

5TH EDITION

# ENVIRONMENT

THE SCIENCE BEHIND THE STORIES

JAY WITHGOTT · MATTHEW LAPOSATA



# Environment

## The Science Behind the Stories

5TH EDITION

**Jay Withgott**  
**Matthew Laposata**

**PEARSON**

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# About the Authors



**Jay Withgott** has authored *Environment: The Science Behind the Stories* as well as its brief version, *Essential Environment*, since their inception. In dedicating himself to these books, he works to keep abreast of a diverse and rapidly changing field and continually seeks to develop new and better ways to help today's students learn environmental science.

As a researcher, Jay has published scientific papers in ecology, evolution, animal behavior, and conservation biology in journals ranging from *Evolution* to *Proceedings of the National Academy of Sciences*. As an instructor, he has taught university lab courses in ecology and other disciplines. As a science writer, he has authored articles for numerous journals and magazines including *Science*, *New Scientist*, *BioScience*, *Smithsonian*, and *Natural History*. By combining his scientific training with prior experience as a newspaper reporter and editor, he strives to make science accessible and engaging for general audiences. Jay holds degrees from Yale University, the University of Arkansas, and the University of Arizona.

Jay lives with his wife, biologist Susan Masta, in Portland, Oregon.



**Matthew Laposata** is a professor of environmental science at Kennesaw State University (KSU). He holds a bachelor's degree in biology education from Indiana University of Pennsylvania, a master's degree in biology from Bowling Green State University, and a doctorate in ecology from The Pennsylvania State University.

Matt is the coordinator of KSU's two-semester general education science sequence titled Science, Society, and the Environment, which enrolls roughly 6000 students per year. He focuses exclusively on introductory environmental science courses and has enjoyed teaching and interacting with thousands of nonscience majors during his career. He is an active scholar in environmental science education and has received grants from state, federal, and private sources to develop and evaluate innovative curricular materials. His scholarly work has received numerous awards, including the Georgia Board of Regents' highest award for the Scholarship of Teaching and Learning.

Matt resides in suburban Atlanta with his wife, Lisa, and children, Lauren, Cameron, and Saffron.

## ABOUT OUR SUSTAINABILITY INITIATIVES

This book is carefully crafted to minimize environmental impact. The materials used to manufacture this book originated from sources committed to responsible forestry practices. The paper is Forest Stewardship Council™ (FSC®) certified. The printing, binding, cover, and paper come from facilities that minimize waste, energy consumption, and the use of harmful chemicals.

Pearson closes the loop by recycling every out-of-date text returned to our warehouse. We pulp the books, and the pulp is used to produce items such as paper coffee cups and shopping bags. In addition, Pearson has become the first climate-neutral educational publishing company.



The future holds great promise for reducing our impact on Earth's environment, and Pearson is proud to be leading the way. We strive to publish the best books with the most up-to-date and accurate content, and to do so in ways that minimize our environmental impact.

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# Preface

## Dear Student,

You are coming of age at a unique and momentous time in history. Within your lifetime, our global society must chart a promising course for a sustainable future. The stakes could not be higher.

Today we live long lives enriched with astonishing technologies, in societies more free, just, and equal than ever before. We enjoy wealth on a scale our ancestors could hardly have dreamed of. Yet we have purchased these wonderful things at a price. By exploiting Earth's resources and ecological services, we are depleting our planet's bank account and running up its credit card. We are altering our planet's land, air, water, nutrient cycles, biodiversity, and climate at dizzying speeds. More than ever before, the future of our society rests with how we treat the world around us.

Your future is being shaped by the phenomena you will learn about in your environmental science course. Environmental science gives us a big-picture understanding of the world and our place within it. Environmental science also offers hope and solutions, revealing ways to address the problems we create. Environmental science is not simply some subject you learn in college. Rather, it provides you basic literacy in the foremost issues of the 21st century, and it relates to everything around you over your entire lifetime.

We have written this book because today's students will shape tomorrow's world. At this unique moment in history, students of your generation are key to achieving a sustainable future for our civilization. The many environmental challenges that face us can seem overwhelming, but you should feel encouraged and motivated. Remember that each dilemma is also an opportunity. For every problem that human carelessness has created, human ingenuity can devise a solution. Now is the time for innovation, creativity, and the fresh perspectives that a new generation can offer. Your own ideas and energy *will* make a difference.

—Jay Withgott and Matthew Laposata

## Dear Instructor,

You perform one of our society's most vital jobs by educating today's students—the citizens and leaders of tomorrow—on the fundamentals of the world around them, the nature of science, and the most central issues of our time. We have written this book to assist you in this endeavor because we feel that the crucial role of environmental science in today's world makes it imperative to engage, educate, and inspire a broad audience of students.

In *Environment: The Science behind the Stories*, we strive to implement a diversity of modern teaching approaches and to show how science can inform efforts to bring about a sustainable society. We aim to encourage critical thinking and to maintain a balanced approach as we flesh out the vibrant social debate that accompanies environmental issues. As we assess the challenges facing our civilization and our planet, we focus on providing forward-looking solutions, for we truly feel there are many reasons for optimism.

In crafting the fifth edition of this text, we have incorporated the most current information from this fast-moving field and have streamlined our presentation to promote learning. We have examined every line with care to make sure all content is accurate, clear, and up-to-date. Moreover, we have introduced a number of major changes that are new to this edition.

## New to This Edition

With the fifth edition we welcome Dr. Matthew Laposata as an author. Professor of environmental science at Kennesaw State University in Georgia, Matt teaches and coordinates his university's environmental science courses while actively engaging in outside projects to promote environmental science education. Matt's ideas, energy, and commitment to outstanding teaching have already enlivened and strengthened this book as well as its brief version, *Essential Environment*. Please welcome him to our author team!

This fifth edition includes an array of revisions that together enhance our content and presentation while strengthening our commitment to teach science in an engaging and accessible way.

### ■ CENTRAL CASE STUDY

Ten of our 23 *Central Case Studies* are new to this edition, providing a wealth of fresh stories and new ways to frame issues in environmental science. Students will travel from Pennsylvania to Hawai'i and from Africa to Japan as they learn how debates over hydraulic fracturing, oil sands extraction, air pollution, and wildlife conservation are affecting people's lives.



- **Chapter 2:** The Tohoku Earthquake: Has it Shaken the World's Trust in Nuclear Power?
- **Chapter 3:** Saving Hawaii's Native Forest Birds
- **Chapter 5:** The Vanishing Oysters of the Chesapeake Bay
- **Chapter 6:** Costa Rica Values its Ecosystem Services
- **Chapter 7:** Hydrofracking the Marcellus Shale
- **Chapter 9:** Iowa's Farmers Practice No-Till Agriculture
- **Chapter 11:** Will We Slice through the Serengeti?
- **Chapter 15:** Starving the Louisiana Coast of Sediment
- **Chapter 17:** Clearing the Air in L.A. and Mexico City
- **Chapter 19:** Alberta's Oil Sands and the Keystone XL Pipeline

## THE SCIENCE BEHIND THE STORY

Fully 18 of our 42 *Science behind the Story* features are new to this edition, providing a current and exciting selection of scientific studies to highlight. Students will follow researchers as they help to restore an oyster fishery; monitor animal populations; evaluate energy sources; and assess impacts of smog, aquifer contamination, fallout from Fukushima, and oil from the *Deepwater Horizon* spill. Selected features are supported by new "Process of Science" exercises online in *MasteringEnvironmentalScience* that use these examples to help students explore how scientists conduct their work.

- **Chapter 2:** Tracking Fukushima's Nuclear Legacy
- **Chapter 3:** Hawaii: Species Factory and Lab of Evolution
- **Chapter 3:** Monitoring Bird Populations at Hakalau Forest
- **Chapter 4:** Chronicling Ecological Recovery at Mount St. Helens
- **Chapter 5:** "Turning the Tide" for Native Oysters in Chesapeake Bay
- **Chapter 6:** Do Payments Help Preserve Forest?
- **Chapter 7:** Does Fracking Contaminate Drinking Water?
- **Chapter 8:** Did Soap Operas Reduce Fertility in Brazil?
- **Chapter 9:** Can No-Till Farming Help Us Fight Climate Change?
- **Chapter 11:** Wildlife Declines in African Reserves
- **Chapter 16:** Predicting the Oceans' "Garbage Patches"
- **Chapter 17:** Measuring the Health Impacts of Mexico City's Air Pollution
- **Chapter 18:** How Do Climate Models Work?
- **Chapter 19:** Discovering Impacts of the Gulf Oil Spill

- **Chapter 20:** Health Impacts of Chernobyl and Fukushima
- **Chapter 20:** Assessing EROI Values of Energy Sources
- **Chapter 21:** Comparing Energy Sources
- **Chapter 21:** What are the Impacts of Solar and Wind Development?

- **FAQ** This new feature highlights questions frequently posed by students in introductory environmental science courses. Some *FAQs* address widely held misconceptions, whereas others fill in common conceptual gaps in student knowledge. This feature addresses not only the questions students ask, but also the questions they sometimes hesitate to ask. In so doing, it shows students they are not alone in having these questions, and it helps to foster an environment of open inquiry in the classroom.

- **DATA Q** Each chapter now contains questions that help students to actively engage with graphs and other data-driven figures. The questions accompany several figures in each chapter, challenging students to practice quantitative skills of interpretation and analysis. To encourage students to test their understanding as they read, answers are provided in Appendix A.

- **Currency and coverage of topical issues** To live up to our book's hard-won reputation for currency, we've incorporated the most recent data possible throughout, and we've enhanced coverage of issues now gaining prominence. As climate change and energy concerns play ever-larger roles in today's world, our coverage has evolved. This edition highlights how renewable energy is growing, yet also how we continue reaching further for fossil fuels with deep offshore drilling, Arctic drilling, hydraulic fracturing for oil and shale gas, and extraction of oil sands. These choices make energy returned on investment (EROI) ratios crucially important, especially as climate change gathers force. Climate change connections continue to proliferate among topics throughout our text, and our climate change chapter includes new coverage of climate modeling, geoengineering, research into jet stream effects on extreme weather, impacts of Hurricane Sandy and other events, the latest climate predictions for the United States and the world, efforts toward carbon neutrality, and political responses at all levels.

This edition also expands its coverage of a diversity of topics including the valuation of ecosystem services, introduced species and their ecological impacts on islands, prospects for nuclear power and safety after Fukushima, advanced biofuels, hormone-disrupting substances, impacts on coastal wetlands, plastic pollution in the oceans, environmental policy, ocean acidification, sustainable agriculture, green-collar jobs, and the rebound effect in energy conservation. We continue to use sustainability as an organizing theme throughout



the book, and we aid these efforts by moving primary coverage of sustainable development to Chapter 6 and previewing Chapter 24's campus sustainability coverage in Chapter 1.

- **Enhanced style elements** We have updated and improved the look and clarity of our visual presentation throughout the text. A more open layout, more engaging photo treatments, improved maps in the case studies, and redesigned table styles all make the book more inviting and accessible for learning. This edition includes over 30% new photos, graphs, and illustrations, while existing figures have been revised to reflect current data or for better clarity or pedagogy.

## Existing Features

We have also retained the major features that made the first four editions of our book unique and that are proving so successful in classrooms across North America:

- **An emphasis on science and data analysis** We have maintained and strengthened our commitment to a rigorous presentation of modern scientific research while at the same time making science clear, accessible, and engaging to students. Explaining and illustrating the *process* of science remains a foundational goal of this endeavor. We also continue to provide an abundance of clearly cited data-rich graphs, with accompanying tools for data analysis. In our text, our figures, and numerous print and online features, we aim to challenge students and to assist them with the vital skills of data analysis and interpretation.
- **An emphasis on solutions** For many students, today's deluge of environmental dilemmas can lead them to believe that there is no hope or that they cannot personally make a difference in tackling these challenges. We have aimed to counter this impression by highlighting innovative solutions being developed around the world. While being careful not to paint too rosy a picture of the challenges that lie ahead, we demonstrate that there is ample reason for optimism, and we encourage action. Our campus sustainability coverage (Chapters 1 and 24) shows students how their peers are applying principles and lessons from environmental science to forge sustainable solutions on their own campuses. To recognize the efforts of faculty and students in encouraging sustainable practices on campus and in their communities, Pearson Education will continue to grant Sustainable Solutions Awards to exceptional campus programs. See [www.masteringenvironmentalscience.com](http://www.masteringenvironmentalscience.com) for entry details and for profiles of previous winners.
- **Central Case Studies integrated throughout the text.** We integrate each chapter's *Central Case Study* into the main text, weaving information and elaboration throughout the chapter. In this way, compelling stories about real people and real places help to teach foundational concepts by giving students a tangible framework

with which to incorporate novel ideas. We are gratified that students and instructors using our book have so consistently applauded this approach, and we hope it continues to bring further success in environmental science education.

- **The Science Behind the Story** Because we strive to engage students in the scientific process of testing and discovery, we feature *The Science Behind the Story* boxes in each chapter. By guiding students through key research efforts, this feature shows not merely *what* scientists discovered, but *how* they discovered it.
- **Weighing the Issues** These questions aim to help develop the critical-thinking skills students need to navigate multifaceted issues at the juncture of science, policy, and ethics. They serve as stopping points for students to reflect on what they have read, wrestle with complex dilemmas, and engage in spirited classroom discussion.
- **Diverse end-of-chapter features** *Reviewing Objectives* summarizes each chapter's main points and relates them to the chapter's learning objectives, enabling students to confirm that they have understood the most crucial ideas and to review concepts by turning to specified page numbers. *Testing Your Comprehension* provides concise study questions on main topics, while *Seeking Solutions* encourages broader creative thinking aimed at finding solutions. "Think It Through" questions place students in a scenario and empower them to make decisions to resolve problems. *Calculating Ecological Footprints* enables students to quantify the impacts of their own choices and measure how individual impacts scale up to the societal level.

## MasteringEnvironmentalScience

With this edition we are thrilled to offer expanded opportunities through *MasteringEnvironmentalScience*, our powerful yet easy-to-use online learning and assessment platform. We have developed new content and activities specifically to support features in the textbook, thus strengthening the connection between these online and print resources. This approach encourages students to practice their science literacy skills in an interactive environment with a diverse set of automatically graded exercises. Students benefit from self-paced activities that feature immediate wrong-answer feedback, while instructors can gauge student performance with informative diagnostics. By enabling assessment of student learning outside the classroom, *MasteringEnvironmentalScience* helps the instructor to maximize the impact of in-classroom time. As a result, both educators and learners benefit from an integrated text and online solution.

- **New to this edition** Informed by instructor feedback and instructors' desires for students to leave their environmental science course with a mastery of science literacy skills, the following are additions to *MasteringEnvironmentalScience*. The first three were created specifically for the fifth edition by our textbook's co-author Matthew Laposata:



- *Process of Science* activities help students navigate the scientific method, guiding them through in-depth explorations of experimental design using *Science Behind the Story* features from the fifth edition. These activities encourage students to think like a scientist and to practice basic skills in experimental design.
- *Interpreting Graphs and Data: Data Q* activities pair with the new in-text *Data Analysis Questions* and coach students to further develop skills related to presenting, interpreting, and thinking critically about environmental science data.
- “*First Impressions*” *Pre-Quizzes* help instructors determine their students’ existing knowledge of environmental issues and core content areas at the outset of the academic term, providing class-specific data that can then be employed for powerful teachable moments throughout the term. Assessment items in the Test Bank connect to each quiz item, so instructors can formally assess student understanding.
- *More Video Field Trips* have been added to the existing library in *MasteringEnvironmentalScience*. With three new videos you can now kick off your class period with a short visit to a wind farm, a site tackling invasive species, or a sustainable college campus.

- **Existing features** *MasteringEnvironmentalScience* also retains its popular existing features. These include existing *Interpreting Graphs and Data* exercises and the interactive *GraphIt!* program, each of which guides students in exploring how to present and interpret data and how to create graphs; interactive *Causes and Consequences* exercises, which let students probe the causes behind major issues, their consequences, and possible solutions; and *Viewpoints*, paired essays authored by invited experts who present divergent points of view on topical questions.

*Environment: The Science Behind the Stories* has grown from our experiences in teaching, research, and writing. We have been guided in our efforts by input from the hundreds of instructors across North America who have served as reviewers and advisors. The participation of so many learned, thoughtful, and committed experts and educators has improved this volume in countless ways.

We sincerely hope that our efforts are worthy of the immense importance of our subject matter. We invite you to let us know how well we have achieved our goals and where you feel we have fallen short. Please write to us in care of our editor Alison Rodal (alison.rodal@pearson.com) at Pearson Education. We value your feedback and are eager to know how we can serve you better.

—Jay Withgott and Matthew Laposata

## Instructor Supplements

### Instructor Resource Center on DVD with TestGen (0-321-93954-9)

This powerful media package is organized chapter-by-chapter and includes all teaching resources in one convenient location. You’ll find Video Field Trips, PowerPoint presentations, Active Lecture questions to facilitate class discussions (for use with or without clickers), and an image library that includes all art and tables from the text.

Included on the IRDVD, the test bank includes hundreds of multiple-choice questions plus unique graphing, and scenario-based questions to test students’ critical-thinking abilities.

### Instructor Guide (0-321-92782-6)

This comprehensive resource provides chapter outlines, key terms, and teaching tips for lecture and classroom activities.

### Blackboard Open Access (0-321-92779-6)

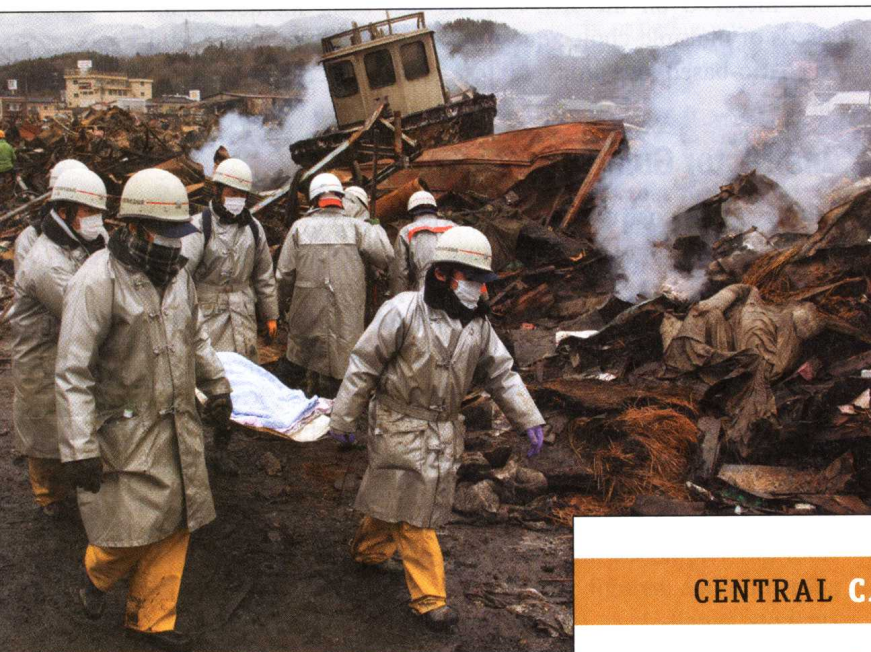
*MasteringEnvironmentalScience*™ for *Environment: The Science Behind the Stories* (0-321-92752-4)

The *MasteringEnvironmentalScience* platform is the most effective and widely used online tutorial, homework, and assessment system for the sciences.



# ENGAGE WITH REAL PEOPLE, REAL PLACES, AND REAL DATA

**Integrated Central Case Studies** highlight the real people, real places, and real data behind environmental issues. The Integrated Central Case Studies provide contextual framework to make science memorable and engaging.



## NEW! 30% of the Central Case Studies

in the book are entirely new. New case studies focus on hydraulic fracturing (Ch07), sustainable agriculture (Ch09), wildlife conservation (Ch12), air pollution (Ch17), oil sands extraction (Ch19), and more!

Central Case Studies draw students into the chapter with engaging topics that begin and are woven throughout each chapter.

## CENTRAL CASE STUDY

### The Tohoku Earthquake: Has It Shaken the World's Trust in Nuclear Power?



*"This used to be one of the best places for a business. I'm amazed at how little is left."*

—Takahiro Chiba, surveying the devastated downtown area of Ishinomaki, Japan, where his family's sushi restaurant was located

*"Fukushima should not just contain lessons for Japan, but for all 31 countries with nuclear power."*

—Tatsujiro Suzuki, Vice-chairman, Japan Atomic Energy Commission

At 2:46 p.m. on March 11, 2011, the land along the northeastern coast of the Japanese island of Honshu began to shake violently—and continued to shake for six minutes. These tremors were caused when a large section of the seafloor along a fault line 125 km (77 mi) offshore suddenly lurched, releasing huge amounts of energy through the crust and generating an earthquake of magnitude 9.0 on the Richter scale (a scale used to measure the strength of earthquakes). Little did any-

as strong ocean surges followed the 1923 Tokyo–Yokohama earthquake, pushing walls of debris in front of them and drowning victims still trapped in the wreckage from the earthquake.

The Japanese had built seawalls to protect against tsunamis, but the Tohoku quake caused the island of Honshu to sink, lowering the height of the seawalls by up to 2 m (6.5 ft) in some locations. Waves reaching up to 15 m (49 ft) in height then overwhelmed these defenses (FIGURE 2.1). The raging water swept up to 9.6

**New topographical maps** help students see the political and environmental context of stories.



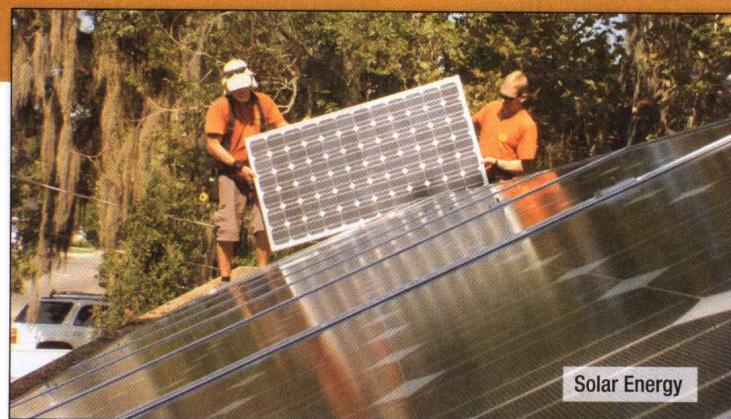


Wind Power

**Video Field Trips** offer fascinating tours of real environmental issues and solutions employed to cope with them. These videos are assignable in MasteringEnvironmentalScience and are on the Instructor Resource DVD.

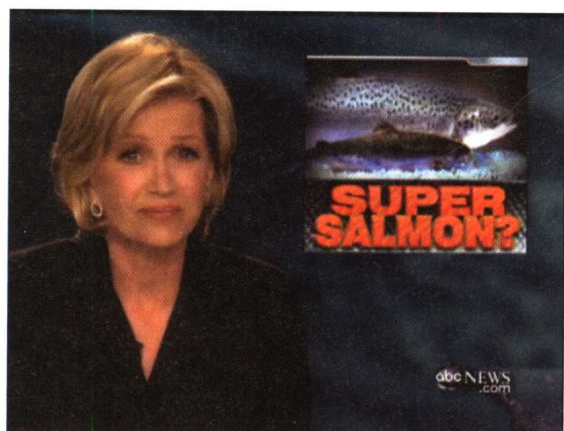
## NEW! Video Field trips include:

- Invasive Species: Lionfish
- Solutions: Sustainability on Campus
- Wind Power



Solar Energy

**Current Events from the *New York Times*** are regularly updated and invite you to connect course topics with current environmental issues.



**ABC News video clips** invite you to engage in the current conversation about the environment and sustainability.

Environmental Science 101

Chapter 15: Nonrenewable Energy and E... Current Events: Baffled About Fracking? You're Not Alone (5/13/2011)

Item Type: Activities | Difficulty: 1 | Time: 6m | Learning Outcomes | Contact the Publisher | Manage this Item

Current Events: Baffled About Fracking? You're Not Alone (5/13/2011)

Read this *New York Times* article and then answer the questions.

[Baffled About Fracking? You're Not Alone \(5/13/2011\)](#)

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**Part A**

Which of the following is true?

- ☐ Drilling is done before fracking
- ☐ Drilling and fracking are the same thing
- ☐ Fracking and drilling are done at the same time
- ☐ Fracking is done before drilling

[Submit](#) [My Answers](#) [Give Up](#)

**Part B**

Which of the following?

**The New York Times**

**Baffled About Fracking? You're Not Alone**

By MIKE ISORACHIAN  
Published May 13, 2011

Hydraulic fracturing, or "fracking," got a clean bill of health this week in the first scientific look at the safety of the oil and production practice.

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# INTERPRET AND ANALYZE STORIES USING SCIENTIFIC LITERACY SKILLS

**Science Behind the Story features** highlight how scientists develop hypotheses, test predictions, analyze and interpret data, and share findings.

## THE SCIENCE BEHIND THE STORY

### Did Soap Operas Reduce Fertility in Brazil?

Over the past 50 years, the South American nation of Brazil experienced the second-largest drop in fertility among developing nations with large populations—second only to China. In the 1960s, the average woman in Brazil had six children. Today, Brazil's total fertility rate is 1.9 children per woman, which is lower than that of the United States. Brazil's drastic decrease in fertility is interesting because, unlike China, it occurred without governmental policies that advocated controls on its citizens' reproduction.

So how did Brazil accomplish this? A major factor was change in society's view of women. It began with a civil rights movement in the 1960s, which gave females equal access to education and the opportunity to pursue careers outside the home. These efforts have been highly successful. Women now comprise 40% of the workforce in Brazil and graduate from college in greater numbers than men. And in 2010, Brazilians elected a woman, Dilma Rousseff, as their nation's president.

Although the Brazilian government



**Brazilian soap operas, called telenovelas, are a surprising cultural force for promoting lower fertility.** Here, residents gather outside a cafe in Rio de Janeiro to watch the popular program *Avenida Brasil*.

China; the procedure is illegal except in rare circumstances.

As Brazil's economy grew with industrialization, people's nutrition and access to health care improved, greatly reducing infant mortality rates. Families no longer needed to have more children than they desired for fear one or more would die at a young age.

characters, settings, and plot lines with which everyday Brazilians can identify.

*Telenovelas* do not overtly address fertility issues, but they do promote a vision of the "ideal" Brazilian family. This family is typically middle or upper class, materialistic, individualistic, and full of empowered women. By challenging existing

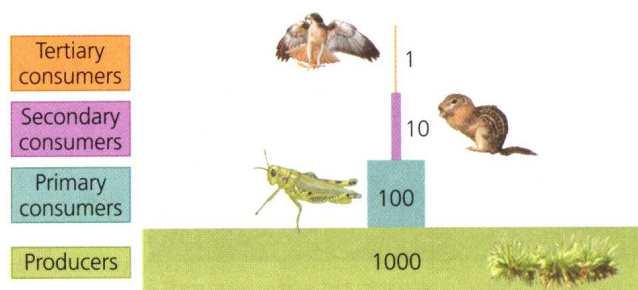
**NEW! 30% of the Science Behind the Stories are entirely new in the text.**

**Topics include:**

- Tracking Fukushima's nuclear legacy (Ch02)
- Tracking Populations of Hakea's Forest Birds (Ch03)
- Does Fracking Contaminate Drinking Water? (Ch07)

**And More!**

**NEW! Data Analysis Q's** are paired with select figures in each chapter to help you develop your scientific literacy skills. These questions allow you to check your own understanding of environmental data as you read through each chapter.



**FIGURE 4.10 Lower trophic levels generally contain more organisms, energy content, and biomass than higher trophic levels.** The tenfold ratio shown here is typical, but the shape of the pyramid may vary greatly.

**DATA Q** Using the ratios shown in this example, let's suppose that a system has 3000 grasshoppers. How many rodents would be expected?



# USE MasteringEnvironmentalScience® TO PRACTICE SCIENTIFIC LITERACY SKILLS

## NEW! Process of Science Coaching Activities,

created by coauthor Matt Laposata, help you practice the process of science demonstrated in the Science Behind the Story feature. These activities allow you to think like a scientist and put the scientific method into practice.

## Wrong Answer Feedback

Gain a better understanding of the process of science with specific wrong-feedback.

Environmental Science 101

Signed in as Juliana Tringali, Operator

Chapter 5: Environmental Systems and... Process of Science: "Turning the Tide" for Native Oysters in the Chesapeake Bay

Item Type: Coaching Activities | Difficulty: -- | Time: -- | [Contact the Publisher](#)

Manage this Item: Standard View

**Part A - Identifying variables**

Artificial reefs of two heights were constructed, and oysters were allowed to colonize the reefs, safe from harvesting. The goal was to get oysters off the bottom -- away from smothering sediments and hypoxic waters -- and up into the plankton-rich upper waters.

Sort the labels by the experimental component that each best represents.

control

treatment

independent variable

dependent variable

**High-relief reef**

**Low-relief reef**

**Unrestored bay bottom**

1. Reef type is the

2. Oyster density is a(n)

3. Spat density is a(n)

[Submit](#) [My Answers](#) [Give Up](#)

**Try Again**

You labeled 6 of 6 targets incorrectly. The control in an experiment is the unmanipulated point of comparison to which manipulated treatments are compared. Which of the labels describes the condition in this experiment that was not manipulated by the experimenter?

Withgott/Laposata 5e

Signed in as Lee Ann Doctor, Instructor

Chapter 8: Climate Change Interpreting Graphs and Data: Projections of Global Warming

Item Type: Coaching Activities | Difficulty: 1 | Time: 3m | [Learning Outcomes](#) | [Contact the Publisher](#)

Manage this Item: Standard View

**Interpreting Graphs and Data: Projections of Global Warming**

Scientists used computer models of global circulation to forecast the amount of global warming likely to result from several different scenarios.

Can you interpret the graph to answer these questions? Note that the shading around the graph lines indicates uncertainty in the predictions.

Source: IPCC, Climate change 2007: Synthesis Report, Geneva, Switzerland

**Part A**

What information is presented on the y-axis of the graph?

☐ global surface warming, in °Celsius

☐ global surface warming, in °Fahrenheit

☐ time, in 100-year intervals

☐ global surface temperature, in °Celsius

[Submit](#) [My Answers](#) [Give Up](#)

**Part B**

What does the yellow line represent?

☐ Sustainable World: The amount of global warming that is likely to occur if governments and individuals take significant actions to slow the increase in CO<sub>2</sub> emissions

☐ Today's World: The amount of global warming that is likely to occur if CO<sub>2</sub> emissions cease immediately and CO<sub>2</sub> concentrations continue at their current level

☐ Business as Usual: The amount of global warming that is likely to occur if governments and individuals take no action to slow the increase in CO<sub>2</sub> emissions

[Submit](#) [My Answers](#) [Give Up](#)

**Part C**

Which line is not a computer-generated forecast?

☐ the black line representing 20<sup>th</sup> century data

☐ the yellow line representing Today's World

☐ the red line representing Business as Usual

☐ the blue line representing a Sustainable World

[Submit](#) [My Answers](#) [Give Up](#)

## Expanded! Interpreting Graphs and Data Activities

help you develop basic data analysis skills and practice interpreting environmental data.

**Keep Practicing**  
GraphIt Activities help you analyze an environmental issue and understand the research data.

xvii



# IDENTIFY LEARNING GOALS AND RECOGNIZE MISCONCEPTIONS

3



Native Hawaiian forest at Hakalau Forest NWR, and the endangered akapolaau

## Evolution, Biodiversity, and Population Ecology

### Upon completing this chapter, you will be able to:

- Explain natural selection and cite evidence for this process
- Describe how evolution influences biodiversity
- Discuss reasons for species extinction and mass extinction events
- List the levels of ecological organization
- Outline the characteristics of populations that help predict population growth
- Assess logistic growth, carrying capacity, limiting factors, and other fundamental concepts in population ecology
- Identify efforts and challenges involved in the conservation of biodiversity

**Learning Objectives** at the beginning of each chapter define what you should be able to do after completing the chapter. MasteringEnvironmentalScience also links assessments to learning objectives so professors can track students' progress.

**Reviewing Objectives** at the end of each chapter use a learning objective framework to help you review concepts and prepare for exams.

**NEW! FAQs** highlight and correct common misconceptions about environmental issues.

### FAQ Isn't evolution based on just one man's beliefs?

Because Charles Darwin contributed so much to our early understanding of evolution, many people assume the concept itself hinges on his ideas. But scientists and laypeople had been observing nature and puzzling over fossils for a long time, and the notion of evolution was being discussed long before Darwin. Once he and Alfred Russel Wallace independently proposed the concept of natural selection, scientists finally gained a precise and feasible mechanism to explain how and why organisms change across generations. Later, geneticists discovered Gregor Mendel's research and worked out how traits are inherited—and modern evolutionary biology was born. Twentieth-century scientists Fisher, Wright, Dobzhansky, Simpson, Mayr, and others ran experiments and developed sophisticated mathematical models, documenting phenomena with extensive evidence and making evolutionary biology into one of science's strongest fields. Since then, evolutionary research by thousands of scientists has driven our understanding of biology and has facilitated spectacular advances in agriculture, medicine, and biotechnology.

## Reviewing Objectives

### You should now be able to:

- **Explain natural selection and cite evidence for this process**
  - Because organisms produce excess young, individuals vary in their traits, and many traits are inherited, some individuals will prove better at surviving and reproducing. Their genes will be passed on and become more prominent in future generations. (p. 50)
  - Mutations and recombination provide the genetic variation for natural selection. (p. 50)



# USE MasteringEnvironmentalScience® TO ENHANCE YOUR UNDERSTANDING AND IMPROVE YOUR GRADE

## Concept Review Activities

guide you through an understanding of complex content.

Withgott, Environment: The Science Behind the Stories, 5e

4 Species Interactions and Community... Concept Review Species Interactions

Item Type: Coaching Activities | Difficulty: 2 | Time: 2m | Learning Outcomes | Contact the Publisher

### Concept Review: Species Interactions

Can you identify the type of species interaction that each label describes?

**Part A**

Drag each description to the appropriate bin.

two species of mussels relying on the same species of phytoplankton as a food source

a cheetah capturing and consuming a gazelle

algae obtaining nutrients from symbiotic coral, and coral obtaining sugars from algal photosynthesis

+/- interaction

-/- interaction

competition

predation/parasitism/herbivory

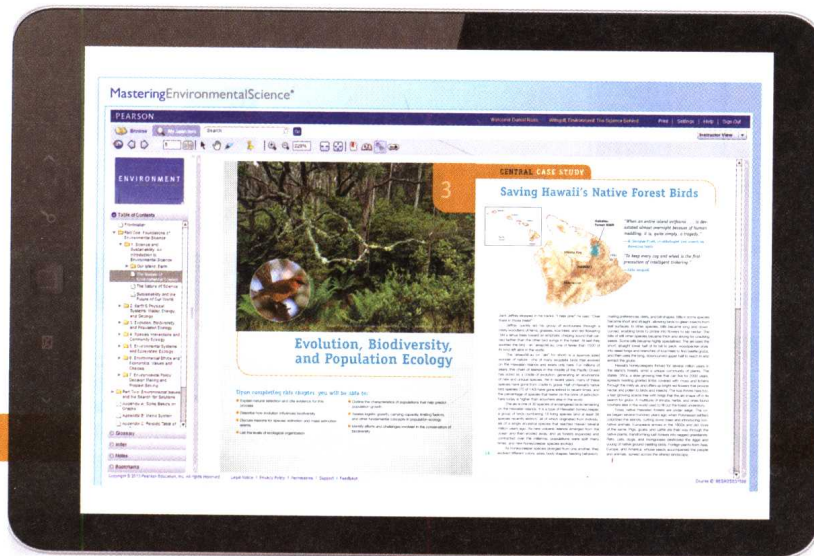
mutualism

+/- interaction

a tick sucking a dog's blood

a rabbit eating the leaves of a dandelion plant

Submit My Answers Give Up



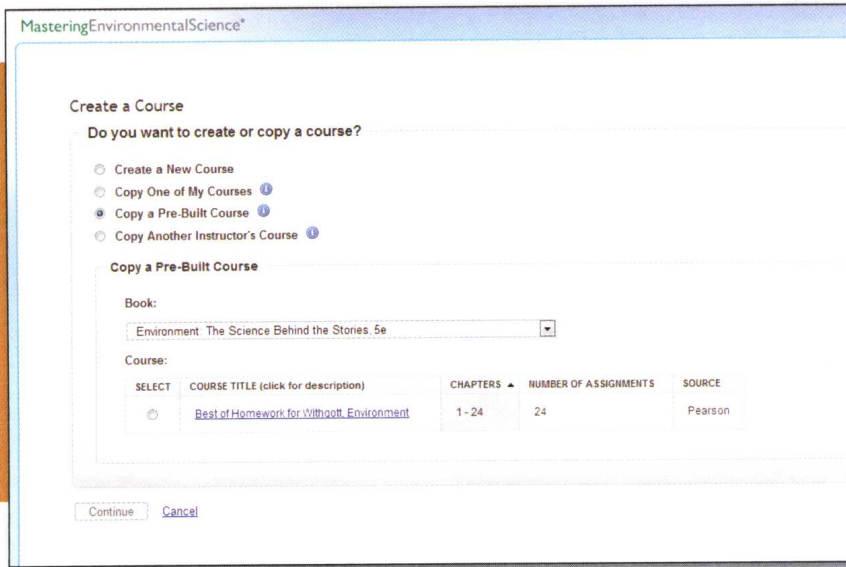
The **Pearson eText** gives you access to your text whenever and wherever you can access the Internet so you can view it on your computer and/or your mobile device (including IOS and Android)

## Additional MasteringEnvironmentalScience Resources Include:

- **Learning Catalytics™** allows you to communicate with your instructor in real time via your mobile device during class to enhance your understanding and comprehension of the course material.
- **First impressions quiz questions** help you assess your understanding of environmental issues and key concepts from the very first day of class.
- **BioFlix coaching activities** use dynamic 3-D animations to teach tough topics in Environmental Science. Activities are highly interactive, automatically graded, and include a wide variety of question types.
- **Study Area** offers a 24/7 self-study resource for you presented in an easy-to-understand chapter guide design.

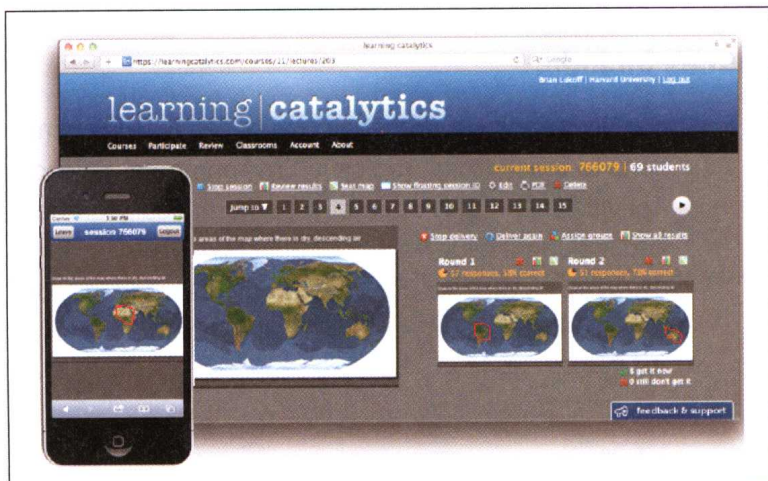
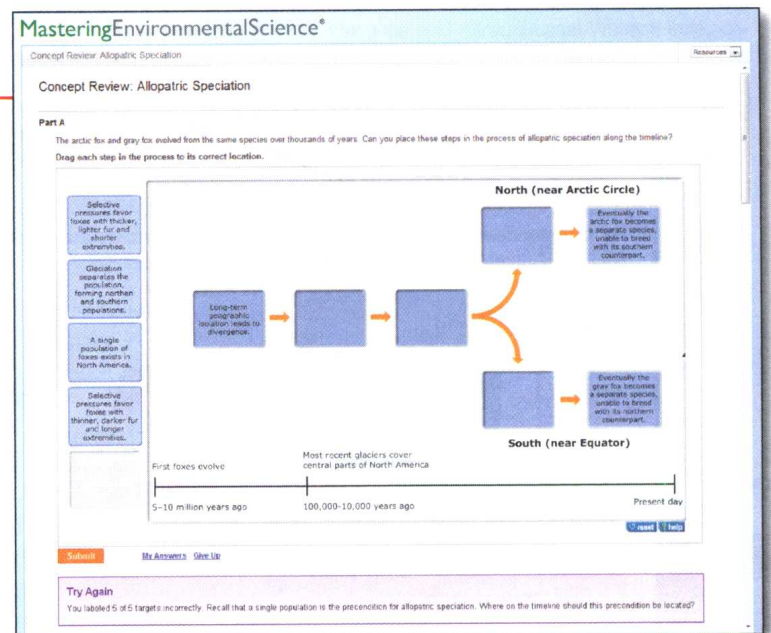


# FOR INSTRUCTORS: ENGAGE AND ASSESS STUDENTS WITH MasteringEnvironmentalScience®



**Quickly select pre-built assignments created by Matthew Laposata** that offer a wide range of interactive, engaging, assignable activities—including animations, videos, and news articles.

With **MasteringEnvironmental Science™** students benefit from activities that feature immediate wrong-answer feedback to help keep them on track.



## NEW! Learning Catalytics

Learning Catalytics™ is a “bring your own device” student engagement, assessment, and classroom intelligence system. With Learning Catalytics you can infuse your lectures with opportunities for active learning, assess student understanding in real time, and adjust your lecture accordingly.



# TRACK STUDENT PERFORMANCE AND HELP STUDENTS SUCCEED

## Gradebook

Get easy-to-interpret insights into student performance using the gradebook.

- Every assignment is automatically graded.
- Shades of red highlight vulnerable students and challenging assignments.

MasteringEnvironmentalScience®

Environmental Science 101

Course Home Assignments Roster Gradebook Item Library

Instructor Resources eText Study Area

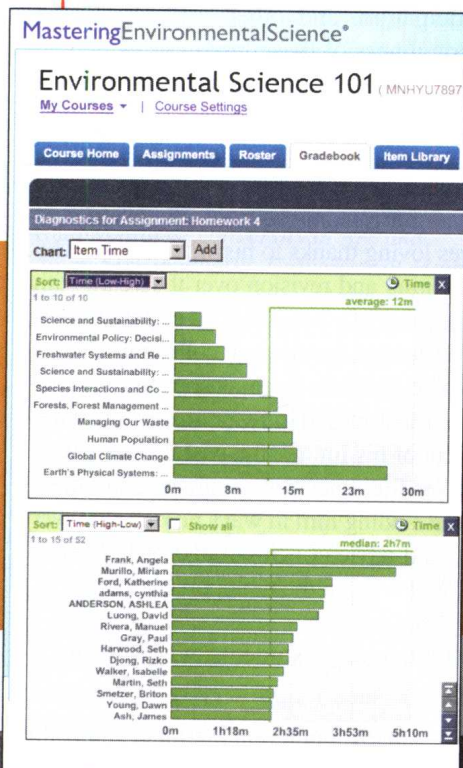
Filter: Showing score in All Categories for All Students

Score Time Difficulty Students Per Page: 25

Name	Intro	Ch. 2	Ch. 3	Ch. 4	Lab 1	Ch. 5	Ch. 6	Ch. 7	Ch. 8	Ch. 9	Lab 2	Ch. 10	Ch. 11	Ch. 12	Total
Class Average	--	91.5	97.3	95.5	63.6	89.5	90.3	87.1	91.8	83.3	86.2	89.4	77.5	72.3	81.3
Mitchell, Doug	--	88.3	69.0	98.9	61.9	104	102	91.4	85.0	100	95.0	99.7	64.9	0.0	73.3
Larsen, Melanie	--	101	100	96.6	83.3	102	99.9	0.0	95.8	101	100	0.0	87.4	0.0	82.1
Thomas, Dylan	--	98.8	104	96.9	64.3	105	0.0	88.9	100	75.8	100	86.3	77.8	102	71.1
Paulson, Madison	--	59.9	65.3	87.5	0.0	102	97.5	83.6	95.0	88.4	95.0	93.2	65.1	94.2	72.2
Chavez, Matthew	--	84.4	97.3	93.8	92.9	98.0	49.5	72.9	72.9	47.5	80.0	86.9	36.3	104	78.1
Patel, Indra	--	101	100	98.9	68.5	97.7	100	96.1	100	99.2	100	89.0	75.3	77.7	90.3
McAllister, Rachel	--	87.0	80.7	93.5	0.0	30.7	86.3	75.7	80.0	83.4	90.0	99.2	67.0	104	64.8
Lee, Erika	--	77.0	98.7	91.8	54.2	65.7	90.1	85.4	96.3	76.2	90.0	66.1	88.3	90.4	77.7

## One-click Diagnostics

show where students are struggling or progressing.



## MasteringEnvironmentalScience®

### Environmental Science 101 (MNHYU78972)

My Courses | Course Settings

### Learning Outcomes Summary

The list below contains learning outcomes specified for items assigned in this course. The initial order reflects the sequence of outcomes as they appear in assignments, but you can sort them by any column. [Learn more about using learning outcomes.](#)

Export

#	LEARNING OUTCOMES	# OF ITEMS	% COMPLETE	% AVERAGE SCORE
1	+ Demonstrate an understanding of the principles of scientific inquiry.	6	100	<div><div></div></div> 87.8
2	+ Demonstrate the ability to think critically and employ critical thinking skills.	4	50	<div><div></div></div> 85.0
3	- Read and interpret graphs and data.	5	50	<div><div></div></div> 72.5
ASSIGNMENTS		ITEMS	% COMPLETE	% AVERAGE SCORE
<a href="#">Week 2 Quiz</a>		<a href="#">Activity: Introduction to Graphs and Data</a>	100	<div><div></div></div> 87.8
<a href="#">Week 2 Quiz</a>		<a href="#">Activity: Interpreting and Analyzing Visual Data</a>	100	<div><div></div></div> 57.1
<a href="#">Week 5 Quiz</a>		<a href="#">Activity: Describing Relationships and Trends in Data</a>	0.0	<div><div></div></div> ..
<a href="#">Week 5 Quiz</a>		<a href="#">Activity: Forming Conclusions Based on Graphical Data</a>	0.0	<div><div></div></div> ..
4	+ Demonstrate the quantitative skills needed to succeed in this course.	2	50	<div><div></div></div> 75.0

Track student performance and concept mastery against publisher-provided learning outcomes, or create your own.



# Acknowledgments

A textbook is the product of *many* more minds and hearts than one might guess from the names on the cover. The two of us are exceedingly fortunate to be supported and guided by a tremendous publishing team and by a small army of experts in environmental science who have generously shared their time and expertise. The strengths of this book result from the collective labor and dedication of innumerable people.

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Moreover, the many sales representatives who help to communicate our vision, deliver our product to instructors, and work with instructors to assure their satisfaction, are absolutely vital. We have been blessed with an amazingly sharp and dedicated sales force, and we deeply appreciate their tireless work and commitment.

In the lists of reviewers that follow, we acknowledge the many instructors and outside experts who have helped us to maximize the quality and accuracy of our content and presentation through their chapter reviews, feature reviews, class tests, focus group participation, and other services. If the thoughtfulness and thoroughness of these hundreds of people are any indication, we feel confident that the teaching of environmental science is in excellent hands!

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We dedicate this book to today's students, who will shape tomorrow's world.

—Jay Withgott and Matthew Laposata