ENVIRONMENTAL SCIENCE 13e

CHAPTER 14: Environmental Hazards and Human Health

Core Case Study: BPA Controversy (1)

- Hormones
- Hormone mimics
- Estrogen mimics
- Bisphenol A, an estrogen mimic

Core Case Study: BPA Controversy (2)

- Found in hardened plastics
  - Baby bottles
  - Sipping cups
  - Reusable water bottles
  - Sports drink and juice bottles
  - Microwave dishes
  - Food storage containers
  - Nearly all canned food liners

Core Case Study: BPA Controversy (3)

- 93% of Americans have BPA in their bodies
- Controversy over health risk
  - Human health
  - Fetuses
  - Infants

Fig. 14-1, p. 344

Fig. 14-2, p. 344

14-1 What Major Health Hazards Do We Face?

- ***Concept 14-1*** *People face health hazards from biological, chemical, physical, and cultural factors, and from the lifestyle choices they make.*
- *사람들은 생물학적, 화학적, 물리적, 문화적 측면에서 각각 건강 위해요소를 겪고 있으며, 또한 라이프스타일의 선택을 통해서도 위협요소를 만날 수 있다*

Risk and Hazards

- **Risk - possibility of suffering harm from a hazard**
  - Probability
  - Possibility
- **Risk assessment - in terms of probability**
- **Risk management - Analysis and reduction**

Risk Assessment and Risk Management

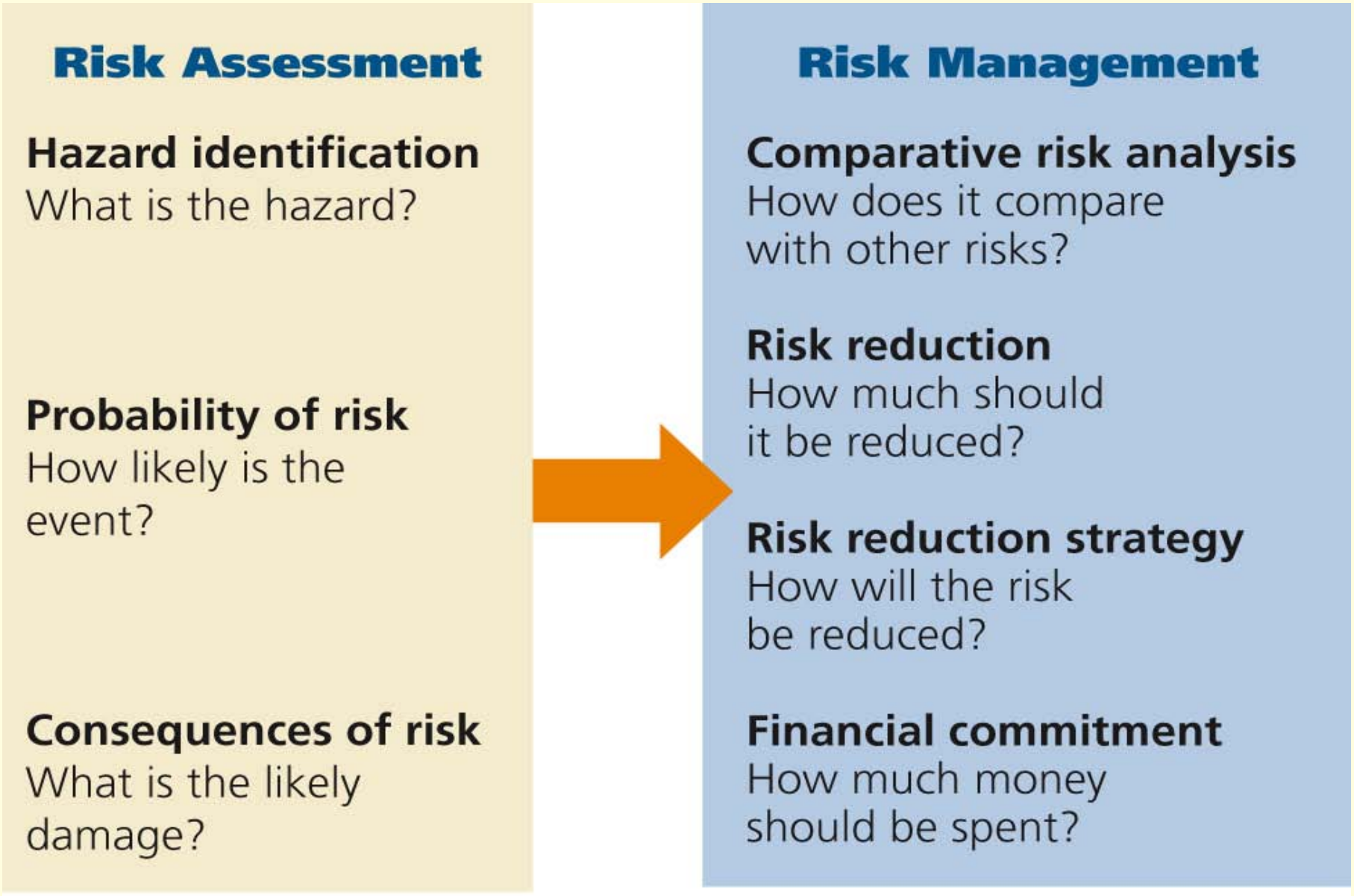


Fig. 14-3, p. 345

Major Types of Hazards

- Biological
- Chemical
- Physical
- Cultural
- Lifestyle

14-2 What Types of Biological Hazards Do We Face?

- ***Concept 14-2*** *The most serious infectious diseases are flu, AIDS, tuberculosis, diarrheal diseases, and malaria.*
- *가장 전염성 높은 질병은 독감, 에이즈, 결핵, 위장관염, 그리고 말라리아가 있다*

Biological Hazards

- **Nontransmissible diseases**
- **Transmissible (infectious) disease**
  - Pathogens – **infectious (bacteria and viruses)**
- Epidemic – **large scale outbreak of an infectious disease in an area or country.**
- Pandemic **– global epidemic**

Pathways for Infectious Disease in Humans

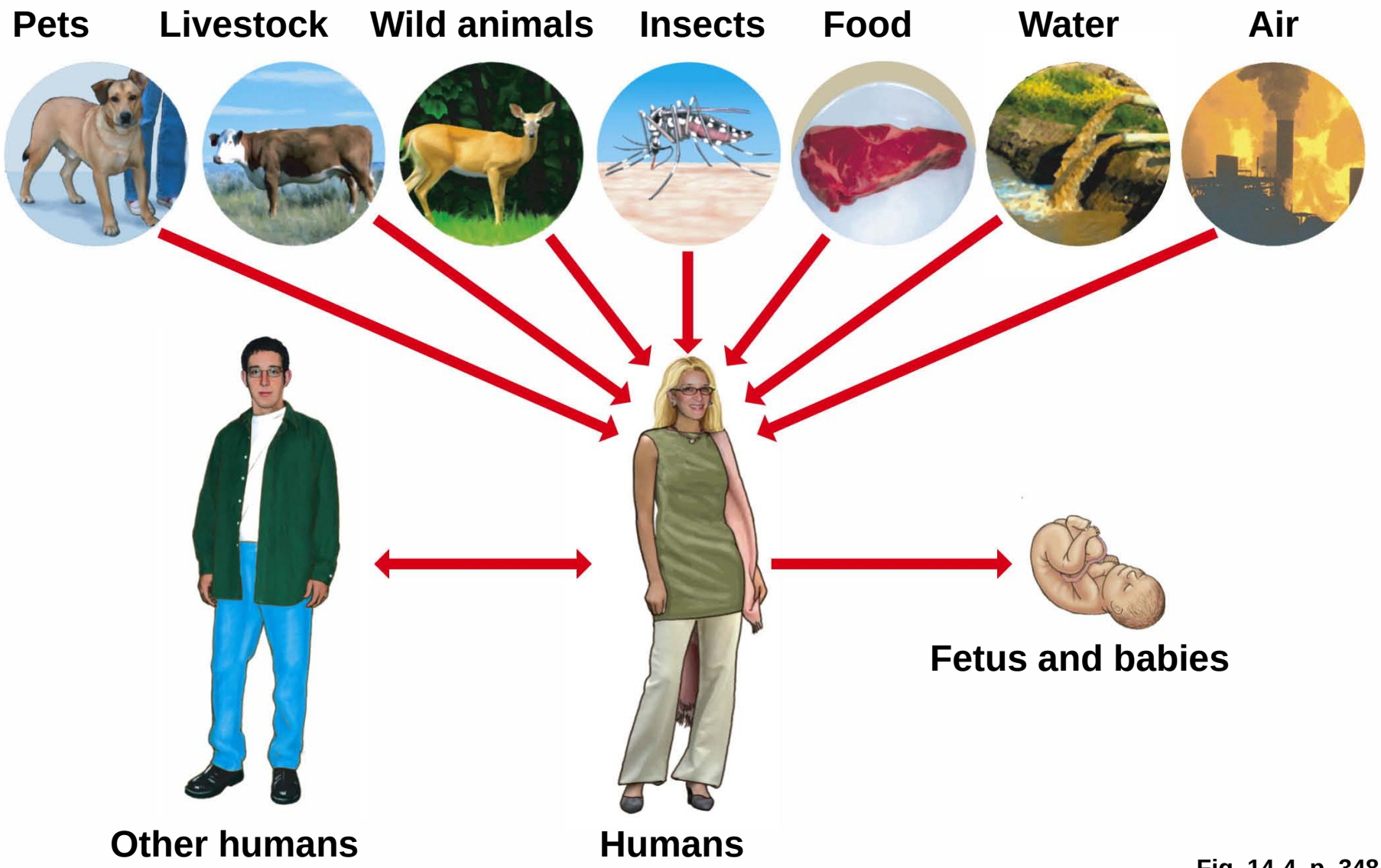
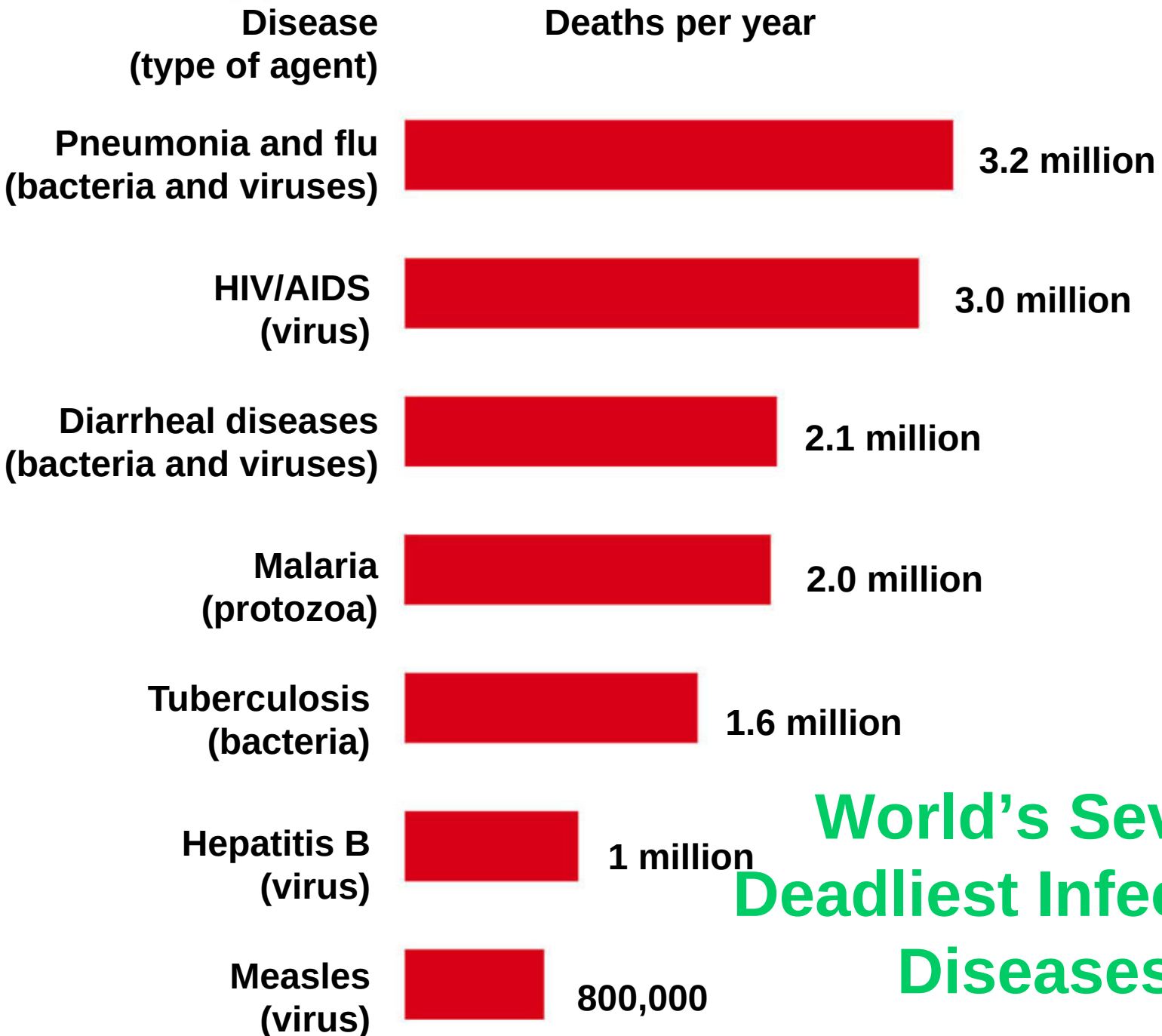


Fig. 14-4, p. 348



World's Seven Deadliest Infectious Diseases

Fig. 14-5, p. 348

Case Study: the **Tuberculosis** Threat

- TB spreading rapidly
- 1 in 3 infected; 5-10% will eventually develop it
- 2008: 9.3 million active cases
  - Poor countries in Asia and Africa
  - ~ 1.6 million will die
- Inadequate screening
- Increased resistance to antibiotics
- Increased person-to-person contacts
- Inadequate treatment
- Multidrug resistant TB

Science Focus: Growing Resistance to Antibiotics

- High bacterial reproductive rate
- Genetic resistance
- Global travel
- Use of pesticides
- Overuse of antibiotics

Most Deadly Viral Diseases

1. Influenza/flu
2. HIV – AIDS
3. Hepatitis B

- Other viruses
  - West Nile
  - SARS

Case Study: HIV/AIDS Epidemic (1)

- Acquired immune deficiency syndrome
- Human immunodeficiency virus
- Spread by
  - Unsafe sex
  - Sharing needles
  - Infected mother to child
  - Exposure to infected blood

Case Study: HIV/AIDS Epidemic (2)

- Living with AIDS 2008
  - 33 million worldwide
  - 2/3 in sub-Saharan Africa
  - 1 million in the U.S.
  - 2.7 million new cases
- 27 million deaths, 1981-2008

Case Study: Malaria

- 1 in 5 at risk
- Parasite spread by mosquitoes
- Kills 2700 people per day, mostly in Africa
- Mosquito nets for beds
- Spray homes with DDT

Distribution of Malaria

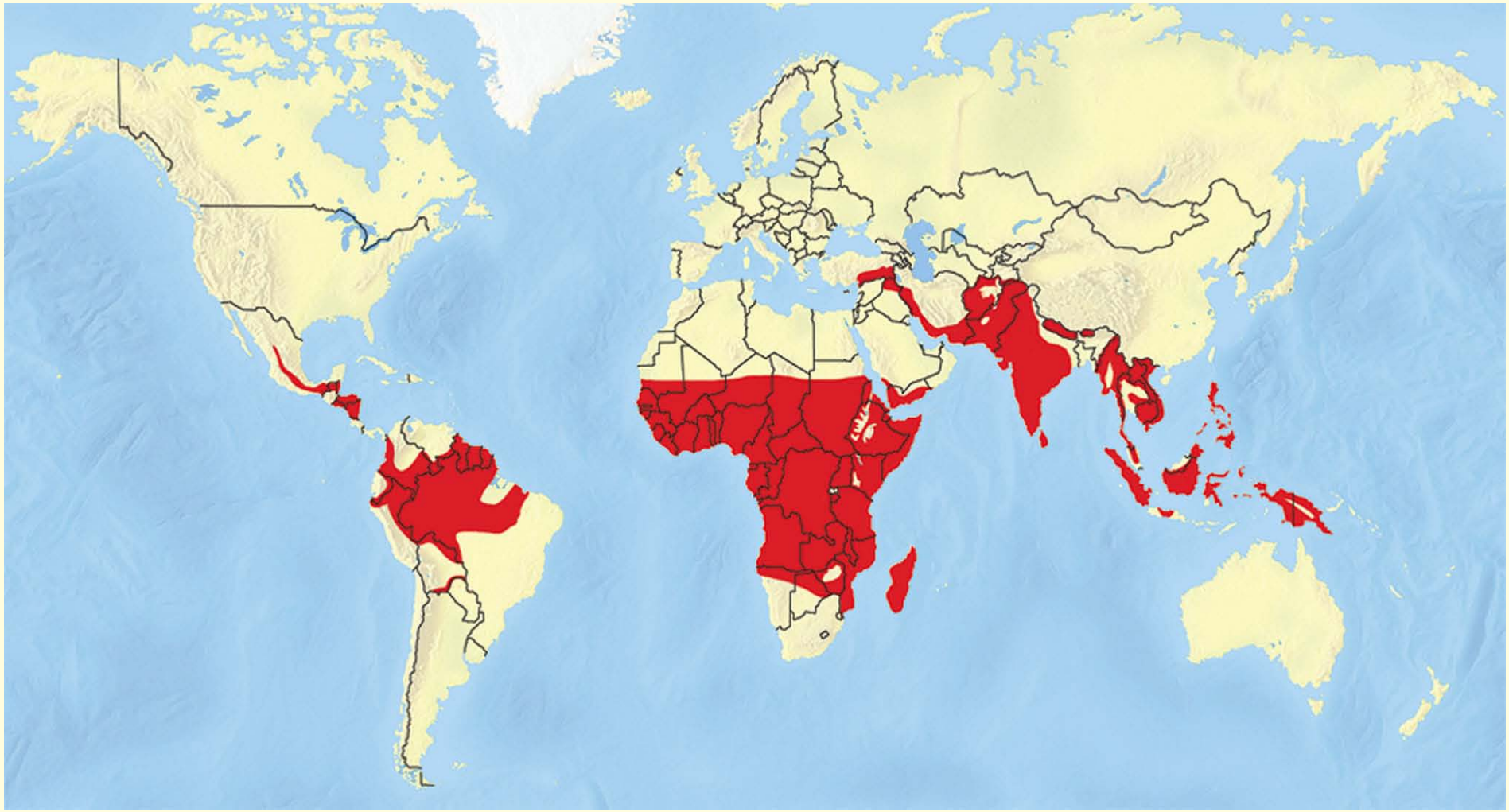


Fig. 14-6, p. 350

The Life Cycle of Malaria

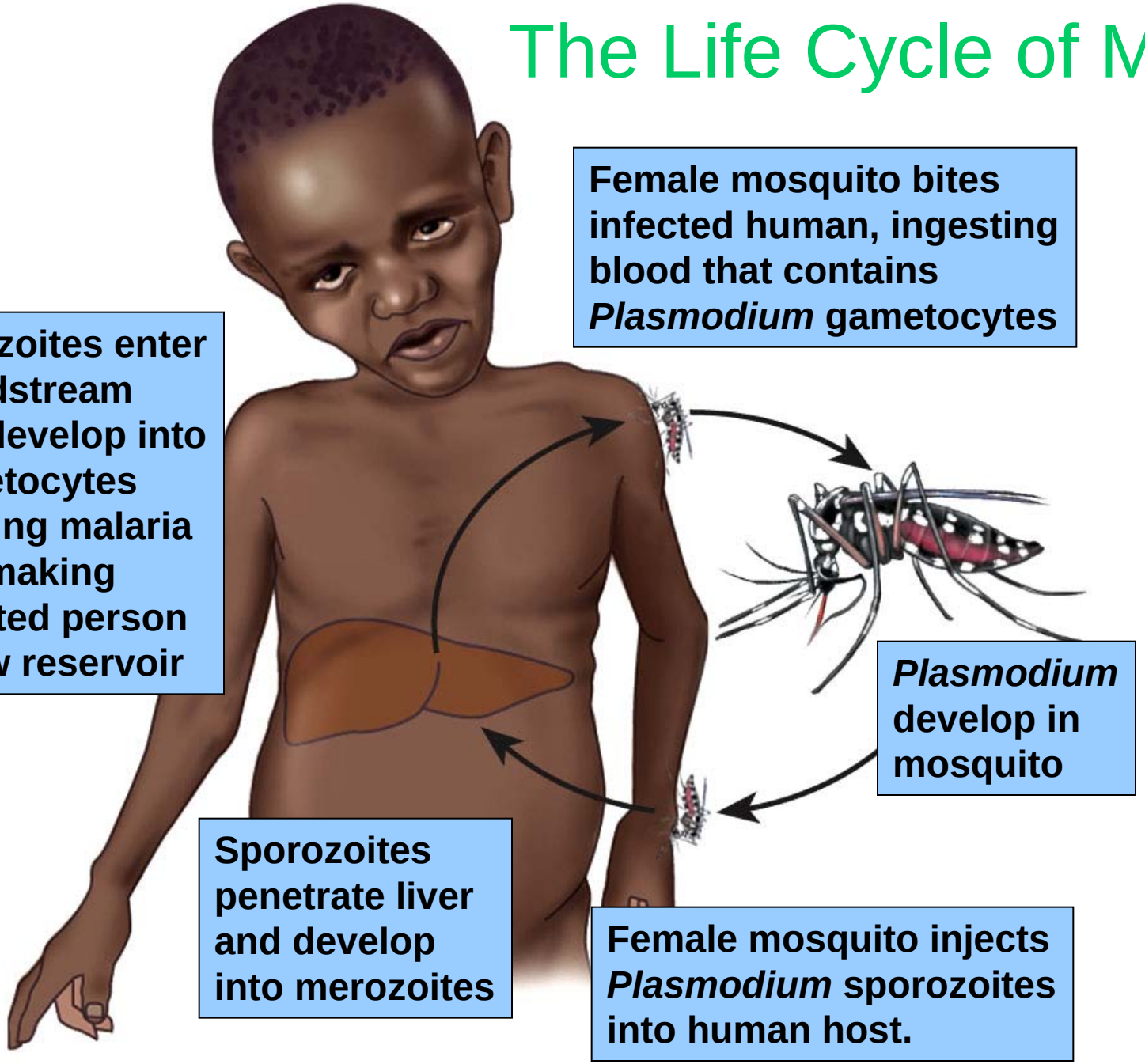


Fig. 14-7, p. 351

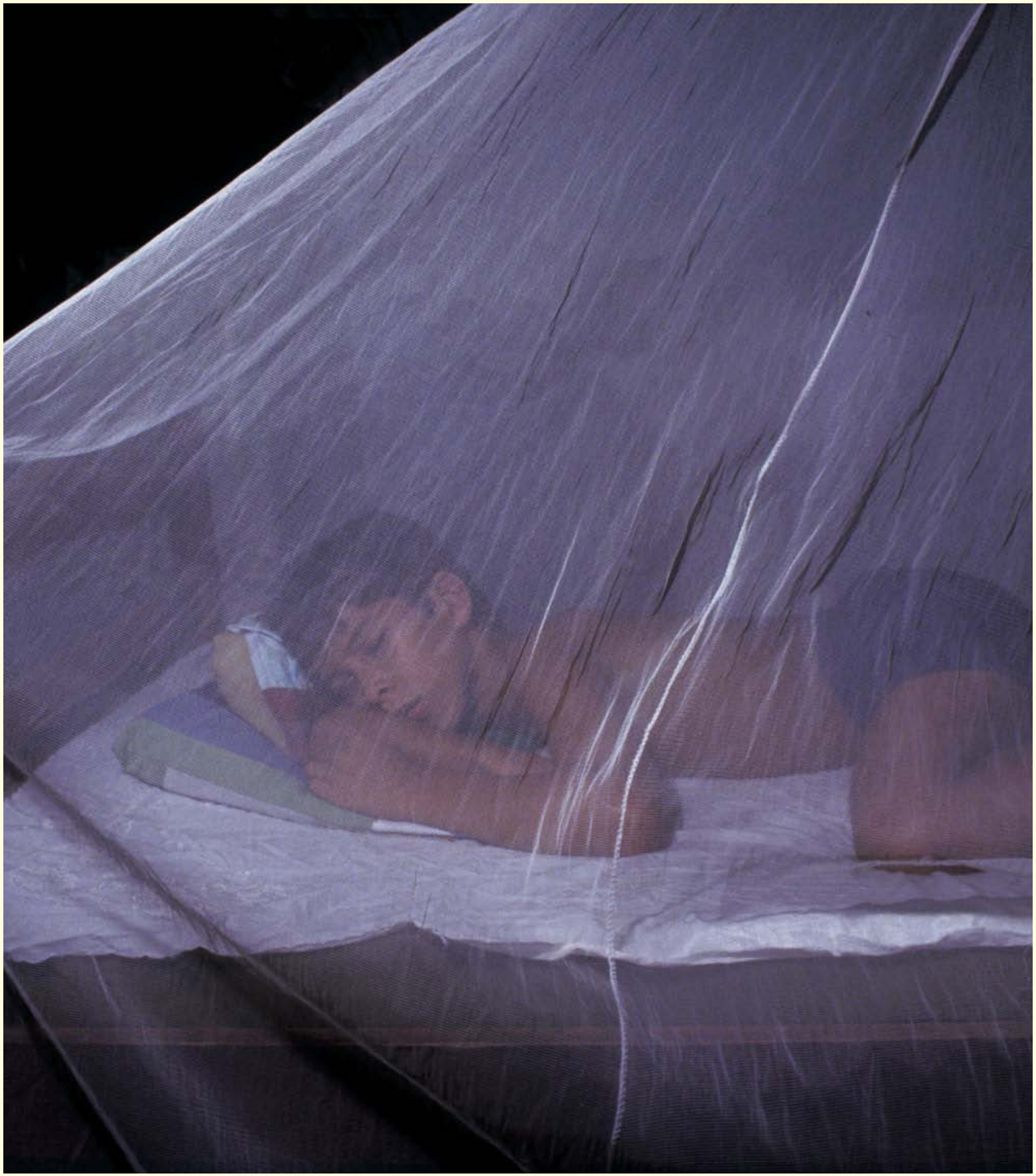


Fig. 14-8, p. 351

Solutions

Infectious Diseases

- Increase research on tropical diseases and vaccines
- Reduce poverty
- Decrease malnutrition

- Improve drinking water quality
- Reduce unnecessary use of antibiotics
- Educate people to take all of an antibiotic prescription

- Reduce antibiotic use to promote livestock growth
- Require careful hand washing by all medical personnel

- Immunize children against major viral diseases
- Provide oral rehydration for diarrhea victims
- Conduct global campaign to reduce HIV/AIDS

Fig. 14-9, p. 352

14-3 What Types of Chemical Hazards Do We Face?

- ***Concept 14-3*** *There is growing concern about chemicals that can cause cancer and birth defects and disrupt the human immune, nervous, and endocrine systems.*
- *암을 유발하고 장애를 일으키거나 사람의 면역, 신경, 내분비체계를 방해하는 화학물질에 대한 염려가 높아지고 있다*

Chemical Hazards (1)

- **Toxic chemicals**
- **Carcinogens** – cause cancer
- **Mutagens**
  – cause mutation/change in DNA molecules
  – lead to cancers
- **Teratogens** – cause harm/birth defects to a fetus or embryo

Chemical Hazards (2)

- Immune system disruptors
- Neurotoxins
- Hormonally active agents (HAA)
  - DDT, PCBs, atrazine, aluminum, mercury, BPA, PCBs
  - Males of many species becoming more feminine
  - BPA of special concern

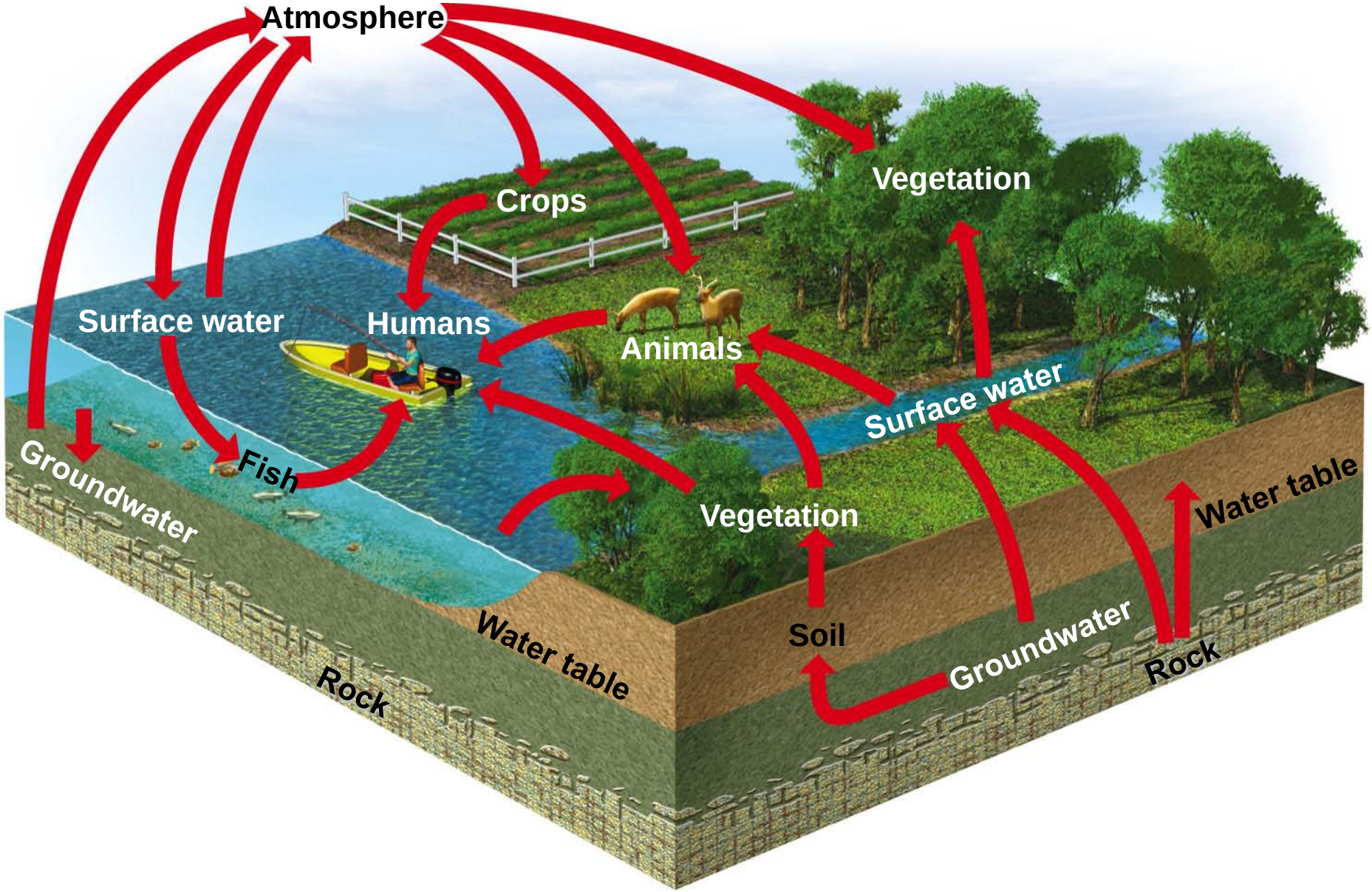


Fig. 14-10, p. 353

Science Focus: Mercury

- **Nerve and organ damage**
- **Birth defects**
- **Natural sources**
- **Human activities**
  - **Coal burning**
- **Humans exposed through**
  - **Inhaling vaporized mercury and mercury compounds**
  - **Contaminated fish**
  - **High fructose corn syrup**
- **30,000 to 60,000 U.S. newborns likely have reduced IQ**
- **Need to end coal burning and waste incineration**

Solutions

Mercury Pollution

Prevention

Phase out waste incineration

Remove mercury from coal before it is burned

Switch from coal to natural gas and renewable energy resources such as wind, solar cells, and hydrogen

Convert coal to liquid or gaseous fuel

Phase out use of mercury in batteries, TVs, compact fluorescent lightbulbs, and all other products unless they are recycled

Control

Sharply reduce mercury emissions from coal-burning plants and incinerators

Heavily tax each unit of mercury emitted by coal-burning plants and incinerators

Require labels on all products containing mercury

Collect and recycle mercury-containing electric switches, relays, compact fluorescent lightbulbs, and dry-cell batteries

Fig. 14-A, p. 354

14-4 How Can We Evaluate Chemical Hazards?

- ***Concept 14-4A*** *Scientists use live laboratory animals, case reports of poisonings, and epidemiological studies to estimate the toxicity of chemicals, but these methods have limitations.*
- *과학자들은 화학물질의 독성을 파악하기 위해 동물실험, 사례연구, 그리고 유행병학 연구를 수행하고 있으나 이러한 방법들로는 한계가 있다*

14-4 How Can We Evaluate Chemical Hazards?

- ***Concept 14-4B*** *Many health scientists call for much greater emphasis on pollution prevention to reduce our exposure to potentially harmful chemicals .*
- *우많은 보건과학자들은 해로울 가능성이 있는 화학물질에 대한 노출을 줄이기 위해 사전예방조치에 더욱 중점이 두어져야 한다고 말하고 있다*

Determining Chemical Safety

- **Toxicology**
- **Toxicity**
- **Dose**
- Water and fat soluble toxins
- Persistence
- Biological magnification

Type and Severity of Health Damage

- **Response** – dose dependent
  - Acute effect
  - Chronic effect

Case Study: Protecting Children from Toxic Chemicals

- Toxic chemicals in newborns' blood
- Infants and children more susceptible
  - Increased intake of air, water, food for their body weights
  - Put contaminated objects in their mouths
  - Less-developed immune systems

Estimating Toxicity

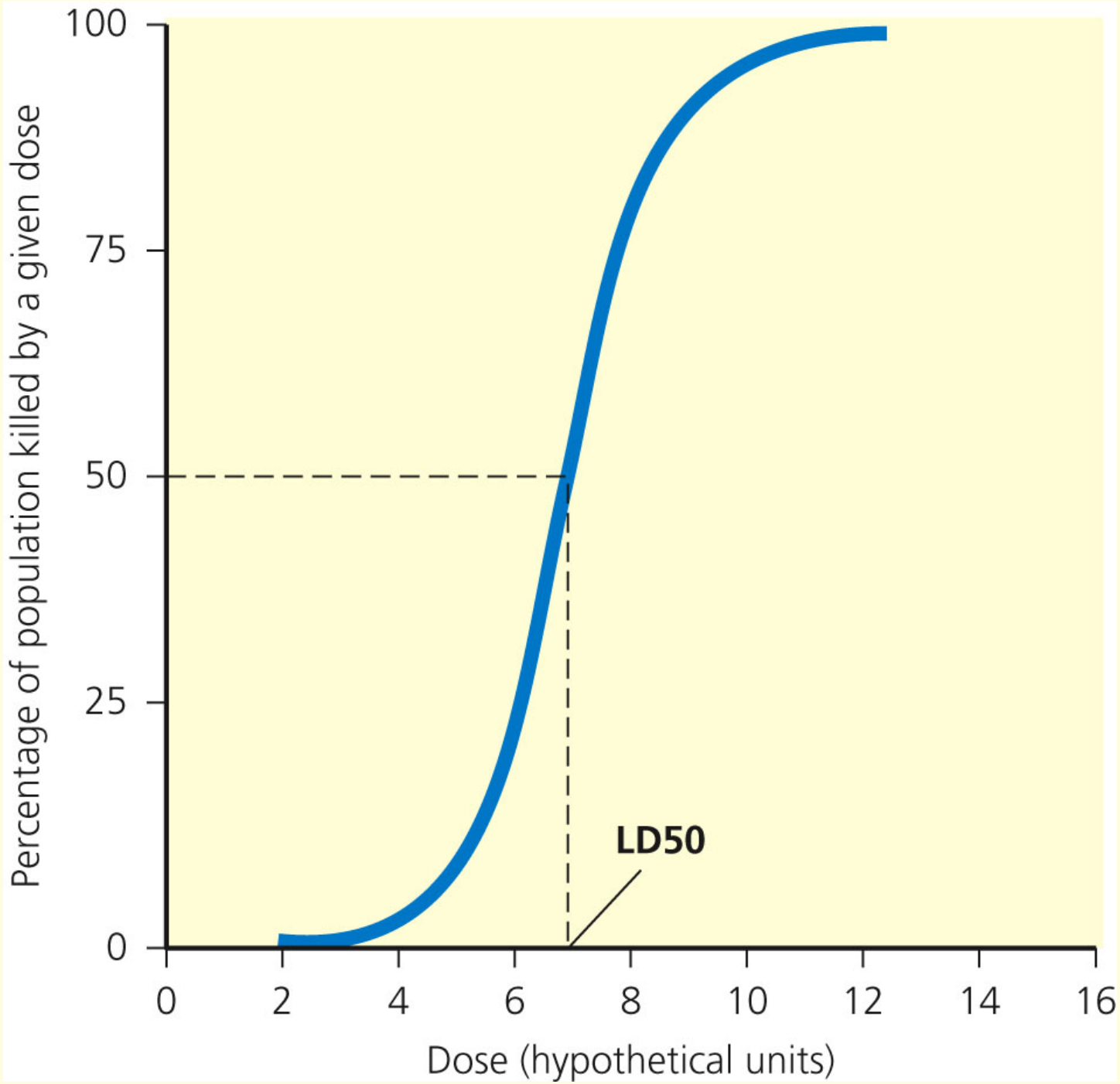
- Test on live animals
- **Dose-response curve**
  - Lethal dose
  - Median lethal dose (LD50)
- Extrapolation from data

Table 14-1

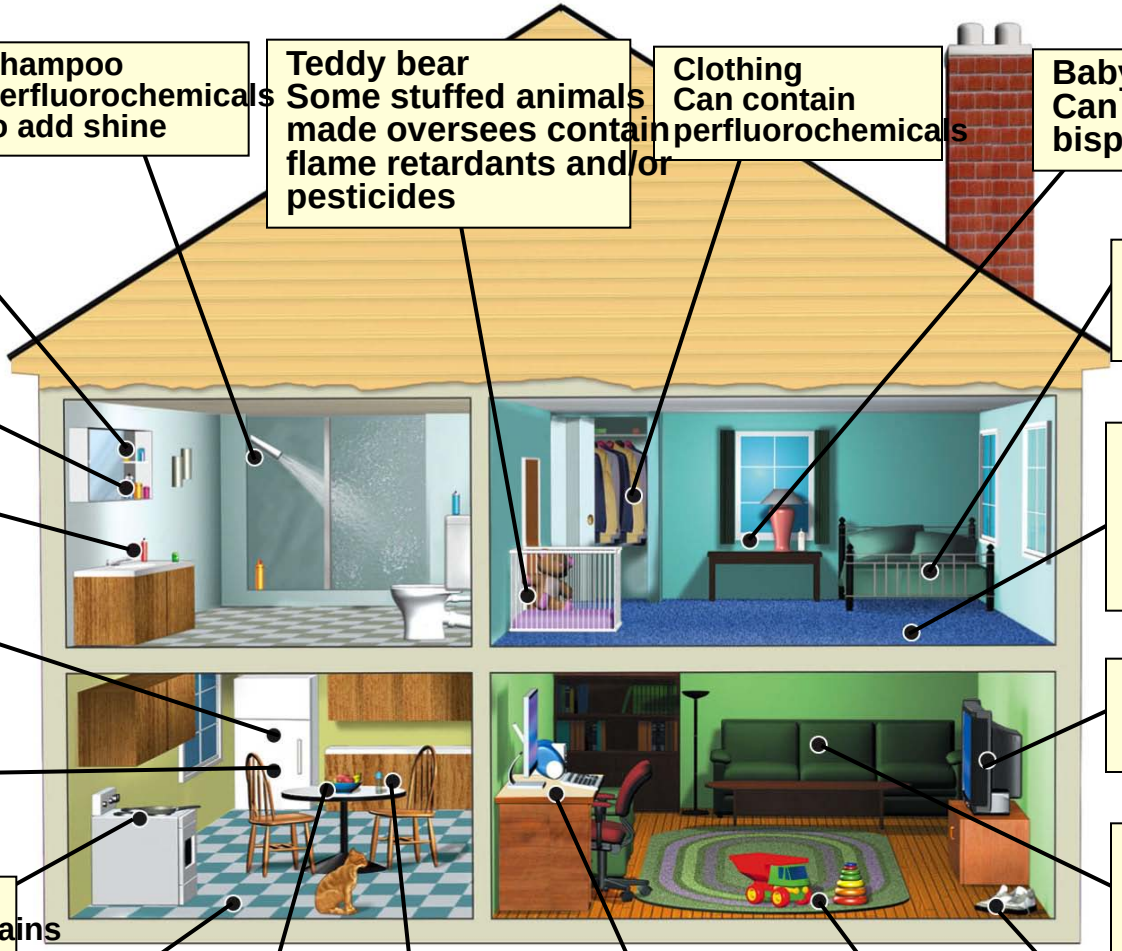
Toxicity Ratings and Average Lethal Doses for Humans

Toxicity Rating	LD50 (milligrams per kilogram of body weight)*	Average Lethal Dose**	Examples
Supertoxic	Less than 5	Less than 7 drops	Nerve gases, botulism toxin, mushroom toxin, dioxin (TCDD)
Extremely toxic	5–50	7 drops to 1 teaspoon	Potassium cyanide, heroin, atropine, parathion, nicotine
Very Toxic	50–500	1 teaspoon to 1 ounce	Mercury salts, morphine, codeine
Moderately toxic	500–5,000	1 ounce to 1 pint	Lead salts, DDT, sodium hydroxide, sodium fluoride, sulfuric acid, caffeine, carbon tetrachloride
Slightly toxic	5,000–15,000	1 pint to 1 quart	Ethyl alcohol, Lysol, soaps
Essentially nontoxic	15,000 or greater	More than 1 quart	Water, glycerin, table sugar

*Dosage that kills 50% of individuals exposed.
**Amounts of substances in liquid form at room temperature that are lethal when given to a 70-kilogram (150-pound) human.


100
75
50
25
0
Percentage of population killed by a given dose
LD50
0
2
4
6
8
10
12
14
16
Dose (hypothetical units)

Potentially Harmful Chemicals Found in Homes



Nail polish
Perfluorochemicals and phthalates

Shampoo
Perfluorochemicals to add shine

Teddy bear
Some stuffed animals made oversees contain flame retardants and/or pesticides

Clothing
Can contain perfluorochemicals

Baby bottle
Can contain bisphenol-A

Perfume
Phthalates

Mattress
Flame retardants in stuffing

Hairspray
Phthalates

Carpet
Padding and carpet fiber contain flame retardants, perfluorochemicals, and pesticides

Food
Some food contains bisphenol-A

TV
Wiring and plastic casing contain flame retardants

Milk
Fat contains dioxins and flame retardants

Sofa
Foam padding contains flame retardants and perfluorochemicals

Frying pan
Nonstick coating contains perfluorochemicals

Tile floor
Nonstick coating contains perfluorochemicals, phthalates, and pesticides

Fruit
Imported fruit may contain pesticides banned in the U.S.

Water bottle
Can contain bisphenol-A

Computer
Flame retardant coatings of plastic casing and wiring

Toys
Vinyl toys contain phthalates

Tennis shoes
Can contain phthalates

Fig. 14-12, p. 360

Protection against Harmful Chemicals

- Pollution prevention
- Precautionary principle
- Persistent organic pollutants (POPs)
  - The dirty dozen

Individuals Matter: Ray Turner

- CFCs harm the ozone layer
- Ray Turner worked at Hughes Aircraft
- Developed citrus-based compounds to clean electronics instead of CFC-based compounds

14-5 How Do We Perceive Risks and How Can We Avoid the Worst of Them?

- ***Concept 14-5*** *We can reduce the major risks we face by becoming informed, thinking critically about risks, and making careful choices.*
- *우리는 보다 많은 정보를 가지고 위험요인에 대해 판단하기 위해 노력해야 하며, 항상 신중히 선택할 필요가 있다*

Evaluating Risks (1)

- **Risk analysis** (risk assessment)
- Comparative risk analysis
- Risk management
- Risk communication
- Poverty – the greatest risk

Evaluating Risks (2)

- Risks from **lifestyles**
  - Don’t smoke
  - Lose excess weight
  - Eat healthy foods
  - Exercise regularly
  - Little or no alcohol
  - Avoid excess sunlight
  - Practice safe sex

Number of Deaths Per Year in the World

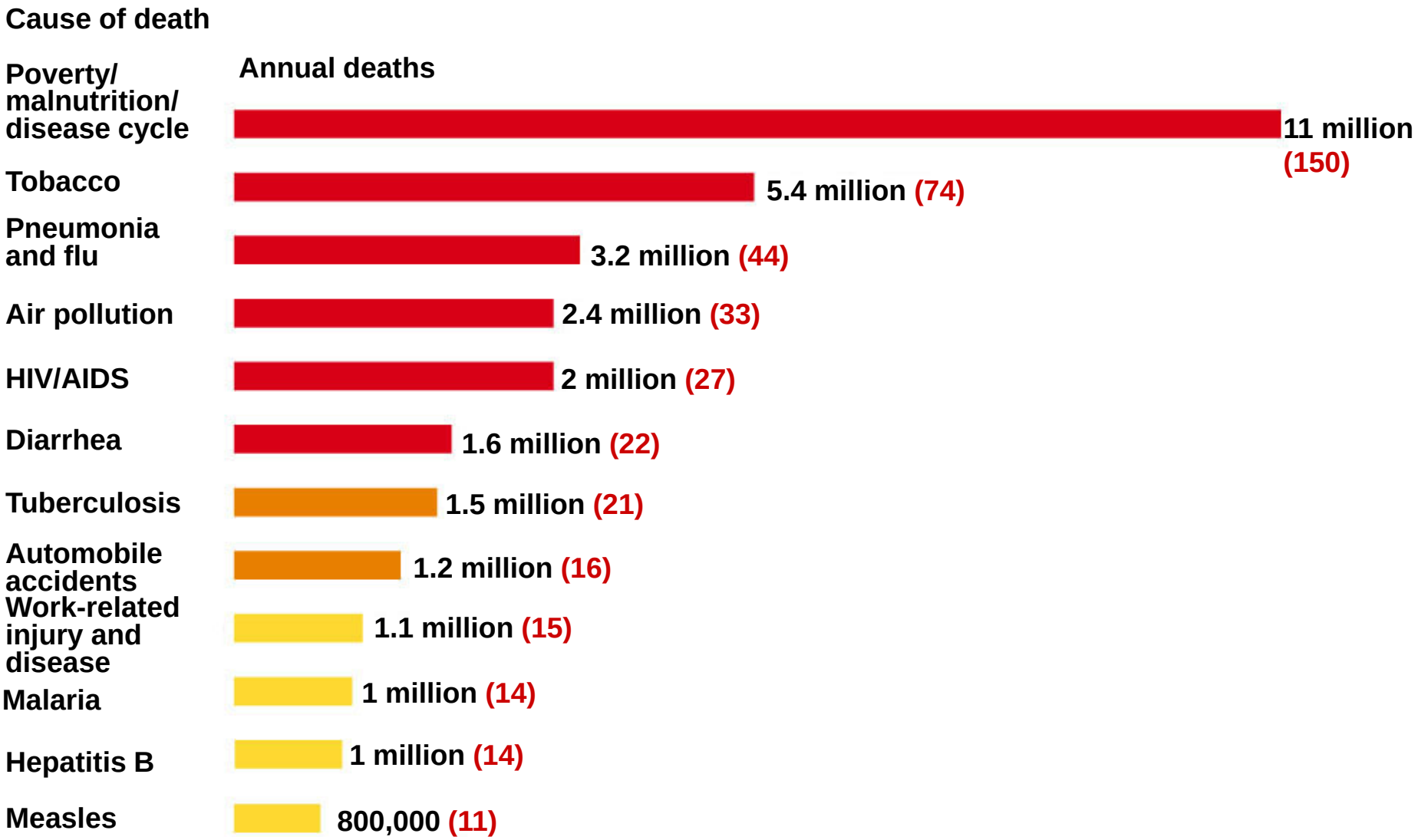
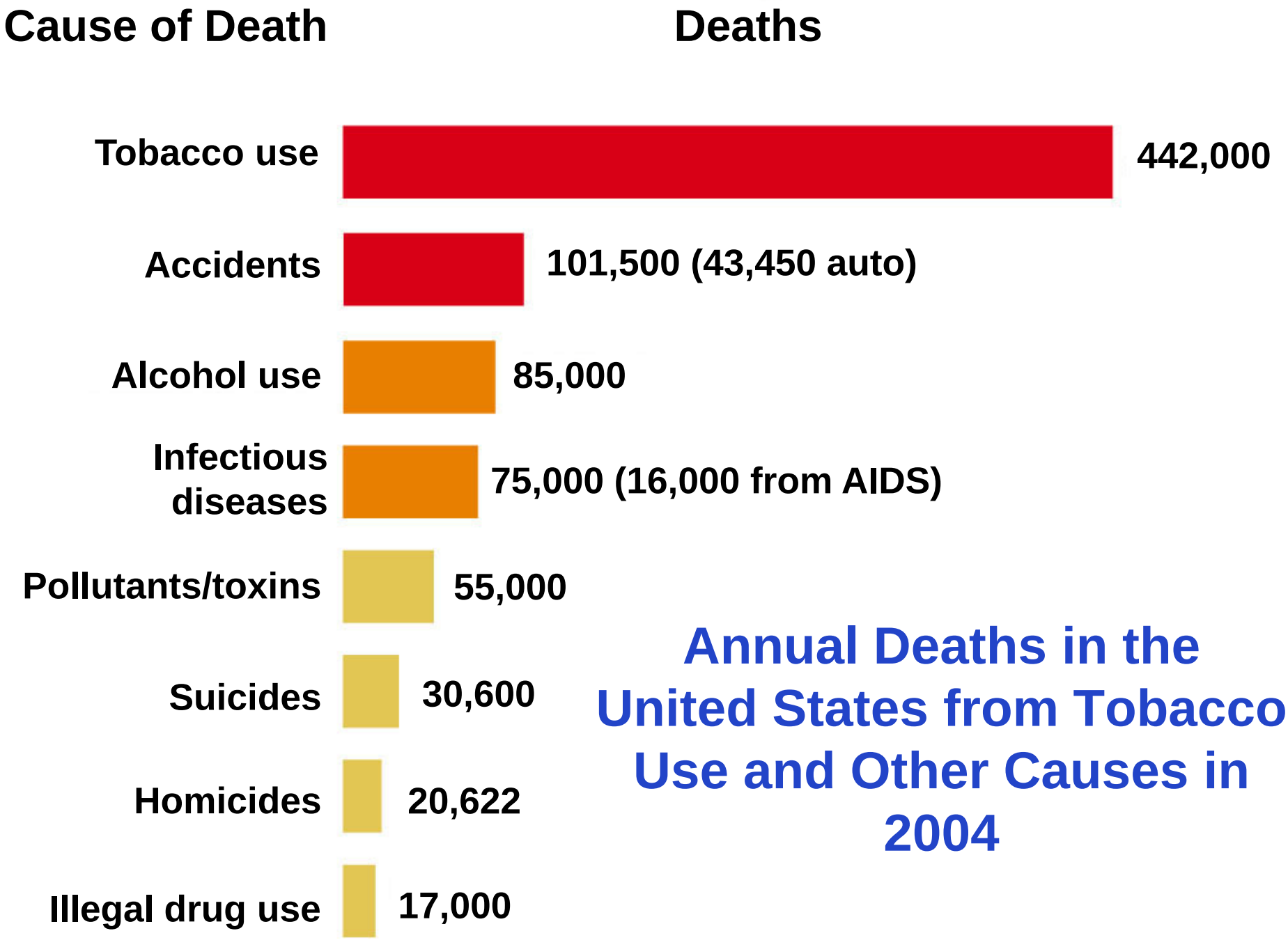


Fig. 14-13, p. 361

Fig. 14-15, p. 364

Fig. 14-15, p. 364



Annual Deaths in the United States from Tobacco Use and Other Causes in 2004

Fig. 14-16, p. 364

Estimating Risks from Technologies

- System reliability (%) = Technological reliability x **Human reliability**
- Difficulties in estimating reliability
- **Perceived risk vs. actual risk**

Improving Risk Evaluation

- Compare risks
- Determine how much risk you are willing to accept
- Determine the actual risk involved
- Concentrate on evaluating and carefully making important lifestyle choices

Three Big Ideas from This Chapter - #1

We face significant hazards from infectious diseases such as flu, AIDS, tuberculosis, diarrheal diseases, and malaria, and from exposure to chemicals that can cause cancers and birth defects and disrupt the human immune, nervous, and endocrine systems.

Three Big Ideas from This Chapter - #2

Because of the difficulty in evaluating the harm caused by exposure to chemicals, many health scientists call for much greater emphasis on pollution prevention.

Three Big Ideas from This Chapter - #3

Becoming informed, thinking critically about risks, and making careful choices can reduce the major risks we face.