

CHAPTER 1

Science and the Environment

Chapter Outline:

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 - 2. Is It All Good?
 - B. Ecosystem Goods and Services
 - 1. Patterns of Resource Consumption
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 - 3. Paradox Resolved?
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 - 1. Monitoring Carbon Dioxide and Its Effects
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Learning Objectives:

1. The State of the Planet: Explain the main reasons for concern about the health of our planet today. Describe what the environmental movement has achieved in recent years, and explain how environmental science has greatly contributed to the environmental movement.
2. Sustainability: Define sustainability and explain ways in which our relationship with the environment needs to be more sustainable.
3. Sound Science: Explain the process of science, how the scientific community tests new ideas, and contrast sound science with junk science, with examples.
4. Stewardship: Define the principle of stewardship and give examples.
5. Moving Toward a Sustainable Future: Identify trends that must be overcome in order to pursue a sustainable future and trends that promote sustainability.

Instructional Goals:

1. Environmental issues are complex. We need to study environmental issues from the perspective of economics, sociology, anthropology, and many other disciplines, which help to explain the problems with which we are faced.
2. Science is a necessary component of environmental decision making. For the science to be useful it must be sound, and sound science involves scientific peer review.
3. Earth is a finite system, and creating a sustainable lifestyle should allow for indefinite continuation of the human species. Stewardship is the actions and programs that manage natural resources and human well-being for the common good. Sound science is the best method for achieving sustainability and for humans to understand our stewardship role.
4. Environmentalism and environmental problems are not new. Environmental problems caused by human activities have occurred since the dawn of agriculture. The current wave of environmentalism began in 1962 with the publication of *Silent Spring* by Rachel Carson, but its roots can be traced to the 19th century.

Concepts and Connections:

Environmental science is a multidisciplinary field. It is not possible to understand and solve environmental problems when the problems are viewed from a narrow or single disciplinary focus. Discussing the possible contributions from various fields would help draw in students whose primary interests are not the sciences and would help science majors understand the true complexity of environmental science. It is possible to improve how humans interact with our environment from almost any field. Anthropology, archaeology, sociology, psychology, and other disciplines that explore how and why people act help a multidisciplinary environmental team determine the most effective way to educate or motivate people to act in environmentally sound ways. Economists and others involved in business decisions influence the quality of the environment around us; many are working to make business decisions “green.” Those individuals who transmit culture—actors, writers, musicians—convey values. The values conveyed include how the natural world is perceived and how we should relate to it. Teachers have a special role because they not only transmit concepts (facts) but they also transmit society’s values.

Putting the environmental movement in historical context can be very important. Most students think that the current problems are the most severe and may be very upset that adults have not “fixed” these problems. A

discussion of success (and failure) stories can be useful. Knowing that people who lived more than 100 years ago cared strongly about the environment can be motivating. Double-edged stories such as John Muir's struggle to save the Hetch Hetchy Valley near Yosemite can be both heartbreaking (because he did not succeed) and enlightening because Muir is an inspiring individual. Another double-edged story involves the first Clean Air Act. To solve the problem of locally high levels of air pollution, the law required the building of tall smokestacks that moved the pollutants to the upper atmosphere, resulting in acid precipitation in areas very far from the pollutant source. We solved the problem of locally severe air pollution, which caused periodic increases in death rates, but moved the problem to places distant from the pollution source. This latter example can be used to demonstrate the need to think through the effects of an action. We may be able to avoid future problems if we try to envision the downstream events that may flow from a decision.

Concepts in Context:

The first chapter is a survey of many of the environmental issues to be covered and the context (sustainability, sound science, and stewardship) in which they will be discussed. We also discuss the historical perspective and the bias and misrepresentations of junk science.

Key Terms and Vocabulary:

Environmentalist's paradox, Human Development Index (HDI), Millennium Development Goals (MDGs), Sustainable Development Goals (SDGs), global climate change, greenhouse effect, mitigation, biodiversity, environmental science, environmental movement, sustainability, sound science, stewardship, sustainable yield, sustainable society, sustainable development, development, equity, scientific method, junk science, observation, model, experimentation, hypothesis, null hypothesis, theory, natural laws, concepts, National Academies of Science (NAS), environmental justice movement, environmental racism

Discussion, Activities, and Labs:

1. Ask the students to name local environmental controversies. At the same time ask if they know of any local environmental problems that have been resolved; it is important for students to see that there is a continuum between the past and the present. Make two lists of all the suggestions on the board. If they do not have many suggestions, broaden the question to include state, national, and/or international issues. Some examples of national-level environmental problems that have been resolved include (1) Air quality: the reduction of lead emissions as a result of the elimination of lead in gasoline, (2) Water quality: the Cuyahoga River, and other rivers, no longer catch on fire, (3) Solid waste: recycling of solid waste is widespread, and (4) Pesticides and hazardous materials/wastes: DDT and most of the persistent organic pollutants are phased out or will be soon.
2. Begin with asking the students to suggest systems (processes) within our society that are sustainable. Have the students provide a justification for why each suggested system (process) is sustainable. Next ask the students to suggest systems within our society that are not sustainable. Have the students provide justification for why the suggested system (process) is not sustainable. Finally, ask the students to summarize the information about sustainable and non-sustainable processes in our society and justify a conclusion about the overall sustainability of our society.
3. Ask the students to suggest examples of sound and junk science. Write all the suggestions on the board, making two lists. If a student suggests an example of sound science but the example is junk science, then put the suggestion within parentheses and discuss as many of these as time allows after the suggestions have ended. Do not interrupt the suggestions to discuss incorrectly placed suggestions.

4. Divide the class into small groups (three to four students). Give each group a small consumer item (e.g., paper bag, plastic bag, electric hair dryer, toothbrush, disposable pen, disposable razor, or reusable razor). Ask the students to first decide if the item is essential for human survival. (None of the items in my list are essential. None are food, shelter, or clothing.) Then ask the students to list the questions they would like to have answered so that they can decide the environmental impact of their item.

Take time before the end of class to bring the groups back together and have each group report on their conclusion concerning whether or not the consumer item is essential for survival and their list of questions. After the students have reported their findings, discuss the difference between needs (essential for survival) and wants (perceived to make life easier, more pleasant, and so forth). Discuss how every item used by humans will have some environmental impact. The goal is to reduce an individual's impact.

5. As a follow-up to the in-class activity, ask the students to go home and evaluate their food, clothing, and shelter. Much of what we describe as food, clothing, and shelter falls within the category of want, not need. Have students list ten items that are wants (these can include the nonessential food, clothing, or shelter items) that are most important to them. A sentence or two should accompany each item explaining why this item is important. Have students list five items they have that they could live without. A sentence or two should accompany each item explaining why this item was chosen.

Suggested Lecture Format

- I. What Is the Real State of the Planet?: A paradox is “A statement exhibiting contradictory or inexplicable aspects or qualities.”
 - A. Population Growth and Human Well-Being: With the human population expanding rapidly, how will we use the Earth's resources responsibly enough to take care of all of the people who will live here?
 1. Human Development Index: “A comprehensive assessment of human well-being in most countries of the world.”
 2. Is It All Good?: Even though most countries have improved in recent years, many inequalities still exist.
 - B. Ecosystem Goods and Services: Are our natural resources being managed well?
 1. Patterns of Resource Consumption: Not all people use the same amount of resources.
 2. Measuring Ecosystem Health: A Huge Undertaking: “To protect ecosystem goods and services for future generations, we need to know what they are, how they are being used, and what is happening to them.”
 3. Paradox Resolved?: Hypotheses have been proposed to help explain why human well-being has been improving despite the fact that the Earth's systems have not.
 - C. Global Climate Change: “Every day in 2013 we burned some 91.3 million barrels of oil, 324 billion cubic feet of natural gas, and 11.6 million tons of coal.”
 1. Monitoring Carbon Dioxide and Its Effects: Increases in the levels of carbon dioxide in the atmosphere can affect temperatures.
 2. Responses: “Most observers believe that the best course forward is to aim toward an effective, binding international treaty to reduce emissions.”
 - D. Loss of Biodiversity: “Once a species is gone, it is gone forever. Finding ways to protect the planet's biodiversity is one of the major challenges of environmental science.”
 - E. Environmental Science and the Environmental Movement: “The environment includes the natural world, human societies, and the human-built world; it is an extremely inclusive concept.”

1. Environmental Science: Discuss examples of historical environmental movements.
 2. The Early Environmental Movement: Discuss leaders in the modern environmental movement and the results of their work, including Rachel Carson's work *Silent Spring*, which resulted in the movement to reduce exposure to a wide variety of chemicals; chemistry was no longer seen as only beneficial.
 3. The Modern Environmental Movement: Discuss current environmental issues then tie them back to the issues mentioned by the students before you began the historical-context discussion.
- II. Sustainability: Use **Discussion Topic #2** to discuss sustainability and its meaning.
- A. Sustainable Yields: Forestry and fisheries; trees and fish, and other biological species that we can normally use and use sustainably.
 - B. Sustainable Societies: What global trends are the results of not having a sustainable society?
 - C. Sustainable Development: Like sustainability, the definition of sustainable development differs by perspective. It is important to uphold sustainable development as an ideal, or goal toward which all human societies should be moving.
 - D. An Essential Transition: There is broad agreement on the necessity of the following changes: 1) a demographic transition from a continually increasing human population to one that is stable; 2) a resource transition to an economy that is not obsessed with growth, but instead relies on nature's income and protects ecosystem capital from depletion; 3) a technology transition from pollution-intensive economic production to environmentally friendly processes; 4) a political/sociological transition to societies that embrace a steward-like and just approach to people's needs and that eliminate large-scale poverty; 5) a community transition from the present car-dominated urban sprawl of developed countries to the "smart growth" concepts of smaller, functional settlements and more livable cities.
- III. Sound Science: Science seeks to acquire and explain factual knowledge, not just belief and opinion. Science restricts itself to considering objects and events that can be observed in an objective way. While religion, ethics, emotions, and so on are important, they cannot be observed in an objective fashion so they are outside the realm of science.
- A. The Scientific Method: A process to gain knowledge; a hierarchical ordering of knowledge from innumerable observations to a few universal natural laws.
 - B. The Scientific Community: "The process of science and its outcomes take place in the context of a scientific community and a larger society. There is no single authoritative source that makes judgments on the validity of scientific explanations."
 1. Professional Societies: "Scientists also operate through professional societies."
 2. Disagreements: Even though the scientific community uses checks and balances, sometimes disagreements over data and conclusions still arise.
 3. Junk Science: Does not conform to the rigors of sound science (because it doesn't undergo the peer-review process) and it usually includes the selective presentation of desired results. **See Discussion Topic #3.**
 4. Evaluating Issues: What are the observations underlying the conclusion or explanation? Can they be satisfactorily confirmed?
- IV. Stewardship: "The actions and programs that manage natural resources and human well-being for the common good."

- A. Who Are Stewards?: How does one become a steward of the environment?
 - B. Justice and Equity: Define environmental racism and ask the students if they know examples of environmental racism.
- V. Moving Toward a Sustainable Future: It is important to recognize globalization and to be honest about its impacts, both good and bad, for the environment.
- A. Social Changes: Examples include the Internet, preferential trade, and transitional corporations.
 - B. Environmental Changes: Examples include more ecosystem-friendly products; the rapid spread of diseases like SARS, H1N1, and AIDS; and the global dispersion of exotic species.
 - C. A New Commitment: It is not business as usual. Food production has improved nutrition, there is an increased life expectancy, and population growth has slowed. There is also an increasing environmental awareness.

Review Questions: Possible Answers

1. *What information made Rachel Carson concerned about chemical pollution?*

The widespread use of pesticides and herbicides on “crops, forests, and towns and cities,” especially the use of the pesticide DDT, were concerning to Rachel Carson and provided an impetus for the research that led her to write *Silent Spring*.

2. *What is the paradox of human population and well-being?*

The environmentalist's paradox refers to the observation that human well-being appears to be increasing while the health of ecosystems has been declining. As human population numbers increase (a seemingly positive thing for the human population), the repercussions for the ecosystems that support humans are dramatic.

3. *Cite four global trends that indicate that the health of planet Earth is suffering.*

“Four global trends are particularly unhealthy: (1) increasing population growth and its detrimental effects on human well-being, (2) a decline of vital ecosystem services, (3) the negative impacts of global climate change, and (4) a loss of biodiversity.”

4. *Define environment, and describe the general development and successes of modern environmentalism.*

The word environment is a broad term and it describes the natural world, human societies, and the human-built world. When the frontier “closed” in the late 19th century, people realized that unique wild areas were disappearing. Different groups formed to help popularize the idea of wilderness and preservation of lands. A second wave came after the Dust Bowl and during the Great Depression with the CCC and others. After WWII a technology explosion caused economic (and population) expansion, which led to many environmental problems. New chemicals led to the decline of bird populations. Rachel Carson’s book and others led to the modern environmental movement. A more militant population demanded decreased pollution and increased cleanup. It was a grassroots movement as opposed to a governmental or official one. New groups formed and old ones found new members and new help. Many laws were passed in the late 1960s and the 1970s, such as the Clean Air and Clear Water Acts. The EPA was also founded. From there all kinds of things happened, depending on the issues, the government, and the people.

5. *What are the concepts behind each of the three unifying themes—sound science, sustainability, and stewardship?*

Sound science is based on the rigors of the methods and practice of legitimate science. This means years of observation, experimentation, and peer review are behind it. Sound science involves an approach to understanding how the natural world works, an approach that has become known as the scientific method. Careful observation is of utmost importance. Solutions to environmental problems should not be implemented without sound science behind them.

Sustainability is a system or process that can be continued indefinitely, without depleting any of the material or energy resources required to keep it running. A solution to any problem isn't useful if it costs too much money to keep doing, uses too many resources, impairs people's ability to work well and live decently, or puts many companies out of business and people out of work. For example, a decree that no more rain forests can be cut is not sustainable unless a way for the indigenous people to survive and live a decent lifestyle can be found to replace their previous livelihood of slash-and-burn agriculture. Mandating that all farms are organic and pesticide free is unsustainable if the crop is lost to locusts or other pests year after year. If a system is to be sustainable, it also has to be well thought out and in balance. Like sound science, solutions to environmental problems should not be implemented unless they are sustainable.

Stewardship ties these together. It is the actions and programs that manage natural resources and human well-being for the common good. Stewards are those who care for something—from the natural world or from human culture—that they do not own and that they will pass on to the next generation. Modern-day environmental stewardship, therefore, incorporates an ethic that guides actions taken to benefit the natural world as well as people. Like the other two concepts, environmental solutions should include stewardship as an impetus. We only have one planet, and we have to share it with the present population and future populations as well.

6. *Explain the role of assumptions, observation, experimentation, and theory formation in the operation of scientific research and thinking.*

Most scientific theories, laws, facts, etc., began with observations and assumptions. A simple example is no matter how far you put something into the air, it always falls to the ground—this eventually led to the Law of Gravity. People assumed if they let go of something, it would fall. These observations and assumptions lead to experimentation and conclusions. Conclusions become a theory only after much testing and confirmation that it is logically consistent with all observations—and there is always the possibility that new information or better observation techniques (such as better microscopes or telescopes) will lead to new theories. It is sometimes more informative if a hypothesis is proven wrong than if the data seems to show it is correct. Through logical reasoning, theories will generally suggest or predict certain events. If an event predicted by a theory is observed, the observation provides strong evidence for the truth of the theory. Predictions require experiments, testing, further data gathering, and more observation. Theories or concepts are perfectly valid explanations of data gathered from the natural world, and they can also be predictive: they model the way we believe the natural world works and enable us to make qualified predictions of future outcomes. For example, if we know that PCBs have a half-life of hundreds of years, we can predict that they will be in the Great Lakes and food chains long after we are gone. Scientific thinking and research requires data, quantification, accurate observations, and experimentation.

7. *Cite some reasons for the existence of controversies within science, and carefully distinguish between sound science and junk science.*

“There [are] at least four reasons” for controversies in science. First, “we are continually confronted by new observation . . . [and it] takes some time before all the hypotheses regarding the cause of what we have observed can be adequately tested. During this time, there may be honest disagreement as to which hypothesis is most likely. Such controversies are gradually settled by further observations and testing. . . .” Second, we are looking at complex phenomena that “do not lend themselves to simple tests of experiments. . . . Gradually, different

lines of evidence come to support one hypothesis and exclude another, enabling the issue to be resolved.” Third, “there are many vested interests which wish to maintain and promote disagreement because they stand to profit by doing so.” Last, “subjective value judgments may be involved.”

Sound science has the scientific method behind it. Assumptions and hypotheses have been tested over and over and over, and papers have been reviewed by peers before being published. Historic sciences such as astronomy and geology have many careful observations and measurements that are repeated over and over. Junk science does not conform to the rigors of science. It picks only the observations or results that “prove” its point. The material may be published but not in recognized peer-reviewed journals.

8. *Define sustainability and sustainable development. What is a sustainable society?*

“A system or process . . . that can be continued indefinitely, without depleting any of the material or energy resources required to keep it running.” By this definition, it would be impossible to run a modern society on fossil fuels. (The rate at which fossil fuels are created is so slow that almost any rate of use would exceed the rate of creation.)

“A sustainable society is a society in balance with the natural world.” It is possible for a sustainable society to continue indefinitely because it does not deplete its resource base or produce pollutants in excess of nature’s ability to absorb/process them.

9. *List five transitions that are necessary for a future sustainable civilization.*

There is broad agreement on the following major points:

- A demographic transition from a continually increasing human population to one that is stable.
- A resource transition to an economy that is not obsessed with growth, but instead relies on nature’s income and protects ecosystem capital from depletion.
- A technology transition from pollution-intensive economic production to environmentally friendly processes.
- A political/sociological transition to societies that embrace a stewardly and just approach to people’s needs and that eliminate large-scale poverty.
- A community transition from the present car-dominated urban sprawl of developed countries to the “smart growth” concepts of smaller, functional settlements and more livable cities.

10. *Describe the origins of stewardship and its modern applications.*

“Stewardship is a concept that can be traced back to ancient civilizations. A steward was put in charge of the master’s household, responsible for maintaining the welfare of the people and the property of the owner. Because a steward did not own the property himself, the steward’s ethic involved caring for something on behalf of someone else.”

“Applying this concept to the world today, stewards are those who care for something—from the natural world or from human culture—that they do not own and that they will pass on to the next generation. Modern-day environmental stewardship, therefore, incorporates an ethic that guides actions taken to benefit the natural world and other people. It recognizes that even our ownership of land is temporary; the land will be there after we die, and others will own it in turn. Stewardly care is compatible with the goal of sustainability, but is different from it, too, because stewardship deals more directly with how sustainability is to be achieved—what actions are taken, and what values and ethical considerations are behind those actions.”

11. *Give an example of environmental injustice.*

Several examples of environmental injustice were given in this chapter. Students may refer to international trade (discrimination against developing countries via taxes and restricting imports), placement of waste sites, and the disproportionate distribution of improvements to white areas of a city or country.

12. *How does justice become an issue between the industrialized countries and the developing countries?*

“Some of the poverty of the developing countries can be attributed to unjust economic practices of wealthy industrialized countries. The current pattern of international trade is a prime example. The industrialized countries have maintained inequities that discriminate against the developing countries by taxing and restricting imports from the developing countries and by flooding the world markets with agricultural products that are subsidized (and, therefore, priced below real costs).

13. *What is globalization? What are its most significant elements?*

Globalization is the accelerating interconnectedness of human activities, ideas, and cultures. The most significant elements are economic changes (such as the dominance of transnational corporations like Nokia and Roche), and environmental changes (including both positive effects like a wider market for environmentally friendly products, and negative effects like the worldwide spread of emerging diseases). An example is how fast the H1N1 virus spread over the world in 2009. The Monroe Doctrine of keeping to ourselves certainly would not work today. Sustainability is going to have to be the key word if we are going to be working so closely with other countries.

14. *Cite some of the recent developments in the movement toward sustainability.*

A list could include: cap and trade markets to curb carbon emissions, the growth of the wind energy industry, hybrid cars and car-sharing companies, better manufacturing for no waste and carbon neutrality, micro-financing and sustainability investments, international agreements like the Kyoto protocol, sustainable agriculture, and green technology (among others).

Thinking Environmentally: Possible Answers

1. *Imagine a class debate between people representing the developing countries and people representing the developed countries. Characterize the arguments of the two sides in terms of the issues surrounding population growth, energy use, resource use, and sustainable development. Then describe what should be the common interests between the two.*

Developing Country Viewpoint:

Population growth—On one hand, excessive population growth hinders our development because of the instability it causes. When people do not have jobs or lack access to social services, the impact on the environment can be substantial. On the other hand, people are our major resource. Children increase the economic stability of families because there are more people to bring in money to support the family, and when the parents are too old to work, the offspring will be able to support them. If people do not have assurance that children will live (infant and childhood mortality need to be low), then it is necessary to have a large family. There is no social structure to replace the family as there is in the developed world. We do not have the economic resources to provide that social structure. Population growth, while important, is not more important than curbing the consumption of energy and resources per person. The developed world consumes vast quantities of energy and resources per person, while the developing world consumes very little. For every decrease in environmental impact from the reduction in population growth, the environmental impact from consumption per person should decline. The developing world has decreased in population growth rate steadily since the 1960s, while the developed world has continued to increase its consumption rate.

Energy use—The developed world is the primary user of energy. The developed world has replaced human power with fossil fuels and other forms of energy. To become a developed nation, we need access to the energy that has been historically used by developed countries. In many instances the energy comes from developed nations.

Resource use—The developed world is the primary user of the world’s resources. This is unjust. Many of the resources upon which the developed world depends comes from the developing countries but are controlled by corporations based in the developed countries. Frequently the removal of the resources from developing

countries has resulted in severe economic and environmental exploitation. We deserve access to these resources, and the resources have to be extracted in a way that does not damage the environment or the people of the developing countries.

Sustainable development—The developed world had the opportunity to develop when the environmental costs of their development process were not understood. Because it would be unjust to prevent our development, and because the costs of the progress of the developed world have been borne by the developing world, the developed nations need to assist in our development. This will help the developed world by ensuring that the development is being accomplished in an environmentally acceptable manner. Additionally, as the standard of living in developing countries improves, there will be greater worldwide stability.

Developed Country Viewpoint:

Population growth—Many of the developing countries are unable to produce sufficient quantities of food to support their population. When a person is trying to ensure that his or her family has sufficient food to eat tomorrow, he or she has little time to care about his or her impact on the environment. Tremendous environmental damage would result from attempting to provide those in the developing world the goods and services that those in the developed world have. It is only ethical that those in the developing world should have access to the kinds of things that we in the developed world have. Therefore, it is necessary for population growth to be curbed.

Energy use—The developed world discovered and continues to discover ways to utilize various energy forms. We cannot be expected to decrease our energy use because the world's economy depends upon our continued economic health, which is dependent on increasing energy use. As new energy forms emerge, especially non-fossil fuel sources, the developing world will have increasing access to energy. It would be environmentally unacceptable for developing countries to begin using fossil fuels, especially coal, to run their economic growth because the environmental impact from the use of coal is too great. The quantity of carbon dioxide would be tremendous and would quickly surpass the release of carbon dioxide from the fossil fuels used by the developed world. The human health impacts from coal use are high. The developed world discovered this during our numerous air pollution disasters of the 1940s and 1950s.

Resource use—The resources used by the developed world are transformed into goods that can be purchased by those in developing countries.

Sustainable development—Sustainable development is good for everyone. Those in the developing world need to evaluate their economic growth plans and alter the plans when they are not sustainable. The developed nations need to do the same thing. Because all countries have to change how economic decisions are made and this change will cost money, each country needs to pay for its own sustainable development.

2. *Some people say that the concept of sustainable development either is an oxymoron or represents going back to some kind of primitive living. Develop an argument contradicting this opinion, and give your own opinion on sustainable development.*

Under the current economic paradigm, sustainable development is an oxymoron because the development model of the last century or more has been dependent upon continued growth; when growth ends, a recession begins. In many ways it is essential that humans develop an economic system that does not require constant growth because constant growth conflicts with natural systems. For example, uncontrolled cell growth is cancer. If taken to its logical extreme our current economic system results in the destruction of natural systems. There is no economic gain associated with not polluting the environment or removing resources at a rate that does not exceed their replacement. Because many industrial processes rely on clean air and/or clean water, polluting these is economically damaging. Yet at the same time there are economic advantages to be gained with releasing wastes into water or air because the cost to clean these resources is not borne by the polluter.

Civilization will not continue without sustainable development. If our current goods and services are produced in a way that destroys the environment, the goods and services provided by the environment will be destroyed and our standard of living will collapse. Therefore, continuation of an economic system that requires

continuous growth will result in primitive living. The only hope for maintaining our standard of living (health care, education, physical comfort) is to create a way of life that lives within the resources that are available.

3. *Study Table 1–1, pick one of the vital ecosystem services listed there, and investigate the reasons why it is placed where it is by the Millennium Ecosystem Assessment.*

Answers will vary by the service chosen. The overall intent of the MEA project is to build a knowledge base for sound policy decisions and management interventions; it remains for policy makers and managers to act on that knowledge. These three types of services encompass the majority of the resources.

Provisioning services are important because we are overusing and depleting our resources, both renewable and nonrenewable, and they are being replaced with “artificial resources” in agriculture and aquaculture.

Regulating services are important because without them, our environment will be even worse than it is. However, as can be seen by the long list of degraded services, we have a very long way to go.

Cultural services are important because we don’t want to forget the aesthetic value of the planet. If we lose our awe of the world around us, how can we be expected to want to protect it?

Examples of why a particular service was placed in the degraded, mixed, or enhanced column:

Capture fisheries are degraded because of overharvesting, pollution, and invasive species. However, aquaculture is enhanced because of an increase in fish farms. This could likely have been spurred by the increase in price for the commodity caused by the degradation of the capture fish industry.

Wild foods are degraded by the loss of habitat, destruction of forests, and by turning some of these areas into agricultural land (thereby enhancing crop production).

Air quality regulation has degraded globally due to the rush to compete in the global economy. This is evidenced by conditions in China, Eastern Europe, and India. A desire to produce cheap goods quickly has undermined efforts to install clean smokestacks, precipitators, and the like.

4. *Look for three articles about a current scientific issue where one reflects sound science, one reflects junk science, and one is hard to distinguish as either. Identify the features of the studies described that qualify as sound science or junk science.*

Answers will vary by the articles chosen. Be sure that students focus on the differences between sound science and junk science as described in section III of this chapter.