ACKNOWLEDGEMENTS

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MY WORLD GIS™ SOFTWARE

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Preface
by Daniel Edelson and Robert Kolvoord

This collection has been written for you—educators—to introduce you and your students to applications of geographic information system (GIS) software in social studies and science. It contains a set of activities that were selected to demonstrate the value of GIS for inquiry-based education. These activities use My World GIS™, a desktop GIS environment that was specifically designed by researchers in educational technology to make interactive mapping and spatial analysis intuitive for your students. Think of these activities as your introduction to a much bigger world. They’ll get you started, and where you go from there is only limited by your imagination.

Interacting with the world is an inherently spatial activity. From the time we get up in the morning until we go to sleep, we are faced with spatial decisions both large and small. From deciding how best to get to work or school to understanding how events in far-off lands impact our lives, we need to be able to reason spatially and think geographically. With the increasing focus on globalization, the need for these skills is more and more acute, yet they remain beyond the reach of many teachers and students.

How then do we help bring spatial reasoning and geographic thinking more to the forefront in classrooms? The editors have each spent a large portion of their careers bringing data visualization tools to K-12 classrooms. In our experience, the use of these tools, and specifically GIS, offers students opportunities to build spatial reasoning and geographic thinking. Those opportunities are currently unavailable in many K-12—and university—classrooms. Note that this is not the same as simply learning to use a piece of software. While developing software skills is certainly a byproduct of the use of GIS in the classroom, it is not the intent. We strongly advocate teaching with GIS as opposed to just teaching about GIS. By integrating the tool in a variety of content areas, it encourages students to take a spatial perspective and makes it easier for teachers to build geographic-thinking and problem-solving skills.

However, this skill-building doesn’t happen by accident. It needs to be thoughtfully constructed, as you’ll see in the activities in this book. We have gathered a group of experienced and dedicated educators to create these activities. All of the activities are classroom tested and range in both grade level and GIS complexity so that you can find activities that work best in your particular situation.

A growing body of research suggests that spatial-thinking skills can be critical to success in science, engineering, technology, and mathematics (STEM) majors and that these skills can be built over time. (It’s not just your native ability that matters). As we consider our national priorities in education, it’s important not to leave spatial thinking and geographic problem-solving by the side of the road.

You’ve taken the first step and at least opened/downloaded this collection. Take another step, and try the activities with your students. You may be surprised by what they can do and the kinds of problems they can start to solve.

Introduction
Welcome to this set of activities for My World GIS. The activities were developed by an outstanding group of authors who are active curriculum developers and users of My World GIS in K-12 and higher education. The set of activities was designed to span a range of curricular areas and grade levels and to use the powerful features of My World GIS to help students learn key content and practice spatial problem solving. The tables on pages iv and v provide a roadmap to the specific content, grade levels, and GIS skills for each activity.
The earlier activities tend to have more detailed instructions to help students new to GIS. If you choose to start with later activities, you will need to provide an introduction for those students unfamiliar with My World GIS.

Each activity comes with a set of student instructions, student worksheets, and instructor notes with additional information and ideas about classroom management. Every activity comes with any required data, though some activities have you and your students collect your own data to import to My World GIS.

The activities focus on inquiry and using GIS for problem solving and decision making, not learning about GIS. Many of the activities suggest ways to extend the inquiry in that activity.

We suggest you always completely test any activity before giving it to your students. Though we've tested and reviewed every activity carefully, there's always the chance we missed something.

You will find that each author presents his/her activity in a slightly different way. We chose not to edit them all into a similar format so that you could see the array of possibilities for activity structure and decide what format works best for you and your students.

Each activity comes with a data dictionary that lists all of the data layers for that lesson, including their type and source. This will help you both use the activities and also know where to go to find more data.
<table>
<thead>
<tr>
<th>Project</th>
<th>Grade level</th>
<th>Guiding Questions</th>
<th>Objectives Students will be able to:</th>
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</thead>
</table>
| I. What’s it Like Where You Live? Mapping Climate and Biomes            | 5-8         | How does climate determine the plants and animals that are able to inhabit a particular location? | • read and analyze climate and biome maps  
• describe geographic and quantitative patterns  
• compare and contrast regional data |
| by Bob Coulter                                                          |             |                                                                                 |                                                                                                     |
| II. How Warm is the Ocean? Currents and Sea Surface Temperature         | 9-12        | How do ocean currents impact seasonal sea surface temperatures?                   | • describe how technological advances have impacted the field of oceanography, focusing on the use of satellites  
• observe seasonal changes in sea surface temperatures (SSTs) throughout the year, identifying months with the warmest and coldest coastal SSTs |
| By Steven Moore, J. Vuturo Brady, and H. Bond                           |             |                                                                                 |                                                                                                     |
| III. Can Global Warming Cause Global Cooling? Climate Change in Greenland and the North Atlantic | 8-12        | How fast is the Greenland ice sheet melting, and what are the possible impacts of that change? | • describe the rate of change of the Greenland ice sheet and the impacts on salinity in the North Atlantic  
• explain the possible impact of climate change on the global thermohaline ocean circulation  
• relate ocean currents to terrestrial climate classification |
| By Betsy Youngman and David Smith                                      |             |                                                                                 |                                                                                                     |
| IV. Water and Community: Seattle’s Urban Creeks                        | 7-12        | What factors influence the health of urban watersheds?                           | • use GIS layers to identify characteristics of watersheds  
• evaluate human impacts on a watershed  
• determine a research question and how GIS can answer the question |
| By Kate Bedient et al                                                  |             |                                                                                 |                                                                                                     |
| V. Alien Invasion: The Spread of Invasive Species in the United States  | 9-12        | What are the limits on the spread of invasive species?                           | • read and analyze maps of invasive species and climate  
• describe limits on the spread of invasive species  
• download and import shapefiles and add fields to shapefiles |
| By Betsy Youngman                                                     |             |                                                                                 |                                                                                                     |
| VI. Clear as Night and Day: Calculating Sunrise and Sunset             | 6-9         | What is the length of a degree longitude and latitude in your geographic location, and how does it affect sunrise and sunset? | • look for patterns in the passage of sunlight across the surface of the Earth  
• calculate ground data from geographic observations  
• calculate the distance from one point to another  
• complete a distance-to-ground time calculation  
• formulate a hypothesis concerning sunrise/sunset variability |
| By Steven Branting                                                     |             |                                                                                 |                                                                                                     |
| VII. GIS Goes Around the World in 80 Days                              | 5-10        | How does the accuracy of what we know about Earth’s surface affect how we think about places? What are the considerations we take when choosing how we get from one place to another? | • research and take notes as it applies to a specific problem  
• explore the relationship between maps and data  
• use their research and maps to make an informed decision |
| By Barbaree Ash Duke                                                  |             |                                                                                 |                                                                                                     |
| VIII. Sailing to Buy a Wedding Dress: The Disaster of the Schooner Industry | 8-11        | How can analysis of both historical accounts and geographic information help us to interpret events of the past? | • locate possible positions of the shipwreck of the schooner Industry |
| By Margaret Shaw Chernosky                                            |             |                                                                                 |                                                                                                     |
| IX. GPS to GIS: What’s So Spatial About the Cemetery? By Steven Branting | 6-12        | How does the mapping of a cemetery allow one to discover burial patterns?         | • investigate the role of field work in the development of GIS data sets  
• visualize possible patterns of human activity  
• experiment with current technology as a mapping tool  
• collect and import GPS data into My World |
• pose questions that can be addressed with available GIS data files and My World analysis tools  
• use My World to create data selection rules using values and math operations  
• prepare side-by-side data maps and identify any correlations |
| By Rick Thomas                                                        |             |                                                                                 |                                                                                                     |
| XI. Connecting Time and Space: 19th Century U.S. Settlement Patterns    | 6-9         | How did the settlement and transportation patterns in early America change over time? | • manipulate and interpret data layers showing spatial relationships of early 19th century settlement and land and water transportation in the United States  
• describe push and pull factors that influence human settlement  
• compare and contrast transportation in the United States from 1810 to 1850  
• explain the relationship between cost, distance, time, and market access to better understand the development of transportation networks |
| By Chris Bunin                                                        |             |                                                                                 |                                                                                                     |
| XII. Young Entrepreneurs: Determining Business Location by Andrew J. Milson | 9-12        | How do demographics influence business decisions? What spatial relationships contribute to the success of businesses? | • analyze the interrelationships between human and physical geographic characteristics in the context of real-world decision-making  
• analyze economic and demographic data to determine the level of development and standard of living of a location  
• analyze data to understand the effects of physical and human processes on economic conditions and resource distribution  
• use geographic information from databases to answer geographic questions  
• use maps and graphs to make decisions and communicate information  
• evaluate the importance of the location in the production of an economic good or service |
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<th>Intermediate</th>
<th>Advanced</th>
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My World GIS Software

My World GIS is a Geographic Information System (GIS) designed for students, featuring intuitive navigation and drag-and-drop layering. Based on more than a decade of research, My World GIS provides the functionality of a full-featured GIS with the ease-of-use required by students and the ease-of-administration critical to schools. My World GIS was developed by the Geographic Data in Education (GEODE) Initiative at Northwestern University with the support of the National Science Foundation. In 2008, the National Geographic Society's division of Education Programs took over development and maintenance of My World. My World GIS is distributed by PASCO Scientific (http://www.pasco.com/myworld).

Designed specifically for use by middle school through college students, My World provides a carefully selected, high-value subset of the features of a professional GIS environment, including multiple geographic projections, table and map views of data, distance-measurement tools, buffering and query operations and customizable map displays. My World comes with a data library of more than 50 data sets including population, climate, elevation, and earthquake and volcano activity.

The goal of My World is to allow students to conduct investigations with scientific data in the same way scientists do. Modern science is largely done computationally. Of all the computational tools used by geoscientists, one of the most powerful is GIS.

My World supports an inquiry-based approach to learning. Conducting scientific investigations enables students to extend and reinforce their understanding of scientific concepts. Just as important, students learn firsthand how scientists develop and collect evidence for hypotheses.

About the Project Contributors

EDITORS

Daniel C. Edelson
As vice president for Education at the National Geographic Society, Daniel Edelson oversees efforts to improve geographic and environmental education in the United States and abroad. This work includes the creation of educational materials for learners of all ages, professional development for educators, public engagement and advocacy on behalf of geographic education, and grant-making to support geo-literacy initiatives. Prior to joining National Geographic, Edelson was a professor at Northwestern University, where he oversaw the GEODE Initiative and oversaw the development of My World GIS™.

Robert Kolvoord
Robert Kolvoord is a professor of Integrated Science and Technology at James Madison University (JMU) and the interim dean of the College of Integrated Science and Engineering. For the last twenty years, he has worked with K-12 teachers to develop curriculum materials to bring data visualization tools, especially GIS, into classrooms across the country and around the world. Robert is the co-author (with Kathryn Keranen) of Making Spatial Decisions Using GIS. He is also the creator of the Geospatial Semester, a unique dual-enrollment partnership between JMU and Virginia schools.

MANAGING EDITORS

Anne P. Haywood
Anne Haywood currently lives in Miami, Florida, and has worked for more than a decade on publishing, public awareness, instructional design, and field-based programs for National Geographic’s education divisions. Her initiatives include producing the Reading Expeditions: World Regions and World Cultures series for School Publishing, managing the My Wonderful World geo-literacy campaign, and developing education components for the National Geographic BioBlitz, a ten-year citizen science effort with the National Park Service. Anne has a B.A. in English from Wake Forest University and an
M.A. in geography from University of North Carolina at Chapel Hill. Prior to work with National Geographic, she taught in environmental, magnet, and gifted-education programs in Texas, Virginia, and Colorado.

Elizabeth Youngman
Betsy Youngman is a retired member of the science faculty at Phoenix Country Day School, where she taught middle and high school science. Betsy held the Dorrance Faculty Chair for Excellence in Science Teaching. Betsy has a master’s degree in science education from Montana State University, where she focused on the use of geospatial tools in science education. Through the Teachers Experiencing Antarctica and the Arctic (TEA) program Betsy participated in two climate change research expeditions to Summit, Greenland (2001) and the South Pole, Antarctica (2002-2003.) Betsy’s dual passions for education and the out-of-doors have driven her to design and lead science-focused trips for students to the beaches of Cape Cod, the kelp forests of the Channel Islands, the tundra of the Arctic, and the rainforests of Costa Rica. Betsy designs and writes environmental science curriculum units for students in grades 5-12.

SOFTWARE DEVELOPER
Eric O. Russell
Eric Russell was the lead software developer on My World GIS and is currently the lead software engineer of the FieldScope project in National Geographic’s Education Division. He has been developing educational GIS software for more than ten years, using a variety of languages and technologies. He has a master of science degree in computer science and a bachelor of arts degree in cognitive science, both from Northwestern University. Eric’s research interests include agent-based modeling, machine learning, and visualization of spatio-temporal data, in addition to GIS in education.

AUTHORS
Kate Bedient
Kate Bedient is currently IslandWood’s Brightwater Education Manager, overseeing program development and implementation at King County’s newest wastewater treatment plant in Washington State. She holds a master’s degree in education from Western Washington University and a bachelor’s of science in geology from Vassar College. Kate has been an educator at the Pacific Science Center and the North Cascades Institute and in both cases was part of curriculum development teams. The work included in this book was a collaboration amongst a number of individuals including Todd Burley, Sharon London, and Darcie Garland-Renn. Homewaters Project, now a program of IslandWood, held the original copyright on much of this material, and she is excited to share now it with a wider audience. She would like to thank King County and the City of Seattle for the use of its data.

Steven Branting
A career educator of gifted students, Steven Branting has been honored for his GIS classroom innovations, research, and field work by, among others, The History Channel, the American Association for State and Local History, the Association of American Geographers, and the Society for American Archaeology. A 2009 nominee for the American Historical Association’s William Gilbert Award to recognize outstanding contributions to the teaching of history through the publication of magazine articles, he has written about historical GIS-related topics for ESRI, URISA, The Western Historical Quarterly, The History Teacher, and the Journal of the Association for History and Computing. In 2011 the Idaho State Historical Society conferred upon him the Esto Perpetua Award, its highest honor, citing his leadership in “some of the most significant preservation and interpretation projects undertaken in Idaho.”

Chris Bunin
Chris Bunin is the director of Teacher Scholar Programs for the “America on the World Stage” Teaching American History project, which is a partnership between five central Virginia school divisions and the University of Virginia. He
facilitates professional development programs that train teachers to blend historical content, critical thinking skills, and 21st century technologies into best practice curriculum for the K-12 classroom. Prior to these positions, Chris spent 8 years teaching middle school history. His teaching and research interests include historical geography, integrating geospatial technologies across the curriculum, and engaging active learners. In his free time Chris enjoys hiking, cycling, and spending time with his family (wife, Elizabeth and 2 year-old son Tucker.)

Margaret Chernosky
Margaret teaches World Geography, AP Human Geography, and GIS in Geography at Bangor High School and has written curriculum for ArcGIS and My World GIS. She earned a masters of education and a CAS from the University of Maine in secondary social studies with a concentration in geospatial education. This year she was named the National Geographic Grosvenor Teacher Fellow, circumnavigating the Svalbard Islands, 80°N, with the National Geographic Explorer. She owns a small farm in central Maine and raises a large organic garden.

Bob Coulter
Bob Coulter, director of the Missouri Botanical Garden’s Litzsinger Road Ecology Center, has more than a decade of experience using geospatial tools with students. He is currently the principal investigator and project director for two National Science Foundation-funded research projects, each of which leverages youth interest in technology and service learning to build commitment to the local environment. Prior to joining the Garden he was an award-winning science and mathematics educator in both formal and informal settings.

Barbaree Ash Duke
Barbaree Ash Duke is veteran classroom teacher and an educational consultant with GISetc based in Covington, LA. She taught English language arts in grades 6-12 as well as a technology and GIS electives. Barbaree also serves as the webinar manager for the National Council for Geographic Education. Barbaree earned her bachelor's degree in secondary education with a concentration in English at Baylor University and taught for 15 years in Texas, Alabama, and North Carolina. She’s been integrating GIS into her the classroom since 2000. Along with numerous articles and lessons on integrating geospatial technologies into the classroom, she’s authored two books: 20 Minute GIS for Young Explorers as well as a solo work, Reading, Writing and Thinking around the Globe: Geospatial Technologies for English Language Arts and Beyond. She also has many free resources on her website, www.barbareeduke.com.

Andrew Milson
Andrew J. Milson, Ph.D. is a professor of social science education and geography at the University of Texas at Arlington. He teaches courses in human geography, GIS, and social studies education, and conducts research on geographic education and the use of geospatial technologies in educational environments. He served as a co-editor of the books, International Perspectives on Teaching and Learning with GIS in Secondary Schools (Springer, 2012) and Digital Geography: Geospatial Technologies in the Social Studies Classroom (Information Age, 2008.) He is an elected member of the Executive Board of the National Council for Geographic Education and serves as an associate editor of the Journal of Geography.

Steven Moore, Jennifer Vuturo-Brady, and Hedley Bond
Steven Moore is chief executive officer (CEO) of Science Approach, LLC, an e-learning business located in Tucson, AZ. Dr. Moore holds a Ph.D. in renewable natural resources studies and sociology. Dr. Moore has served as the principal investigator for seventeen federally and privately funded projects. Development of the “How Warm is the Ocean?” lesson was funded by the projects: CoastLines and Exploring Data with GIS to Experience Sanctuaries.

Jennifer Vuturo-Brady is one of Science Approach’s founding members. She holds bachelor of science degrees in biology...
and secondary education and a master's degree in biology. Ms. Brady directed the CoastLines and Exploring Data with GIS to Experience Sanctuaries projects.

Hedley Bond served as a programmer and materials developer for Science Approach projects. He holds a Ph.D. in biology (community ecology) from the University of Utah and a M.Sc. in computer science from the University of Tennessee. He has taught classes in botany, general biology, and ecology at Melbourne State College, Australia, and the University of Tennessee, in addition to courses in computer science at the University of Tennessee. Dr. Bond was also a systems analyst and programmer for the radiology department at the University of Tennessee Memorial Hospital where he was particularly involved in developing networking and supplementing imaging software in PET and Nuclear Medicine. He recently completed a Peace Corps assignment in Armenia.

Rick Thomas
Rick Thomas is a retired secondary history and math teacher with an extensive background in the use of computers in education. Most recently this includes curriculum development involving the application of GIS in the history classroom. His website, In Time and Place (www.intimeandplace.org), provides materials for students and teachers on topics such as those related to the Japanese Internment included here and ranging from the Cherokee Removal to the environmental history of the gold rush in California’s Mother Lode.

David Smith
David Smith is currently the GIS and Mapping Support Consultant at the University of Redlands in Redlands California where he provides GIS and computer mapping support for the university’s Spatial Thinking Initiative which includes data acquisition, visualization and analysis for student and faculty use across the campus. Prior to coming to the University of Redlands, he was an educational designer for THE GLOBE Program and project manager of the Watershed Dynamics Earth System Science Project. Mr. Smith was also on the original My World development and technical team at Northwestern University, acting as a curriculum development specialist where he developed a series of My World activities for use in K-12 education.