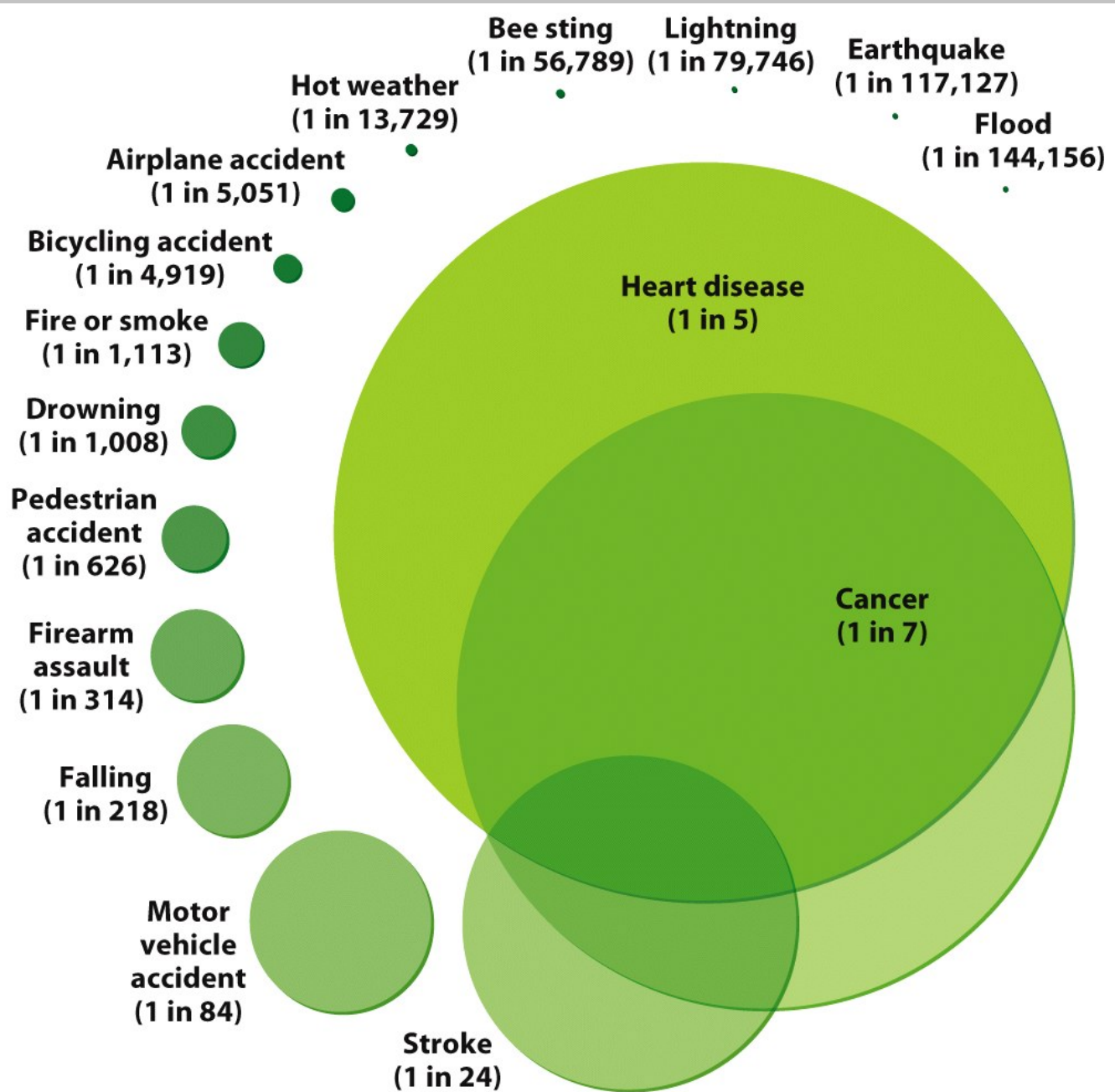
# Risk Analysis



**Figure 17.22**

*Environmental Science*

© 2012 W. H. Freeman and Company



**Figure 17.23**

*Environmental Science*

© 2012 W. H. Freeman and Company



# Qualitative Risk Assessment

- ▣ Making a judgment of the relative risks of various decisions
- ▣ Probability- the statistical likelihood of an event occurring and the probability of that event causing harm

# Quantitative Risk Assessment

- ▣ The approach to conducting a quantitative risk assessment is:
- ▣ Risk= probability of being exposed to a hazard X probability of being harmed if exposed

# Stockholm Convention – the “dirty dozen”

- ▣ In 2001, a group of 127 nations gathered in Stockholm, Sweden, to reach an agreement on restricting the global use of some chemicals
- ▣ 12 chemicals were to be banned, phased out, or reduced
- ▣ These include DDT, PCBs, and certain chemicals that are by-products of manufacturing processes (all endocrine disruptors).
- ▣ 2009, 9 additional chemicals added