CHAPTER 2 Essential Chemistry for Biology

Why This Chapter Matters

1. Many important biological questions can be reduced to aspects of chemistry.
2. Living organisms are, at their most basic level, chemical systems.
3. Understanding the chemical level of biology requires a basic understanding of chemistry.
4. Water's unique life-supporting properties can be traced to the structure and interactions of its molecules.

Chapter Objectives

Biology and Society: More Precious than Gold

1. Explain why water is precious to life and how droughts cause such damage.

Some Basic Chemistry

2. Distinguish between matter, chemical elements, and compounds. Give examples of each.
3. Explain the significance of trace elements to human health.
4. Describe the relative size, location, and electrical charge of protons, neutrons, and electrons within an atom. Explain how the atomic number and mass number are determined.
5. Define an isotope and explain how isotopes are used in biological research and medicine.
6. Explain how the location of electrons determines the chemical properties of an atom.
7. Distinguish between ionic, covalent, and hydrogen chemical bonds.
8. Describe the structure of water and explain how its shape makes water a polar molecule.
9. Write the chemical formula for the creation of water from hydrogen and oxygen. Identify the reactants and products of this reaction.

Water and Life

10. Describe the four life-supporting properties of water. Describe an example of how each property affects some form of life.
11. Describe the relationship between aerobic exercise and brain size.
12. Distinguish between the chemical properties of acids, bases, and neutral solutions. Explain how buffers stabilize the pH of acidic and basic solutions.
13. Describe the potential impact of rising levels of carbon dioxide on the pH of the ocean.

Evolution Connection: The Search for Extraterrestrial Life

14. Explain why the search for extraterrestrial life centers on the search for water.

Lecture Outline

I. Biology and Society: More Precious than Gold

1. A drought is
   - **a.** a period of abnormally dry weather that changes the environment and
   - **b.** one of the most devastating disasters.

2. Droughts can cause
   a. severe crop damage,
   b. shortages of drinking water,
   c. dust storms,
   d. famine,
   e. habitat loss, and
   f. mass migration.
3. Throughout human history, droughts have helped wipe out societies and even whole civilizations
4. Droughts are catastrophic because life cannot exist without water

II. Some Basic Chemistry

1. Take any biological system apart, and you eventually end up at the chemical level
2. Chemical reactions are always occurring in the human body

A. Matter: Elements and Compounds

1. **Matter** is anything that occupies space and has mass
2. Matter is found on Earth in three physical states:
   a. solid,
   b. liquid, and
   c. gas.
3. Matter is composed of chemical elements
   a. An **element** is a substance that cannot be broken down into other substances by chemical reactions.
   b. There are 92 naturally occurring elements on Earth.
4. All of the elements are listed in the periodic table
5. Twenty-five elements are essential to people
6. Four elements make up about 96% of the weight of most cells:
   a. oxygen,
   b. carbon,
   c. hydrogen, and
   d. nitrogen.
7. **Trace elements** are
   a. required in only very small amounts and
   b. essential for life.
8. An iodine deficiency causes goiter
9. Fluorine
   a. is added to dental products and drinking water and
   b. helps to maintain healthy bones and teeth.
10. Elements can combine to form compounds
    a. **Compounds** are substances that contain two or more elements in a fixed ratio.
    b. Common compounds include
       i. NaCl (table salt) and
       ii. H2O (water).

B. Atoms

1. Each element consists of one kind of atom
   - **a.** An **atom** is the smallest unit of matter that still retains the properties of an element.
2. The Structure of Atoms
3. Atoms are composed of subatomic particles
   - **a.** A **proton** is positively charged.
   - **b.** An **electron** is negatively charged.
   - **c.** A **neutron** is electrically neutral.
4. Most atoms have protons and neutrons packed tightly into the nucleus
   - **a.** The **nucleus** is the atom's central core.
   - **b.** Electrons orbit the nucleus.
5. Elements differ in the number of subatomic particles in their atoms
   - **a.** The number of protons, the **atomic number**, determines which element it is.
   - **b.** **Mass** is a measure of the amount of material in an object.
   - **c.** An atom's **mass number** is the sum of the number of protons and neutrons in its nucleus.
6. Isotopes
7. **Isotopes** are alternate mass forms of an element
8. Isotopes
   - **a.** have the same number of protons and electrons but
   - **b.** differ in their number of neutrons.
9. The nucleus of a **radioactive isotope** decays spontaneously, giving off particles and energy
10. Radioactive isotopes have many uses in research and medicine
    - **a.** They can be used to determine the fate of atoms in living organisms.
    - **b.** They are used in PET scans to diagnose heart disorders and some cancers.
11. Uncontrolled exposure to radioactive isotopes can harm living organisms by damaging DNA
    - **a.** The 1986 Chernobyl nuclear accident released large amounts of radioactive isotopes.
    - **b.** Naturally occurring radon gas may cause lung cancer.
12. Electron Arrangement and the Chemical Properties of Atoms
13. Of the three subatomic particles, only electrons are directly involved in the chemical activity of an atom
14. Electrons orbit the nucleus of an atom in specific electron shells
15. The farther an electron is from the nucleus, the greater its energy
16. The number of electrons in the outermost shell determines the chemical properties of an atom

C. Chemical Bonding and Molecules

1. Chemical reactions enable atoms to give up or acquire electrons, completing their outer shells
2. Chemical reactions usually result in atoms
   - **a.** staying close together and
   - **b.** being held together by attractions called **chemical bonds**.

3. Ionic Bonds
4. When an atom loses or gains electrons, it becomes electrically charged
    a. Charged atoms are called **ions**.
    b. **Ionic bonds** are formed between oppositely charged ions.
5. Covalent Bonds
6. A **covalent bond** forms when two atoms *share* one or more pairs of outer-shell electrons
7. Covalent bonds are the strongest of the various bonds
8. Covalent bonds hold atoms together in a **molecule**
9. The number of covalent bonds an atom can form is equal to the number of additional electrons needed to fill its outer shell
10. Hydrogen Bonds
11. Water is a compound in which the electrons in its covalent bonds are not shared equally
    a. This causes water to be a polar molecule, one with an uneven distribution of charge.
12. The polarity of water results in weak electrical attractions between neighboring water molecules
    a. These weak attractions are called **hydrogen bonds**.

D. Chemical Reactions

1. Cells constantly rearrange molecules by breaking existing chemical bonds and forming new ones
    a. Such changes in the chemical composition of matter are called **chemical reactions**.
    b. A simple example is the reaction between oxygen gas and hydrogen gas that forms water.
2. Chemical reactions include
    a. **reactants**, the starting materials, and
    b. **products**, the end materials.
3. Chemical reactions
    a. can rearrange matter
    b. but cannot create or destroy matter.

III. Water and Life

1. Life on Earth began in water and evolved there for 3 billion years
    a. Modern life remains tied to water.
    b. Your cells are composed of 70–95% water.
2. The abundance of water is a major reason Earth is habitable

A. Water's Life-Supporting Properties

1. The polarity of water molecules and the hydrogen bonding that results explain most of water's life-supporting properties
    a. Water molecules stick together.
    b. Water has a strong resistance to change in temperature.
    c. Frozen water floats.
    d. Water is a common solvent for life.
2. The Cohesion of Water

3. Water molecules stick together as a result of hydrogen bonding
    a. This tendency of molecules of the same kind to stick together is called **cohesion**.
    b. Cohesion is vital for the transport of water from the roots to the leaves of plants.
4. Surface tension is the measure of how difficult it is to stretch or break the surface of a liquid
    a. Hydrogen bonds give water an unusually high surface tension.
5. How Water Moderates Temperature
6. Because of hydrogen bonding, water has a strong resistance to temperature change
7. Heat and temperature are related, but different
    a. **Heat** is the amount of energy associated with the movement of the atoms and molecules in a body of matter
    b. **Temperature** measures the intensity of heat
8. Water can absorb and store large amounts of heat while only changing a few degrees in temperature
9. Water can moderate temperatures
    a. Earth's giant water supply causes temperatures to stay within limits that permit life.
    b. **Evaporative cooling** occurs when a substance evaporates and the surface of the liquid remaining behind cools down.
10. The Biological Significance of Ice Floating
11. When water molecules get cold enough, they move apart, forming ice
12. A chunk of ice has fewer water molecules than an equal volume of liquid water
13. Ice floats because it is less dense than liquid water
14. If ice did not float, ponds, lakes, and even the oceans would freeze solid
15. Life in water could not survive if bodies of water froze solid
16. Water as the Solvent of Life
17. A **solution** is a liquid consisting of a homogeneous mixture of two or more substances
    a. The dissolving agent is the **solvent**.
    b. The dissolved substance is the **solute**.
18. When water is the solvent, the result is an **aqueous solution**

B. The Process of Science: Can Exercise Boost Your Brain Power?
1. **Observation**: Human brains shrink as we age
2. **Question**: Can aerobic exercise slow or reverse brain loss?
3. **Hypothesis**: MRI scans will reveal differences between people who regularly exercised aerobically and those who did not
4. **Prediction**: Brains of active people shrink less than the brains of less active people
5. **Experiment**: Twenty-nine people in their 60s and 70s exercised for three one-hour sessions per week. A control group of 29 people engaged in non-aerobic stretching exercises for the same periods
6. **Results**: The aerobic group showed significant increases in brain volume compared to the non-aerobic group

C. Acids, Bases, and pH
1. A chemical compound that releases H^+ to a solution is an **acid**
2. A compound that accepts H^+ and removes them from solution is a **base**

3. To describe the acidity of a solution, chemists use the **pH scale**
4. **Buffers** are substances that resist pH change
5. Buffers
   a. accept H+ ions when they are in excess and
   b. donate H+ ions when they are depleted.
6. Increases in global CO_2 concentrations may lead to
   a. the acidification of the oceans and
   b. ecological disasters.

D. Evolution Connection: The Search for Extraterrestrial Life
1. If life similar to ours has evolved elsewhere in the universe, then it too would depend upon water
2. Researchers at NASA missions have found evidence that water was once abundant on Mars
3. Microbial life may exist below the Martian surface

Chapter Guide to Teaching Resources

Some Basic Chemistry

Student Misconceptions and Concerns

1. The dangers posed by certain chemicals in our food and broader environment often mislead people to associate “chemicals” with harm. People might not want “chemicals” added to their food or in their environment. Students often fail to appreciate the chemical nature of our bodies and our world and the potential harm or benefits of naturally occurring chemistry. They often fail to understand why “natural” does not necessarily mean “good.” (Consider presenting a long list of naturally occurring toxins to make this point.) Your class may benefit from a class discussion of these misconceptions about our attitudes toward “chemicals.”
2. Students with limited backgrounds in chemistry and physics might struggle with basic concepts of mass, weight, compounds, elements, and isotopes. It may also be early in the semester when mature study habits have not yet developed. Consider passing along basic studying advice and tips to help students master these early chemistry concepts. In-class quizzes (graded or not) or a few homework problems will also provide reinforcing practice.
3. The half-lives of many radioactive substances, especially those used for dating fossils, might lead some students to expect very long periods of decay for any radioactive substance. This might even be alarming if students are someday asked to consume a radioactive substance for a medical test. However, some medically significant isotopes have relatively short half-lives. Radioactive iodine-131 is often used to diagnose or treat certain thyroid problems. Its half-life of 8 days means that it will decay quickly.

Teaching Tips

1. Students might be interested in the following aside: One of the challenges of raising captive, exotic animals is meeting the unique dietary requirements of the species. A zoo might have trouble keeping a particular animal because science has not fully determined what trace elements the animal requires.

2. Many breakfast cereals are fortified with iron. A person can crush the cereal and extract distinct iron particles with a magnet. An overhead projector or video imagining device should clearly reveal the iron particles stuck to the magnet. This short practical demonstration can help connect an abstract concept to a concrete example.
3. Students with limited backgrounds in chemistry will benefit from a discussion of Figure 2.7 and the differences and limitations of diagrams of atomic structures. The contrasts in Figure 2.7 are a good beginning of such a discussion.
4. Here is a comparison that helps make the point about the differences in mass of protons and electrons. If a proton is as massive as a bowling ball, an electron will be the mass of a Life Saver candy. (This is calculated by considering a 15-pound bowling ball, a Life Saver with a mass of 0.12 ounces, and the textbook's formula that an electron is 1/2,000 the mass of a proton.)
5. Here is an analogy regarding the size of a helium atom. If a helium atom were the size of Yankee Stadium, the nucleus would be about the size of a fly in center field, and the two electrons would be like tiny gnats buzzing around the stadium. This analogy helps to relate the great distances between parts of an atom. Consider modifying the analogy to any local stadium in your region.
6. After sharing teaching tips 4 and 5 above, consider asking your students to compare the mass of the gnat orbiting Yankee Stadium to the mass of the fly in center field. If a proton or neutron is about 2,000 times more massive than an electron, how does the mass of a helium nucleus compare to the mass of one of its electrons?
7. Have your students try to calculate the number of covalent bonds possible for a variety of atoms. Then provide the students with a list of elements and the number of outer electrons for each and have them make predictions about the chemical formula for many types of molecules.
8. Consider challenging your students to suggest relationships in human lives that are analogous to each of the three types of chemical bonds (covalent, ionic, and hydrogen). Evaluating the accuracy of potential analogies requires careful analysis of the chemical bonding relationships and practices critical thinking skills. Small groups might provide immediate critiques before passing along analogies for the entire class to consider. The following is one example.

   Ionic and covalent bonds are different types of relationships. Consider this analogy. A woman taking out a loan has a specific relationship to her bank. She owes the bank money, something she got from the bank. A man shares an office with another man. Both look out the same window and answer the same phone. Ionic bonds are like a bank loan, in which something is borrowed. Covalent bonds are like sharing an office, with items (electrons) shared by both members of the relationship. After presenting this analogy, ask your students to modify the office analogy to represent a polar covalent bond. (Perhaps one man in the office sits closer to the window and the phone.)
9. As noted in the text, chemical reactions do not create or destroy matter. Instead, they rearrange the structure and form new relationships. This is much like shuffling and dealing cards. When playing poker, cards are not created nor destroyed. Instead, new combinations are formed as the cards are dealt to the players.

Water and Life

Student Misconceptions and Concerns

1. Students are unlikely to have carefully considered the four special properties of water that are apparent in our lives. However, these properties are of great biological significance and are often familiar. The connections between these properties and personal experiences can invest great meaning into a discussion of water's properties. A homework assignment asking for three examples of each of these properties in each student's experiences will require reflection and potentially produce meaningful illustrations. Similarly, quizzes or exam questions matching examples of each property to a list of the properties requires high-level evaluative analysis.
2. Students at all levels struggle with the distinction between heat and temperature. Students might also expect that all ice is about the same temperature, 0°C. Redefining and correcting misunderstandings often takes more class time and energy than introducing previously unknown concepts.

Teaching Tips

1. Here is a way to have your students think about the "sticky" nature of water in their lives. Ask them to consider the need for a towel after a shower or a bath. Once we get out of the shower or bath, we have left the source of water. So why do we need the towel? The reason we need a towel to dry off is that water is still clinging to our bodies because water molecules are polar. The molecules on cell surfaces are also polar, so our skin and the water both "stick" to each other.
2. Some students may be intrigued if you tell them that you too can stand on the surface of water—*when it is frozen*. Thus, it is necessary to note a liquid water surface when talking about surface tension.
3. Have students compare the seasonal ranges of temperatures of Anchorage and Fairbanks, Alaska. (Many websites provide weather information about various cities.) These two northern cities have large differences in their annual temperature ranges. Make the point that the coastal location of Anchorage moderates the temperature.
4. Several versions of the following analogy are easy to relate to students. (a) Ask students how the average on an exam would be affected if the brightest students did not take the test. (b) The authors note that the performance of a track team would drop if the fastest sprinters didn't compete. In both analogies, removing the top performers lowers the average just as the evaporation of the most active water molecules cools the evaporative surface.
5. "It is not the heat, it is the humidity." The efficiency of evaporative cooling is affected by humidity. As humidity rises, the rate of evaporation decreases, making it more difficult to cool our heat-generating bodies on a warm and humid summer day.
6. Ask your students if the ocean levels would change if ice did not float or if all the floating ice in the oceans were to melt. They can try this experiment to find out. Place several large chunks of ice in a glass and fill the glass up completely with water to the top rim. Thus, the ice cubes should be sticking up above the top of the filled glass. Will the glass overflow when the ice melts? (No.) This phenomenon is important when we consider the potential consequences of global warming. If floating glaciers melt, ocean levels will not be affected. However, if the ice over land melts, we can expect increased ocean levels.

7. Challenge students to think of other consequences from the expansion of water when it forms ice. (These include the ability to widen cracks in rocks, roads, and sidewalks!)
8. A simple demonstration of a solute dissolving in a solvent can focus students' attention on the process when discussing solutions. Using colored water and white sugar or salt may make it easier to see and reference while you are discussing the process. Such simple visual aids add life to a lecture. (You might also add corn oil to the top of the solution to demonstrate the properties of hydrophobic substances, and challenge your class to explain why oil and water do not mix.)
9. Discussions of pH are enhanced by lab activities that permit students to test the pH of everyday items (foods and household solutions). If students do not have opportunities to conduct such tests in lab, consider testing a few items during your class (pH paper or a basic pH meter will, of course, be necessary).
10. The Environmental Protection Agency website www.epa.gov/acidrain/ includes good information about acid precipitation and teaching ideas.
11. The SETI (Search for Extraterrestrial Intelligence) Institute's Mission is "to explore, understand and explain the origin, nature, and prevalence of life in the universe" (www.seti.org). Your students might enjoy exploring this respected scientific organization.

Key Terms

acid	compounds	isotopes	products
aqueous solution	covalent bond	mass	proton
atom	electron	mass number	radioactive isotope
atomic number	elements	matter	reactants
base	evaporative cooling	molecule	solute
buffers	heat	neutron	solution
chemical bonds	hydrogen bonds	nucleus	solvent
chemical reactions	ions	pH scale	temperature
cohesion	ionic bond	polar molecule	trace elements

Word Roots

aqua = water (aqueous: a type of solution in which water is the solvent)

co = together; **valent** = strength (covalent bond: an attraction between atoms that share one or more pairs of outer-shell electrons)

electro = electricity (electron: a subatomic particle with a single unit of negative electrical charge)

iso = equal (isotope: an element having the same number of protons and electrons but a different number of neutrons)

neutr = neither (neutron: a subatomic particle with a neutral electrical charge)

Relevant Songs to Play in Class

"Neutron Dance," Pointer Sisters

"Better Living Through Chemistry," Queens of the Stone Age

"Meet the Elements," They Might Be Giants

"Chemistry," Rush

"Opposites Attract," Paula Abdul

Answers to End-of-Chapter Questions

The Process of Science

11. Suggested answer: Allow an animal to breathe radioactively labeled oxygen. After the animal has had ample time for aerobic respiration, test the carbon dioxide and water in the exhaled gases to see where the labeled oxygen is found. The primary location of the radioactively labeled oxygen should be in the water molecules formed during aerobic respiration.

12. Suggested answer: These two atoms would form an ionic bond. The potassium atom would donate an electron to the fluorine atom. As a result of this transfer of electrons, each atom would complete its outer electron shell and be chemically stable. However, they would become ions and therefore attract each other, resulting in an ionic compound otherwise known as a salt.

Biology and Society

13. Do chemicals produced by human technology differ from naturally occurring substances? If so, how?

Suggested answer: A molecule of sugar, water, or carbon dioxide is the exact same whether or not it was made by a plant, animal or in a factory. They are made by the same elements regardless of the molecule's origin. However, a potential problem may be contaminants from industrial cleaners found in highly processed food. Also, some processed foods may contain high amounts of fructose or trans fats that are not as healthy as naturally occurring foods that have more nutrients

14. Some issues and questions to consider: What chemicals are in the coal being burned? How does burning the coal affect the chemicals (or what type of chemical reactions are taking place); what types of new chemicals are formed? How are these chemicals harmful to the environment? Which is less expensive, power from nuclear power plants or power from fossil-fuel plants? Does the price of electricity from nuclear versus coal fired plants reflect its actual cost, including environmental costs?

Which would be more harmful: the environmental effects of acid precipitation, ocean acidification, coal mining, and global warming from fossil-fuel power plants or the effects of nuclear wastes and potential nuclear accidents? What are the environmental impacts of mining coal or uranium; which one has more environmental impacts? How do we dispose of the waste from nuclear power plants and coal plants?

Additional Critical Thinking Questions

The Process of Science

1. The atomic number for chlorine is 17 and the atomic number for potassium is 19. Draw electron shell diagrams for each atom. Predict what would happen with the electrons if a chlorine atom and a potassium atom came into contact. What kind of bond do you think they would form?

Suggested answer: Chlorine needs 1 electron for a full outer shell of 8, and if potassium loses 1 electron, its outer shell will have 8. Potassium will lose an electron (becoming a positive ion), and chlorine will pick it up (becoming a negative ion). The oppositely charged ions will attract to each other and form an ionic bond.

2. A newspaper headline reads "Acid Precipitation Not a Threat." The article states that the city's air pollution control board has been monitoring sulfur oxides and nitrogen oxides in the air and recording the pH of precipitation for the past five years. Air samples have been collected daily at two sites: at the busiest downtown intersection and at the entrance to a privately owned electrical power–generating station. On most days, the power station is downwind from the downtown area. Over the period studied, sulfur oxides and nitrogen oxides have increased at both sites, with the power station always having higher levels than the downtown site. However, at no time in the past five years have any of the pollutant levels exceeded the nationally acceptable standards. Moreover, the pH of precipitation has remained essentially the same (slightly acidic) at both monitoring sites throughout the period. City officials have concluded that there is no immediate reason for alarm, that acid precipitation has not been a problem, but that monitoring should continue. The news article, however, goes on to point out that not everyone agrees with the city officials. One resident living 10 miles outside the city is quoted: "The trees on our streets and in our yards are dying from acid precipitation. Five years ago, all our trees were healthy, but we've lost a dozen in this neighborhood in the past two years. We're directly downwind from that power plant, and I know acid rain killed my trees. My neighbors and I are going to sue the power company for losses."

Do you think these residents have the scientific evidence needed to win their lawsuit? Why or why not? Would they have a clear-cut case if a monitoring site had been set up in their neighborhood and data collected there showed an increase in acid precipitation during the five-year period? If the residents hired you as a scientific consultant, what advice would you give them?

Suggested answer: The situation is complex, and the residents' case seems to be weak, at best. Assuming they are downwind from the city and the power plant, their air might be more polluted and their precipitation more acidic than air sampled at either collection site; however, there seems to be no evidence backing their claim. Evidence from sampling stations suggests that the city and the power plant are adding pollutants to the air, but there is no indication that the added pollution is causing acid precipitation. If samples collected at a monitoring station in the residents' neighborhood showed an increase in acid precipitation, the residents' case might still be weak (they could not tell if the power plant was the main source of pollutants if their air comes from both the city and the power plant). Also, the courts might not view the residents' air pollution problem as serious unless the pollutant levels in their air exceeded national standards. Where would you place sampling stations to get the best idea of the source of air pollutants? Would the residents' case be strengthened if they discovered that the power plant monitoring station was not downwind from the city or that for three of the five years, the wind actually blew in the other direction most days and nights? A scientific consultant might initially suggest a study to determine if other air pollutants, infectious diseases, insects, groundwater pollution, or other factors are responsible for the tree deaths. Would eliminating these factors as causative agents strengthen the acid precipitation case? Are the nationally accepted standards of pollutants based on what is safe for humans or for nature (nutrient concentrations for drinking water are based on consumption; however, higher nutrient concentrations in water that is safe for drinking can have large effects on freshwater communities. The pH of a soda is safe for consumption but is acidic enough to kill many species of plants and animals.

Biology and Society

3. Many communities add fluoride to the drinking water supplies because of the ability of fluoride to bond with tooth enamel and prevent cavities, which are holes in the enamel caused by bacteria in the mouth. Fluoride is a negatively charged ion formed when a salt (such as sodium fluoride) is added to water. A tin salt, stannous fluoride, is a common ingredient in toothpaste. Is your water supply fluoridated? If you were choosing whether or not to drink fluoridated water, what questions or concerns would you have before making your decision?

Some issues and questions to consider: How strong is the evidence that fluoride reduces the rate of cavities in treated populations? What is the evidence that adding fluoride to the water supply is safe? Is there data suggesting that fluoride can have damaging effects on the body? If you discover some of these effects, keep in mind the importance of the concentration of the fluoride tested. How high is the fluoride concentration in fluoride-supplemented water? Since fluoride salts are a significant part of Earth's crust, small amounts of fluoride are found in all groundwater. What is the range of normal concentrations found throughout the country? How does this concentration compare to the amount added artificially? Since fluoride's effect is on the teeth, could applying fluoride directly to the teeth rather than ingesting it in the water be safer?

4. Considering the number of cases of food-borne illness each year, some people (including the U.S. Food and Drug Administration, FDA) have suggested that the irradiation of food is a solution to decreasing illness and death from contaminated foods. In addition, thisSS process helps to extend shelf life and prevent spoilage of perishable foods. During the process, foods are exposed to various types of radiation. This radiation damages and kills any cells that might be living on the surface (such as bacteria). Some people are against the use of irradiation without ever really understanding how the process works. Would you be willing to eat foods that have been irradiated? Should these foods have to be labeled as irradiated? Would you be willing to pay more for these products?

Some issues and questions to consider: Consider the lengthy history of testing irradiation on foods and the current use of radiation on spices. Do irradiated foods become radioactive? Is there any health risk associated with eating these products? Is the expense warranted? How much more will irradiated foods cost? Should the food be labeled to give consumers a choice? Will irradiated foods actually decrease illness and death from contaminated foods?

