

CHAPTER

1

An Introduction to Environmental Science

YOUR WORLD
YOUR TURN





Fixing a Hole in the Sky

- Ozone is a naturally occurring molecule that absorbs and redirects harmful UV radiation.
- In the 1970s, Mario Molina and Sherwood Rowland discovered that CFCs were rapidly destroying ozone in the stratosphere.
- Today, most nations have banned CFCs, and the ozone hole is expected to close up around 2050.



Talk About It *Should environmental scientists' discoveries about the natural world influence human activity? If so, how?*

Lesson 1.1 Our Island, Earth

Like all species on Earth, humans rely on a healthy, functioning planet for air, water, food, and shelter.



What Is Environmental Science?



National Marine Fisheries Service scientists studying whether commercial boats are harming endangered killer whales

- The study of our planet's natural systems and how humans and the environment affect one another
- The environment includes all living and nonliving things with which organisms interact.
- Understanding the interactions between humans and the environment is the first step to solving environmental problems.

Environmental Science vs. Environmentalism

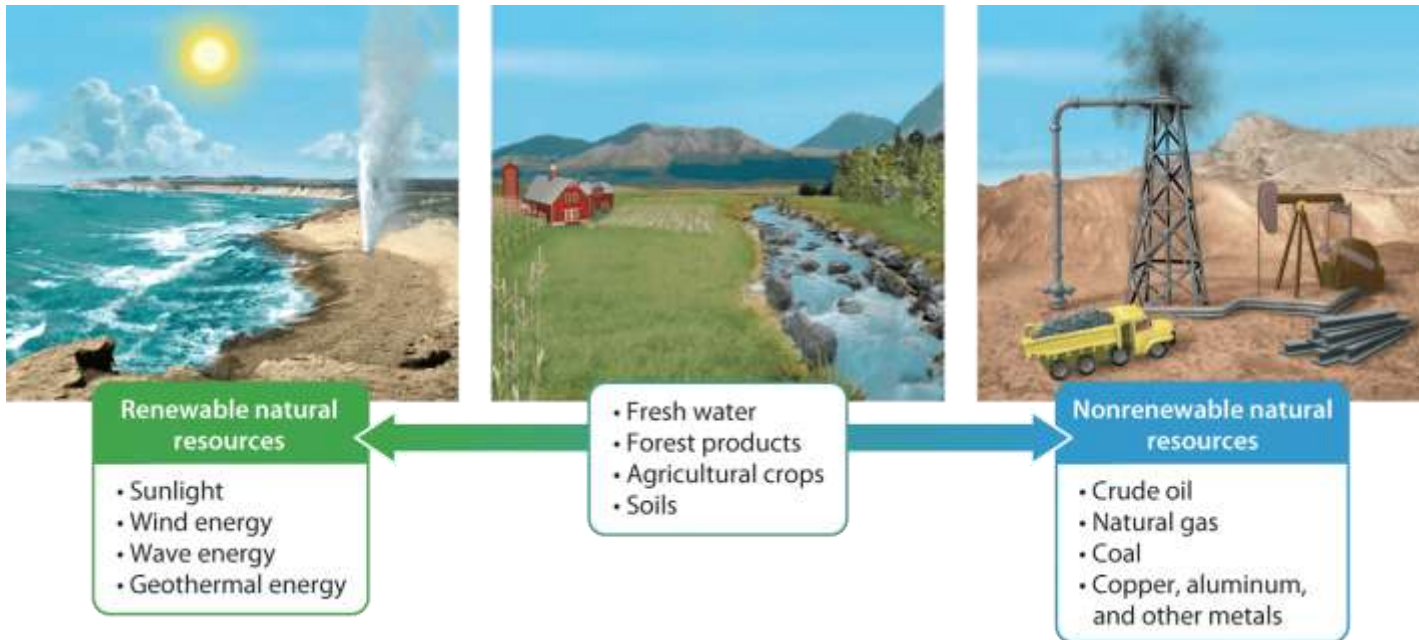


- **Environmental Science:** Objective, unbiased pursuit of knowledge about the workings of the environment and our interactions with it
- **Environmentalism:** Social movement dedicated to protecting the natural world

Environmentalists protesting the use of nuclear power

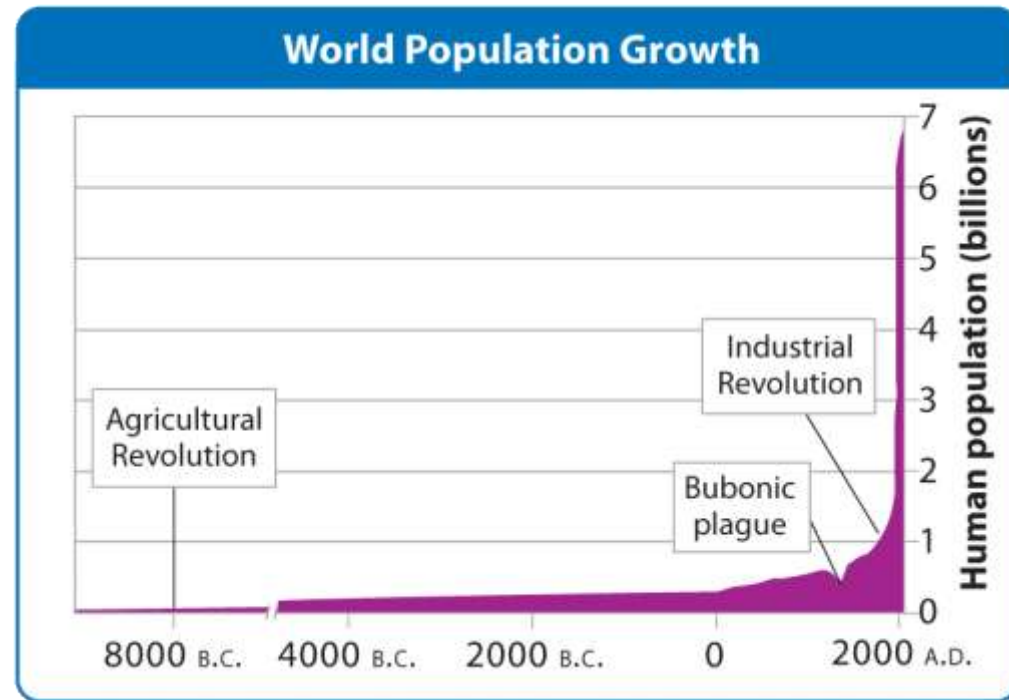
Natural Resources

- Natural resources are materials and energy sources found in nature that humans need to survive.
 - **Renewable resources:** Naturally replenished over short periods
 - **Nonrenewable resources:** Naturally formed more slowly than we use them.
 - Renewable resources can become nonrenewable if used faster than they are replenished.



Human Population Growth

- Tremendous and rapid human population growth can be attributed to:
 - **The Agricultural Revolution:** About 10,000 years ago; humans began living in villages, had longer life spans, and more surviving children.
 - **Industrial Revolution:** Began in early 1700s; driven by fossil fuels and technological advances



Did You Know? *The human population increases by about 200,000 people every day.*

Ecological Footprints



Ecological footprints include land and water used to grow food at farms hundreds or thousands of miles away.

- The total amount of land and water required to:
 - provide the raw materials an individual or population consumes
 - dispose of or recycle the waste an individual or population consumes
- Most informative when footprints are calculated using the same method

Did You Know? *By one calculation, the ecological footprint of the average American is 3.5 times the global average.*

Tragedy of the Commons

- Describes a situation in which resources, made available to everyone, are used unsustainably and eventually depleted
- Resource management, whether voluntary or mandated, can help avoid resource depletion.



The “commons” refers to a public pastureland that was shared by villagers in 19th-century England.

Overexploiting Shared Renewable Resources: Tragedy of the Commons

- Three types of property or resource rights
 - Private property
 - Common property
 - Open access renewable resources
- Tragedy of the commons
- **The Once-ler attitude – “If I don’t do it, someone else will.”**
 - Common property and open-access renewable resources degraded from overuse
 - Solutions



Tragedy of the Commons

***What has
happened
to
Alaskan
wildlife?***



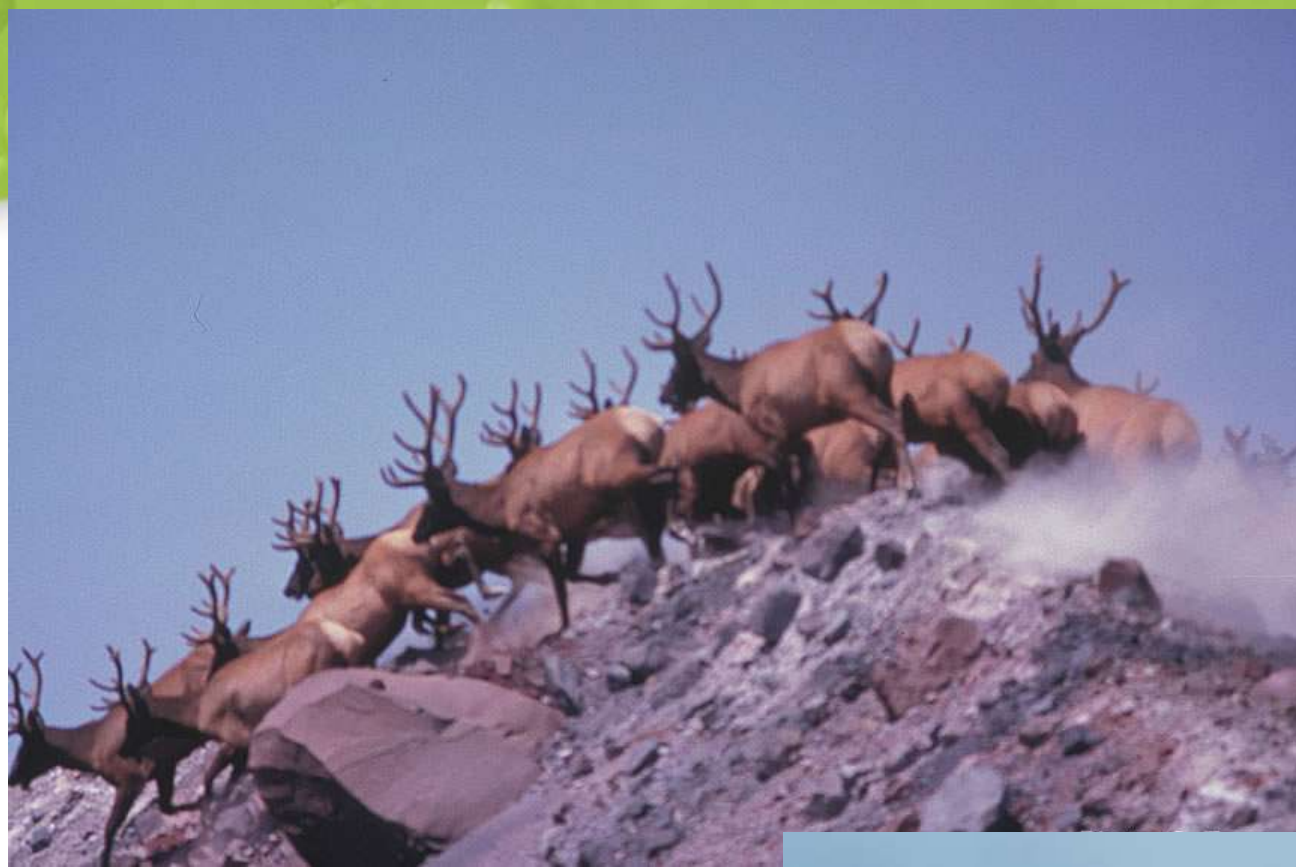




© 2000 W. Steve Sherman, Lone Wolf Photography











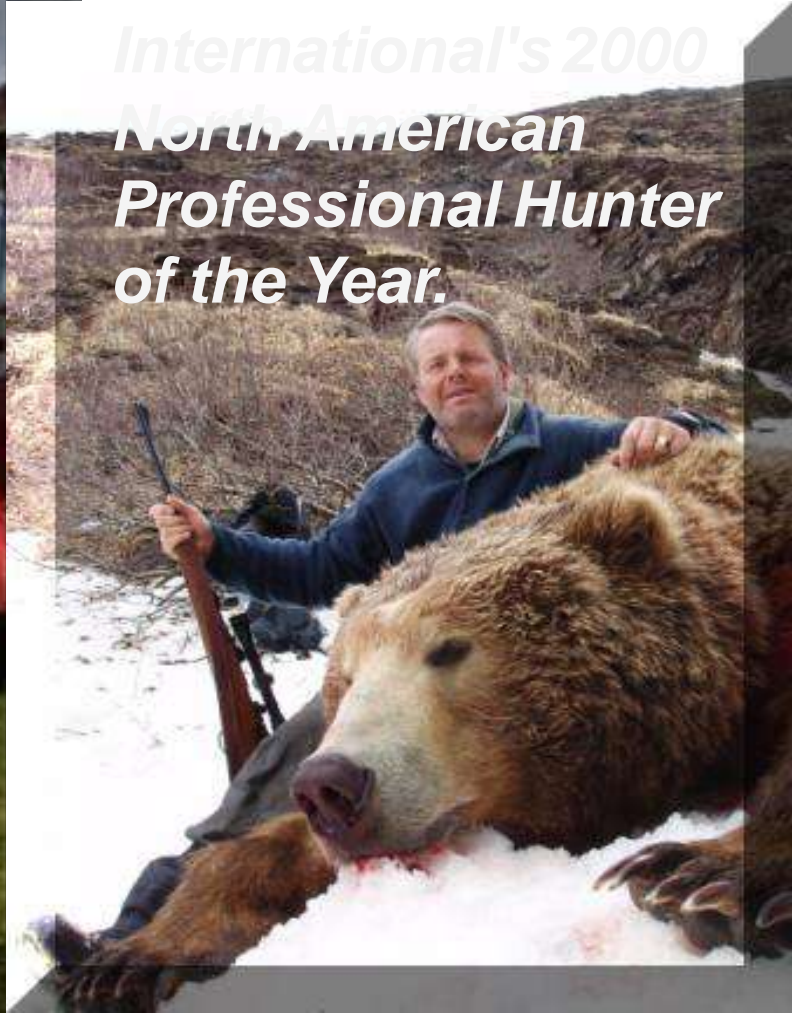


Alaska Big Game

*Hunting with Gary
"Butch" King -
Master Guide*

Safari Club

*International's 2000
North American
Professional Hunter
of the Year.*











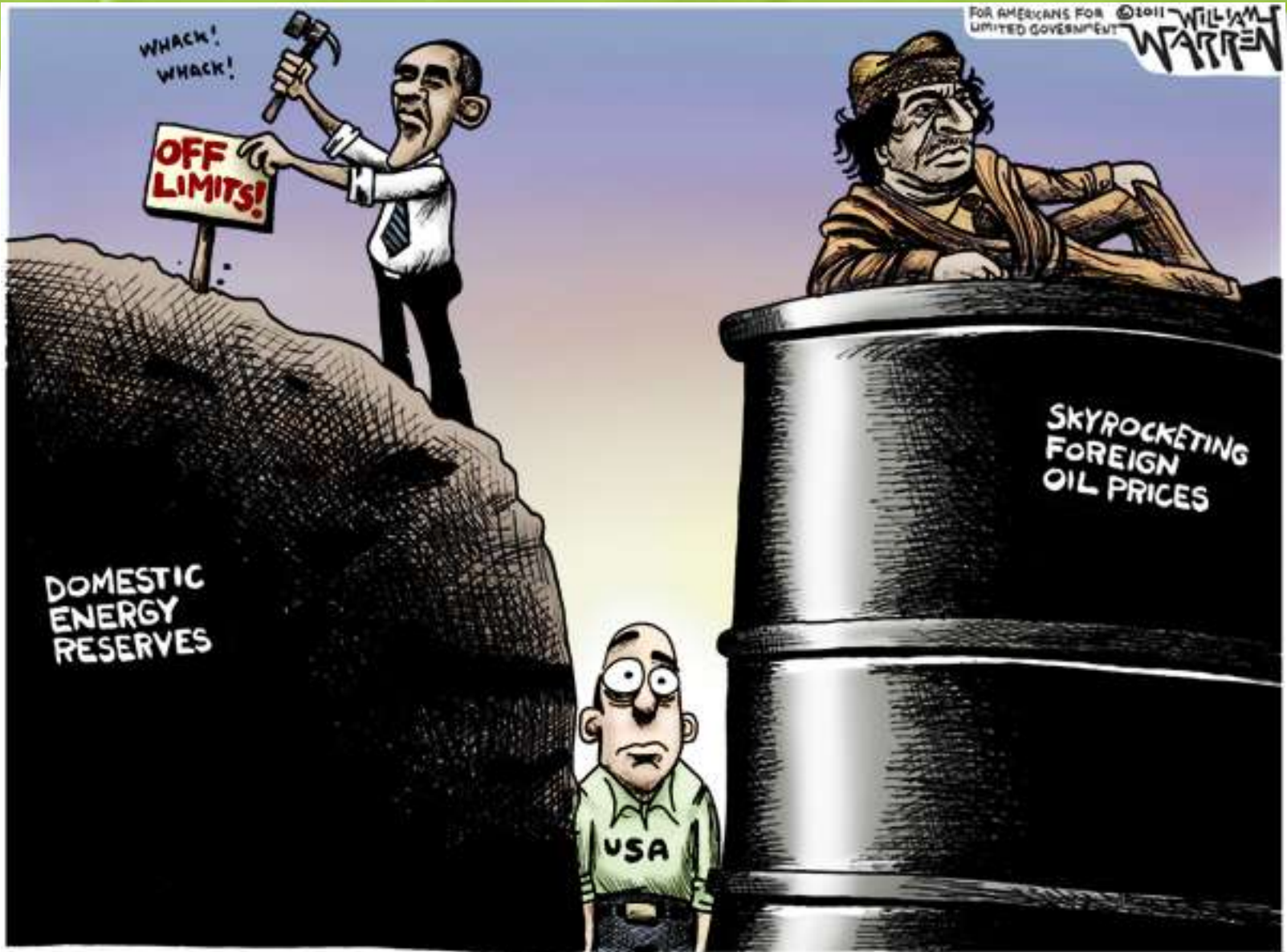




2 Sides to every issue....



- <http://www.mooseland.com/2011/01/aiwr-big-lie.html>
- <http://www.nrdc.org/land/wilderness/arctic.asp>



BETWEEN **BARACK** AND A **HARD PLACE**.

Ecological Footprints: A Model of Unsustainable Use of Resources

- **Ecological footprint:** the amount of biologically productive land and water needed to provide the people in a region with indefinite supply of renewable resources, and to absorb and recycle wastes and pollution
- **Per capita ecological footprint**
- Unsustainable: footprint is larger than biological capacity for replenishment

- Beware the concept of per capita
- Environmental footprint – large in developed countries (affluence) smaller in developing countries BUT developing have high population growth and are showing a shift towards western cultural attitudes (the need for thneeds)
- 53% of the world survives on less than \$1/day
- 19% of the worlds population uses 88% of its resources
- Poverty affects environmental quality b/c to survive many will deplete and degrade forests, grasslands, soils and wildlife.

Patterns of Natural Resource Consumption



Patterns of Natural Resource Consumption



Fig. 1-12b, p. 15

Experts Have Identified Four Basic Causes of Environmental Problems

1. Population growth
2. Wasteful and unsustainable resource use
3. Poverty
4. Failure to include the harmful environmental costs of goods and services in market prices

Causes of Environmental Problems



Population growth



Unsustainable resource use



Poverty



Excluding environmental costs from market prices

Congratulations!!!!

You have won a MILLION dollars....now what?



- Invest the capital and live off of the interest.
- \$1 million at 5% will give you 50,000 per year in dividends. The million will last forever.
- Spend \$100,000 per year and your capital will be gone in 14 years.
- ***Protect the capital and live off of the income provided by that resource!!!***



Environmentally Sustainable Societies Protect Natural Capital and Live Off Its Income

- **Environmentally sustainable society**: meets current needs while ensuring that needs of future generations will be met
- Live on natural income of **natural capital** without diminishing the natural capital

Lesson 1.2 The Nature of Science

Mark E. Brown/Alamy

The word *science* comes from the Latin word *scientia*, meaning “knowledge.”



What Science Is and Is Not



- ♣ Science is an organized way of studying the natural world, and the knowledge gained from such studies.
 - Science assumes that the natural world functions in accordance with rules that do not change.
 - Science does **not** deal with the supernatural.
 - Science relies on evidence from measurements and observations.
 - Scientific ideas are “supported,” not “proven,” and “accepted,” not “believed in.”

The Process of Science

- ♣ Science involves asking questions, making observations, seeking evidence, sharing ideas, and analyzing results.
- Science is not linear—the process loops back on itself and follows many different paths.



Lesson 1.2 The Nature of Science

- Many investigations start with the observation of a phenomenon that the scientist wishes to explain.
- Observations can be made with the eye, with instruments, or by reading scientific literature.
- Observations translate to data which may be
 - Qualitative
 - Quantitative



Identify some ways a scientist may begin an investigation.

*Explain why scientists **MUST** research a problem **BEFORE** designing an experiment.*

Hypotheses



- Scientists attempt to answer questions by devising hypotheses—testable ideas
- Hypotheses:
 - Explain a phenomenon or answer a scientific question
 - Can be supported or rejected by data
 - May prompt new hypotheses or a new experimental design.

Gathering Data



Peter Rejcek/National Science Foundation

Did You Know? Gulls are protected by the Migratory Bird Treaty Act, and government agencies like the U.S. Fish and Wildlife Service continually collect data on seagull populations and habitats.

- Scientists test predictions by gathering evidence in the form of data.
 - If data match predictions, hypothesis is supported.
 - If data do not match predictions, hypothesis is rejected.
- Data can come from an experiment or observational studies; ideally experiments and studies are controlled and **repeated**.

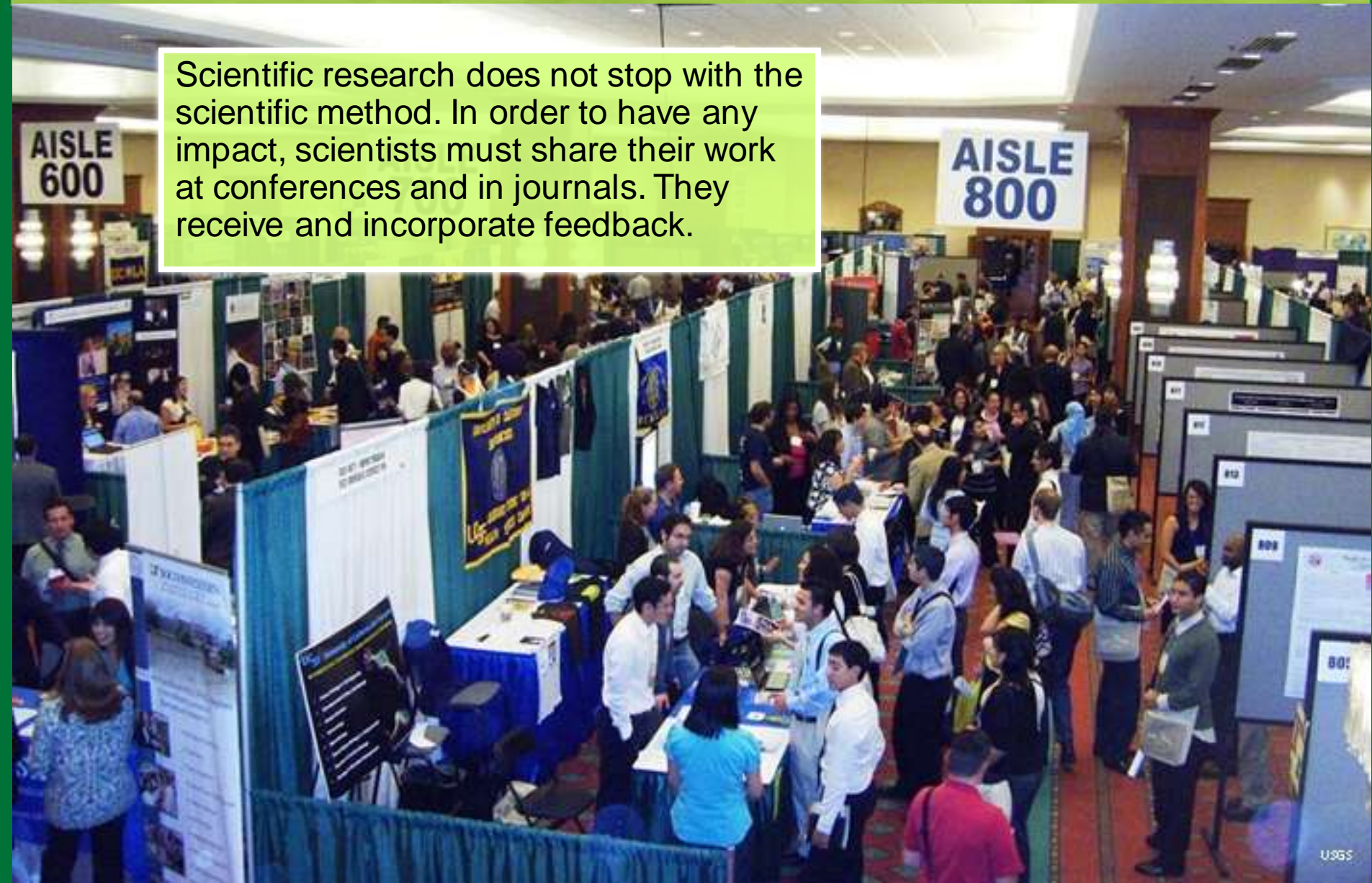
Using Models



- Scientists will use models when they cannot directly perform a controlled experiment OR when they cannot observe phenomenon.
- **Weather forecasting uses models to predict weather patterns**

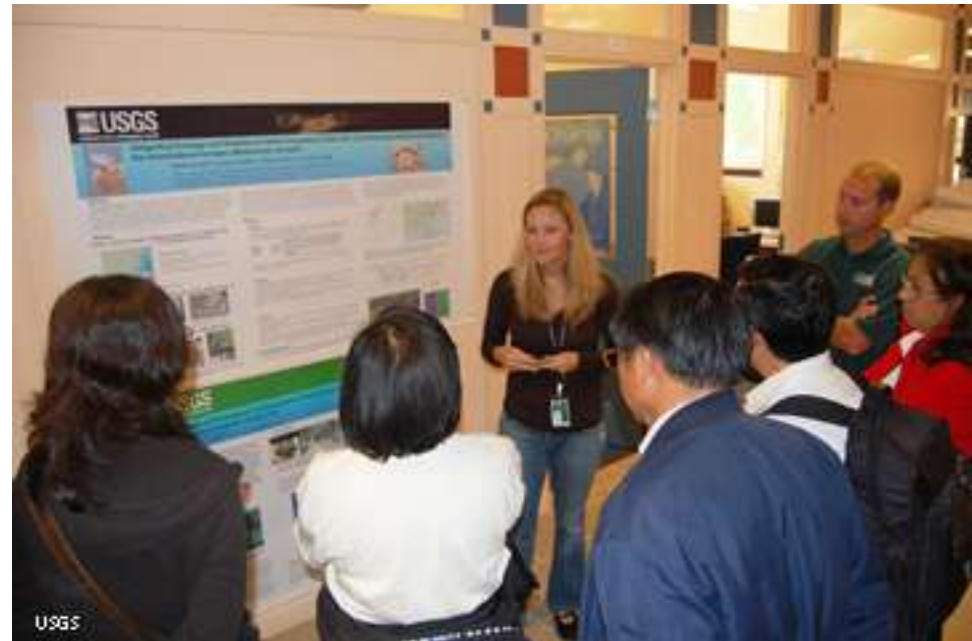
Lesson 1.3 The Community of Science

Scientific research does not stop with the scientific method. In order to have any impact, scientists must share their work at conferences and in journals. They receive and incorporate feedback.



Community Analysis and Feedback

- After completing their study, scientists:
 - Present their work and get feedback from other researchers at conferences
 - Write papers about their study
 - Submit papers for publication in a journal



- Many journals are **peer-reviewed**, meaning scientists review papers submitted for publication, recommend changes, and reject or accept the paper for publication.

Replication and Self-Correction



Terrestrial globe with armillary sphere (1543), Caspar Vogel. Wood and metal.
Library of Congress Geography and Map Division [85.1]

- Hypotheses should be tested several times, in several ways, before they are accepted.
- Interpretations of data can change over time as knowledge accumulates.
- Science constantly refines and improves itself.
- ***SCIENCE IS ALWAYS CHANGING!!!!***

Did You Know? *Scientists believed the sun and planets revolved around the Earth until Nicolaus Copernicus proved this was false in the 1500s.*

Building on Environmental Science



40,000 buffalo hides, 1872

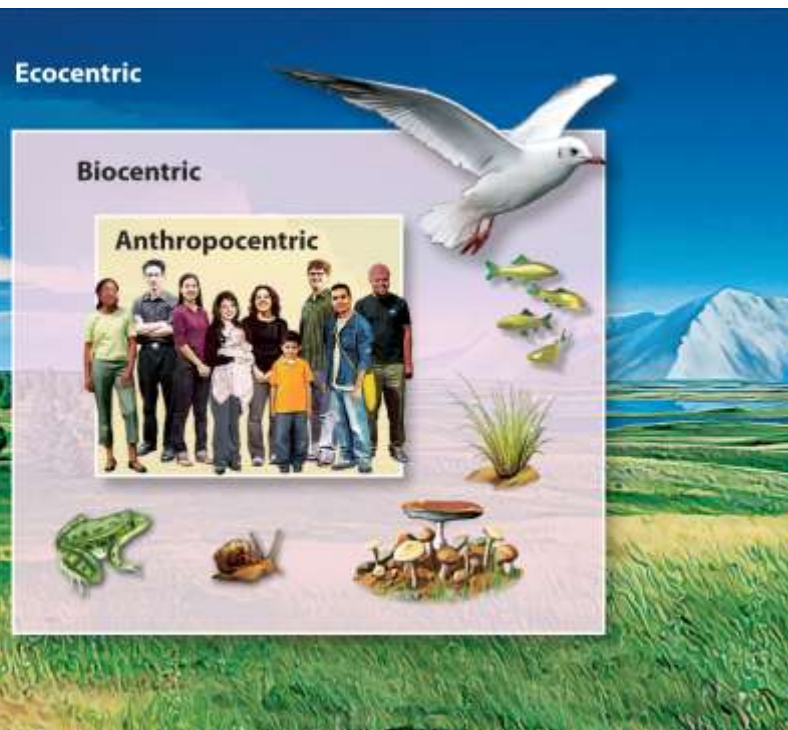


Ducks killed by an oil spill

- Addressing environmental problems involves more than just understanding the science.
 - **Ethics:** Study of behavior (good and bad, right and wrong), moral principles, and values
 - **Culture:** Ensemble of knowledge, beliefs, values, and learned ways of life shared by a group of people
 - **Worldview:** Perception of the world and a person's place in it

Environmental Ethics

- Environmental ethics is the application of ethical standards to the relationship between humans and the environment.



- **Anthropocentrism:** Humans and human welfare most important
- **Biocentrism:** All living things have value; some may be more important than others
- **Ecocentrism:** Well-being of a species or community more important than that of an individual

TOPIC: Easter Island

Easter's End by Jared Diamond

➤ ESSENTIAL QUESTION:

Why do scientists believe the Moai were important in the decline of the Rapi Nui civilization and the Easter Island ecosystem?



• FOCUS QUESTIONS:

1. *Define Moai and Rapi Nui*
2. *Compare and contrast the island when the Rapi Nui first arrived and when Roggeveen arrived many centuries later.*
3. *Describe how the island's trees were used and explain why they are gone.*
4. *Explain why there is almost no wildlife on the island.*
5. *What evidence supports the theory that the Rapi Nui civilization descended into chaos?*

Figure 2-1

TOPIC: Easter Island

Rethinking the Fall of Easter Island by Terry Hunt

➤ ESSENTIAL QUESTION:

What evidence points to an alternative explanation for the collapse of Easter Island's civilization and ecosystem?

• FOCUS QUESTIONS:

1. *Why does Hunt disagree with Diamond after he arrived at Easter Island and looked at his own evidence?*
2. *Why did the trees disappear?*
3. *What evidence does Hunt present to support this idea?*
4. *Why did the Rapa Nui civilization collapse?*



Figure 2-1 <http://www.youtube.com/watch?v=J5YR0uqPAI8>

Core Case Study: Environmental Lesson from Easter Island



- Thriving society
 - 15,000 people by 1400.
- Used resources faster than could be renewed
 - By 1600 only a few trees remained.
- Civilization collapsed
 - By 1722 only several hundred people left.

Science Focus: Easter Island: Revisions to a Popular Environmental Story

- Some revisions to a popular environmental story
- Polynesians arrived about 800 years ago
- Population may have reached 3000
- Used trees in an unsustainable manner, **but** rats may have multiplied and eaten the seeds of the trees

Stone Statues on Easter Island



AND....The debate continues....a mark of good scientific debate ☺

<http://discovermagazine.com/1995/aug/eastersend543>

<http://www.americanscientist.org/issues/pub/rethinking-the-fall-of-easter-island/1>

<http://www.marklynas.org/2011/09/the-myths-of-easter-island-jared-diamond-responds/>

Figure 2.A: These and many other massive stone figures once lined the coasts of Easter Island and are the remains of the technology created on the island by an ancient civilization of Polynesians. Some of these statues are taller than an average five-story building and can weigh as much as 89 metric tons (98 tons).