OBJECTIVES

1. Define risk, probability, and risk assessment. List four general types of common hazards, and give two examples of each. Describe the relationship between health and the American workplace.

2. Define dose and response. Distinguish among acute and chronic exposures. Distinguish among acute and chronic effects. Summarize three methods used to enhance our understanding of toxicity of chemicals.

3. Define a dose-response curve. Distinguish between a linear dose-response model and a threshold dose-response model. Describe the difficulty in deciding which model applies best when low doses are involved. Assess the limits of toxicological research.

4. List five principal types of chemical hazards, and give two examples of each.

5. Define mutagen, teratogen, and carcinogen. Summarize current research implying chemical effects on the immune, nervous, and endocrine systems.


7. Summarize steps to improve health in developing countries.

8. Summarize key questions to be answered in risk-benefit analysis, risk assessment, and risk management. What are the useful applications and limits of these analyses?

9. List several cases in which the public generally perceives that a technology or product has a greater risk than the risk estimated by experts.

KEY TERMS (Terms are listed in the same font style as they appear in the text.)

- passive smoking (p. 409)
- risk (p. 440)
- risk assessment (p. 410)
- risk management (p. 410)
- probability (p. 410)
- possibility (p. 410)
- cultural hazards (p. 410)
- physical hazards (p. 410)
- chemical hazards (p. 410)
- biological hazards (p. 410)
- environmental factors (p. 229)
- toxicity (p. 410)
- dose (p. 410)
- genetic makeup (p. 411)
- solubility (p. 411)
- water-soluble toxins (p. 411)
- oil (fat) soluble toxins (p. 411)
- persistence (p. 411)
- bioaccumulation (p. 411)
- biomagnification (p. 411)
- chemical interactions (p. 412)
- antagonistic interaction (p. 412)
- synergistic interaction (p. 412)
- response (p. 412)
- acute effect (p. 412)
- chronic effect (p. 412)
- poison (p. 413)
- toxin (p. 413)
- lethal dose (LD) (p. 413)
- median lethal dose (p. 413)
- LD50 (p. 413)
- case reports (p. 413)
- epidemiological studies (p. 413)
- experimental group (p. 413)
- control group (p. 413)
- dose-response curve (p. 414)
- controlled experiments (p. 414)
- nonthreshold dose-response model (p. 414)
- threshold dose-response model (p. 415)
- hormesis (p. 415)
- toxic chemical (p. 416)
- hazardous chemical (p. 416)
- mutagens (p. 416)
- mutations (p. 416)
- teratogens (p. 416)
- carcinogens (p. 416)
- metastasis (p. 416)
- immune system (p. 416)
- neurotoxins (p. 416)
- nervous system (p. 416)
- endocrine system (p. 416)
- hormones (p. 416)
- hormone disrupters (p. 417)
- hormonally active agents (HAAs) (p. 417)
- thyroid disrupters (p. 417)
- pollution prevention (p. 418)
- precautionary principle (p. 418)
- persistent organic pollutants (POPs) (p. 418)
- dirty dozen (p. 418)
- nontransmissible disease (p. 419)
- transmissible disease (p. 419)
- infectious agent (p. 419)
Instructions: Answer the following questions for extra-credit on the next test.

1. Define the boldfaced terms in this chapter. (OMIT)

2. What voluntary human activity kills the largest number of people each year?

3. What are risk and probability? Distinguish between risk assessment and risk management.

4. List two (a) cultural hazards, (b) chemical hazards, (c) physical hazards, and (d) biological hazards.

5. What is toxicity? Distinguish between dose and response for a potentially harmful substance. Distinguish between bioaccumulation and biomagnification.

6. Explain what is meant by the phrase, "The dose makes the poison." Explain how modern toxicologists have modified this principle.

7. How much should we be concerned about exposure to trace amounts of toxic chemicals?

8. What is the median lethal dose of a poison or toxin?

9. Describe how scientists use case reports, epidemiological studies, and laboratory experiments to estimate toxicity. (OMIT)

10. What is a dose-response curve? Distinguish between a linear dose-response curve and a threshold dose-response curve.

11. Describe the controversy over the hormesis hypothesis that very small doses of radiation and some toxins may be good for you.

12. Why do scientists usually set allowed exposure levels to various toxins 100 to 1,000 times lower than their estimated toxicities?

13. Distinguish between toxic chemicals and hazardous chemicals. Distinguish among mutagens, teratogens, and carcinogens.

14. Distinguish among the immune system, nervous system, and endocrine system. What are hormone disrupters and hormone mimics? Describe two potentially harmful effects of exposure to hormonally active agents (HAAs) on wildlife and two such effects on humans.

15. About what percentage of the at least 80,000 chemicals in commercial use in the United States have been screened (a) to assess toxicity, (b) to determine whether they are carcinogens, teratogens, or mutagens, and (c) to determine whether they damage the nervous, endocrine, or immune systems?

16. List three reasons for the lack of information about the potentially harmful effects of most chemicals in commercial use. Distinguish between the regulation strategy and the pollution prevention (or precautionary) strategy for protecting the public from potentially harmful chemicals. What is the precautionary principle? Why is it rarely used? (OMIT)

17. Distinguish between nontransmissible and transmissible diseases, and give two examples of each type. Distinguish between a bacterium and a virus, and explain how a virus replicates itself.

18. Give some good news and bad news about our efforts to reduce the incidence of infectious diseases.
19. What are the seven deadliest infectious diseases in order of the number of deaths they cause each year?

20. Describe two ways that infectious bacteria become resistant to antibiotics.

21. What causes tuberculosis, and how is it transmitted? About how many people died of TB during the past year? List four reasons for the increase in TB infections in recent years. How can the spread of this bacterial infectious disease be slowed?

22. In terms of deaths, what are the three most serious viral diseases?

23. Distinguish between HIV and AIDS. About how many people in the world (a) are infected with HIV, (b) have died of AIDS, and (c) are expected to die of AIDS between 2004 and 2020?

24. What causes malaria? About how many people die from malaria each year?

25. List five pieces of good news and two pieces of bad news about efforts to reduce the incidence of infectious disease in developing countries. List eleven ways to prevent or reduce the incidence of infectious diseases throughout the world. (OMIT)

26. Describe the threat from bioterrorists unleashing strains of deadly bacterial and viral diseases and give three examples of such diseases. Describe two ways to reduce these threats.

27. What is risk analysis? What are its major limitations? What is comparative risk analysis? How can we estimate the risks from technological systems?

28. What is risk management?

29. List four reasons why people often perceive that certain risks are greater than experts say they are.

30. What are four things you can do to become better at estimating and dealing with risks?

**Outline**

19-1 Risk, Probability, and Hazards
Risks and hazards—some avoidable, some not—compromise everyday life.

A. A risk is a measure of your likelihood of suffering harm from a hazard.
   1. Such a hazard may cause injury, disease, economic loss, or environmental damage.
   2. Risk assessment is projected as a probability: a mathematical statement about how likely it is that harm will result from a hazard. It gives the estimate of an event’s actually happening.
   3. Risk management involves deciding whether or how to reduce a particular risk to a certain level and at what cost.

B. There are four major types of hazards.
   1. One major hazard is a cultural hazard, such an unsafe working conditions, smoking, poor diet, drugs, unsafe sex, poverty, criminal assault, etc.
   2. Chemical hazards are harmful chemicals in the air, water, soil, and food.
   3. Physical hazards include radioactivity, fire, earthquake, floods, etc.
   4. Biological hazards come from pathogens, pollen, other allergens, and animals such as bees and poisonous snakes.

19-2 Toxicology: Assessing Chemical Hazards
A. Harm from chemical exposure depends on the amount of exposure (dose), frequency of exposure, which chemical is exposed, the body’s detoxification system, and one’s genetic makeup.
1. Toxicity measures how harmful a substance is in causing injury, illness, or death to a living organism. Several factors to consider are:
   a. dose, the amount of a substance a person is exposed to,
   b. frequency of exposure,
   c. age and size of the individual exposed,
   d. the health of the body’s detoxification system, and
   e. the genetic makeup of the individual, which is also important for determining sensitivity to a toxin.

2. Five major factors can affect the harm caused by a substance.
   a. Solubility. Water-soluble toxins can move throughout the environment. Oil- or fat-soluble toxins (generally organic compounds) can penetrate the membranes surrounding an organism’s cells and accumulate in the body.
   b. Persistence of a substance is also important. Some substances resist breakdown and remain in the environment a long time and can have long-lasting harmful effects.
   c. Bioaccumulation is a third factor. Molecules are absorbed and stored in the body at higher than normal levels.
   d. Biomagnification is where toxins accumulate at greater levels as they are moved up from one trophic level to the next higher one.
   e. Chemical interactions can decrease or multiply the harmful effects of a toxin. An antagonistic interaction reduces the harmful effect, while a synergistic interaction multiplies the harmful effects.

3. The effects of a chemical can be chronic or acute. An acute effect is immediate; a chronic effect is a long-lasting consequence from exposure to a harmful substance. The type and amount of health damage from exposure to a chemical is called the response.

B. In toxicology, any synthetic/natural chemical can be harmful if a large enough quantity is ingested. Therefore, it is critical to determine the amount of exposure that produces a harmful response.
   1. The critical question is: How much exposure to a particular toxic chemical causes a harmful response? It is different for each individual.
   2. The body has three major mechanisms for reducing the harmful effects of some chemicals.
      a. It can break down, dilute, or excrete small amounts of most toxins to keep them from reaching harmful levels.
      b. Certain enzymes can sometimes repair damage to DNA and protein molecules.
      c. Cells in certain parts of the body (skin, gastrointestinal tract, lungs, and blood vessels) can reproduce fast enough to replace damaged cells.

C. Trace levels of toxic chemicals in human bodies or in the environment may be benign or harmful; it depends on the chemical in question. We do not know the long-term effects of most chemicals in the environment, many of them introduced by man.
   1. Some scientists think that trace levels of most chemicals are not harmful.
   2. Other scientists feel we need to evaluate the long-term harm caused by exposure to low doses of many new synthetic chemicals.
   3. Natural chemicals in the environment are sometimes thought to be safe, but this is a false impression since nature has an arsenal of harmful chemicals for defense also.

D. A poison or toxin is a chemical that adversely affects the health of a living human or animal by causing injury, illness, or death.
   1. A widely used method for estimating the toxicity of a chemical is to determine its lethal dose. A median lethal dose (LD50) for a chemical is the amount in one dose that kills 50% of the test animals within a 14-day period.
   2. Chemicals vary widely in their toxicity. The five top toxic substances named by the EPA in 2004 are arsenic, lead, mercury, vinyl chloride, and polychlorinated biphenyls, in that order.
E. Toxicity estimates are based on case reports and epidemiological studies.
1. Case reports compare the health of a group of people exposed to a chemical to the health of a similar group that was not exposed. This comparison is used to estimate toxicity.
2. These reports are generally not reliable in determining toxicity.
3. The reports can provide clues about environmental hazards.
4. Epidemiological studies compare the health of people exposed to a particular chemical (the experimental group) with the health of another group statistically similar but not exposed to the chemical (the control group). A dose-response curve can often result from such a study; it shows the effects of various dosages of a toxic agent on a group of test organisms.
   a. The study can be limited as to usefulness because too few people have been exposed to high enough levels of a substance for there to be statistically significant differences.
   b. Another limitation is that it is difficult to conclusively link an observed effect with exposure to a specific chemical because people are exposed to many different toxic agents throughout their lives.
   c. These studies cannot evaluate hazards from new technologies/chemicals to which people have not been exposed.

F. Animal testing is also used to estimate toxicity.
1. A population of live laboratory animals is exposed to measured doses of a substance under controlled conditions.
2. Such a study takes from 2–5 years.
3. Methods other than animal testing include: computer simulations, using tissue cultures of cells and bacteria and chicken membranes, as well as measuring changes in the electrical properties of individual animal cells.
4. Two dose-response models provide information on chemicals.
   a. The non-threshold dose-response model states that any dosage of a toxic chemical/ionizing radiation causes harm that increases with dosage.
   b. The threshold dose-response model states that a threshold dosage must be reached before any detectable harmful effects occur. This may be because the body can repair damage caused by low dosages of some substances.
5. There are limitations on the results of toxicity tests.
   a. Extrapolation of data from test animals to humans is controversial.
   b. There is controversy, also, on assuming that an increased dosage always causes great harm.
   c. The toxicity of a single substance is difficult to estimate, especially with the varying chemical exposures on individuals.
   d. There are debates over chemical interactions and their effect on toxicity.
6. Determining the toxicity of a single substance is difficult because people are exposed to a variety of chemicals and separating out which ones are the culprits and how they interact is overwhelming.
Chapter 19

7. The effects of a particular chemical is different for children than for adults since on a weight basis they eat more, drink more, and breathe more air and dust.
8. Some scientists feel that the exposure level acceptable for children should be 10 times less than for adults and other scientists feel it should be 100 times less than for adults. A study was instituted in 2003 that will follow the health and exposure levels to key toxins for 100,000 children from birth to age 18.
G. A controversial hypothesis states that small doses of radiation and some toxins may have beneficial health effects.
   1. The phenomenon of beneficial effects from small doses of toxins is called hormesis.
   2. Edward Calabrese at the University of Massachusetts has examined the literature and feels that this hypothesis might have some merit.
H. All methods to estimate toxicity have serious limitations. Therefore, allowed exposure levels are set well below estimated harmful levels.

19-3 Chemical Hazards
A. Toxic chemicals can kill, and hazardous chemicals can cause various types of harm.
   1. A toxic chemical can cause temporary or permanent harm or death to humans or animals.

   2. A hazardous chemical can harm because it is flammable or explosive or because it irritates or damages skin or lungs or induces allergic reactions.

   3. There are three major types of potentially toxic agents.
      a. Mutagens are chemicals or ionizing radiation that cause or increase the frequency of random mutations in the DNA molecules. It is generally accepted that there is no safe threshold for exposure to harmful mutagens.
      b. Teratogens are chemicals that cause harm or birth defects to a fetus or embryo. Alcohol and thalidomide are examples of teratogens.
      c. Carcinogens are chemicals or ionizing radiation that cause or promote cancer.

B. Chemicals disrupt the immune, nervous, and endocrine systems with long-term exposure to low doses of chemicals.
   1. The immune system consists of specialized cells and tissues that protect the body against disease and harmful substances. It forms antibodies that make invading agents harmless.
   2. Neurotoxins are types of poisons that attack the nervous system that consists of the brain, spinal cord, and peripheral nerves.

   3. The endocrine system is a complex glandular system that releases small amounts of hormones into the bloodstream of vertebrates. Low levels of these chemicals turn on and off bodily systems controlling sexual reproduction, growth, development, learning ability, and behavior.

C. Over the last 25 years, experts from a number of disciplines have analyzed information gained from many studies that indicate human-made chemicals can act as hormone or endocrine disrupters that disrupt the effect of natural hormones.
   1. Human-made chemicals known as hormonally active agents (HAAs) can act as hormone/endocrine disrupters.
2. These HAAS may disrupt human immune functions and may have adverse reproductive and developmental effects on vertebrates exposed to them. We do not know if they pose a threat to human health, even at low levels in the environment.

D. Existing laws consider chemicals benign unless the opposite is proved. Estimating toxicity is difficult, uncertain, and expensive.
1. The toxicity of most chemicals has not been determined.
2. Only 2% of the chemicals in commercial use have been adequately tested to determine whether they are carcinogens, teratogens, or mutagens.
3. 99.5% of commercially used chemicals in the U. S. are not regulated.
   a. Most chemicals are considered innocent until shown to be guilty.
   b. There are also not enough funds, personnel, facilities, and test animals available to provide information for all the chemicals we encounter in our daily lives.

E. The precautionary principle says that if there is plausible but incomplete evidence that a chemical/technology may cause significant harm, we should act to prevent/reduce its risk.
1. Two major changes in the way we evaluate risks would be:
   a. New chemicals and technologies would be assumed harmful until studies show otherwise.
   b. Existing chemicals and technologies that appear to have a strong chance of causing harm would be removed from the market until their safety is established.
2. The European Union agreed to a global treaty that would ban or phase out use of 12 of the most notorious persistent organic pollutants. This treaty went into effect in 2004.
3. There is controversy about whether this precautionary principle will stifle or promote research and new technology.

19-4 Biological Hazards: Disease in Developed and Developing Countries
A. Diseases not caused by living organisms do not spread from one person to another; those caused by living organisms can spread from person to person.
1. Non-transmissible disease tend to develop slowly, have multiple causes, are not caused by living organisms, and do not spread from one person to another. Examples are cancer, diabetes, asthma, malnutrition, and blood vessel disorders.
2. Transmissible disease is caused by a living organism and can spread from on to another. Infectious agents/pathogens are spread in air, water, food, and body fluids and by some insects and vectors.
3. The World Health Organization stated that about 30% of all deaths per year are caused by non-transmissible cardiovascular disease, 26% by transmissible infectious disease, and 12% by non-transmissible cancers.

4. An epidemiological transition usually occurs as a country industrializes. Incidence of infectious disease-caused deaths decreases and chronic diseases of adulthood increase.
5. Mixed news is that death from infectious diseases has decreased, but many bacteria have developed immunity to widely used antibiotics.

B. Bacteria can reproduce rapidly and can become genetically resistant to widely used antibiotics through natural selection.
1. The bacteria can transfer this resistance to nonresistant bacteria.
2. Human travel and trade spread bacteria rapidly across the globe.
3. Doctors overuse antibiotics.
4. The availability of antibiotics in many countries without a prescription makes them abundant.
5. Resistance to antibiotics has increased because of antibiotics being used in livestock and dairy animals to control disease and promote growth.
6. Overuse of pesticides increases pesticide resistant insects and other carriers of bacterial diseases.
7. Public pressure has caused some phasing out of antibiotic use in cattle.
8. We should focus on learning how to weaken the effects of infectious microbes by making them less virulent rather than trying to wipe them out.

Infectious Diseases:
C. Tuberculosis kills about 1.7 million people per year and infects about 9 million annually.
   1. Tuberculosis is a silent global epidemic, since many people do not know that they have been infected.

   2. Several factors account for the recent increase in TB:
      a. lack of screening, especially in developing countries,
      b. increased population growth and urbanization means greater contact between people,
      c. there are genetically resistant strains of TB to almost all effective antibiotics, and
      d. the spread of AIDS weakens the immune system and allows the TB bacteria to multiply.
   3. There must be early detection and treatment of people with active TB to slow the spread of the disease.

D. Viral disease is a great threat to people worldwide.
   1. The biggest killer is HIV, transmitted in a variety of ways. Globally, it infects at least 5 million people a year. The resulting complications from AIDS kill about 3 million people a year.
   2. Influenza virus is the second biggest killer from viral infection. It kills about 1 million people a year.

   3. The third largest killer is the hepatitis B virus (HBV) that damages liver and kills about 1 million people a year. It is transmitted by the same methods as HIV.
   4. Health officials are concerned about the emergence of Ebola, West Nile virus, and severe acute respiratory syndrome (SARS) in recent years.
   5. Vaccines are the best weapons against viruses. They stimulate the body’s immune system to produce antibodies to ward off viral infections.

E. A still rapidly growing health threat is the spread of AIDS which does not kill, but which leaves the body defenseless against infectious bacteria and other viruses.
   1. The WHO stated that by the beginning of 2004 there were 43 million people worldwide who were infected with HIV.
   2. Each day about 14,000 more people are infected with HIV.
   3. Within 7–10 years at least half of those with HIV develop AIDS, with most of them in the 15–24 age group and most in developing countries, especially in Africa south of the Sahara Desert.
   4. There is no vaccine for HIV and no cure for AIDS.
   5. Life expectancy in sub-Saharan Africa has dropped from 62 years to 47 years.
   6. The death toll to AIDS will reach 5 million a year by 2020, the same as losing one of every five people in the U.S.
   7. The WHO stated that five major strategies are needed to slow the spread of AIDS.
      a. Shrink the number of people capable of infecting others by quickly reducing the number of new infections below the number of deaths.
      b. Concentrate on the groups that are most likely to spread the disease such as truck drivers, sex workers, and soldiers.
      c. Provide free HIV testing.
      d. Use mass advertising and education for adults and school children.
      e. Provide free or low-cost drugs to slow the progress of the disease.

F. Malaria kills about 1 million people a year and is caused by a parasite that is spread by the bites of certain mosquitoes.
1. It is caused by four species of protozoan parasites in the genus *Plasmodium*.
2. The parasite circulates from mosquito to human and back to mosquito.
3. The cycle repeats until immunity develops or treatment is given or the victim dies.
4. During the 1950s and 1960s, malaria was curtailed by spraying and draining swamps and marshes, but most species of mosquito have become genetically resistant to insecticides and anti-malarial drugs.
5. In 2002, scientists announced that they had broken the genetic code for both the mosquito and the parasite that causes malaria. This could eventually lead to control of this organism.
6. Currently, prevention is the best method to control its spread. Methods include fixing leaking water pipes, using mosquito netting, cultivating fish that feed on mosquito larvae, planting trees that soak up water in marshy areas, and using zinc and vitamin A supplements to boost resistance in children.

G. We can sharply reduce incidence of infectious diseases if the world is willing to provide the necessary funds and assistance.
1. Death rates from infectious diseases in developing countries are unacceptably high.
2. Only about 10% of global medical research and development money is spent on infectious diseases in developing countries.
3. Research on antibiotics and vaccines has decreased because they are difficult and costly to develop and produce lower profits compared to medicines used for chronic diseases.
4. About one-third of the world’s people lack access to clean drinking water and sanitation facilities.
5. Children under five make up about 10% of the world’s population, but account for 40% of global illness.
7. To reduce the incidence of infectious disease, we now use oral rehydration therapy to replace water in victims of diarrheal diseases.

H. Bioterrorism that involves releasing infectious organisms into the air, water supply, or food supply is a serious and a growing threat.
1. Biological warfare agents are easy and cheap to produce in a small area.
2. Recombinant DNA techniques are used to produce more virulent, faster acting organisms, and they are resistant to antibiotics.
3. Many people now have the knowledge to make recombinant organisms, and some of these people live in poverty.
4. Biological weapons can be carried in small vials that are not detectable by any of the standard methods.
5. Scientists are experimenting with bees, beetles, moths, and crickets to see whether they can be used as environmental monitors of chemical and biological agents.
6. DNA detectors are also being developed to test for biological agents.

19-5 Risk Analysis
A. There are scientific ways to evaluate and compare risk, to decide how much risk is acceptable, and find affordable ways to reduce risk.
1. Risk assessment involves identifying hazards and evaluating their associated risks.
2. In terms of premature deaths per year and reduced life span, the greatest risk by far is poverty.
3. Reducing poverty would improve human rights, provide more people with income to stimulate economic development, and reduce environmental degradation and the threat of terrorism.
4. Avoidance of cultural hazards also improves longevity of life.

B. Estimation of risk for complex technology is difficult due to unpredictability of human behavior, human error, and sabotage.
   1. System reliability (%) = Technology reliability x Human reliability.

   2. One way to make a system more foolproof or failsafe is to move more of the potentially fallible elements from the human side to the technical side.
   3. Chance events can still cause problems.

C. The results of risk analysis are usually very uncertain. (FIGS. 19-17 & 19-18 KNOW)
   1. There are key questions involved in evaluating the reliability of risk analysis.
      a. How reliable are risk assessment data and models?
      b. Who profits and who suffers from letting harmful chemicals into the environment?
      c. Should estimates apply to short-term or long-term risks; who should decide this?
      d. Who should do a specific risk analysis, and who should review the results?
      e. Should the primary goal be to determine acceptable risk or to figure out a way to do the least damage?
      f. Should cumulative effects be considered, or should risks be considered separately?
      g. How widespread is each risk?
      h. Should risk levels be higher for workers than for the general public?
      i. What is the acceptable level of risk and to whom?

   2. There are advantages of risk analysis such as organizing and analyzing available scientific information and the identification of significant hazards.

   3. The results of risk analysis are often very uncertain. Regulators usually divide the best results by 100 to 1,000 to provide the public a margin of safety.

D. Risk management means answering the following questions.
   1. How reliable is the risk analysis for each risk?
   2. Which risks have the highest priority?
   3. How much risk is acceptable?
   4. How much is a life worth?
   5. How much will it cost to reduce each risk to an acceptable level?
   6. How should funds be spent to provide the greatest benefit?
   7. How will the risk management plan be monitored, enforced, and communicated to the public?

E. Most people are poor at evaluating their relative risks. That is because information is misleading, and people have irrational fears.

F. What factors distort our sense of risk, and how can we become better at evaluating risk?
   1. One factor is the degree of control we have.
   2. Another factor is fear of the unknown.
   3. If the risk is voluntary rather than forced, we will have a different view of the risk itself.
   4. The catastrophic or chronic nature of the risk will also influence our perception of it.
   5. Is the risk seen as unfair distribution of the danger, such as a nuclear power plants being built close to one’s home?
G. To become better at risk analysis, one must analyze, compare, and focus on risks from one’s individual lifestyle.
   1. Carefully evaluate what the media presents; it is often an exaggerated view of risks.
   2. Compare risks and evaluate the risk of an action compared to other risks.
   3. Concentrate on the most serious risks to life and health, and do not worry about the small risks and those over which you have little or no control.

Summary

1. Major types of hazards faced by humans include cultural, physical, chemical, and biological hazards.

2. Toxicology is the scientific field that measures the degree of harm a hazardous agent can cause. Scientists measure toxicity based on dosage, solubility, persistence, bioaccumulation, biomagnification, and chemical interactions.

3. Chemical hazards include agents that are flammable or explosive, damage or irritate lungs or skin, interrupt oxygen uptake, and cause allergies. Chemical hazards are defined by their toxicity, the person’s acute and chronic reactions to it, and its pervasiveness in the environment.

4. The types of disease threatening people in developing countries are primarily infectious diseases of childhood while those threatening people in developed countries tend to be chronic diseases of adults, such as heart disease, stroke, cancer, and respiratory conditions.

5. Risks can be estimated, managed, and reduced by identifying hazards, evaluating related risks (risk assessment), ranking risks (comparative risk analysis), determining alternative solutions, making decisions about reducing risks (risk management), and informing decision-makers about risk (risk communication).