Swing Set Makeover

STEM Road Map for Elementary School

Grade 3

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

NSTApress
National Science Teachers Association

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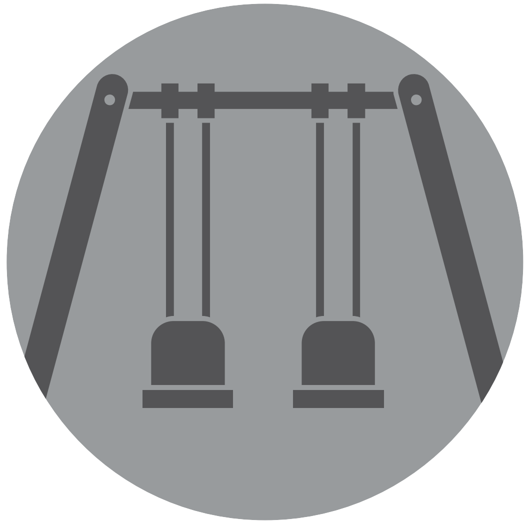

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National Science Teachers Association
Arlington, Virginia

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1840 Wilson Blvd., Arlington, VA 22201
www.nsta.org/store
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ABOUT THE EDITORS AND AUTHORS

Dr. Carla C. Johnson is the associate dean for research, engagement, and global partnerships and a professor of science education at Purdue University's College of Education in West Lafayette, Indiana. Dr. Johnson serves as the director of research and evaluation for the Department of Defense–funded Army Educational Outreach Program (AEOP), a global portfolio of STEM education programs, competitions, and apprenticeships. She has been a leader in STEM education for the past decade, serving as the director of STEM Centers, editor of the *School Science and Mathematics* journal, and lead researcher for the evaluation of Tennessee's Race to the Top–funded STEM portfolio. Dr. Johnson has published over 100 articles, books, book chapters, and curriculum books focused on STEM education. She is a former science and social studies teacher and was the recipient of the 2013 Outstanding Science Teacher Educator of the Year award from the Association for Science Teacher Education (ASTE), the 2012 Award for Excellence in Integrating Science and Mathematics from the School Science and Mathematics Association (SSMA), the 2014 award for best paper on Implications of Research for Educational Practice from ASTE, and the 2006 Outstanding Early Career Scholar Award from SSMA. Her research focuses on STEM education policy implementation, effective science teaching, and integrated STEM approaches.

Dr. Janet B. Walton is a research assistant professor and the assistant director of evaluation for AEOP at Purdue University's College of Education. Formerly the STEM workforce program manager for Virginia's Region 2000 and founding director of the Future Focus Foundation, a nonprofit organization dedicated to enhancing the quality of STEM education in the region, she merges her economic development and education backgrounds to develop K–12 curricular materials that integrate real-life issues with sound cross-curricular content. Her research focuses on collaboration between schools and community stakeholders for STEM education and problem- and project-based learning pedagogies. With this research agenda, she works to forge productive relationships between K–12 schools and local business and community stakeholders to bring contextual STEM experiences into the classroom and provide students and educators with innovative resources and curricular materials.

Dr. Erin Peters-Burton is the Donna R. and David E. Sterling endowed professor in science education at George Mason University in Fairfax, Virginia. She uses her experiences from 15 years as an engineer and secondary science, engineering, and mathematics teacher to develop research projects that directly inform classroom practice in science and engineering. Her research agenda is based on the idea that all students should build self-awareness of how they learn science and engineering. She works to help students see themselves as "science-minded" and help teachers create classrooms that support student skills to develop scientific knowledge. To accomplish this, she pursues research projects that investigate ways that students and teachers can use self-regulated learning theory in science and engineering, as well as how inclusive STEM schools can help students succeed. During her tenure as a secondary teacher, she had a National Board Certification in Early Adolescent Science and was an Albert Einstein Distinguished Educator Fellow for NASA. As a researcher, Dr. Peters-Burton has published over 100 articles, books, book chapters, and curriculum books focused on STEM education and educational psychology. She received the Outstanding Science Teacher Educator of the Year award from ASTE in 2016 and a Teacher of Distinction Award and a Scholarly Achievement Award from George Mason University in 2012, and in 2010 she was named University Science Educator of the Year by the Virginia Association of Science Teachers.

Dr. Tamara J. Moore is an associate professor of engineering education in the College of Engineering at Purdue University. Dr. Moore's research focuses on defining STEM integration through the use of engineering as the connection and investigating its power for student learning.

Paula Schoeff taught grades K–8 for 20 years in Indiana and Ohio and assisted in helping educate teachers in Ohio and Kentucky in STEM practices. Schoeff has a master's degree from the University of Cincinnati in curriculum and instruction with a focus on science.

Dr. Toni A. Sondergeld is an associate professor of assessment, research, and statistics in the School of Education at Drexel University in Philadelphia. Dr. Sondergeld's research concentrates on assessment and evaluation in education, with a focus on K–12 STEM.

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SWING SET MAKEOVER MODULE OVERVIEW

Paula Schoeff, Janet B. Walton, Carla C. Johnson, and Erin Peters-Burton

THEME: The Represented World

LEAD DISCIPLINE: Science

MODULE SUMMARY

In this module, students examine the STEM aspects involved in constructing a new and improved design for playground equipment, referred to as *swing sets* throughout the module. Science inquiry activities allow students to explore the impact of balanced and unbalanced forces on motion. Students gain a conceptual understanding of motion and force when they relate how the body moves to the objects they have explored, paying close attention to the forces each exerts and the positions maintained to keep balance. In mathematics, students identify geometric shapes, collect data using mathematical tools, and then record and analyze data using line plots and bar graphs to explain and make predictions. Students are challenged to apply this knowledge in the Swing Set Makeover Design Challenge. In this challenge, students examine a variety of swing sets and respond to a survey. They work collaboratively using the engineering design process (EDP) to sketch and develop a small-scale model of their proposed design, using geometric shapes and precise measurements. Finally, students draft a blog or newsletter detailing the key components of their design and justifying how their design is an improvement on existing swing set designs (adapted from Capobianco et al. 2015).

ESTABLISHED GOALS AND OBJECTIVES

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

- Use the EDP to design a swing set
- Compare and contrast swing set designs as they improve on or diminish a "fun factor" score on a survey
- Recognize and describe gravity and friction as forces

- Evaluate forces that interact with the body and swing set unit on the playground and associate these forces with design challenges
- Evaluate and recommend alternative shapes and designs for the swing set
- Design and implement an investigation around a testable question
- Use data analysis as evidence to answer a question under investigation
- Evaluate and implement safety features and materials of a swing set design
- Write a blog that describes the swing set design and the strengths of the design
- Recognize that citizens have civic responsibilities, which include helping care for public parks
- List ways that we, as citizens, can help care for our public parks

CHALLENGE OR PROBLEM FOR STUDENTS TO SOLVE: SWING SET MAKEOVER DESIGN CHALLENGE

Student teams are challenged to survey existing playground equipment (referred to as *swing sets* throughout the module), compare and contrast different designs in light of safety concerns connected to the playground equipment and its environment, and then sketch and build a small-scale model of their proposed design using geometric shapes and precise measurements. Details of the swing set and evidence of its improvement on existing playground equipment are synthesized in a blog or newsletter.

Students create swing set designs that will

- include a swing, a slide, and some sort of connecting partition;
- take advantage of features that maximize lessons about force and motion; and
- use fun features outlined in discussions while maintaining high standards of safety.

Driving Question: How can I use what I know about force and motion to create a plan and build a model of a swing set that is both fun and safe?

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 the 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. 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

Students will engage in a group discussion about the swing sets at school or their neighborhood park to activate prior knowledge, share personal experiences, and highlight their ideas of what components they enjoy most. After the discussion, teams will be given a picture of a swing set that they will use to generate a list of criteria to analyze the swing set for fun factors on a scale of 1 to 5 (see the Fun Factor Survey on p. 77). After the teams complete their tables, the class will visit the school playground swing set and use the same scale to determine its score on the survey.

Introduce the challenge by telling students that after they explore force and motion, their challenge will be to act as mechanical engineers to create a model of a swing set that will meet their standards for fun and safety. After they have developed their models, they will share their designs and defend their reasoning for design decisions online in a blog.

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 Knowledge
Science Knowledge • Force is a push or pull. • Gravity pulls objects down (toward the Earth). • Friction causes objects to slow down. • Squares and rectangles have length and width measurements. All four sides are added to find the perimeter and the length and width are multiplied to find the area. • Scientists and engineers solve problems in a similar fashion. • Some spaces are public spaces.	*Science Knowledge* • Experience, model, and describe gravitational force on an inclined plane using a variety of angles and materials. • See the impact of friction when testing a variety of materials on the ramp. • Experience, model, and describe rotational force using a variety of types of pendulums. • Design a swing set that demonstrates careful examination of materials and how the design is affected by gravitational force.	*Science Knowledge* • Provide adequate scaffolding to allow students to make informed decisions when designing tests. • Provide opportunities to work in teams as students draft sketches of their models and tests. • Provide opportunities to use oral and written language to describe scientific processes and principles.
Inquiry Skills • Ask questions, make logical predictions, plan investigations, and represent data. • Use senses and tools to make observations. • Communicate and plan simple investigations. • Communicate understanding of data using age-appropriate vocabulary.	*Inquiry Skills* • Select and use appropriate tools and equipment to conduct an investigation. • Identify tools needed to investigate specific questions. • Maintain a notebook that includes observations, data, diagrams, and reflections. • Analyze and communicate findings from multiple investigations of similar phenomena to reach a conclusion.	*Inquiry Skills* • Model selection and use appropriate tools and simple equipment to conduct an investigation. • Provide samples of a STEM Research Notebook. • Scaffold student efforts to organize data into appropriate tables, graphs, drawings, or diagrams by providing step-by-step instructions. • Identify specific investigations that could be used to answer a particular question and identify reasons for this choice.

Continued

Table 3.1. (*continued*)

Prerequisite Key Knowledge	Application of Knowledge by Students	Differentiation for Students Needing Knowledge
Measurement Skills • Measuring distance using standard and metric units. • Measuring distance to the nearest inch, half inch, and one-quarter inch. • Evaluating time to the nearest minute and second.	*Measurement Skills* • Measure distances using a tape measure with metric units. • Calculate distances using methods developed through experimentation. • Use stopwatches and other strategies to determine periods of motion. • Calculate speeds in units they create as well as cm units over a period of time.	*Measurement Skills* • Provide students with opportunities to practice measuring distances using various units and measuring time. • Provide students with additional content, including textbook support, teacher instruction, and online videos for using stopwatches and explaining strategies for measuring time. • Provide instruction in use of a stopwatch and identifying the units as seconds and minutes.
Numbers and Representation • Represent whole numbers up to and including 1,000. • Add and subtract whole numbers. • Multiply and divide whole numbers. • Create real data and represent findings in appropriately labeled tables. • Represent data using line plots.	*Numbers and Representation* • Add, subtract, multiply, and divide numbers to analyze findings and make decisions. • Calculate distances and speeds and track the results in tables. • Support design decisions using numbers in tables and graphs (line plots).	*Numbers and Representation* • Review and provide models of addition and subtraction up to 1,000. • Review multiplication and division using examples of distance and time. • Use textbook support, teacher instruction, models, graphic organizers, and online videos to provide practice using tables and graphs.
Geometry • Recognize and identify geometric shapes and patterns. • Recognize that a plane is composed of geometric shapes and patterns. • Measure perimeter and area of geometric shapes.	*Geometry* • Find geometric shapes and patterns in the playground and playground swing sets. • Experiment with geometric shapes while designing playground equipment. • Consider the space that is available and the size of the apparatus being designed (perimeter and area).	*Geometry* • Review and provide tessellation models and manipulatives. • Put together puzzles composed of geometric shapes to get a sense of how shapes make up planes. • Practice measuring shapes around the classroom.

Continued

Table 3.1. (*continued*)

Prerequisite Key Knowledge	Application of Knowledge by Students	Differentiation for Students Needing Knowledge
Reading • Use information gained from illustrations and words in print or digital text to build understanding of scientific concepts. • Use information gained from illustrations and words in print or digital text to build understanding of safe and dangerous conditions on a playground.	*Reading* • Describe the relationship between a group of images and descriptions using language that describes where, when, why, and how as it pertains to playgrounds and safe versus unsafe conditions.	*Reading* • Provide reading strategies to support comprehension of nonfiction texts, including using vocabulary notecards, creating graphic organizers, writing in the STEM Research Notebook, and discussions.
Writing • Use science terms to inform and explain thoughts and ideas about the topic. • Use key terminology as words and pictures.	*Writing* • Write informative and explanatory narratives to convey ideas and information clearly. • Write narratives to describe experiences using effective techniques, descriptive details, and clear event sequences.	*Writing* • Provide a template for writing. • Provide writing organization handouts to scaffold student work. • Provide rubrics that have a consistent format so students can measure their own writing.
Communication Skills • Participate in collaborative conversations using appropriate language and skills. • Effectively support scientific knowledge with appropriate language and relevant, descriptive details.	*Communication Skills* • Engage in a number of collaborative discussions that convey and support learning. • Write a blog to describe the swing set design and support it with scientific reasoning.	*Communication Skills* • Scaffold student understanding of communication skills by providing examples of appropriate language and presentation. • Provide handouts and rubrics to support organization of facts and use of relevant descriptive details.

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 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 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 activities in the Swing Set Makeover 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 Swing Set Makeover Module	Lesson Number and Learning Component
BEFORE LEARNING		
Motivates students	Students discuss their ideas with the class of the most enjoyable components of the swing sets they have experienced.	Lesson 1, Introductory Activity/Engagement
Evokes prior learning	Students engage in a group discussion about the swing sets at school or their neighborhood and share their personal experiences. Teacher relates this information to the challenge.	Lesson 1, Activity/ Exploration
DURING LEARNING		
Focuses on important features	Students revisit the Fun Factor Survey from the launch and draw a sketch of a slide for a swing set, using their skills and knowledge learned about Newton's first law of motion and geometric figures.	Lesson 2, Activity/ Exploration
Helps students monitor their progress	Students share their sketches and proposals for their slide designs.	Lesson 2, Activity/ Exploration
AFTER LEARNING		
Evaluates learning	After student teams plan the arrangement of the swing set on the site, identify the parts, choose the materials, and build the model, they test their model and document the process.	Lesson 4, Activity/ Exploration
Takes account of what worked and what did not work	Students reflect on what works with their original design and refine the model. Then they defend their design decisions by communicating them in a blog.	Lesson 4, 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 are 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 playground equipment from the perspectives of science, safety, and fun 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, tiered assignments and scaffolding, and mentoring.

Flexible Grouping. Students work collaboratively in a variety of activities throughout this module. Grouping strategies you may choose to employ include student-led grouping, placing students in groups according to ability level, grouping students randomly, 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), or grouping students according to common interests.

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 in inquiry and design activities. In addition, students learn in a variety of ways through doing inquiry activities, journaling, reading a variety of texts, watching videos, 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, electronic slide 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. Because student work in science is largely collaborative throughout the module, this strategy may be most appropriate for mathematics, English language arts (ELA), or social studies activities. You may wish to compile a classroom database of research resources and supplementary readings for a variety of reading levels and on a variety of topics related to the module's topic to provide opportunities for students to undertake independent reading.

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.

Mentoring. As group design teamwork becomes increasingly complex throughout the module, you may wish to have a resource teacher, older student, or parent volunteer work with groups that struggle to stay on task and collaborate effectively.

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. This module incorporates a variety of sensory supports and offers ongoing opportunities for ELL students to work collaboratively. The focus on playground equipment affords an opportunity for ELL students to share culturally diverse experiences with parks and playgrounds.

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 preK–5 WIDA learning standards are relevant to this module:

- Standard 1: Social and Instructional Language. Focus on following directions, personal information, and collaboration with peers.
- Standard 2: The language of Language Arts. Focus on nonfiction, fiction, sequence of story, and elements of story.

- Standard 3: The language of Mathematics. Focus on basic operations, number sense, interpretation of data, and patterns.
- Standard 4: The language of Science. Focus on forces in nature, scientific process, Earth and sky, living and nonliving things, organisms and environment, and weather.
- Standard 5: The language of Social Studies. Focus on community workers, homes and habitats, jobs and careers, and representations of Earth (maps and globes).

SAFETY CONSIDERATIONS FOR THE ACTIVITIES IN THIS MODULE

Student safety is a primary consideration in all subjects where students may interact with tools and materials with which they are unfamiliar and which may pose additional safety risks. You should ensure that your classroom set-up is in accord with your school's safety policies and that students are familiar with basic safety procedures, the location of protective equipment (e.g., safety glasses, gloves), and emergency exit procedures. For more general safety guidelines, see the Safety in STEM section in Chapter 2 (p. 18).

Internet safety is also important. You should develop an internet/blog protocol with students if guidelines are not already in place. Since students will use the internet for their research to acquire the needed data, you should monitor students' access to ensure that they are accessing only websites that you have clearly identified. Further, you should inform parents or guardians that students will create blogs and that you will closely monitor these projects. It is recommended that you not allow any website posts created by students to go public without first approving them.

During this module, students will be spending time outside exploring your school's playground. Before conducting these outdoor explorations, instruct students in safe practices for exploring the playground area.

DESIRED OUTCOMES AND MONITORING SUCCESS

The desired outcome for this module is 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 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 apply an understanding of balanced and unbalanced forces and predict the motion of unbalanced forces that are applied to an object.	• Students maintain STEM Research Notebooks that contain graphic organizers with lab test data, sketches, research notes, and ELA-related work. • Students design a model of a swing set. • Students defend their design decisions in a blog or newsletter by making correlations to their observations from the unit. • Students are assessed using project rubrics that focus on learning and application of skills related to the academic content.	• STEM Research Notebooks are assessed using a STEM Research Notebook rubric. Clarify expectations and when necessary reproduce rubrics. • Student collaboration is evaluated using a self-assessment reflection form and peer feedback.

ASSESSMENT PLAN OVERVIEW AND MAP

Table 3.4 provides an overview of the major group and individual *products* and *deliverables,* or things that comprise the assessment for this module. See Table 3.5 (p. 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	• Fun Factor Survey • Forces Push Back handout	• Bar graph • STEM Research Notebook entries
2	• Slide Makeover Sketch • Park Exhibition Showcase (research, collection of artifacts, and presentation)	• Ramp Investigation handouts • Slide Makeover Plan Book • Opinion Essay • STEM Research Notebook entries
3	• Swing Makeover Sketch • Jigsaw Research Template	• Pendulum Investigation handouts • Swing Makeover Plan Book • STEM Research Notebook entries
4	• Swing Set Makeover Model • Proposal Presentation • Blog or newsletter that provides evidence to support decisions for final swing set design	• STEM Research Notebook entries • Blog or newsletter contributions

Table 3.5. Assessment Map for Swing Set Makeover Module

Lesson	Assessment	Group/ Individual	Formative/ Summative	Lesson Objective Assessed
1	STEM Research Notebook *prompt*	Individual	Formative	• Recognize and describe gravity as a force. • Recognize and describe friction as a force.
1	Fun Factor Survey *handout*	Group	Formative	• Evaluate the impact of a swing set on its "fun factor" score.
1	Forces Push Back *handout*	Group	Formative	• Recognize and describe gravity as a force. • Recognize and describe friction as a force. • Evaluate a variety of activities to identify the forces that affect motion.
1	Bar Graph *rubric*	Individual/ Group	Summative	• Create bar graph with appropriate features.
1	Park Presentation *rubric*	Group	Formative	• Research a local park.
2	Ramp Investigations *handouts*	Individual	Formative	• Design and implement an investigation around a testable question. • Use data analysis as evidence to answer a question under investigation. • Relate the angle and length of a ramp to increased/ decreased speed.
2	Slide Makeover Plan Book *handout*	Individual	Formative	• Compare and contrast materials and angles to make decisions for a new slide design.
2	Slide Design Sketch *rubric*	Group	Formative	• Explain that friction causes work (energy) to be wasted when objects go down the slide. • Compare and contrast materials and angles to make decisions for a new slide design. • Critique slide designs of classmates to provide constructive feedback.

Continued

Table 3.5. (*continued*)

Lesson	Assessment	Group/ Individual	Formative/ Summative	Lesson Objective Assessed
2	Geometry Scavenger Hunt *handout*	Group	Formative	• Calculate the area of a surface. • Identify the geometric shapes that appear in a swing set.
2	Writing the OREO Way *handout*	Individual	Formative	• Formulate opinion statements and provide supporting reasons for opinions.
2	Park Presentation *rubric*	Group	Formative	• Present research on local park.
2	STEM Research Notebook *prompt*	Individual	Formative	• Understand area and perimeter.
3	Pendulum Investigations *handouts and rubric*	Individual	Formative	• Recognize and describe gravity and inertia's influence on pendulum motion. • Analyze the motion of a pendulum to make predictions.
3	Swing Makeover Plan Book *handout*	Individual	Formative	• Compare and contrast materials and angles to make decisions for a new slide design.
3	Jigsaw Research *template*	Individual	Formative	• Understand that components of swing design include motion, safety, materials, and aesthetics.
3	Swing Design Sketch *rubric*	Group	Formative	• Predict and evaluate the impact of design and materials on the swing's fun factor rating. • Understand that components of swing design include motion, safety, materials, and aesthetics. • Design a swing for the Swing Set Makeover Design Challenge.

Continued

Table 3.5. (*continued*)

Lesson	Assessment	Group/ Individual	Formative/ Summative	Lesson Objective Assessed
4	Model for Swing Set Makeover *handouts and rubrics*	Group	Summative	• Build a model for a new swing set that considers shapes and forces and has a high rating on the Fun Factor Survey from Lesson 1. • Build a model for a new swing set that incorporates an understanding of basic safety features. • Effectively use shapes, materials, and measurements that affect speed, aesthetics, and safety on a new swing set design.
4	Blog/ Newsletter *handouts and rubrics*	Group	Summative	• Create a blog or newsletter that addresses the design decisions made in the design process and the benefits of the swing set design.
4	Proposal Presentation *rubric*	Group	Summative	• Communicate information about swing set designs in a presentation.

MODULE TIMELINE

Tables 3.6–3.10 (pp. 41–43) 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 *Forces Push Back* • Launch the module and introduce the Fun Factor Survey as a tool to analyze swing sets. • In ELA, students begin to explore module concepts through fiction and nonfiction literature.	*Lesson 1* *Forces Push Back* • Students explore personal preferences for swing sets and work with their design teams to generate team standards and a team "fun factor" rubric.	*Lesson 1* *Forces Push Back* • Teams use their fun factor rubrics to evaluate playground images. • Graphing activities support understanding of fun factor data. • Launch a team social studies park research project to explore parks in the area and investigate social responsibilities to the community.	*Lesson 1* *Forces Push Back* • Explore forces associated with playground activities. • Identify how gravity and friction forces affect motion.	*Lesson 2* *Slippery Slide Design* • Introduce balanced and unbalanced forces. • Introduce the use of geometric shapes in buildings and playground equipment.

Table 3.7. STEM Road Map Module Schedule for Week Two

Day 6	Day 7	Day 8	Day 9	Day 10
Lesson 2 *Slippery Slide Design* • Investigate balanced and unbalanced forces using inclined planes. • Explore geometric shapes on the school playground, take measurements, and create maps of the playground.	*Lesson 2* *Slippery Slide Design* • Investigate balanced and unbalanced forces using inclined planes. • Continue to explore geometric shapes on the school playground, take measurements, and create maps of the playground.	*Lesson 2* *Slippery Slide Design* • Introduce annotated sketching. • Teams begin their Slide Makeover Plan Books.	*Lesson 2* *Slippery Slide Design* • Teams work on their Slide Makeover Plan Books. • In ELA, students begin to write opinion essays.	*Lesson 2* *Slippery Slide Design* • Teams complete their Slide Makeover Plan Books and provide feedback to other teams on their designs. • In social studies, students present their park research projects.

Table 3.8. STEM Road Map Module Schedule for Week Three

Day 11	Day 12	Day 13	Day 14	Day 15
Lesson 3 *Swinging Pendulums* • Introduce pendulum motion and pendulum activities to explore and predict the behavior of swinging objects.	*Lesson 3* *Swinging Pendulums* • Students participate in a pendulum activity. • In ELA, students begin a jigsaw research activity to investigate topics related to playgrounds.	*Lesson 3* *Swinging Pendulums* • Introduce scaled drawings. • Teams begin their Swing Makeover Plan Books.	*Lesson 3* *Swinging Pendulums* • Teams continue working on their Swing Makeover Plan Books.	*Lesson 3* *Swinging Pendulums* • Teams complete their Swing Makeover Plan Books and provide feedback to other teams on their designs.

Table 3.9. STEM Road Map Module Schedule for Week Four

Day 16	Day 17	Day 18	Day 19	Day 20
Lesson 4 *Swing Set Makeover Design Challenge* • Introduce the engineering design process (EDP). Students participate in an EDP activity. • In ELA, introduce blogging and the blog (or newsletter) students will create for their swing set models and design process.	*Lesson 4* *Swing Set Makeover Design Challenge* • Teams create a layout of the site for their swing set models.	*Lesson 4* *Swing Set Makeover Design Challenge* • Teams choose materials and begin to construct their swing set models.	*Lesson 4* *Swing Set Makeover Design Challenge* • Teams continue to build their swing set models.	*Lesson 4* *Swing Set Makeover Design Challenge* • Teams continue to build their swing set models.

Table 3.10. STEM Road Map Module Schedule for Week Five

Day 21	Day 22	Day 23	Day 24	Day 25
Lesson 4 *Swing Set Makeover Design Challenge* • Teams test and refine their swing set models.	*Lesson 4* *Swing Set Makeover Design Challenge* • Teams document their design process and details in blogs or newsletters.	*Lesson 4* *Swing Set Makeover Design Challenge* • Teams present their models and discuss and defend design decisions in presentations.	*Lesson 4* *Swing Set Makeover Design Challenge* • These days are left open to accommodate Lesson 4 activities that may have taken longer than anticipated. If the module is complete by day 23, options include a field trip to a local park or science museum or guest speakers.	

RESOURCES

The media specialist can help teachers locate resources for students to view and read about recreational equipment, parks, and related physics 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 mechanical engineers, representatives of parks departments, and playground manufacturing representatives.

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

Grade 3

STEM Road Map for Elementary School

Swing Set Makeover

What if you could challenge your third graders to design a swing set that's safe but still lots of fun? With this volume in the *STEM Road Map Curriculum Series*, you can!

Swing Set Makeover outlines a journey that will steer your students toward authentic problem solving while grounding them in integrated STEM disciplines. As are the other volumes in the series, this book is designed to meet the need to infuse real-world learning into K–12 classrooms.

The book is an interdisciplinary module that uses project- and problem-based learning. Students will draw on physical science, mathematics, engineering, English language arts, and social studies to do the following:

- Compare swing set designs for both safety and fun factors.
- Recognize gravity and friction as forces; evaluate the forces that affect both children's bodies and swing sets on the playground; and spot ways these forces play into design challenges.
- Work through the engineering design process to create alternative shapes and designs for a swing set.
- Collect data using mathematical tools and record data with line plots and bar graphs.
- Build models of their proposed designs and write blogs to summarize the improvements that maximize playground fun while minimizing risks.

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, *Swing Set Makeover* 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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