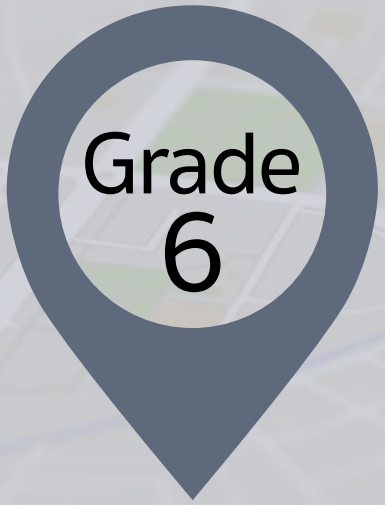
Human Impacts on Our Climate

STEM Road Map for Middle School



Edited by Carla C. Johnson,
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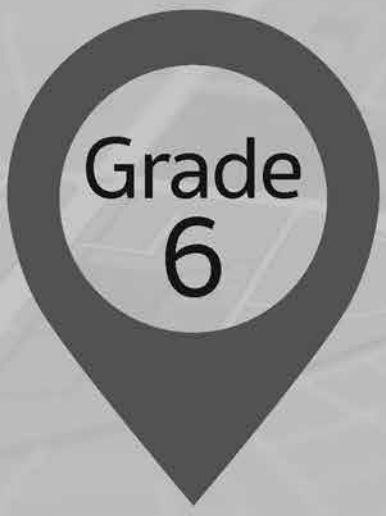

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STEM Road Map for Middle School

Edited by Carla C. Johnson, Janet B. Walton, and Erin Peters-Burton

nsta Press
National Science Teaching Association
Arlington, Virginia

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For customer service inquiries, please call 800-277-5300.

23 22 21 20 4 3 2 1

Library of Congress Cataloging-in-Publication Data
Names: Johnson, Carla C., 1969- editor. | Walton, Janet B., 1968- editor. | Peters-Burton, Erin E., editor.
Title: Human impacts on our climate, grade 6 : STEM road map for middle school / edited by Carla C. Johnson, Janet B. Walton, and Erin Peters-Burton.
Description: Arlington, VA : National Science Teaching Association, [2020] | Includes bibliographical references and index.
Identifiers: LCCN 2019056397 (print) | LCCN 2019056398 (ebook) | ISBN 9781681404080 (paperback) | ISBN 9781681404097 (pdf)
Subjects: LCSH: Climatic changes--Effect of human beings on. | Climatic changes--Study and teaching (Middle school)
Classification: LCC QC903 .H855 2020 (print) | LCC QC903 (ebook) | DDC 363.738/740712--dc23
LC record available at *https://lccn.loc.gov/2019056397*
LC ebook record available at *https://lccn.loc.gov/2019056398*

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ACKNOWLEDGMENTS

This module was developed as a part of the STEM Road Map project (Carla C. Johnson, principal investigator). The Purdue University College of Education, General Motors, and other sources provided funding for this project.

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HUMAN IMPACTS ON OUR CLIMATE MODULE OVERVIEW

Toni Ivey, Adrienne Redmond-Sanogo, Juliana Utley, Sue Christian Parsons, Janet B. Walton, Carla C. Johnson, and Erin Peters-Burton

THEME: Cause and Effect

LEAD DISCIPLINE: Science

MODULE SUMMARY

In sixth grade, students begin to grapple with some of the biggest challenges, and often debates, within and outside of the scientific community. In this module, science teachers take the lead, integrating with mathematics, social studies, and English language arts contexts, which could be collaborations with these classes. Students will investigate aspects of climate change driven by the rise in global temperatures over the past century and will develop potential solutions that might address one aspect of human activity that has contributed to global climate change. This project requires students to use an engineering design process to identify a problem and develop a method to help mitigate the identified problem (adapted from Johnson et al. 2015, p. 99).

ESTABLISHED GOALS AND OBJECTIVES

At the conclusion of this module, students will be able to do the following:

- Explain the causes and effects of climate change and how humans have influenced climate change
- Understand how mathematical modeling and numerical data are used to determine the impacts of climate change
- Analyze and synthesize reputable media to form scientific arguments regarding climate change
- Describe the effects of climate change on the economy, society, and human populations

CHALLENGE OR PROBLEM FOR STUDENTS TO SOLVE: THINK GLOBALLY, ACT LOCALLY CHALLENGE

Student teams are challenged to identify a local environmental problem and develop a method for monitoring and minimizing its impact on the environment. To support this goal, they learn about the differences between weather and climate and explore changes in temperature as an indicator of global warming. Students also investigate the role that greenhouse gases play in global warming.

Driving Question: How can we develop a local response to address an aspect of human impact on global climate change?

CONTENT STANDARDS ADDRESSED IN THIS STEM ROAD MAP MODULE

A full listing with descriptions of the standards this module addresses can be found in the appendix. Listings of the particular standards addressed within lessons are provided in a table for each lesson in Chapter 4.

STEM RESEARCH NOTEBOOK

Each student should maintain a STEM Research Notebook, which will serve as a place for students to organize their work throughout this module (see p. 12 for more general discussion on setup and use of this notebook). All written work in the module should be included in the notebook, including records of students' thoughts and ideas, fictional accounts based on the concepts in the module, and records of student progress through the module's engineering design process (EDP). The notebooks may be maintained across subject areas, giving students the opportunity to see that although their classes may be separated during the school day, the knowledge they gain is connected.

Each lesson in this module includes student handouts that should be kept in the STEM Research Notebooks after completion, as well as prompts to which students should respond in their notebooks. You may also wish to have students include the STEM Research Notebook Guidelines student handout in their notebooks.

Emphasize to students the importance of organizing all information in a Research Notebook. Explain that scientists and other researchers maintain detailed Research Notebooks in their work. These notebooks, which are crucial to researchers' work because they contain critical information and track the researchers' progress, are often considered legal documents for scientists who are pursuing patents or wish to provide proof of their discovery process.

STUDENT HANDOUT

STEM RESEARCH NOTEBOOK GUIDELINES

STEM professionals record their ideas, inventions, experiments, questions, observations, and other work details in notebooks so that they can use these notebooks to help them think about their projects and the problems they are trying to solve. You will each keep a STEM Research Notebook during this module that is like the notebooks that STEM professionals use. In this notebook, you will include all your work and notes about ideas you have. The notebook will help you connect your daily work with the big problem or challenge you are working to solve.

It is important that you organize your notebook entries under the following headings:

1. **Chapter Topic or Title of Problem or Challenge:** You will start a new chapter in your STEM Research Notebook for each new module. This heading is the topic or title of the big problem or challenge that your team is working to solve in this module.
2. **Date and Topic of Lesson Activity for the Day:** Each day, you will begin your daily entry by writing the date and the day's lesson topic at the top of a new page. Write the page number both on the page and in the table of contents.
3. **Information Gathered From Research:** This is information you find from outside resources such as websites or books.
4. **Information Gained From Class or Discussions With Team Members:** This information includes any notes you take in class and notes about things your team discusses. You can include drawings of your ideas here, too.
5. **New Data Collected From Investigations:** This includes data gathered from experiments, investigations, and activities in class.
6. **Documents:** These are handouts and other resources you may receive in class that will help you solve your big problem or challenge. Paste or staple these documents in your STEM Research Notebook for safekeeping and easy access later.
7. **Personal Reflections:** Here, you record your own thoughts and ideas on what you are learning.
8. **Lesson Prompts:** These are questions or statements that your teacher assigns you within each lesson to help you solve your big problem or challenge. You will respond to the prompts in your notebook.
9. **Other Items:** This section includes any other items your teacher gives you or other ideas or questions you may have.

MODULE LAUNCH

To launch the module, introduce the Think Globally, Act Locally Challenge by informing students that their challenge in this module will be to develop a method for monitoring and minimizing a human activity that has an impact on the environment and has contributed to global climate change. To do so, they will first learn about weather and climate, global warming, climate change, and climate change indicators. Then, they will identify a local environmental problem and develop their own solutions to address the challenge. This challenge will require them to conduct research on the causes of climate change, interview experts and others with understanding of this topic, and use mathematical modeling and numerical data to determine what steps have been taken to mitigate climate change.

PREREQUISITE SKILLS FOR THE MODULE

Students enter this module with a wide range of preexisting skills, information, and knowledge. Table 3.1 provides an overview of prerequisite skills and knowledge that students are expected to apply in this module, along with examples of how they apply this knowledge throughout the module. Differentiation strategies are also provided for students who may need additional support in acquiring or applying this knowledge.

Table 3.1. Prerequisite Key Knowledge and Examples of Applications and Differentiation Strategies

Prerequisite Key Knowledge	Application of Knowledge	Differentiation for Students Needing Additional Support
Science • Organize data into appropriate tables, graphs, drawings, or diagrams. • Have knowledge of basic weather and different types of climates.	*Science* • Create tables, graphs, and charts of climate data. • Differentiate between weather and climate data.	*Science* • Preselect data to assist students in collecting data. • Provide opportunities for students to practice creating graphs. • Provide templates for students to fill out with collected information so that the data can be transferred to their STEM Research Notebooks. • Provide students with handouts to help them develop their multimedia presentations. • Provide access to texts and media for students to learn about weather and climate. • Include a lesson on weather if needed.

Continued

Table 3.1. (*continued*)

Prerequisite Key Knowledge	Application of Knowledge	Differentiation for Students Needing Additional Support
Mathematics Numbers and Operations: • Multiply a whole number of up to four digits by a one-digit whole number, and multiply two two-digit numbers, using strategies based on place value and the properties of operations. • Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models. • Solve word problems involving multiplication of a fraction by a whole number. The Number System: • Solve real-world and mathematical problems by graphing points in all four quadrants of the coordinate plane. • Include use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinates. Measurement and Data: • Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. • Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. • Apply the area and perimeter formulas for rectangles in real world and mathematical problems.	*Mathematics* Numbers and Operations: • Use whole number operations and multiplication and division of fractions to solve problems in the module. • Understand the area of a rectangle with whole number and fractional side measurements in order to understand the size of an acre. The Number System: • Understand how to read and plot points in the four quadrants of a Cartesian plane in order to create and interpret graphs. Measurement and Data: • Measure temperature and volumes. • Read graphs and create graphs. • Collect data from databases. • Understand the concepts of mean, median, and mode.	*Mathematics* Numbers and Operations: • Provide calculators. • Allow students to have access to hundreds grids, physical manipulatives, and other representations so that they can work with fractions and decimals. The Number System: • Use anchor charts and other representations to help students understand coordinate grids. Measurement and Data: • Work with students individually or pair them with other students to help them understand the data and measurement objectives. • Provide digital thermometers if necessary.

Continued

Table 3.1. (*continued*)

Prerequisite Key Knowledge	Application of Knowledge	Differentiation for Students Needing Additional Support
Reading • Have critical reading skills, including making inferences, citing textual evidence, and summarizing central ideas.	*Reading* • Engage with a wide variety of texts. • Analyze and evaluate data and argument. • Analyze nonfiction texts for purpose, structures, and features, and use learned comprehension strategies.	*Reading* • Take care to include texts reflecting a range of reading levels. • Use nonfiction trade books with photographs, illustrations, and graphics to support student understanding of text.
Writing • Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence. • Use technology, including the internet, to interact and collaborate with others.	*Writing* • Explore background knowledge and grow understandings, take notes in the process of research, and integrate and share information recorded in this way. • Create and share presentations and develop action plans. • Apply developing strategies related to nonfiction writing. • Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach.	*Writing* • Provide writing skill support as necessary.
Research and Communication • Clearly present information, findings, and supporting evidence in a manner appropriate to the task, purpose, and audience. • Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentation.	*Research and Communication* • Prepare and give presentations to peers or to invited members of the community and parents.	*Research and Communication* • Monitor and support learners as they work to express their ideas. • Actively support student presentation skills as needed.

POTENTIAL STEM MISCONCEPTIONS

Students enter the classroom with a wide variety of prior knowledge and ideas, so it is important to be alert to misconceptions, or inappropriate understandings of foundational knowledge. These misconceptions can be classified as one of several types: "preconceived notions," opinions based on popular beliefs or understandings; "nonscientific beliefs," knowledge students have gained about science from sources outside the scientific community; "conceptual misunderstandings," incorrect conceptual models based on incomplete understanding of concepts; "vernacular misconceptions," misunderstandings of words based on their common use versus their scientific use; and "factual misconceptions," incorrect or imprecise knowledge learned in early life that remains unchallenged (NRC 1997, p. 28). Misconceptions must be addressed and dismantled in order for students to reconstruct their knowledge, and therefore teachers should be prepared to take the following steps:

- *Identify students' misconceptions.*
- *Provide a forum for students to confront their misconceptions.*
- *Help students reconstruct and internalize their knowledge, based on scientific models. (NRC 1997, p. 29)*

Keeley and Harrington (2010) recommend using diagnostic tools such as probes and formative assessment to identify and confront student misconceptions and begin the process of reconstructing student knowledge. Keeley's *Uncovering Student Ideas in Science* series contains probes targeted toward uncovering student misconceptions in a variety of areas and may be a useful resource for addressing student misconceptions in this module.

Some commonly held misconceptions specific to lesson content are provided with each lesson so that you can be alert for student misunderstanding of the science concepts presented and used during this module. The American Association for the Advancement of Science has also identified misconceptions that students frequently hold regarding various science concepts (see the links at *http://assessment.aaas.org/topics*).

SRL PROCESS COMPONENTS

Table 3.2 (p. 30) illustrates some of the activities in the Human Impacts on Our Climate module and how they align with the self-regulated learning (SRL) process before, during, and after learning.

Table 3.2. SRL Process Components

Learning Process Components	Example From Human Impacts on Our Climate Module	Lesson Number and Learning Component
BEFORE LEARNING		
Motivates students	Students participate in a gallery walk of pictures they have created of their perception of the environment.	Lesson 1, Introductory Activity/ Engagement
Evokes prior learning	Students tap into their prior experience with weather and apply it to distinguish between weather and climate.	Lesson 1, Activity/ Exploration
Helps students monitor their progress	Students reflect on the use of biased or misleading data in their personal decision-making processes and consider their own understanding of climate change in this context.	Lesson 1, Elaboration/ Application of Knowledge
DURING LEARNING		
Focuses on important features	Students create models of greenhouses to explore the effects of greenhouse gases on Earth.	Lesson 2, Activity/ Exploration
Helps students monitor their progress	Students respond to STEM Research Notebook prompts to check their understanding of climate change indicators and evidence for climate change.	Lesson 2, Elaboration/ Application of Knowledge
AFTER LEARNING		
Evaluates learning	In the final challenge, students present their solutions to a problem and obtain feedback.	Lesson 3, Elaboration/ Application of Knowledge
Takes account of what worked and what did not work	Students complete post-tests and reflect on their mitigation plans.	Lesson 3, Elaboration/ Application of Knowledge

STRATEGIES FOR DIFFERENTIATING INSTRUCTION WITHIN THIS MODULE

For the purposes of this curriculum module, differentiated instruction is conceptualized as a way to tailor instruction—including process, content, and product—to various student needs in your class. A number of differentiation strategies are integrated into

lessons across the module. The problem- and project-based learning approach used in the lessons is designed to address students' multiple intelligences by providing a variety of entry points and methods to investigate the key concepts in the module. Differentiation strategies for students needing support in prerequisite knowledge can be found in Table 3.1 (p. 26). You are encouraged to use information gained about student prior knowledge during introductory activities and discussions to inform your instructional differentiation. Strategies incorporated into this lesson include flexible grouping, varied environmental learning contexts, assessments, compacting, and tiered assignments and scaffolding.

Flexible Grouping. Students work collaboratively in a variety of activities throughout this module. Grouping strategies you might employ include student-led grouping, grouping students according to ability level or common interests, grouping students randomly, or grouping them so that students in each group have complementary strengths (for instance, one student might be strong in mathematics, another in art, and another in writing).

Varied Environmental Learning Contexts. Students have the opportunity to learn in various contexts throughout the module, including alone, in groups, in quiet reading and research-oriented activities, and in active learning through inquiry and design activities. In addition, students learn in a variety of ways, including through doing inquiry activities, journaling, reading fiction and nonfiction texts, watching videos, participating in class discussion, and conducting web-based research.

Assessments. Students are assessed in a variety of ways throughout the module, including individual and collaborative formative and summative assessments. Students have the opportunity to produce work via written text, oral and media presentations, and modeling. You may choose to provide students with additional choices of media for their products (for example, PowerPoint presentations, posters, or student-created websites or blogs).

Compacting. Based on student prior knowledge, you may wish to adjust instructional activities for students who exhibit prior mastery of a learning objective. For instance, if some students exhibit a pre-existing understanding of the differences between weather and climate in Lesson 1, you may wish to limit the amount of time they spend on learning this content and instead introduce ELA or social studies connections with associated activities.

Tiered Assignments and Scaffolding. Based on your awareness of student ability, understanding of concepts, and mastery of skills, you may wish to provide students with variations on activities by adding complexity to assignments or providing more or fewer learning supports for activities throughout the module. For instance, some students may need additional support in identifying key search words and phrases for web-based research or may benefit from cloze sentence handouts to enhance vocabulary

understanding. Other students may benefit from expanded reading selections and additional reflective writing or from working with manipulatives and other visual representations of mathematical concepts. You may also work with your school librarian to compile a set of topical resources at a variety of reading levels.

STRATEGIES FOR ENGLISH LANGUAGE LEARNERS

Students who are developing proficiency in English language skills require additional supports to simultaneously learn academic content and the specialized language associated with specific content areas. WIDA (2012) has created a framework for providing support to these students and makes available rubrics and guidance on differentiating instructional materials for English language learners (ELLs). In particular, ELL students may benefit from additional sensory supports such as images, physical modeling, and graphic representations of module content, as well as interactive support through collaborative work.

When differentiating instruction for ELL students, you should carefully consider the needs of these students as you introduce and use academic language in various language domains (listening, speaking, reading, and writing) throughout this module. To adequately differentiate instruction for ELL students, you should have an understanding of the proficiency level of each student. The following five overarching WIDA learning standards are relevant to this module:

- Standard 1: Social and Instructional Language. Focus on social behavior in group work and class discussions.
- Standard 2: The Language of Language Arts. Focus on forms of print, elements of text, picture books, comprehension strategies, main ideas and details, persuasive language, creation of informational text, and editing and revision.
- Standard 3: The Language of Mathematics. Focus on numbers and operations, patterns, number sense, measurement, and strategies for problem solving.
- Standard 4: The Language of Science. Focus on safety practices, scientific process, and scientific inquiry.
- Standard 5: The Language of Social Studies. Focus on resources and environmental issues.

SAFETY CONSIDERATIONS FOR THE ACTIVITIES IN THIS MODULE

For precautions, see the specific safety notes after the list of materials in the first two lessons. For more general safety guidelines, see the Safety in STEM section in Chapter 2

(p. 18). We also recommend that you go over the safety rules that are included as part of the safety acknowledgment form with your students before beginning the first investigation. Once you have gone over these rules with your students, have them sign the safety acknowledgment form. You should also send the form home with students for parents or guardians to read and sign to acknowledge that they understand the safety procedures that must be followed by their children. A sample middle school safety acknowledgment form can be found on the NSTA Safety Portal at *http://static.nsta.org/pdfs/SafetyAcknowledgmentForm-MiddleSchool.pdf.*

DESIRED OUTCOMES AND MONITORING SUCCESS

The desired outcomes for this module are outlined in Table 3.3, along with suggested ways to gather evidence to monitor student success. For more specific details on desired outcomes, see the Established Goals and Objectives sections for the module (p. 23) and individual lessons.

Table 3.3. Desired Outcome and Evidence of Success in Achieving Identified Outcome

Desired Outcome	Evidence of Success	
	Performance Tasks	Other Measures
Students create and present a solution to a problem illustrating their understanding of the causes and effects of human impacts on the environment.	• Students are assessed on their presentations and their written descriptions of their solutions to reduce human impacts on the environment. • Students maintain STEM Research Notebooks that contain designs, research notes, evidence of collaboration, and mathematics, social studies, and ELA-related work.	Students are assessed on the following: • Collaboration in their groups. • Use of claim, evidence, reasoning responses to assess changes in their understandings. • Climate change pre- and post-tests. • Participation in classroom discussions.

ASSESSMENT PLAN OVERVIEW AND MAP

Table 3.4 (p. 34) provides an overview of the major group and individual products and deliverables, or things that student teams will produce in this module, that constitute the assessment for this module. See Table 3.5 (p. 34) for a full assessment map of formative and summative assessments in this module.

Table 3.4. Major Products and Deliverables for Groups and Individuals

Lesson	Major Group Products and Deliverables	Major Individual Products and Deliverables
1	• Graphs of changes in average global temperatures	• STEM Research Notebook entries
2	• Greenhouse Model Activity Sheet	• Greenhouse Effect Simulation Student Handout • STEM Research Notebook entries
3	• Plan to save the bees	• STEM Research Notebook entries • Think Globally, Act Locally presentation and paper

Table 3.5. Assessment Map for Human Impacts on Our Climate Module

Lesson	Assessment	Group/ Individual	Formative/ Summative	Lesson Objective Assessed
1	Global temperature trends *activity*	Group	Formative	• Analyze data and interpret trends in changes in average global temperature.
1	STEM Research Notebook *prompts*	Individual	Formative	• Identify and describe the layers of Earth's atmosphere. • Use scientific data to form an informed position on changes in average global temperatures. • Describe the differences between weather and climate.
2	Greenhouse model *activity*	Group	Formative	• Collect and analyze data to study the greenhouse effect.

Continued

Table 3.5. (*continued*)

Lesson	Assessment	Group/ Individual	Formative/ Summative	Lesson Objective Assessed
2	Greenhouse effect *simulation*	Group or individual	Summative	• Determine whether all greenhouse gases contribute to the greenhouse effect. • Collect and analyze data to determine which gases are greenhouse gases. • Make conclusions about the role of greenhouse gases in Earth's atmosphere, consider how greenhouse gases affect our climate, and predict what will happen to average global temperature.
2	STEM Research Notebook *prompt*	Individual	Formative	• Use scientific data to form an informed position on changes in Earth's climate.
3	STEM Research Notebook *prompts*	Individual	Formative	• Calculate their own and their households' carbon footprints. • Describe the importance of reducing their carbon footprints. • Understand how climate change affects other organisms and why this is important to humans.
3	Think Globally, Act Locally *presentation and paper*	Group or individual	Summative	• Synthesize their understanding of climate change to identify a climate concern in their own lives or in their school or community. • Design a solution to reduce the carbon footprint associated with the identified climate concern.

MODULE TIMELINE

Tables 3.6–3.10 (pp. 37–40) provide lesson timelines for each week of the module. These timelines are provided for general guidance only and are based on class times of approximately 45 minutes.

Table 3.6. STEM Road Map Module Schedule for Week One

Day 1	Day 2	Day 3	Day 4	Day 5
Lesson 1 *Weather Versus Climate and Global Warming Trends* • Launch the module by introducing the challenge. • Students complete pre-test and drawings of environment, then hold gallery walk. • Students write questions about climate change on exit tickets. • Students explore the average temperature by month for various U.S. cities.	*Lesson 1* *Weather Versus Climate and Global Warming Trends* • Class discusses weather. • Students watch a video explaining weather and make notes on a T-chart. • Students explore the local 5-day weather forecast and make predictions using the claim, evidence, reasoning model.	*Lesson 1* *Weather Versus Climate and Global Warming Trends* • Class discusses learnings from the video about weather. • Students watch a video about the layers of Earth's atmosphere and respond to a prompt in their STEM Research Notebooks, then make a Layers of Earth's Atmosphere Foldable. • Students research human inventions and how they transformed society.	*Lesson 1* *Weather Versus Climate and Global Warming Trends* • Student groups graph changes in average global temperatures and reflect on trends. • Students use claim, evidence, reasoning model to summarize the trend of data over the last century. • Students continue to learn about weather versus climate by watching a video, adding to their T-charts, and responding to a prompt in their notebooks. • Students construct a scatter plot and extrapolate from the data. • Students explore average monthly temperatures. • Students research engineering and compare it to inventing, and research the creation of an object of their choice.	*Lesson 2* *The Greenhouse Effect and Climate Change* • Class discusses how everyday items insulate body for warmth. • Student teams build and test greenhouse models. • Students learn about tides and sea level rise. • Students investigate the use of persuasive language in advertising related to climate change. • Students learn about biased versus unbiased data through simulations.

Table 3.7. STEM Road Map Module Schedule for Week Two

Day 6	Day 7	Day 8	Day 9	Day 10
Lesson 2 *The Greenhouse Effect and Climate Change* • Students work on greenhouse simulation, Parts 1–2. • Students complete exit ticket on which gases are greenhouse gases.	*Lesson 2* *The Greenhouse Effect and Climate Change* • Students work on greenhouse simulation, Parts 3–4. • Students propose possible solutions for helping communities deal with the effects of climate change and create multimedia presentations.	*Lesson 2* *The Greenhouse Effect and Climate Change* • Students work on greenhouse simulation, Parts 4–5. • Students consider how the data from their greenhouse models correlate with what they learned from the simulation. • Students connect to the politics of climate change through studying current events. • Students examine how the Industrial Revolution changed society and how industry is continually revolutionizing.	*Lesson 2* *The Greenhouse Effect and Climate Change* • Students watch videos on greenhouse effect and causes of climate change. • Students begin climate change indicator jigsaw activity. • Students share their multimedia presentations.	*Lesson 2* *The Greenhouse Effect and Climate Change* • Students complete climate change indicator jigsaw activity. • Students respond to prompt in STEM Research Notebook. • Small groups develop a claim, evidence, reasoning response based on data from NOAA indicator graphs and discuss the influence on our climate. • Students investigate how climate change affects different sectors of society.

Table 3.8. STEM Road Map Module Schedule for Week Three

Day 11	Day 12	Day 13	Day 14	Day 15
Lesson 3 *Reducing Your Carbon Footprint* • Students watch a video about the impact of climate change on bees, and then respond to related questions in their STEM Research Notebooks.	*Lesson 3* *Reducing Your Carbon Footprint* • Read aloud several books on bees. • Students learn about bees around the world. • Students read and analyze the Entomology Society of America's (ESA) position statement on climate change and answer questions about the accompanying figures.	*Lesson 3* *Reducing Your Carbon Footprint* • Students complete analysis of the ESA position statement. • Teams list all the foods their team members eat regularly and consider which rely on bees. • Students evaluate the reliability of digital resources. • Teams create plans for saving the bees from extinction. • Students begin work on visual presentation on causes and effects of climate change.	*Lesson 3* *Reducing Your Carbon Footprint* • Students continue work on climate change visual presentation. • Students perform more calculations with the percentages of their food consumption that relies on bees. • Students discuss and analyze how persuasive writing is used in advertising related to climate change.	*Lesson 3* *Reducing Your Carbon Footprint* • Teams make visual presentations on climate change. • Students discuss issues that the death of the bees would cause and how changes in climate might change human activity.

Table 3.9. STEM Road Map Module Schedule for Week Four

Day 16	Day 17	Day 18	Day 19	Day 20
Lesson 3 *Reducing Your Carbon Footprint* • Introduce final challenge. • Students calculate individual carbon footprints and compare with those of classmates. • Students document ways they can reduce their carbon footprints.	*Lesson 3* *Reducing Your Carbon Footprint* • Students identify and research a local environmental problem. • Read aloud *Energy Island: How One Community Harnessed the Wind and Changed Their World,* by Allan Drummond.	*Lesson 3* *Reducing Your Carbon Footprint* • Students research and discuss actions aimed at reducing carbon emissions. • Students brainstorm solutions and pick the best one. • Students determine any constraints to the plan.	*Lesson 3* *Reducing Your Carbon Footprint* • Students identify resources for plan and begin to interview experts.	*Lesson 3* *Reducing Your Carbon Footprint* • Students continue to interview experts.

Table 3.10. STEM Road Map Module Schedule for Week Five

Day 21	Day 22	Day 23	Day 24	Day 25
Lesson 3 *Reducing Your Carbon Footprint* • Students begin to develop and test mitigation plan.	*Lesson 3* *Reducing Your Carbon Footprint* • Students continue to develop and test mitigation plan.	*Lesson 3* *Reducing Your Carbon Footprint* • Students continue to develop, test, and revise mitigation plan.	*Lesson 3* *Reducing Your Carbon Footprint* • Students present final projects.	*Lesson 3* *Reducing Your Carbon Footprint* • Students write final paper. • Students take post-test and make new environment drawing and compare with the pre-test and earlier drawing. • Students hold a gallery walk. • Students discuss how their ideas have changed since beginning the module.

RESOURCES

The media specialist can help you locate resources for students to view and read about weather, climate, environmental issues, climate change, and related content. Special educators and reading specialists can help find supplemental sources for students needing extra support in reading and writing. Additional resources may be found online. Community resources for this module may include community members for students to interview (e.g., city board members, city utilities and parks and recreation representatives, and school administrators), as well as meteorologists, climate scientists, and representatives of the state department of wildlife and fisheries.

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Grade 6

STEM Road Map for Middle School

Human Impacts on Our Climate

What if you could challenge your sixth graders to come up with a way to help tackle climate change in their own community? With this volume in the *STEM Road Map Curriculum Series,* you can!

Human Impacts on Our Climate outlines a journey that will steer your students toward authentic problem solving while grounding them in integrated STEM disciplines. Like the other volumes in the series, this book is designed to meet the growing need to infuse real-world learning into K–12 classrooms.

This interdisciplinary, three-lesson module uses project- and problem-based learning to help students investigate aspects of climate change that have been driven by the rise in global temperatures over the past century. Working in teams, students will use an engineering design process to identify a local environmental problem, develop a model to help monitor and minimize its impact, and create a presentation about their findings. To support this goal, students will do the following:

- Explore differences between weather and climate and explore temperature as an indicator of global warming.
- Examine the role that greenhouse gases play in global temperature warming.
- Explain the causes and effects of climate change and how humans have influenced it.
- Use mathematical modeling and numerical data to explore climate change's impact.
- Analyze and synthesize credible resources to form scientific arguments regarding climate change.
- Develop a deeper understanding of how climate change influences the economy, our society, and people everywhere.

The *STEM Road Map Curriculum Series* is anchored in the *Next Generation Science Standards,* the *Common Core State Standards,* and the Framework for 21st Century Learning. In-depth and flexible, *Human Impacts on Our Climate* can be used as a whole unit or in part to meet the needs of districts, schools, and teachers who are charting a course toward an integrated STEM approach.

PB425X15
ISBN 978-1-68140-408-0

Grade 6

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