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# Science and Sustainability: An Introduction to Environmental Science

## Chapter Objectives

This chapter will help students:

- Describe the field of environmental science
- Compare renewable and nonrenewable resources, and explain the importance of natural resources and ecosystem services to our lives
- Discuss population growth, resource consumption, and their consequences
- Explain what is meant by an ecological footprint
- Describe the scientific method and the process of science
- Identify and illustrate major pressures on the global environment
- Discuss the concept of sustainability, and cite sustainable solutions being pursued on campuses and in the wider world

## Lecture Outline

**I. Our Island, Earth**

1. The astronaut's view of Earth reveals that its systems are finite and limited.
2. As our population, technological power, and resource consumption all increase, so does our capacity to alter our surroundings and damage the very systems that keep us alive.

A. Our environment surrounds us.

1. Our **environment** consists of all the living and nonliving things around us.
2. We are part of the "natural" world, and our interactions with the rest of it matter a great deal.

B. Environmental science explores our interactions with the world.

1. We have modified our environment.
2. **Environmental science** is the scientific study of how the natural world works, how our environment affects us, and how we affect our environment.
3. Environmental scientists study the issues most centrally important to our world and its future.

C. We rely on natural resources.

1. **Natural resources** are the substances and energy sources we take from our environment and that we rely on to survive.
2. **Renewable natural resources**, such as sunlight, wind, and wave energy, are perpetually renewed and essentially inexhaustible. Nonrenewable natural resources, such as minerals and fossil fuels, are in finite supply and are formed far more slowly than we use them. Once we deplete a nonrenewable resource, it is no longer available.

D. We rely on ecosystem services.

1. Our planet's ecological systems purify air and water, cycle nutrients, regulate climate, pollinate plants, and recycle our waste. Such essential services are commonly called **ecosystem services**.
2. In recent years, our depletion of nature's goods and our disruption of nature's services have intensified, driven by rising resource consumption and a human population that grows larger every day.

E. Population growth amplifies our impact.

1. Today, our population has grown beyond 7 billion people.
2. Two phenomena triggered our remarkable increase in population size. The **agricultural revolution** occurred around 10,000 years ago as humans transitioned from a hunter-gatherer lifestyle to an agricultural way of life.
3. The **industrial revolution** began in the mid-1700s. It entailed a shift from rural life, animal-powered agriculture, and hand-crafted goods toward an urban society provisioned by the mass-production of factory-made goods and powered by **fossil fuels** (nonrenewable energy sources including oil, coal, and natural gas).
4. Our sheer numbers are putting unprecedented stress on natural systems and the availability of resources.

F. Resource consumption exerts social and environmental pressures.

1. Industrialization increased the amount of resources each of us consumes.

2. One way to quantify resource consumption is to use the concept of the **ecological footprint**, which expresses the cumulative area of biologically productive land and water required to provide the resources a person or population consumes and to dispose of or recycle the waste the person or population produces.
3. Wackernagel and his colleagues calculate that our species is now using 50% more of the planet's renewable resources than are available on a sustainable basis. This excess use has been termed **overshoot**.
4. People from wealthy nations have much larger ecological footprints than do people from poorer nations.

G. Conserving Earth's natural capital is like maintaining a bank account.

1. We can think of our planet's vast store of resources and ecosystem services—Earth's natural capital—as a bank account. To keep a bank account full, we need to leave the principal intact and spend just the interest, so that we can continue living off the account far into the future. If we begin depleting the principal, we draw down the bank account.

H. Environmental science can help us learn from mistakes.

1. Historical evidence suggests that civilizations can crumble when pressures from population and consumption overwhelm resource availability.
2. If we cannot forge sustainable solutions to our problems, then the resulting societal collapse will be global. Fortunately, environmental science holds keys to building a better world.

## II. The Nature of Environmental Science

1. Environmental scientists aim to comprehend how Earth's natural systems function, how these systems affect people, and how we influence those systems.
2. Solutions are *applications* of environmental science.

A. Environmental science is interdisciplinary.

1. Environmental science is **interdisciplinary**, bringing techniques, perspectives, and research results from multiple disciplines together into a broad synthesis.
2. Interdisciplinary fields are valuable because their practitioners consolidate and synthesize the specialized knowledge from many disciplines and make sense of it in a broad context.

3. Environmental science is broad because it encompasses not only the **natural sciences** but also the **social sciences**. Most environmental science programs focus more on the natural sciences, whereas programs that emphasize the social sciences often use the term *environmental studies*.
4. An interdisciplinary approach to addressing environmental problems can produce effective solutions for society.

B. Environmental science is not the same as environmentalism.

1. Environmental science involves the scientific study of the environment and our interactions with it.
2. **Environmentalism** is a social movement dedicated to protecting the natural world from undesirable changes brought about by human actions.

## III. The Nature of Science

1. **Science** is a systematic process for learning about the world and testing our understanding of it.
2. Knowledge gained from science can be applied to address society's needs.
3. Virtually everything in our lives has been improved by the application of science.

A. Scientists test ideas by critically examining evidence.

1. Scientists examine how the world works by making observations, taking measurements, and testing whether their ideas are supported by evidence.
2. A great deal of scientific work is **descriptive science**, research in which scientists gather basic information about organisms, materials, systems, or processes that are not yet well known.
3. Once enough basic information is known about a subject, scientists can begin posing questions that seek deeper explanations about how and why things are the way they are. At this point scientists may pursue **hypothesis-driven science**, research that proceeds in a more targeted and structured manner, using experiments to test hypotheses within a framework traditionally known as the scientific method.

B. The scientific method is the traditional approach to research.

1. The **scientific method** is a technique for testing ideas with observations.

2. The steps of the scientific method are:
    a. Make observations.
    b. Ask questions.
    c. Develop a hypothesis. A **hypothesis** is a statement that attempts to explain a phenomenon or answer a scientific question.
    d. Make predictions. A **prediction** is a specific statement that can be directly and unequivocally tested.
    e. Test the predictions. An **experiment** is an activity designed to test the validity of a prediction or hypothesis; it involves manipulating **variables**, or conditions that can change. The **independent variable** is the variable that the scientist manipulates, while the **dependent variable** is the one that depends on the independent variable. Scientists conduct **controlled experiments** by controlling for the effects of all variables except the tested one. Often, controlled experiments have a **treatment** area that is manipulated and another that is not, called a **control**.
    f. Analyze and interpret results. Scientists record **data**, or information, from their studies and analyze the data using statistical tests. If experiments disprove a hypothesis, the scientist will reject it and may formulate a new hypothesis to replace it. If experiments fail to disprove a hypothesis, this lends support to the hypothesis but does not prove it is correct.

C. We test hypotheses in different ways.
1. A *manipulative experiment* is an experiment in which the researcher actively chooses and manipulates the independent variable.
2. Researchers conduct *natural experiments* to test their hypothesis by searching for **correlation**, or statistical association among variables.
3. This type of evidence is not as strong as the causal demonstration that manipulative experiments can provide, but often a natural experiment is the only feasible approach.

D. The scientific process continues beyond the scientific method.
1. To have impact, a researcher's work must be published and made accessible to the community. The scientific method is embedded in this larger process, including:

a. Peer review. Research results are submitted to a journal for publication. Other scientists who specialize in the subject area are asked to provide comments and criticism and judge whether the work merits publication. This process is known as **peer review**.

b. Conference presentations. Scientists frequently present their work at professional conferences and receive comments on their research.

c. Grants and funding. Most scientists spend considerable time writing grant applications to private foundations or government agencies for support of their research. Conflicts of interest sometimes arise when results are in conflict with the interests of the funding agency.

d. Repeatability. The careful scientist may test a hypothesis repeatedly in various ways before submitting it for publication. After publication, other scientists will attempt to reproduce the results in their own experiments.

e. Theories. If a hypothesis survives repeated testing by numerous research teams, it may be incorporated into a theory. A **theory** is a widely accepted, well-tested explanation of one or more cause-and-effect relationships that has been extensively validated by a great amount of research. In science, a theory is not speculation or hypothesis.

E. Science goes through paradigm shifts.

1. A **paradigm** is a dominant view regarding a topic, and the “shift” is when one is abandoned for another.

2. Paradigm shifts demonstrate the strength and vitality of science, showing science to be a process that refines and improves itself through time.

3. Understanding how science works is vital to assessing how scientific interpretations progress through time as information accrues.

## IV. Sustainability and Our Future

A. Achieving sustainable solutions is vital.

1. Society’s primary challenge today is finding out how to live within our planet’s means, such that Earth and its resources can sustain us—and all life—for the future. This is the challenge of sustainability, a guiding principle of modern environmental science.

B. Population and consumption drive environmental impact.

   1. Like rising population, rising per capita consumption magnifies the demands we make on our environment.
   2. Discrepancies in affluence lead to large differences in the ecological footprint of citizens from different nations.
   3. The most comprehensive scientific assessment of the condition of the world's ecological systems and their capacity to continue supporting our civilization was completed in 2005, called the Millennium Ecosystem Assessment.

C. Energy choices will shape our future.

   1. Our reliance on fossil fuels amplifies virtually every impact we exert on our environment.
   2. In extracting coal, oil, and natural gas, we are splurging on a one-time bonanza, because these fuels are nonrenewable and in finite supply. Attempts to reach further for new fossil fuel sources all seem to threaten to have more impact for relatively less fuel.

D. Sustainable solutions abound.

   1. Many workable solutions are at hand.
      a. Renewable energy sources are beginning to replace fossil fuels, and energy-efficiency efforts are gaining ground.
      b. Scientists are pursuing soil conservation, high-efficiency irrigation, and organic agriculture.
      c. Laws and new technologies have reduced air and water pollution in wealthier societies.
      d. Conservation biologists are helping to protect habitat and safeguard endangered species.
      e. Better waste management is helping us to conserve resources.
      f. Governments, businesses, and individuals are taking steps to reduce emissions of the greenhouse gases that drive climate change.
   2. These are a few of many efforts.

E. Students are promoting solutions on campus.

   1. Proponents of **campus sustainability** seek ways to help colleges and universities reduce their ecological footprints.
   2. College and universities are centers of lavish resource consumption.

3. Reducing the ecological footprint of a campus can be challenging.
4. Students, faculty, staff, and administrators on thousands of campuses are working together to make the operations of educational institutions more sustainable.

F. Environmental science prepares you for the future.

1. As our society comes to appreciate the challenges of creating a sustainable future, colleges and universities are helping students to learn how to confront these challenges.
2. At most schools, fewer than half of students take even a single course on the basic functions of Earth's natural systems, and still fewer take courses on the links between human activity and sustainability.
3. **Environmental literacy** is a basic understanding of Earth's physical and living systems and how we interact with them.
4. Students taking environmental science will be better qualified for the green-collar job opportunities of today and tomorrow. They will also be better prepared to navigate the many challenges of creating a sustainable future.

**V. Closing the Loop**

A. Finding effective ways of living peacefully, healthfully, and sustainably on our diverse and complex planet will require a thorough scientific understanding of both natural and social systems.

B. Environmental science helps us understand our intricate relationship with our environment and informs our attempts to solve and prevent environmental problems.

# Key Terms

**agricultural revolution**
**campus sustainability**
**control**
**controlled experiment**
**correlation**
**data**
**dependent variable**
**descriptive science**
**ecological footprint**
**ecosystem services**
**environment**
**environmentalism**
**environmental literacy**
**environmental science**
**environmental studies**
**experiment**
**fossil fuels**
**hypothesis**
**hypothesis-driven science**
**independent variable**

**industrial revolution**
**interdisciplinary**
**natural capital**
**natural resources**
**natural sciences**
**nonrenewable natural resources**
**overshoot**
**paradigm**
**peer review**
**predictions**
**renewable natural resources**
**science**
**scientific method**
**social sciences**
**sustainability**
**theory**
**treatment**
**variables**

# Teaching Tips

1. Begin class by asking students to define the term *environment* in their own words, on an index card. In addition, have the students find an image in a magazine that matches their definition and attach it to the other side of the index card. Collect the cards. At the end of the semester, return the cards to the students and ask them to redefine the term based on what they learned during the course. Also ask them to evaluate the image—is this what they think of now when they hear the term "environment?" Lead a discussion about how their definitions changed.
2. To teach the scientific method, present a situation to the class and ask students to work in groups to address the issue using the scientific process. For example: A farmer in South Carolina notices that the pond on his property contains an unusually high amount of algae. Because of the algal growth, his cattle will not drink from the pond. Based on this information (the observation), ask students to formulate a hypothesis, make a prediction, and design an experiment.
3. To make environmental science more appealing, have students investigate local environmental issues so they can relate to them personally and realize that they can make a difference. One possibility is for students to look at the Environmental Protection Agency's Superfund Sites in their state. The National Priorities List of sites in the United States can be found at: http://www.epa.gov/superfund/sites/npl/. From there they can choose their state or territory. They can click on any site shown on the state map to see names and locations. They then can click on the site name to go to a page devoted to that site, its description, cleanup approach, progress, potentially responsible parties, and many other site-related documents.
4. Ask students to conduct an Internet search on Easter Island. What is it like today? How many people live on the island? What are the main resources? Now tell them to research one of the success stories, the island of Tikopia, which lies in the Pacific Ocean east of Australia and New Guinea, west of Tonga and Fiji. Refer to Jared Diamond's book *Collapse* (2005, Viking Press). Ask students to compare and contrast the stable culture that has lasted at least 3,000 years on Tikopia with the fallen and failed culture of Easter Island. What are the major differences in how the people approached the idea of sustainability?

5. Quick feedback: Use a technique known as “muddiest point” to assess student understanding of the material. During the last 5 minutes of class, pass out $3 \times 5$ cards and ask students to anonymously write down the one point from the lecture that they don’t quite grasp—the “muddiest point.” Students leave cards in a pile as they exit. You don’t need to read every one of them in a large class—a random sample will indicate whether there are a couple of concepts that many students find unclear, or whether most everyone understood most everything. The technique has two benefits: First, the students must engage in some higher-order thinking to quickly review the lesson and their notes, assessing for clarity; and, second, you will learn whether there are small, scattered misunderstandings or a single issue that needs to be revisited. (From Thomas A. Angelo and K. Patricia Cross, *Classroom Assessment Techniques: A Handbook for College Teachers,* 2nd ed., San Francisco, Jossey-Bass Publishers, 1993).
6. Divide the class into six teams. Assign a chapter from *Overshoot* by William Catton, Jr. (see text reference below) to each team. Ask students to summarize the main points, analyze the information presented by the author, and explain if or how the text is relevant today. Encourage discussion about how issues raised in the text were addressed with legislation and action. Consider dividing students into small groups, each having responsibility for making an oral presentation during the semester.
7. Consider dividing students into small groups, each having responsibility for a “teach back” during the semester—repeating chapter content, using an application of that content. This chapter’s group might investigate the ecological footprint of the community where the school is located and explore its sustainability issues. They might investigate whether there are identifiable groups impacted by current transportation or energy issues in the community.
8. Community Service: Ask students to brainstorm, individually or as a group, ways in which they might explore the issues of this chapter in their community and take action. A specific example might be to educate consumers about the use of phosphates in dishwashing detergents. If your course contains a service learning or community service component, some students might want to take an idea from this section as a project.

# Additional Resources

## Websites

1. NASA Education, NASA (http://www.nasa.gov/audience/foreducators/index.html)

   This website provides educator guides for life science activities that integrate the scientific method.

2. *U.S. and World Population Clock—POPClock,* U.S. Census Bureau (http://www.census.gov/popclock)

   This website provides the current total population of the world, as well as a plethora of demographic information.

3. Earth Day Network—Ecological Footprint Calculator (http://www.earthday.org/take-action/footprint-calculator)

   This simple ecological footprint calculator allows college students to see their demand on resources through answering a few simple questions.

4. *The Millennium Ecosystems Assessment* (http://www.millenniumassessment.org/en/index.html)

   A comprehensive website containing reports and summaries of the commission's work.

5. AASHE (Association for the Advancement of Sustainability in Higher Education) Campus Sustainability Hub (http://www.aashe.org)

   This website contains seemingly unlimited sustainability resources and also sustainable actions taken by institutions of higher education.

## Audiovisual Materials

1. *Earth on Edge,* Bill Moyers Reports, 2001, distributed by Films for the Humanities and Sciences (http://www.shoppbs.org)

   In collaboration with the World Resources Institute, Bill Moyers assesses the state of the environment in interviews with scientists from around the world (2001).

2. *Scientific Methods & Values,* 1999, distributed by Hawkhill Video (http://www.hawkhill.com)

   This 35-minute program describes the history of the scientific method and explains how scientists use the technique.

3. *State of the Planet: Biosphere in the Balance,* 2005, produced by BBC Worldwide and distributed by Films for the Humanities and Sciences (http://www.worldcat.org/title/state-of-the-planet-biosphere-in-the-balance/oclc/062074760)

   This video, narrated by David Attenborough, is the first in a three-part series that describes worldwide biodiversity and the human activities that are destroying it.

4. *World in the Balance,* 2004, produced by NOVA and distributed by WGBH/PBS (http://shop.wgbh.org)

   This video is a 2-hour program that investigates social and environmental strains placed on the world due to rapidly increasing human populations.

5. *Planet Earth,* 2007, produced by the BBC (http://www.pbs.org)

   This series first aired on the Discovery Channel and captured the attention of very diverse viewers. The compelling footage highlights many interesting and rare species, their habitat preferences, and also projects the viewer into the future, inspiring one to ask, "What next? What will happen if these areas and creatures are not recognized and protected?"

6. *Planet in Peril,* 2009, produced by CNN (http://www.cnn.com/SPECIALS/2009/planet.in.peril and http://www.cnn.com/2007/TECH/science/07/12/pip.resources/index.html)

   This documentary talks about the state of the planet from the standpoints of CNN correspondents Jeff Corwin (wildlife biology), Anderson Cooper (social perspective), and Dr. Sanjay Gupta (human medicine).

## Suggested Texts

1. *People and the Land Through Time: Linking Ecology and History*. Emily Russell. Yale University Press, New Haven, 1997.

   For students who want an in-depth analysis of ecological issues based on human settlement patterns, this text provides valuable insights into the evolution of contemporary environmental issues. The author begins with geology, moves through disturbance features such as anthropogenic fire, and finishes with actual case studies grounded in historical ecology.

2. *Overshoot: The Ecological Basis of Revolutionary Change*. William R. Catton, Jr. University of Illinois Press, Chicago, 1980.

   The term *overshoot* is used and described in your textbook. *Overshoot*, now several decades in print, was a validation of Garrett Hardin's *Tragedy of the Commons* and Paul Ehrlich's *The Population Bomb*. *Overshoot* skillfully unpacks the growing dependence of human culture on technologies that enabled the exploitation of more land. Sobering and well-written, with chapters reviewing issues of carrying capacity, the cornucopian myth, drawdown, "cargoism," overshoot, and crash.

# Weighing the Issues

## Follow the Money

**Facts to consider:** A research scientist who is dependent on external funding is also generally dependent on the successful publication of his or her results to continue to receive funding. If the funding contract includes requiring review of results prior to publication, the results may be suppressed. There are well-documented instances of this in tobacco research in this country, although this is still contested by the tobacco companies. For a well-documented discussion of this see: Brian Martin, "Suppressing Research Data: Methods, Context, Accountability, and Responses." *Accountability in Research,* Vol. 6, 333-372, 1999. During President George W. Bush's administration, 2000–2008, a number of stories appeared documenting the editing for political purposes of internal scientific reports, particularly from the Environmental Protection Agency, by non-scientists.

## Ecological Footprints

**Facts to consider:** The science behind the ecological footprint can be found in Wackernagel and Rees' text, *Our Ecological Footprint,* New Society Publishers, 1996, and a number of footprint calculators can be found online. The answers to this question are clearly rooted in values, not in science, except that the authors make a strong case for our societal inability to continue to use resources at our current rate, the richer nations being responsible for the excess use.

# The Science behind the Story

## What Are the Lessons of Easter Island?

**Observation:** Although it is presently lacking large vegetation, examination of sediment cores from lakes, ancient pollen and nut casings, and charcoal all indicate that Easter Island once had a thriving palm forest.

**Hypothesis:** Human-introduced rats contributed to palm forest loss.

**Results:** When Polynesians settled new islands, they brought crop plants as well as chickens and other domestic animals. They also brought rats—intentionally as a food source or unintentionally as stowaways. In either case, rats multiplied quickly, and they soon overran Rapa Nui. Researchers found rat tooth marks on old nut casings, and Hunt and Lipo suggested that rats ate so many palm nuts and shoots that the trees could not regenerate. With no young trees growing, the palm went extinct once mature trees died.

The collapse of this sustainable civilization also came with the arrival of Europeans, who unwittingly brought contagious diseases to which the islanders had never been exposed. Indeed, historical journals of sequential European voyages depict a society falling into disarray as if reeling from epidemics. Peruvian ships then began raiding Rapa Nui and taking islanders away into slavery. Foreigners acquired the land, forced the remaining people into labor, and introduced thousands of sheep, which destroyed the few native plants left on the island. Thus, the new hypothesis holds that the collapse of Rapa Nui's civilization resulted from a barrage of disease, violence, and slave raids following foreign contact.

# Answers to End-of-Chapter Questions

## Testing Your Comprehension

1. Renewable and nonrenewable resources are categories of natural resources, the various substances and energy sources we need to survive. Resources replenished by the environment over relatively short periods of time are renewable resources. Sunlight and wind energy are examples. Those in limited supply and that are formed more slowly than we use them are nonrenewable resources. Oil and coal are examples.
2. The human population grew markedly as a result of both the agricultural and industrial revolutions. The agricultural revolution made it easier for humans to meet their nutritional needs; thus they lived longer and had more children. The industrial revolution brought improved sanitation and medical technology, and increased agricultural productivity fueled by fossil fuels and fertilizer. This significantly increased life expectancy, decreased mortality, and expanded the capacity to feed a growing population. However, this has also created more pollution, and the rising number of humans puts scarce resources in higher demand.
3. The ecological footprint expresses the environmental impact in terms of the cumulative area of biologically productive land and water required to provide the resources a person or population consumes and to dispose of or recycle the waste they produce. We can think of our planet's vast store of resources and ecosystem services—Earth's natural capital—as a bank account. To keep a bank account full, we need to leave the principal intact and spend just the interest, so that we can continue living off the account far into the future. If we begin depleting the principal, we draw down the bank account. To live off nature's interest—the renewable resources that are replenished year after year—is sustainable. To draw down resources faster than they are replaced is to eat into nature's capital, the bank account for our planet and our civilization.

4. Environmental science seeks to understand how Earth's natural systems function, how humans are influenced by them, and how we are influencing them. It includes the disciplines of ecology, earth sciences, economics, political science, demography, and ethics, among others.
5. Science is both the systematic process for learning about the world and the accumulated body of knowledge that arises from this process. It can be applied to the development of new technologies, such as electrical lighting, nuclear power, and antibiotics. It can also be applied to policy decisions and resource management strategies.
6. The scientific method includes making observations, asking questions, developing a hypothesis, making predictions, and testing those predictions, often through experiment. Once data are gathered, the final step is to analyze the experimental data.
7. In a manipulative experiment, a scientist actively chooses and controls the independent variable. In this type of experiment, causation can generally be shown because the change in the dependent variable can be measured as a direct result of the manipulated independent variable. In a natural experiment, a scientist measures and correlates the response of a system to naturally occurring variation in the independent variable, often because the process of interest is beyond the scientist's ability to alter or control.
8. Before being published, a researcher's results go through a process of peer review, which guards against faulty science contaminating the literature.
9. Major environmental problems in the world today include loss of biodiversity, increasing depletion and pollution of available freshwater resources, soil erosion, global climate change, and air pollution (among others). These may be caused directly or indirectly by human population growth and by increasing human consumption of natural resources. These problems are interrelated because of their causes, but also the complexity of any potential solutions. Potential solutions include: limiting human population growth, lessening the use of synthetic fertilizers and pesticides, and reducing the use of fossil fuel resources.
10. Sustainability is the use of renewable and nonrenewable resources to maintain or increase human living standards in ways that satisfy our current needs without compromising the resources' future availability. Students, faculty, and administrators can make their campuses more sustainable by promoting efficient transportation options, running recycling programs, restoring native landscape, and fostering sustainable dining halls and sustainable residence halls.

# Calculating Ecological Footprints

| Nation | Ecological footprint (hectares per person) | Proportion relative to world average footprint | Proportion relative to world area available |
|---|---|---|---|
| **Bangladesh** | 0.7 | 0.3 (0.7 ÷ 2.7) | 0.4 (0.7 ÷ 1.8) |
| **Tanzania** | 1.2 | 0.4 | 0.7 |
| **Colombia** | 1.8 | 0.7 | 1.0 |
| **Thailand** | 2.4 | 0.9 | 1.3 |
| **Mexico** | 3.3 | 1.2 | 1.8 |
| **Sweden** | 5.7 | 2.1 | 3.2 |
| **United States** | 7.2 | 2.7 | 4 |
| **World average** | 2.7 | 1 (2.7 ÷ 2.7) | 1.5 (2.7 ÷ 1.8) |
| **Your personal footprint (see Question 4)** | | | |

1. Bangladesh has a low per-capita income.
2. The United States has a high per-capita income.
3. Higher per-capita income suggests a higher consumption of goods, which require natural resources in their production. There is also a correlation between the use of energy resources, especially for transportation, and income. Wealthier societies can decrease water consumption by reducing their demand on that resource; generate less waste by investing in more durable, reusable products; and simply purchase fewer goods.
4. Student answers will vary.