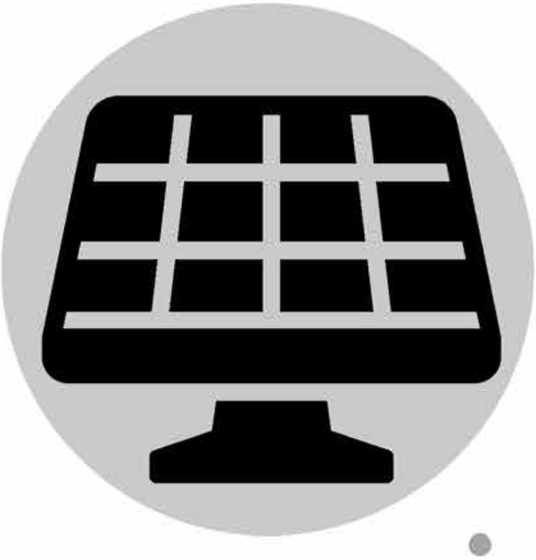
Harnessing Solar Energy

STEM Road Map for Elementary School

Grade 4

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

NSTA press
National Science Teachers Association



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HARNESSING SOLAR ENERGY MODULE OVERVIEW

Janet B. Walton, Jessica Carr, Carla C. Johnson, and Erin Peters-Burton

THEME: Innovation and Progress

LEAD DISCIPLINES: Social Studies and Science

MODULE SUMMARY

In this module, students learn about energy and energy sources, with a focus on solar energy. Students explore the science concepts of potential and kinetic energy, solar energy, the greenhouse effect, and salinity. They investigate solar energy's potential as an energy source and limitations associated with its widespread use as a power source. The concept of scarce resources is introduced from a global perspective, centering on the availability of potable water worldwide. As a social studies connection, teams of students each choose one country or region facing water scarcity and research that area to understand its geographic features, climate, and culture. Putting together what they have learned about solar energy, desalination, and the engineering design process (EDP), student teams then design, build, and test passive solar desalination devices in the Water for All Challenge. Each team creates a public service announcement (PSA) highlighting features of its device and the need for such devices around the world, concentrating on the water-scarce country it chose to research. The module culminates with a Water Conservation Expo in which students exhibit their understanding of solar energy, water scarcity, and desalination in the global context (adapted from Capobianco et al. 2015).

ESTABLISHED GOALS AND OBJECTIVES

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

- Provide examples of potential and kinetic energy
- Design a device in which potential energy is transformed into kinetic energy

- Provide evidence that energy can be transferred from place to place by various mediums
- Understand the difference between renewable and nonrenewable resources and describe their sources
- Understand and discuss the advantages and disadvantages of nonrenewable and renewable energy sources
- Understand solar energy's benefits and limitations as an energy source
- Apply their understanding of solar power to create devices that are powered by passive solar energy
- Identify areas of the world where water is a scarce resource
- Identify and discuss causes and effects of water scarcity
- Understand that ocean water is a solution of salt and water and apply this understanding to measuring salinity of various solutions of salt water
- Combine their understanding of solar energy, water scarcity, and desalination to justify a design for a solar desalination device
- Use the EDP to create solutions to problems
- Collaborate with peers to create solutions to problems and design products as assigned
- Understand the role of PSAs in disseminating information about social causes

CHALLENGE OR PROBLEM FOR STUDENTS TO SOLVE: WATER FOR ALL CHALLENGE

Student teams are challenged to use their understanding of solar energy and the EDP to design and build desalination devices powered by passive solar energy. They also create PSAs to highlight the features of their devices and relate their usefulness to water-scarce countries worldwide. Then, students exhibit their devices and present their PSAs in a Water Conservation Expo.

Driving Question: How can we design a solar-powered device that will help people access drinkable water in a country where water is scarce?

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. 26 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 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 a prompt to which students should respond in their notebooks. Students will have the opportunity to create covers and tables of contents for their STEM Research Notebooks in Lesson 1. You may also wish to have students include the STEM Research Notebook Guidelines student handout on page 26 in their notebooks.

Emphasize to students the importance of organizing all information in a Research Notebook. Explain to them 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 students to the idea of scarce resources through the Popcorn for All activity. Students then participate in a class discussion about scarcity that leads to a discussion of energy sources as scarce resources. Next, students watch an age-appropriate video about energy and energy sources. After viewing the video, students create a list of all the sources of energy they noticed in the video, as well as other sources they can think of that were not included.

PREREQUISITE SKILLS FOR THE MODULE

Students enter this module with a wide range of preexisting skills, information, and knowledge. Table 3.1 (p. 28) 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 by Students	Differentiation for Students Needing Additional Knowledge
Measurement skills: • Volume • Length • Time	Measurement skills: • Students measure volumes, length, and time using standard units.	Measurement skills: • Provide students with opportunities to practice measuring length and volume using various units and measuring time to the nearest minute. • Provide students with additional content, including textbook support, teacher instruction, and online videos for telling time to the nearest minute.
Map-reading skills	Map-reading skills: • Students use a world map to identify water-scarce countries globally and water-scarce regions within the United States.	Map-reading skills: • Review basic map-reading and geography skills, including continents and oceans. • Have the whole class practice identifying features on a map, such as oceans, islands, and countries.
Inquiry skills: • Ask questions, make logical predictions, plan investigations, and represent data. • Use senses and simple tools to make observations. • Communicate interest in phenomena and plan for simple investigations. • Communicate understanding of simple data using age-appropriate vocabulary.	Inquiry skills: • Select and use appropriate tools and simple equipment to conduct an investigation. • Identify tools needed to investigate specific questions. • Maintain a STEM Research Notebook that includes observations, data, diagrams, and explanations. • Analyze and communicate findings from multiple investigations of similar phenomena to reach a conclusion.	Inquiry skills: • Select model and use appropriate tools and simple equipment to help students conduct an investigation. • Provide samples of a STEM Research Notebook. • Scaffold student efforts to organize data into tables, graphs, drawings, or diagrams by providing step-by-step instructions. • Use classroom discussions to identify specific investigations that could be used to answer a particular question and identify reasons for this choice.
Numbers and operations: • Add and subtract numbers within 1,000. • Multiply and divide whole numbers.	Numbers and operations: • Engage in activities that involve finding sums of numbers within 1,000. • Understand percentages with a focus on division. • Use division to calculate speed.	Numbers and operations: • Review and provide models of adding and subtracting within 1,000 using the standard algorithm. • Review multiplication and division and provide examples.

Table 3.1. (*continued*)

Prerequisite Key Knowledge	Application of Knowledge by Students	Differentiation for Students Needing Additional Knowledge
Reading: • Use information gained from the illustrations and words in a print or digital text to demonstrate understanding of the connection between a series of events, scientific ideas or concepts, or steps in technical procedures in a text.	Reading: • Read informational texts to understand the relationship between geography and water scarcity; environmental effects of various energy sources; and topics associated with solar energy.	Reading: • Provide reading strategies to support comprehension of nonfiction texts, including activating prior knowledge, previewing text by skimming content and scanning images, and rereading.
Writing: • Write informative/explanatory and narrative texts in which students introduce a topic, use facts and definitions to develop points, and provide a concluding statement or section.	Writing: • Write informative/explanatory texts to examine a topic and convey ideas and information clearly. • Write narratives to develop real or imagined experiences or events using effective technique, descriptive details, and clear event sequences.	Writing: • Provide a template for writing informative/explanatory texts to scaffold student writing exercises. • Provide writing organizer handouts to scaffold student work in describing details and clarifying event sequence.
Speaking and listening: • Participate in collaborative conversations using appropriate language and listening skills. • Tell a story or recount an experience with appropriate facts and relevant, descriptive details, speaking audibly in coherent sentences.	Speaking and listening: • Engage in a number of collaborative discussions and presentations in which they need to provide evidence and speak persuasively. • Present factual information to an audience.	Speaking and listening: • Scaffold student understanding of speaking skills by providing examples of appropriate language and presentation, with an emphasis on presentation techniques and language use. • Provide handouts or graphic organizers to support organization of appropriate facts and relevant descriptive details for presentations.

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 and Harrington's *Uncovering Student Ideas in Science* series contains probes targeted toward uncovering student misconceptions in a variety of areas and may be useful resources 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 illustrates some of the activities in the Harnessing Solar Energy module and how they align to the SRL processes before, during, and after learning.

Table 3.2. SRL Process Components

Learning Process Components	Examples From Harnessing Solar Energy Module	Lesson Number and Learning Component
BEFORE LEARNING		
Motivates students	Students participate in an inquiry activity demonstrating resource scarcity and the unequal distribution of resources worldwide.	Lesson 1, Activity/ Exploration
Evokes prior learning	Students share their ideas about the "fairness" of the distribution of natural resources and share ideas about whether and how more equality in the distribution of natural resources should be addressed.	Lesson 1, Activity/ Exploration
DURING LEARNING		
Focuses on important features	Students use solar energy to heat food by creating solar ovens using the engineering design process.	Lesson 3, Activity/ Exploration
Helps students monitor their progress	Students are given the opportunity to improve on their solar oven designs based on the ovens' performance.	Lesson 3, Elaboration/ Application of Knowledge
AFTER LEARNING		
Evaluates learning	Students receive feedback on rubrics for various components of their responses (the device design, a public service announcement, and a presentation) to the Water for All Challenge.	Lesson 5, Assessment
Takes account of what worked and what did not work	Students use prior observations of desalination devices recorded in their STEM Research Notebooks to design their challenge solutions.	Lesson 5, Activity/ Exploration

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 (for example, investigating solar power from the perspectives of science and social issues via scientific inquiry, literature, journaling, and collaborative design). Differentiation strategies for students needing support in prerequisite knowledge can be found in Table 3.1 (p. 28). 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, 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). You may also choose to group students based on their prior knowledge about solar energy. Beginning with the Not Enough Water Here activity in Lesson 3, you should group students into the teams with which they will work for the module's culminating challenge, since they start collecting geographically specific information for their final challenge in this activity.

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 proficiency in working with percentages in mathematics in Lesson 1, you may wish to limit the amount of time they spend practicing these skills and instead have students analyze and compare charts and graphs representing the proportions of energy that are provided by solar power in the United States and globally.

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 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) (see *www.wida.us/get.aspx?id=7*). 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. This module incorporates a variety of sensory supports and offers ongoing opportunities for ELL students to work collaboratively. The focus on global water access issues affords an opportunity for ELL students to share culturally diverse experiences with water access and quality.

Teachers differentiating instruction for ELL students should carefully consider the needs of these students as they introduce and use academic language in various language domains (listening, speaking, reading, and writing) throughout this module. To adequately differentiate instruction for ELL students, teachers should have an understanding of the proficiency level of each student. The following five overarching preK–5 WIDA learning standards are relevant to this module:

- Standard 1: Social and Instructional language. Focus on social behavior in group work and class discussions, following directions, and information gathering.
- Standard 2: The language of Language Arts. Focus on biographies and autobiographies, informational texts, and main ideas and details.
- Standard 3: The language of Mathematics. Focus on numbers and operations, patterns, number sense, percentages, and measurement.
- Standard 4: The language of Science. Focus on safety practices, energy sources, ecology and conservation, natural resources, and scientific inquiry.
- Standard 5: The language of Social Studies. Focus on resources and products; needs of groups, societies, and cultures; topography; and location of objects and places.

SAFETY CONSIDERATIONS FOR THE ACTIVITIES IN THIS MODULE

This module's science component focuses on solar energy. Students should understand that items left in the sun can become hot and that they should always use appropriate caution when handling items heated by solar power, using potholders or oven mitts. Additionally, students may need to cut through rigid materials such as plastics in this lesson. You may choose to do this cutting if you feel it would be too difficult for students to cut the material with scissors, or instruct them in the safe use of scissors to cut rigid materials. All laboratory occupants must wear safety glasses or goggles during all phases of inquiry activities (setup, hands-on investigation, and takedown). Everyone should also wash their hands with soap and water after completing the activities. For more general safety guidelines, see the section on Safety in STEM in Chapter 2 (p. 18).

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 section for the module (p. 23) and individual lessons.

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

Desired Outcome	Evidence of Success	
	Performance Tasks	Other Measures
Students complete a variety of group projects and individual tasks related to the projects within the module. Completion of these tasks demonstrates student understanding of the concepts and ability to apply these concepts to solving problems.	• Students are assessed on individual work, including handouts and STEM Research Notebook entries, throughout the module. • Students are assessed individually and as groups using project rubrics that focus on content and application of skills related to the academic content.	• Student collaboration is assessed using a collaboration rubric.

ASSESSMENT PLAN OVERVIEW AND MAP

Table 3.4 provides an overview of the major group and individual *product*s and *deliverables*, or things that constitute the assessment for this module. See Table 3.5 (pp. 36–38) for a full assessment map of formative and summative assessments in this module.

Table 3.4. Major Products and Deliverables in Lead Disciplines for Groups and Individuals

Lesson	Major Group Products and Deliverables	Major Individual Products and Deliverables
1	• The Marshmallow Mile marshmallow launcher	• You've Got Potential data sheet • World Water Scarcity Map • The Marshmallow Mile Engineer It! handouts • STEM Research Notebook prompt
2	• Sunsational Energy Poster • Sunsational Energy Presentation • Team choice of water-scarce country	• Energy Beans data sheet • Energy Flows handout • Sunsational Energy graphic organizer • Heat It Up data sheet • Evidence of collaboration (Sunsational Energy collaboration rubric) • STEM Research Notebook prompt
3	• Team report on energy source and contribution to class chart for Powerful Pollution activity • Sun Chefs solar oven • Not Enough Water Here lapbook	• Powerful Pollution graphic organizer • Sun Chefs Engineer It! handouts • Evidence of collaboration (Sun Chefs collaboration rubric) • STEM Research Notebook prompt
4	• Not applicable.	• How Salty Is Salt Water? data sheet handout • Desalination Station handouts • STEM Research Notebook prompts
5	• Desaladora device for Water for All Challenge • Budget for Water for All Challenge • Public service announcement for Water for All Challenge	• Water for All Challenge Engineer It! handouts • Evidence of collaboration (Water for All Challenge collaboration rubric) • STEM Research Notebook prompt

Table 3.5. Assessment Map for Harnessing Solar Energy Module

Lesson	Assessment	Group/ Individual	Formative/ Summative	Lesson Objective Assessed
1	You've Got Potential *data sheet*	Individual	Formative	• Provide examples of potential and kinetic energy. • Demonstrate transformations of potential to kinetic energy.
1	World Water Scarcity *map*	Individual	Formative	• Use understanding of the concept of scarcity to discuss resource scarcity and identify geographic areas with water scarcity. • Use maps to identify areas with water scarcity and understand geographic features of these regions.
1	The Marshmallow Mile *design challenge*	Group	Formative	• Apply understanding of potential and kinetic energy and the EDP to design a device that demonstrates transformations from potential to kinetic energy.
1	The Marshmallow Mile Engineer It! *handouts*	Individual	Formative	• Apply understanding of potential and kinetic energy and the EDP to design a device that demonstrates transformations from potential to kinetic energy.
1	STEM Research Notebook *prompt*	Individual	Formative	• Use understanding of the concept of scarcity to discuss resource scarcity and identify geographic areas with water scarcity.
2	Energy Beans *data sheet*	Individual	Formative	• Understand and discuss the differences between renewable and nonrenewable energy sources.
2	Sunsational Energy *poster and presentation*	Group	Formative	• Understand and discuss the advantages and disadvantages of using solar energy as an energy source to supply human needs.
2	Sunsational Energy *graphic organizer*	Individual		• Understand and discuss the advantages and disadvantages of using solar energy as an energy source to supply human needs.
2	Energy Flows *handout*	Individual	Formative	• Trace the source of the energy in their bodies back to the Sun.
2	Sunsational Energy *collaboration rubric*	Individual	Formative	• Apply collaboration skills to solve a problem.

Table 3.5. *(continued)*

Lesson	Assessment	Group/ Individual	Formative/ Summative	Lesson Objective Assessed
2	STEM Research Notebook *prompt*	Individual	Formative	• Demonstrate an understanding of patterns of energy consumption, identifying renewable and nonrenewable resources students use as they consume energy daily.
3	Powerful Pollution *graphic organizer*	Individual	Formative	• Apply understanding of the greenhouse effect to an understanding of the environmental effects of solar energy and fossil fuels.
3	Sun Chefs *oven design* and Engineer It! *handouts*	Group and individual	Formative	• Apply the EDP and understanding of solar energy to design and build a solar oven.
3	Sun Chefs *collaboration rubric*	Individual	Formative	• Collaborate with peers to solve problems and create products as assigned.
3	Not Enough Water Here *lapbook*	Group	Summative	• Understand the physical and cultural characteristics of a country with water scarcity.
3	STEM Research Notebook *prompt*	Individual	Summative	• Demonstrate an understanding of the physical and cultural characteristics of a country with water scarcity.
4	How Salty Is Salt Water? *data sheet handout*	Individual	Formative	• Understand the concept of salinity. • Measure the salinity of various water samples.
4	Desalination Station *handouts*	Individual	Formative	• Discuss the effects of salinity on the human body. • Discuss various methods of removing salt and other particles from water.
4	STEM Research Notebook *prompts*	Individual	Formative	• Demonstrate a conceptual understanding of the water cycle and observe examples of the water cycle in their daily lives. • Demonstrate an understanding of why solar energy is a better choice than fuel-based energy to power a desalination device.

Table 3.5. (*continued*)

Lesson	Assessment	Group/ Individual	Formative/ Summative	Lesson Objective Assessed
5	Water for All Challenge *design, budget, PSA*	Group	Summative	• Apply understanding of solar energy and desalination techniques to create a desalination device. • Communicate the benefits of a device students designed using persuasive language. • Demonstrate an understanding of a water-scarce country by targeting a PSA to residents of that country.
5	Water for All Challenge Engineer It! *handouts*	Individual	Summative	• Apply understanding of solar energy and desalination techniques to create a desalination device. • Demonstrate understanding of the EDP by applying it to create a solution to a challenge.
5	Water for All Challenge *collaboration rubric*	Individual	Summative	• Successfully collaborate with peers to create a solution to a challenge.
5	STEM Research Notebook *prompt*	Individual	Summative	• Discuss the EDP and its usefulness in solving problems.

MODULE TIMELINE

Tables 3.6–3.10 (pp. 39–40) provide lesson timelines for each week of the module. The 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 *Energetic Interactions* • Launch the module by introducing the concept of scarcity and potential and kinetic energy. • Have students prepare STEM Research Notebooks. • Introduce the Water for All Challenge.	*Lesson 1* *Energetic Interactions* • Students explore potential and kinetic energy in the You've Got Potential activity. • Introduce the EDP and continue exploration of scarcity. • Introduce literature connection.	*Lesson 1* *Energetic Interactions* • Students apply the EDP and their understanding of potential and kinetic energy in the Marshmallow Mile activity.	*Lesson 1* *Energetic Interactions* • Students test and redesign marshmallow launchers and present designs.	*Lesson 2* *Renewable or Not?* • Introduce the concept of renewable and nonrenewable energy sources with the Energy Beans activity.

Table 3.7. STEM Road Map Module Schedule for Week Two

Day 6	Day 7	Day 8	Day 9	Day 10
Lesson 2 *Renewable or Not?* • Introduce the concept of energy transformations in the Energy Flows activity.	*Lesson 2* *Renewable or Not?* • Students research topics related to solar power in the Sunsational Energy activity.	*Lesson 2* *Renewable or Not?* • Students create Sunsational Energy posters.	*Lesson 2* *Renewable or Not?* • Student teams present their Sunsational Energy posters to the class. • Students investigate radiant heat in the Heat It Up activity. • Student teams choose a water-scarce country to investigate.	*Lesson 3* *Energy and Earth* • Introduce the idea that accessing and using energy sources can affect the environment. • Students participate in the Greenpeople Effect activity. • Introduce the Powerful Pollution research activity. • Introduce Not Enough Water Here lapbook project.

Table 3.8. STEM Road Map Module Schedule for Week Three

Day 11	Day 12	Day 13	Day 14	Day 15
Lesson 3 *Energy and Earth* • Students research environmental effects of various energy sources in the Powerful Pollution activity. • Continue work on lapbooks.	*Lesson 3* *Energy and Earth* • Students complete Powerful Pollution activity. • Introduce Sun Chefs solar oven activity. • Continue work on lapbooks.	*Lesson 3* *Energy and Earth* • Students create solar ovens in the Sun Chefs activity. • Continue work on lapbooks.	*Lesson 3* *Energy and Earth* • Students complete Sun Chefs activity. • Students complete lapbooks.	*Lesson 4* *Salty Seas* • Introduce the properties of salt water using discussion and the Floating Away demonstration.

Table 3.9. STEM Road Map Module Schedule for Week Four

Day 16	Day 17	Day 18	Day 19	Day 20
Lesson 4 *Salty Seas* • Students create and use a hydrometer in the How Salty Is Salt Water? activity.	*Lesson 4* *Salty Seas* • Students continue their investigation of salinity and desalination by participating in Desalination Stations.	*Lesson 5* *Water for All Challenge* • Introduce materials for the Water for All Challenge and have students begin planning.	*Lesson 5* *Water for All Challenge* • Students continue work on Water for All Challenge by completing planning and "purchasing" supplies.	*Lesson 5* *Water for All Challenge* • Students continue work on Water for All Challenge by building their devices and leaving them in a sunny spot for at least a day to test them.

Table 3.10. STEM Road Map Module Schedule for Week Five

Day 21	Day 22	Day 23	Day 24	Day 25
Lesson 5 *Water for All Challenge* • Students continue work on Water for All Challenge with testing and redesign. • Students begin to work on their PSAs.	*Lesson 5* *Water for All Challenge* • Students continue work on Water for All Challenge with further testing and redesign. • Students continue work on their PSAs.	*Lesson 5* *Water for All Challenge* • Students continue work on Water for All Challenge by filming PSAs.	*Lesson 5* *Water for All Challenge* • Students complete all work for the Water for All Challenge.	*Lesson 5* *Water for All Challenge* • Students present their devices, PSAs, and lapbooks in a Water Conservation Expo.

RESOURCES

The media specialist can help teachers locate resources for students to view and read about the solar energy and provide technical help with spreadsheets and multimedia production software. 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 civil engineers, energy company representatives, and local water conservation group representatives.

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Page numbers printed in **boldface type** indicate tables, figures, or handouts.

Grade 4

STEM Road Map for Elementary School

Harnessing Solar Energy

What if you could challenge your fourth graders to use solar energy to provide the world with clean water? With this volume in the *STEM Road Map Curriculum Series*, you can!

Harnessing Solar Energy outlines a journey that will steer your students toward authentic problem solving while grounding them in integrated STEM disciplines. The series is designed to meet the growing need to infuse real-world learning into K–12 classrooms.

This book is an interdisciplinary module that uses project- and problem-based learning to investigate energy and energy sources, with a focus on solar energy and water scarcity. Your students will do the following:

- Investigate potential and kinetic energy, solar energy, the greenhouse effect, and salinity. Students will examine solar energy's potential and limitations while being introduced to the concepts of scarce resources and potable water.
- Make a social studies connection by investigating water scarcity around the world. Teams will choose regions facing water scarcity and research the areas' geographies, climates, and cultures.
- Use their understanding of solar energy, desalination, and the engineering design process to design a passive solar desalination device in the Water for All Challenge. Teams will also create public service announcements about the need for their devices in the water-scarce countries they researched.
- Take part in a Water Conservation Expo to exhibit their understanding of solar energy, water scarcity, and desalination worldwide.

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, *Harnessing Solar Energy* 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.

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