To our families, especially our husbands, Pat, Roger, and Brian—
Thank you for your support, guidance, patience, and love.

Lyn Malone, Anita M. Palmer, Christine L. Voigt

To Joe Ferguson and Ann Judge, devoted teachers and eager students
who lost their lives on September 11, 2001—
Your passion and dedication to geographic education lives on.
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I have always had a fascination with maps. I like maps that tell me where I am or where I can go and what I can do and see once I get there. I have always wanted to share that fascination with my colleagues and students.

As soon as I was introduced to GIS, I set upon finding out how to introduce and use it in the classroom. But I was lost and didn’t have a clue where to begin. At a conference in Austin, Texas, I discovered a book called Mapping Our World: GIS Lessons for Educators and had the opportunity to talk with the authors. Little did I know that this would become my own map into the world of GIS in the classroom.

Like most teachers who see GIS being used in the classroom, I immediately had tons of questions, mostly about making different maps with the software. Mapping Our World gave me—and can give other teachers who are not experienced with GIS—the confidence to introduce it to their students and go forward with the lessons. With Mapping Our World we have the structure and support we need to integrate GIS into the curriculum.

What really clicked for me was seeing Mapping Our World move students and teachers into the realm of spatial inquiry. I finally understood that I had a tool with the flexibility to get students hooked into exploring their world beyond a paper map; they could learn to ask questions, to seek answers, and to develop solutions based upon their findings. As I used Mapping Our World more I could see students growing from making cool labels on maps and identifying countries and locations to thinking critically and solving problems. This was very exciting.

Mapping Our World can really begin to bring to students the ability to take charge of their own learning. Watching students help each other sort data, make decisions, come to a consensus, and finally make a finished map to explain how they would answer their questions is something that most teachers strive for in the classroom. This only becomes available during special, specific lessons, but with Mapping Our World, it can occur throughout the year within the curriculum.

During this past year, I have been taking notes on how teachers are using Mapping Our World in the classroom. Students have told me excitedly, “I like this better than using paper maps” and “I can explore on my own.” One time I was working with a sixth-grade class, where part of the lesson was for students to study a thematic map to look at population patterns and the countries in the African continent. One student thought that two red polygons represented two population ranges within the same country, but when we used the Identify tool and discussed the importance of reading legends on a GIS map, she saw they were really two different countries. How often do we miss glimpses into students’ misconceptions?

I am often asked about using GIS with students who have learning challenges. I have seen all students from the very young to gifted and talented to learning challenged who respond remarkably well to GIS. This is because GIS allows...
students to think visually or spatially (also because young people understand computers, often better than we do). I believe GIS is the tool to help all students develop their spatial thinking skills.

In its first incarnation, this book helped me to share my fascination with maps with other educators, teachers, and students. I am delighted that this new edition, updated to the latest software, is available because it can only widen the audience. *Mapping Our World* answers many questions and opens the door to more questions. I encourage all educators and teachers to use this resource; *Mapping Our World* has everything you need to be successful.

Eric Bowman  
Instructional Technology Specialist  
North East Independent School District  
San Antonio, Texas
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All the lessons in this book were reviewed and tested by classroom teachers. We thank them for taking the time to work through these lessons with their students to ensure their accuracy and relevance: Brad Baker of Bishop Dunne Catholic School, Dallas, Texas; Gerry Bell of Port Colborne High School, Port Colborne, Ontario; Shanna Hurt of Arapahoe High School, Littleton, Colorado; Marsha MacLean of the Redlands Unified School District, Redlands, California; Bart Manson and Joe Myszkowski of Red River High School, Grand Forks, North Dakota; Cathy Pleau of V. J. Gallagher Middle School, Smithfield, Rhode Island; Cynthia J. Ryan of Barrington Middle School, Barrington, Rhode Island; Herb Thompson of Greenspun Junior High School, Henderson, Nevada; and Patricia Walls of Taylor County Middle School, Grafton, West Virginia.

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Thanks also to Roger Palmer of Red River High School, Grand Forks, North Dakota, who spent countless hours to ensure that the book aligns with the national science and technology standards.

We also say thanks to Jim Trelstad-Porter, Director of International Student Advising at Augsburg College, who interpreted Spanish data and correspondence with the Instituto Nacional de Estadistica, Geografia e Informatica in Mexico.
Data acknowledgments

The authors and ESRI would like to thank the following data providers for contributing data and maps to this book:

Color shaded relief image of the world (modules 2 and 5) provided by WorldSat International, Inc. Copyright © 2004. All rights reserved (www.worldsat.com).

Agriculture (modules 3, 5 and 7), airports (module 7), energy (module 7), faults (module 2), lakes (module 5), oil and gas (module 5), population density (modules 2, 3, and 5), precipitation (modules 3 and 7), relief (module 3), rivers (module 5), tectonic plates (module 2), and volcanoes (module 2) are ArcAtlas™ layers based on data provided by Data+ and ESRI. Copyright © 1996 Data+ and ESRI. All rights reserved.

World economics and vital statistics data (modules 4 and 6) provided by CountryWatch.com, Inc. Copyright © CountryWatch.com, Inc. (www.countrywatch.com). All rights reserved.

2000 earthquake data (module 2) provided by Advanced National Seismic System (ANSS), formerly Council of the National Seismic System (CNSS). On the Web: quake.geo.berkeley.edu/cnss.


Supplemental volcano data (module 2) provided by Smithsonian Institution, Global Volcanism Program. On the Web: www.volcano.si.edu/world.

Temperature and precipitation data for cities (module 3) provided by Worldclimate.com (www.worldclimate.com).

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Historical city data from Four Thousand Years of Urban Growth: An Historical Census (module 4) provided by Edwin Mellen Press. Copyright © 1987.

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Yemen border map data was constructed by the authors from information published by the British Yemeni Society.

California counties (module 6) provided by Tele Atlas and ESRI. Copyright © 2004. All rights reserved.

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Introduction

Dear Teacher,

Welcome to Mapping Our World: GIS Lessons for Educators, ArcGIS 9 Desktop Edition. This is a book of ideas, resources, exercises, and data that we believe will prove a valuable supplement to your World Geography course. It’s not meant to take the place of your current textbook or curriculum, but to enhance it, to expand it into the world of high-speed computing, vast databases, the World Wide Web, and the supermaps of geographic information systems.

This book updates the materials from the original Mapping Our World book for use with the latest GIS software, ArcGIS 9 Desktop. If you have experience using “The Big Green Book” with your students, don’t worry—all of your favorite lessons are still here. The intent and general design of the lessons, including the standards covered and the assessment rubrics, have not changed. In general, exercises were modified only where necessary to accommodate changes and new tools in the software. Exercise data has been reorganized to take advantage of the geodatabase format.

This book contains everything you need to create GIS projects: lessons with student handouts and data; answer keys; and assessments and rubrics. It also contains a one-year site license of ArcGIS 9 Desktop software. This means that your students will be using the same tools as the ones being used by professional planners, emergency- and disaster-response personnel, government agencies around the world, and businesses of every description. There is also a companion Web site (www.esri.com/mappingourworld) that has additional resources to help you integrate GIS technology and your curriculum as easily as possible.

We have designed the book with teachers in mind. For example, the physical shape of this book is one inch wider than the standard 8½-by-11 size, to make it easier for you to make copies of the student handouts. The unique binding allows the book to lie as flat as possible when making copies or on your desk. A digital copy of the book is provided on the data CD if you prefer to print the handouts from your computer. The lessons themselves have graphical cues to remind your students of questions they should answer and key items to notice.

Please take some time to read the How to Use this Book section. There you will find information on how the book is organized, what order to go through the lessons, and some important technical information related to the software and exercise data.

We hope you find Mapping Our World to be a useful tool for your classroom!

Sincerely,

The Mapping Our World Team
Using the lessons in this book, you and your class will investigate patterns of human life and the physical environment that span the globe, explore issues of concern to millions of people, and analyze data and information gathered from across the world to across the street. Your students will find, integrate, and use data culled from many sources, and build the core knowledge and skills essential for coping in a world increasingly characterized by vast quantities of raw information. Best of all, it will be fun.

**Where to begin**

Before using the *Mapping Our World* materials with your class, we recommend that you review and complete the following ordered list:

1. Finish reading this section and skim through the book to locate the various sections (modules, lessons, rubrics, answer keys, and so on).
2. Install software on your computer and the student computers. (Refer to “Setting up the software and data” later in this section and “Installing and Registering the ArcView 9 Demo Edition Software” at the back of the book.)
3. Install data on your computer and student computers. (Refer to “Setting up the software and data” later in this section and “Installing the Exercise Data” at the back of the book.)
4. Work through the module 1 activity by yourself. Once you’ve completed module 1, you will be ready to guide your students through it.
5. Introduce students to GIS using the suggestions in the module 1 lesson introduction.
6. Make copies and work through module 1 with your students. The one-lesson design of this module introduces students to the concept of GIS, basic ArcMap skills, and the steps of the geographic inquiry process.

**The modules**

Once you’ve finished module 1, you and your students are free to explore the content and lessons in modules 2–7 in any order you choose. You can teach each module or lesson independently of the others, and you can tailor the material to suit the specific needs of your class and curriculum.

Each module illustrates an important theme or concept of geographic knowledge. These concepts were derived from the *National Geography Standards—Geography for Life*, published in 1994. The following is a list of modules 2–7 and a brief description of the concepts they address:

**Module 2: Physical Geography I—Landforms and Physical Processes**

Powerful forces originating deep in the earth shape the landforms that characterize its surface.

**Module 3: Physical Geography II—Ecosystems, Climate, and Vegetation**

Four major determinants of climate are latitude, elevation, landforms, and proximity to the ocean.
Module 4: Human Geography I—Population Patterns and Processes
Many factors are involved in the distribution and migration of human populations.

Module 5: Human Geography II—Political Geography
Cultural concerns and conflicts continually reshape the political makeup of the world.

Module 6: Human Geography III—Economic Geography
Economic development, modernization, and trade illustrate the interrelatedness of the global community.

Module 7: Human/Environment Interaction
Physical processes influence patterns of human activity, just as human activities have an effect on the environment.

The lessons
Modules 2–7 approach a geographic theme from three perspectives: a global perspective, a regional case study, and an advanced investigation. These perspectives are presented as lessons. Like the modules, each lesson can be used in isolation; they do not need to be completed in any particular order.

Global perspective explores a geographic concept from a worldwide point of view. The focus is on how a particular concept affects human society on a global level. These lessons are designed for the beginning GIS student and provide detailed step-by-step instructions in the GIS investigation.

Regional case study targets the same geographic concept from a regional perspective. Students examine one world region and use examples and data specific to that area. These lessons also are designed for beginning GIS students and provide detailed step-by-step instructions.

Advanced investigation addresses the same geographic concept, but provides the students an opportunity to research and input data from outside sources such as the Internet or other GIS datasets. These lessons are designed for experienced GIS students. They typically ask students to create and save their own ArcMap™ map documents and use the more advanced tools in the software. They require significant self-motivation and critical thinking.

The teacher notes
The first few pages of each lesson have a lesson overview and teacher notes that contain the following items.

Lesson overview: A short summary gives you a snapshot of the lesson.

Materials and time: What you’ll need and how long it will take. This is included to help you plan.

Standards: A list of the National Geography Standards (as published in Geography for Life: The National Geography Standards, 1994) covered in this lesson for middle school and high school students is included here. (Note: A matrix that matches all lessons in the book to the National Geography Standards follows this section. It is followed by a matrix matching the lessons to the National Science and Technology Standards.)

Objectives: Specific learning objectives for each lesson give you more detailed information about the lesson.

GIS skills and tools: Important GIS skills and tools that are taught and used in this lesson are summarized here.
How to Use this Book

Geographic inquiry graphic: These are the five steps of geographic inquiry that are incorporated into each lesson. See the section “Geographic Inquiry and GIS” for more information about the geographic inquiry process.

Lesson introduction: This section incorporates practical information—when to pass out specific handouts, for example—along with lists of questions for a class discussion introducing the topic.

Student activity: The primary student activity in each lesson is the GIS Investigation performed at the computer. This section offers Teacher Tips and information specific to the GIS Investigation.

Assessment: A summary of what your students will do to demonstrate their understanding of concepts and the proficiency of their skills upon completion of each GIS Investigation. Complete student assessment handouts are located at the end of the lesson, along with their evaluation rubrics.

Extensions: Consult these lists of ideas if you wish to expand the lesson for your class or individual students.

Student answer sheets and handouts

All of the GIS investigations, with the exception of some advanced investigations, include questions for students to answer as they work. Separate answer sheets are provided for students to write their answers on. This design makes it easier for you to review student answers and allows you to reuse the investigation sheets if you wish. Answer keys for all investigations are located in the tabbed section at the back of the book.

Some lessons include other student handouts, such as a map or table to be completed in the lesson introduction or conclusion. A few lessons include transparency masters for use in a class discussion.

The “ArcMap Toolbar Quick Reference” and “ArcMap Zoom and Pan Tools” are two optional handouts that can be used with any of the lessons. Consider giving these to your students with module 1, and then have them save these sheets for use with later lessons. The “GIS Terms Quick Reference” can also be handed out to students if desired. All of these handouts are located at the back of the book.

Rubric-based assessment

The lessons in Mapping Our World allow and encourage your students to explore a variety of geographic concepts and topics. A single letter or number grade won’t be an accurate representation of the depth or completeness of their understanding of all concepts they’ve dealt with. The rubrics included with each lesson will allow you to evaluate your student’s performance in a number of different ways. A learner may show mastery of one particular concept, but perform another task at the introductory level. The rubrics will also help you provide specific feedback to your students, showing them exactly where they need additional assistance or practice.

Exemplary: The student has gone above and beyond a particular standard. He or she has a strong understanding of the concept and has the ability to mentor other students.

Mastery: This is the target level for all students. Performance at this level shows that they have a good understanding of the concept illustrated in the standard.

Introductory: The student has limited understanding of the standard. Or, the product he or she produced shows little evidence of meeting the standard.

Does not meet requirements: The student does not show any foundational knowledge of the standard and the products they produce show no evidence of their understanding.
**Suggested ways to use the evaluation rubrics:**

- Distribute a copy of the rubric to students when you return their evaluated work. Circle or highlight the student’s level of achievement for each standard. This provides the greatest amount of feedback for the student on each particular standard. Use the back of the form to make additional comments.
- Use the rubric as a form of student self-evaluation. Give students an unscored copy of the rubric and ask them to evaluate their own work. In the case of group projects, you can also let each group member evaluate the performance of the other members of the group.

**ArcGIS Desktop software**

The title of this book includes the words “ArcGIS Desktop.” The software that comes with the book is called ArcView®. The GIS investigations refer to ArcMap and ArcCatalog™. You may be wondering, why are three different terms used?

ESRI ArcGIS Desktop consists of three software products: ArcView, ArcEditor™, and ArcInfo®. These three products look and work the same—they differ only in how much they can do. This book uses ArcView, but the lessons apply to ArcEditor and ArcInfo as well.

Each ArcGIS Desktop software product includes the same two applications—ArcMap and ArcCatalog. You use ArcMap to make maps, analyze them, and print them. You use ArcCatalog to browse and preview GIS data contained on your computer’s hard disk or on a network. All of the lessons in this book use ArcMap exclusively, except for module 7’s advanced investigation, which uses both ArcMap and ArcCatalog.
**Setting up the software and data**

**Using the CDs**

This book comes with two CDs. One CD contains a one-year licensed copy of ArcView 9 for Microsoft® Windows® operating system versions. The other CD contains the data and map documents used in the GIS investigations. Refer to the installation guides at the back of the book for detailed instructions on how to install the software and the data. If you do not feel comfortable installing programs on your computers, please be sure to ask your campus technology specialist for assistance. The software and data on these CDs need to be installed on your computer and all computers that the students will use to complete the GIS investigations.

**Setting up the desktop and user interface**

Once ArcView is installed, consider creating an ArcMap shortcut icon on the desktop of each student’s computer so that students can quickly locate and start the ArcMap program. If students will be using ArcCatalog, create an ArcCatalog shortcut icon as well.

Instructions and graphics assume that students can see the file extensions, for example Global1.mxd or Cities.lyr. If your students cannot see file extensions (e.g., they see Global1 or Cities), you can either turn off this preference or have students ignore references to file extensions. Layer files, which sometimes have the same name as their data sources, are stored in separate folders to avoid confusion when file names are hidden. (To show file extensions, start ArcCatalog and go to Tools, Options. Click the General tab and uncheck the Hide file extensions box.)

Most exercises instruct students to add data to their map documents at some point. To navigate to the exercise data, a connection to the drive or folder where the data is stored is necessary. You may want to make sure this folder connection is set up in advance on each student’s computer, or you may direct students to create the folder connection themselves during the exercise. If you choose to create the folder connection yourself, “Installing the Exercise Data” at the back of the book explains how to do this using ArcCatalog. Otherwise, follow the instructions in module 1, part 2, step 5 to create the folder connection when students add data for the first time.

**Troubleshooting ArcGIS**

Exercise instructions are written assuming the user interface and user preferences have the default settings. Unless students are working with a fresh installation of the software, however, chances are they will encounter some differences between the instructions and what they see on their screen. This is because ArcMap remembers settings from a previous session. For instance, if one student stretches the ArcMap window, the window will still be large when the next student starts ArcMap on that computer. Other potential differences include what toolbars are visible, where toolbars are located, the width of the table of contents, or whether or not the map scale changes when the window is resized.

Normally such differences will not be a problem, but you should be prepared to help individual students if they question an instruction or want to know why their ArcMap looks different than their neighbor’s. A list of commonly encountered troubles and their solutions can be found on this book’s Web site. You may want to print out this list for reference. If you have other software questions relating to this book, you can send e-mail to workbooksupport@esri.com with your questions.
Metadata

Metadata (information about the data) is included for all of the GIS data provided on the data CD. The metadata includes a description of the data, where it came from, a definition for each attribute field, and much other useful information.

To view metadata, open ArcCatalog and browse the Catalog Tree to the feature class of interest (e.g., C:\MapWorld9\Mod1\World1.mdb\phones). Click the Metadata tab on the right side of the window. You may find it easiest to view metadata using the FGDC FAQ stylesheet, which you can select from the Metadata toolbar.

If you want to know more about metadata and ArcGIS, we suggest that you work through the module 7 advanced investigation.

The companion Web site

This book’s companion Web site is www.esri.com/mappingourworld. This Web site places a variety of GIS resources and other helpful information at your fingertips. For example:

- If you are new to GIS, you may want to visit the “Getting Started” section of the Web site before you begin the lessons.
- You’ll want to check the Web site’s “Resources by Module” section for specific resources, Web links, or changes when you get ready to use a particular lesson with your class.
- The Web site will have information on migrating from ArcView 3.x to ArcGIS Desktop 9 for those of you who also use the ArcView 3 Mapping Our World lessons.
- Any significant changes or corrections to the book will be posted here.

What’s next?

After you and your students have used the lessons in this book for a while, the natural question is what comes next? Here are some suggestions:

- Incorporate one or more of the lesson extensions into your lesson plans.
- Challenge your students to apply the geographic inquiry process to current events or local issues. The book Community Geography: GIS in Action and the companion teacher’s guide, also from ESRI Press, offer examples.
- Have your students put together a profile of your community and post it on the ESRI Community Atlas Web site (www.esri.com/communityatlas). (Note: Your school may be able to earn software through this program.)
- Get connected. Find out who’s doing what with GIS near you and contact them for ideas. The following resources can help you with this:
  - ESRI Education User Conference. For information, see www.esri.com/educ.
  - GIS Day™ Web site (www.gisday.com)
  - GIS.com Web site (www.gis.com)
  - KanGIS Web site (kangis.org/learn)
- Bring GIS professionals into the classroom. Most cities now use GIS; find out if the GIS coordinator would come to your classroom and present how they use GIS.
- Make GIS a permanent part of your classroom. Be sure to check with your district or state technology coordinator before you purchase an ArcView license for your school or classroom. A districtwide or statewide software license may already cover your school.
Geographic inquiry is at the core of Mapping Our World: GIS Lessons for Educators. In this book’s lessons, you will use GIS as a tool kit to explore many issues and, as you use GIS, you will engage in the geographic inquiry process. This section introduces you to geographic inquiry and GIS.

Geography is the study of the world and all that is in it: its peoples, its places, and its environments, and all the connections among them. When you are investigating the physical world and its events, you are dealing with geography. Knowing where something is located, how its location influences its characteristics, and how its location influences relationships with other phenomena are the foundation of geographic thinking. To learn how to think geographically, you can use a process called geographic inquiry. Geographic inquiry asks you to see the world and all that is in it in spatial terms. Like other research methods, it also asks you to explore, analyze, and act upon the things you find.

**The geographic inquiry process**

<table>
<thead>
<tr>
<th>STEPS</th>
<th>WHAT TO DO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Ask geographic questions</td>
<td>Ask questions to learn about the world around you</td>
</tr>
<tr>
<td>2 Acquire geographic resources</td>
<td>Identify data and information that you need to answer your questions</td>
</tr>
<tr>
<td>3 Explore geographic data</td>
<td>Turn the data into maps, tables, and graphs and look for patterns and relationships</td>
</tr>
<tr>
<td>4 Analyze geographic information</td>
<td>Go deeper into a geographic exploration and draw conclusions to answer your questions</td>
</tr>
<tr>
<td>5 Act upon geographic knowledge</td>
<td>Take your work to others to educate, make a decision, or solve a problem</td>
</tr>
</tbody>
</table>

The five steps of geographic inquiry are explicitly labeled in part 2 of the module 1 activity. The same steps form the foundation of the other investigations, but they are not labeled. You will naturally integrate geographic inquiry into the process of doing the exercises throughout this book.
What is GIS?

Chances are that GIS technology has already touched your life. If you flipped on a light switch today, chances are that GIS was used to help make sure the electricity was there to light up the room. When you drove down a highway, chances are that GIS managed the signs and streets along the way. If you received a delivery, chances are that GIS helped the driver find the way to your house. If you bought fresh vegetables, chances are that GIS helped manage the land and calculate the fertilizer needed for the crop. If you looked at a map on the Internet, chances are that GIS had a hand in that, too.

A geographic information system (GIS) uses computers and software to organize, develop, and communicate geographic knowledge. In simple terms, GIS takes the numbers and words from the rows and columns in databases and spreadsheets and puts them on a map.

GIS is about visualizing information

The vast amounts of information available today require powerful tools like GIS to help people determine what it all means. GIS can make thematic maps (maps coded by value) to help illustrate patterns. To explore cities at risk of an earthquake, you might first make a map of where earthquakes have already occurred. You could explore further by coding earthquakes by magnitude. You might use one color to locate those that were strong and a second color for those that were weak, and then you might see a more complex pattern. Then you could analyze the patterns to answer questions about earthquakes. You will pursue this inquiry and more in a module 2 exercise.
GIS is a tool that can simplify and hasten geographic investigations. Like any tool, GIS has no answers packed inside it. Instead, for those who engage the tool and the process of geographic inquiry, it provides a means to discover pathways through our remarkable world of unending geographic questions.

Now it’s your turn to start investigating and mapping our world with GIS.
## Correlation of National Geography Standards to *Mapping Our World* Lessons

<table>
<thead>
<tr>
<th>STANDARD</th>
<th>MODULE 1</th>
<th>MODULE 2</th>
<th>MODULE 3</th>
<th>MODULE 4</th>
<th>MODULE 5</th>
<th>MODULE 6</th>
<th>MODULE 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  How to use maps and other geographic representations, tools, and technologies to acquire, process, and report information from a spatial perspective</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>2  How to use mental maps to organize information about people, places, and environments in a spatial context</td>
<td></td>
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</tr>
<tr>
<td>3  How to analyze the spatial organization of people, places, and environments on Earth’s surface</td>
<td>✔</td>
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G = Global investigation  
R = Regional case study  
A = Advanced investigation
### National Science and Technology Standards

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M = Middle school    H = High school