http://testbanklive.com/download/environment-the-science-behind-the-stories-second-canadian-edition-with-myen

1

An Introduction to Environmental Science

Chapter Objectives

This chapter will help students

Define the term *environment*

Describe natural resources and explain their importance to human life

Characterize the interdisciplinary nature of environmental science

Understand the scientific method and how science operates

Diagnose and illustrate some of the pressures on the global environment

Articulate the concepts of sustainability and sustainable development

Lecture Outline

I. Central Case: Earth from Space: The Power of an Image

1. First photograph of Earth from space was in 1967.

II. Our Island, Earth

A. Our **environment** is more than just our surroundings

1. It includes both biotic factors and abiotic factors.
2. The fundamental insight of environmental science is that we are part of the natural world and we are dependent on a healthy, functioning planet.

B. Environment

C. **Environmental science** explores interactions between humans and the physical and biological world

1. Environmental science is the study of how the natural world works, how our environment affects us, and how we affect our environment.

Copyright © 2013 Pearson Canada Inc.

Full download all chapters instantly please go to Solutions Manual, Test Bank site: testbanklive.com

D. **Natural resources** are vital to our survival

1. Natural resources are the various substances and forces we need in order to survive.
2. **Renewable natural resources** are virtually unlimited or can be replenished by the environment over short periods of time.
3. **Nonrenewable natural resources** are in limited supply and are not replenished or are formed much more slowly than we use them.
4. Some renewable resources may turn nonrenewable if we deplete them too drastically.

E. Human population growth has shaped our resource use

1. Early humans gained control of fire around 2.5 million years ago and began to shape and use stones to modify their environment.
2. 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, shifting from a rural, agricultural life to an urban society powered by **fossil fuels.**
4. The Medical–Technological Revolution began recently and includes advances in medicine, sanitation, communication technologies, and the shift toward Green Revolution.

F. Resource consumption exerts social and environmental impacts

1. Carrying capacity and the “tragedy of the commons”
    a. Hardin analyzed how people approach resource use.
    b. Resources that are open to unregulated exploitation, the “commons,” will eventually be depleted.
    c. He disputed the economic theory that individual self-interest, in the long term, serves the public.
2. Calculating our ecological footprint
    a. The **ecological footprint** expresses the environmental impact of an individual or a population in terms of the cumulative amount of land and water required to provide the raw materials consumed and to recycle the waste produced.
    b. The ecological footprint is the sum of the amount of Earth’s surface “used” once all direct and indirect impacts are totalled.
    c. Using these calculations, it is clear that we are depleting our resources about 30% faster than they are being replenished. *Overshoot* is the term that describes the actions of humans surpassing the productive capacity of the planet.

G. Environmental science can help us avoid mistakes made in the past

1. The philosopher Plato commented on the deforestation and environmental destruction he observed in ancient Greece.

Copyright © 2013 Pearson Canada Inc.

2. Contemporary social scientists, including archeologists, historians, and paleoecologists, validate this trend.

III. The Nature of Environmental Science

A. Environmental science is an interdisciplinary pursuit

1. **Environmental studies** are especially broad because they encompass the **natural sciences** and also many **social sciences.**
2. An interdisciplinary approach to addressing environmental problems can produce effective and lasting solutions.

B. People differ in their perception of environmental problems

1. An environmental problem is any undesirable change in the environment.
2. A person's age, gender, class, race, nationality, employment, and educational background can all affect whether he or she considers an environmental change a "problem."
3. In other cases, different types of people may vary in their awareness of problems.

C. Environmental science is not the same as **environmentalism**

1. Environmentalism is a social movement dedicated to protecting the natural world from undesirable changes brought about by human choices.
2. Environmental science is the pursuit of knowledge about the environment, how it works, and our interactions with it.

IV. The Nature of Science

1. Modern scientists describe **science** as a systematic process for learning about the world and testing our understanding of it.
2. Environmental science is a dynamic yet systematic way of studying the world, and it is also the body of knowledge accumulated from this process.

A. Science

B. Scientists test ideas by critically examining evidence

C. The **scientific method** is the key element of science

1. It is a technique for testing ideas with observations and involves several assumptions and a series of interrelated steps.
2. The assumptions are
    a. The universe functions in accordance with fixed natural laws.
    b. All events arise from some cause and cause other events.
    c. We can use our senses and reasoning abilities to detect and describe natural laws.
3. The steps of the scientific method are
    a. Make observations.
    b. Ask a question.

c. Develop a **hypothesis.** A hypothesis is an educated guess that explains a phenomenon or answers 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 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 first variable.
f. Use **controlled experiments** by managing the variables. Have an unmanipulated point of comparison, called a **control,** and a manipulated treatment.
g. A **correlation** is a relationship among two or more variables.
h. Analyze and interpret results. **Data** are collected from experiments. Statistical tests are used to understand the significance of the data and the probability that a conclusion is true or untrue.
i. If repeated tests do not find a hypothesis to be untrue, then the conclusion is that the idea is supported. However, alternative hypotheses also need to be tested and ruled out.

D. There are different ways to test hypotheses

1. A **manipulative experiment** is an experiment in which the researcher actively chooses and manipulates the independent variable.
2. When variables cannot be manipulated, a **natural experiment** is performed.
3. In **ecology,** both manipulative and natural experiments are used. Ecology deals with the distribution and abundance of organisms and the interactions among organisms and with their abiotic environments.
4. Observational studies and natural experiments can show correlation between variables but cannot prove that one variable causes a change in another variable.

E. The scientific process does not stop with the scientific method

1. **Peer review**, when other scientists examine and comment on an experiment, is an essential part of the scientific process.
2. Scientists frequently present their work at professional conferences and in written publications.
3. Sound science is based on doubt rather than on certainty and on repeatability rather than on one-time occurrence.
4. If a hypothesis survives repeated testing by numerous research teams, it may be modelled and potentially be incorporated into a theory.

5. A **theory** is a widely accepted, well-tested explanation of one or more cause-and-effect relationships that has been extensively validated by a large amount of research.

F. Science may go through "**paradigm** shifts"

1. A paradigm is a dominant view regarding a topic, based on the facts and experiments known at that time.
2. Thomas Kuhn argued that science goes through periodic revolutions in which one dominant view is abandoned for another, as more information becomes available.

V. Sustainability and the Future of Our World

A. Population and consumption lie at the root of many environmental impacts

1. The ways we modify the environment have been influenced by the sudden rise in human population.
2. Our consumption of resources rises even faster than our population growth.

B. We face many environmental challenges

1. Advancing technology has enabled us to grow more food per unit of land. Massive use of chemical fertilizers and pesticides and the resulting runoff and pollution, along with the widespread conversion of natural habitats, are some of the environmental costs of conventional agriculture.
2. Artificial chemicals pollute land, water, and air.
3. Political will is crucial if we are to address the looming spectre of climate change. Our dependence on fossil fuels is the major cause.
4. Overharvesting, the introduction of non-native species, and habitat alteration cause serious problems with biodiversity, the number and diversity of living things, which is declining dramatically.

C. Solutions to environmental problems must be global and sustainable

1. Globalization is changing all environmental issues.
2. **Millennium Ecosystem Assessment** is the most comprehensive scientific assessment of the world's ecological systems.

D. Our energy choices will influence our future immensely

1. Reliance on fossil fuels has intensified the negative impact we have on the environment.
2. We have already depleted half of the world's oil supplies and are searching for alternatives.

E. Fortunately, potential solutions abound

1. Technological advances and new laws are decreasing pollution in some countries.
2. Advances in conservation biology enable scientists and policy makers to work together to protect habitat and organisms.
3. Recycling and renewable energy sources are increasing.

F. Are things getting better or worse?

G. **Sustainability** is a goal for the future

1. Sustainability means living within our resources such that they sustain us, and the rest of Earth's biota, for the foreseeable future.

H. Sustainable development involves environmental protection, economic welfare, and social equity

1. **Sustainable development** is using renewable and nonrenewable resources in a way that satisfies current needs without compromising their availability in the future.

VI. Conclusion

1. Identifying a problem is the first step in devising a solution to it.
2. Solving environmental problems can move us toward health, longevity, peace, and prosperity.

Key Terms

abiotic factors
biodiversity
biotic
carrying capacity
control
controlled experiment
correlation
data
dependent variable
development
ecological footprint
ecology
environment
Environment Canada
environmental science
environmental studies
environmentalism
experiment
hypothesis
independent variable
interdisciplinary field
manipulative experiment
natural experiment
natural resources
natural sciences
nonrenewable natural resources
paradigm
peer review
predictions
renewable natural resources
resource management
science
scientific method
social sciences
stock
stock-and-flow resources
sustainability
sustainable development
theory
tragedy of the commons
variables

Teaching Tips

1. Begin class by asking the students to define the term *environment* in their own words. Ask students to respond on a notecard to be submitted. At the end of the semester, return the notecards to the students and ask them to redefine the term based on what they learned during the course. Lead a discussion about how their definitions changed.

Copyright © 2013 Pearson Canada Inc.

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 has an unusually high amount of algae in it. Because of the algal growth, his cattle will not drink from the pond. What is happening, and what could he do? 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 to students, present information about local environmental issues. When students are faced with environmental problems where they live, they see how they relate to them personally and realize that they can make a difference. One possibility is to look at the Canadian Environmental Protection Act's (CEPA) policies, which can be found at www.ec.gc.ca/cepaRegistry/.

4. Ask students to conduct internet research on Easter Island. What is it like today? How many people live on the island? What are the main resources? Now 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. Look in Jared Diamond's book *Collapse* (2005, Viking Press) or at some of the internet sites showing his lectures. Compare and contrast the stable culture that has lasted at least 3000 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 index cards (or have students use their own paper, but in a large class index cards will be faster to assess) and ask students to write down, anonymously, the one point from the day that they do not quite grasp—the "muddiest point." Students leave cards in a pile as they exit. You do not need to read every one of them in a large class—a random sample of 20 will give you a good indication of whether there are a couple of concepts that many students find unclear and you need to go over again, or whether most students understood 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 get a snapshot of whether there are small, scattered misunderstandings or a single issue that needs to be revisited. (From Thomas A. Angelo and K. Patricia Cross. 1993. *Classroom Assessment* Techniques: A Handbook for College Teachers, 2nd ed. San Francisco: Jossey-Bass Publishers.)

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, or not.

Copyright © 2013 Pearson Canada Inc.

Discussion Questions

1. Discuss some ways that environmental science has impacted your 'social' lives.

   Answers will vary but the idea is to get students to make the link between environmental science and their everyday, non-academic lives.

2. Discuss what the term sustainability means to you.

   Answers will vary but again, this is strengthening students' realization of the linkages between environmental science and their lives and then going further to make the link to the concept of sustainability.

3. Discuss ways in which you are living a sustainable life.

   Getting students to discuss how they are living sustainably on an individual level will help other students make the link and see what they are able to do as well.

Essay Questions

1. Detail the linkages between the interactions of humans and the physical and biological world.
2. Discuss how the human population growth has *and continues to* shape our resource usage.
3. Why is environmental science considered an interdisciplinary pursuit?

Additional Resources

Websites

1. NASA *Spacelink Curriculum Support*, NASA (http://www.nasa.gov/audience/foreducators/index.html)
   This website provides educator guides for life science activities that integrate the scientific method.
2. *Sustainable Development Topics*, United Nations Division for Sustainable Development (www.un.org/esa/sustdev/sdissues/sdissues.htm)
   Information, documents, and publications related to sustainable development and Agenda 21 can be accessed from this website.
3. *U.S. and World Population Clocks*, U.S. Census Bureau (www.census.gov/main/www/popclock.html)
   This website provides the current total population of the world.
4. *Fished Out: The Rise and Fall of the Cod Fishery*, Canadian Broadcasting Corporation (http://archives.cbc.ca/economy_business/natural_resources/topics/1595/)
   Archival video reports can be found here about the collapse of the cod fishery in the Grand Banks off the eastern coast of Canada.

Copyright © 2013 Pearson Canada Inc.

Audiovisual Materials

1. *Earth on Edge*, Bill Moyers Reports, 2001, distributed by Films for the Humanities and Sciences (www.films.com). This film can also be found at the NOVA online store (http://shop.wgbh.org).
   In collaboration with the World Resources Institute, Moyers assesses the state of the environment in interviews with scientists from around the world. \
2. *Paul Ehrlich and the Population Bomb*, 1996, distributed by Films for the Humanities and Sciences (www.films.com)
   This program presents interviews with Ehrlich and his critics about his belief that an unchecked population would upset the balance of nature.
3. *Scientific Methods and Values*, distributed by Hawkhill Video (www.hawkhill.com)
   This 35-minute program describes the history of the scientific method and explains how the technique is used by scientists.
4. *State of the Planet: A Biosphere in the Balance*, 2001, produced by BBC Worldwide and distributed by Films for the Humanities and Sciences (www.films.com)
   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.
5. *World in the Balance*, 2004, produced by NOVA and distributed by WGBH/PBS (http://shop.wgbh.org)
   This video is a two-hour program that investigates social and environmental strains placed on the world due to rapidly increasing human populations.
6. *Planet Earth*, 2007, produced by the BBC (www.pbs.org)
   This series first aired on the Discovery Channel and captured the attention of 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?"

Suggested Texts

1. *People and the Land through Time: Linking Ecology and History*. 1997. Emily Russell. New Haven: Yale University Press.
   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*. 1980. William R. Catton, Jr. Chicago: University of Illinois Press.
   The term *overshoot* is used and described in your textbook. *Overshoot*, now several decades in print, was a validation of Garrett Hardin's "The Tragedy of the Commons" and Paul Ehrlich's *The Population Bomb*. *Overshoot* skillfully packs the growing dependence of human culture on technologies that enabled the xploitation 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: Facts to Consider

The Tragedy of the Commons

Facts to consider: Biologically based resources are somewhat more resilient to exploitation, as populations of harvested animals are usually replenished year after year depending on environmental conditions. However, as more fishers enter an area and move further away from fishing grounds used in the past, the reproductive adult lobsters that restocked the fished-out population are taken as well, and populations begin to decline as the number of reproductive adults decreases. With more fishers, more reproductive adults are taken until most of the lobsters harvested are small, one molt above minimum size. At this size, the lobsters are only 50% mature, and because they are harvested, these lobsters will never reproduce, further depleting the population of reproductive adults for the future (www.nefsc.noaa.gov/sos/spsyn/iv/lobster/). A real-life example of this scenario is the closing of the Grand Banks fishery off the east coast of Canada to commercial fishing. See Additional Resources for a website link to archival television and radio reports about this topic. Information about this topic from the Canadian government can be found at http://www.dfo-mpo.gc.ca/overfishing-surpeche/index-eng.htm. Individual responses will vary about whether government regulation or private cooperative regulation would be more appropriate solutions.

Follow the Money

Facts to consider: If you were a research scientist and were asked by a company to do an environmental impact assessment on a pollutant it was dumping into a river for which it would pay all of your funding plus give you a nice fee for doing the work, what are the pros and cons of accepting such an offer? The pro for doing the work is that you would be able to determine the true extent of the damage (if any) to the environment. The con is that there is usually a hitch. Most companies want to keep the work you do hidden from the public view and prohibit you from sharing your results with any governmental regulatory agency or even with other colleagues at universities. Furthermore, the company may write into the contract that the results are never to be discussed or disclosed to anyone. So, while you may satisfy yourself that something may be wrong, those findings cannot be transmitted to anyone else. The company has, in essence, bought your research soul on this matter.

The Science behind the Story

The Lesson of Rapa Nui

Observation: While presently denuded of large vegetation, examination of sediment cores from lakes, ancient nut casings, carbon-channels in the soil, charcoal, and analysis of ancient script all indicate that Easter Island once had a thriving palm forest.
Hypothesis: The forest was lost due to climate change.
Results: Evidence disproved this hypothesis, supporting an alternative hypothesis that the forest was lost due to human-caused environmental degradation. Archeological

evidence indicates that, traditionally, the palms and other trees were used for fuel, for building materials for houses and canoes, and as fibres for clothing, and for the fruit that was eaten. However, as tribes began to make and move massive stone statues, palms were harvested for rope and for use as rollers to move the statues. Pollen analysis of the lake sediment cores shows decreasing plant populations and plant species diversity until there was very little vegetation by 1400 C.E. Deforestation led to increased erosion, as revealed by the increasing depth of the lake sediment layers. Higher erosion rates decreased soil quality, resulting in smaller crop yields. Other evidence of forest loss can be seen in the decreasing diversity of animal species used as food, with early islanders eating many species of forest birds and marine animals and later islanders eating only domesticated chickens. Archeological evidence supports the conclusion that extreme scarcity of food led to intertribal warfare and the collapse of the Easter Island society.

Mission to Planet Earth: Monitoring Environmental

Observation: Observing the changes in Earth from space between 1972 and the present. Original observation was with a hand-held camera. Today, many sophisticated remotely-run instrumentation is able to provide more detailed information of Earth from space.
Hypothesis: Use of information from space will give us a better understanding of changes occurring on Earth.
Results: The results have been spectacular. The changes in the environment over time have been recorded. This shows how human activity has affected Earth using detail that was unthinkable in 1972. For example, a photograph depicting Ellesmere Island National Park Reserve in 2003 shows a tidewater glacier in Greely Fjord. It also shows icebergs that have broken off the glacier. As well, it demonstrates the flow lines running through the glacier with dark blue melt ponds.

Answers to End-of-Chapter Questions

Testing Your Comprehension

1. Renewable and nonrenewable resources are both 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 (e.g., sunlight, wind energy). Those in limited supply that are formed much more slowly than we use them are nonrenewable resources (e.g., oil, coal).
2. 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 than they could as hunter-gatherers; 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.
3. *The tragedy of the commons* refers to a situation in which resources that are open to unregulated exploitation will eventually be depleted. In a publicly held pasture, each person whose animals graze there would benefit from grazing more animals.

Copyright © 2013 Pearson Canada Inc.

Environment The Science Behind the Stories Second Canadian Edition with MyEnvironmentPlace Canadian 2nd Edition V
Full Download: http://testbanklive.com/download/environment-the-science-behind-the-stories-second-canadian-edition-with-myen

If each individual makes the rational decision to graze more, eventually the pasture will be overgrazed and its value destroyed. In the case of an industry that pollutes waterways, publicly accessible freshwater is the "commons," and pollution is analogous to overgrazing.

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.
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 by means of an experiment.
7. In a manipulative experiment, a scientist actively chooses and controls the 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 provides a valuable guard 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.
10. Sustainable development 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. Sustainable development will be necessary if we are to continue human civilization far into the future. The triple bottom line refers to three goals of sustainability: social justice, economic equity, and environmental health.

Interpreting Graphs and Data

1. Graph (a): 0; 0; 1 billion; 10 billion; graph (b): 1000; 10 000 000; 1 billion; 10 billion.
2. Graph (a) gives the impression that the population does not grow at all during the first 600 generations, whereas graph (b) gives the impression that the population is growing at a constant rate. Graph (a) gives the impression that the population grows exceedingly quickly during the last 100 generations, whereas graph (b) gives the impression that the population grows at a constant rate.
3. A linear graph like part (a) gives an accurate idea of the relative rate of change at one time versus another, when the rate of change is highly variable, or when it occurs at a large scale. A logarithmic graph like part (b) shows greater accuracy at small scales, but obscures the acceleration in amount of change.

Full download all chapters instantly please go to Solutions Manual, Test Bank site: testbanklive.com