# Transportation in the Future

## 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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National Science Teachers Association
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See *www.routledge.com/products/9781138804234* for more information about *STEM Road Map: A framework for integrated STEM education.*

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# TRANSPORTATION IN THE FUTURE MODULE OVERVIEW

*Janet B. Walton, Sandy Watkins, Carla C. Johnson, and Erin E. Peters-Burton*

**THEME:** Innovation and Progress

**LEAD DISCIPLINES:** Social Studies and Science

## MODULE SUMMARY

In this module, students learn about the geography of the continental United States, explore the role of trains in the nation's development, and consider train travel in the context of the 21st century. Students develop conceptual understanding of innovations in train technology, with a focus on magnetic levitation (maglev) trains. Inquiry activities in science allow students to gain an understanding of magnetic interactions. Using mathematics, students learn to calculate distances and time intervals. Students apply this knowledge in the Maglevacation Train Challenge, working collaboratively using the engineering design process (EDP) to create a prototype train that can safely carry passengers a given distance and then to prepare a presentation that includes information about their destination and the design features of their train (adapted from Capobianco et al. 2015).

## ESTABLISHED GOALS AND OBJECTIVES

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

- Apply their understanding of U.S. geography to locate a destination and calculate distances
- Use map skills to identify geographic features including rivers, mountains, and oceans
- Understand the relationship between the development of the rail system and the progressive development of the United States

- Apply their conceptual understanding of the history of train technology and its role in train efficiency, performance, and safety to solving a design challenge
- Apply their understanding of magnetism to create a maglev vehicle
- Understand that magnets can play an important role in transportation innovations
- Apply mathematics skills to calculate distances, speeds, and time intervals
- Demonstrate their understanding of the EDP by using it to collaboratively complete assigned tasks
- Discuss geographic and demographic features of a location in the continental United States
- Present their projects in a clear, concise presentation format

## CHALLENGE OR PROBLEM FOR STUDENTS TO SOLVE: THE MAGLEVACATION TRAIN CHALLENGE

Student teams are challenged to each choose a vacation destination, research that destination, and create a prototype Maglevacation Train to carry passengers to that destination. Then, each team creates a video presentation to provide information about its destination and train to a fictional client, including the following:

- Geographic, climatic, and cultural information about the destination
- A review of the design features of the prototype train
- A demonstration of the prototype's performance
- A persuasive argument about why travelers should choose the team's destination and train

**Driving Question:** How can we create a plan and build a prototype for a maglev train to carry passengers to a vacation destination?

## 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 Research Notebooks in Lesson 1. You may also wish to have students include the STEM Research Notebook Guidelines student handout on p. 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, have students engage in a group discussion about train travel to activate prior knowledge, share personal experiences, and highlight perceptions about this mode of travel. After the discussion, the class views a video clip about transportation that emphasizes high-speed trains and the advanced technology associated with this mode of travel. (Relevant videos can be found on YouTube by searching for "future of transportation technologies"; one example is "Hyperloop and Future Transport Technology" at *www.youtube.com/watch?v=YHiKjJEFY6A.*) After viewing the video, the students revisit their earlier discussion and reflect on what surprised them about train travel in this video and what they learned.

Tell students that as part of their challenge in this module, they will be acting as design engineers to create a model or prototype of a train that can carry passengers from their hometown to a vacation spot of their choice as quickly and safely as possible and will also be acting as travel agents to provide information about a vacation spot.

## 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:<br>• Distance<br>• Time | Measurement skills:<br>• Measure distances using standard units.<br>• Use timetables and clocks to measure arrival and departure times for trains to the nearest minute. | Measurement skills:<br>• Provide students with opportunities to practice measuring distances using various units and measuring time to the nearest minute.<br>• Provide students with additional content, including textbook support, teacher instruction, and online videos for telling time to the nearest minute. |
| Inquiry skills:<br>• Ask questions, make logical predictions, plan investigations, assess and address safety issues, and represent data.<br>• Use senses and simple tools to make observations.<br>• Communicate interest in simple phenomena and plan for simple investigations.<br>• Communicate understanding of simple data using age-appropriate vocabulary. | Inquiry skills:<br>• Select and use appropriate tools, simple equipment, and safety equipment to conduct an investigation.<br>• Identify tools needed to investigate specific questions.<br>• Maintain a STEM Research Notebook that includes observations, data, diagrams, and explanations.<br>• Analyze and communicate findings from multiple investigations of similar phenomena to reach a conclusion. | Inquiry skills:<br>• Select, model, and use appropriate tools and simple equipment to help students conduct an investigation.<br>• Provide samples of a STEM Research Notebook.<br>• Scaffold student efforts to organize data into tables, graphs, drawings, or diagrams by providing step-by-step instructions.<br>• 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:<br>• Add and subtract numbers within 1,000.<br>• Multiply and divide whole numbers. | Numbers and operations:<br>• Engage in activities that involve finding sums of numbers within 1,000.<br>• Calculate distances using a map scale.<br>• Calculate speeds in units of miles per hour. | Numbers and operations:<br>• Review and provide models of adding and subtracting within 1,000 using the standard algorithm.<br>• Review multiplication and division and provide examples of map scale and speed calculations. |

| Prerequisite Key Knowledge | Application of Knowledge by Students | Differentiation for Students Needing Additional Knowledge |
| --- | --- | --- |
| Reading:<br>• Use information gained from the illustrations and words in a print or digital text to demonstrate understanding of the connection between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text. | Reading:<br>• Describe the relationship between a series of historical events and train travel using language that pertains to time, sequence, and cause and effect. | Reading:<br>• Provide reading strategies to support comprehension of nonfiction texts, including activating prior knowledge, previewing text by skimming content and scanning images, and rereading. |
| Writing:<br>• 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:<br>• Write informative/explanatory texts to examine a topic and convey ideas and information clearly.<br>• Write narratives to develop real or imagined experiences or events using effective technique, descriptive details, and clear event sequences. | Writing:<br>• Provide a template for writing informative/explanatory texts to scaffold student writing exercises.<br>• Provide writing organizer handouts to scaffold student work in describing details and clarifying event sequence. |
| Speaking and listening:<br>• Participate in collaborative conversations using appropriate language and listening skills.<br>• Tell a story or recount an experience with appropriate facts and relevant, descriptive details, speaking audibly in coherent sentences. | Speaking and listening:<br>• Engage in a number of collaborative discussions and presentations in which students need to provide evidence and speak persuasively.<br>• Present factual information to an audience. | Speaking and listening:<br>• Scaffold student understanding of speaking skills by providing examples of appropriate language and presentations, with an emphasis on presentation techniques and language use.<br>• Provide handouts 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. In particular, Volumes 1 and 2 of *Uncovering Student Ideas in Physical Science* (Keeley and Harrington 2010, 2014), about force/motion and electricity/magnetism, 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 Transportation in the Future module and how they align to the SRL process before, during, and after learning.

## 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,

**Table 3.2.** SRL Process Components

| Learning Process Components | Examples From Transportation in the Future Module | Lesson Number and Learning Component |
|---|---|---|
| | **BEFORE LEARNING** | |
| Motivates students | Students choose a destination for the maglev train they will create. | Lesson 1, Introductory Activity/Engagement |
| Evokes prior learning | Students engage in group discussions about their personal experiences with trains and other modes of travel and reflect on the availability of trains for passenger travel in their geographic area. | Lesson 1, Introductory Activity/Engagement |
| | **DURING LEARNING** | |
| Focuses on important features | Students gain experience in using magnets as a propulsion system in the Magnificent Magnet Match mini design challenge. | Lesson 2, Activity/ Exploration |
| Helps students monitor their progress | Students create a STEM Research Notebook entry reflecting on how their team used the engineering design process, with a focus on things that went well, challenges, and teamwork. | Lesson 2, Elaboration/ Application of Knowledge |
| | **AFTER LEARNING** | |
| Evaluates learning | Students receive feedback on rubrics for their Maglevacation Train design and their presentations. | Lesson 4, Assessment |
| Takes account of what worked and what did not work | Students examine their prior work in their STEM Research Notebooks to determine what they learned over the course of the lesson and how this learning can be applied to creating a solution for the module challenge. | Lesson 4, Activity/ Exploration |

investigating magnetism via scientific inquiry, literature, journaling, and collaborative design). Differentiation strategies for students needing support in prerequisite knowledge can be found in Table 3.1. 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 trains and magnetism. For Lesson 2, you may choose to maintain the same student groupings as in Lesson 1 or regroup students according to another of the strategies described here. Students begin to use the EDP during the Magnificent Magnet Match in Lesson 2 and continue to use the EDP throughout the module and for their final challenge. You may therefore wish to consider grouping students in Lesson 2 into design teams on which they will remain throughout the module.

*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 mastery of calculating map distances and speeds in mathematics in Lesson 1, you may wish to limit the amount of time they spend practicing these skills and instead introduce various units of measurement and unit conversions to these students or introduce the concept of map scale and proportions 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. The World-Class Instructional Design and Assessment Consortium (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 with collaboratively. The focus in this module on various modes of transportation and high-speed trains in a global context affords opportunities to access the culturally diverse experiences of ELL students in the classroom.

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.
- 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, magnetism, energy sources, scientific process, and scientific inquiry.
- Standard 5: The language of Social Studies. Focus on change from past to present, historical events, resources, transportation, map reading, and location of objects and places.

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

| Desired Outcomes | Evidence of Success | |
|---|---|---|
| | Performance tasks | Other measures |
| Students can apply an understanding of geography, mapping, and various science and mathematics concepts to complete small group projects and individual tasks related to the projects within the unit. | • Students maintain STEM Research Notebooks that contain designs, research notes, evidence of collaboration, and ELA-related work.<br>• Students design a working prototype.<br>• Student teams research and present information on a destination of their choice.<br>• Students are able to discuss how they applied their understanding of concepts introduced in the module to their designs (individual and team) and presentations.<br>• Students are assessed using project rubrics that focus on content and application of skills related to the academic content. | • Student collaboration is assessed using a collaboration rubric. |

## SAFETY CONSIDERATIONS FOR THE ACTIVITIES IN THIS MODULE

This module's science component focuses on magnets. Ensure that no students have health conditions that could be affected by use of magnets (e.g., pacemakers). All laboratory occupants must wear safety glasses or goggles during all phases of inquiry activities (setup, hands-on investigation, and takedown). Students should be instructed not to blow on or throw iron filings. 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 sections for the module and the individual lessons.

## ASSESSMENT PLAN OVERVIEW AND MAP

Table 3.4 provides an overview of the major group and individual *products* and *deliverables*, or things that constitute the assessment for this module. See Table 3.5 (p. 36) 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 | • Map Me! group decision and geographic information about vacation destination | • Map Me! handouts and maps<br>• Magnet preassessment<br>• Magnetic or Not? data sheet handout<br>• STEM Research Notebook prompt |
| 2 | • My Magnetic Question presentation<br>• Magnificent Magnet Match boat design | • My Magnetic Question research question<br>• Magnificent Magnet Match Engineer It! handouts<br>• STEM Research Notebook prompt |
| 3 | • Expert group contribution to Planes, Trains, and Automobiles class chart<br>• Let's Go! presentation and budget | • Electromagnetic Demonstration handouts and data<br>• Planes, Trains, and Automobiles expert group graphic organizer<br>• Let's Go! handouts<br>• Balloon Car handouts and data<br>• STEM Research Notebook prompt |
| 4 | • Maglevacation Train Challenge presentation and train design | • Maglevacation Train Challenge student packet pages<br>• STEM Research Notebook prompt |

**Table 3.5. Assessment Map for Transportation in the Future Module**

| Lesson | Assessment | Group/ Individual | Formative/ Summative | Lesson Objective Assessed |
|---|---|---|---|---|
| 1 | Map Me! *handouts* | Individual | Formative | • Use a map to identify student's region, state, county, and town.<br>• Identify the geographic features of student's hometown and state. |
| 1 | Magnetic or Not? *handouts* | Individual | Formative | • Describe and demonstrate the ways magnetic poles attract and repel one another. |
| 1 | Magnet Magic *handouts* | Individual | Formative | • Describe and demonstrate the ways magnetic poles attract and repel one another. |
| 1 | My Magnetic Question *STEM Research Notebook entries* | Individual | Formative | • Formulate a testable research question.<br>• Design an investigation and draw conclusions from that investigation |
| 1 | STEM Research Notebook *prompt* | Individual | Formative | • Calculate distances on a map using the map scale. |
| 2 | Riding the Rails *handouts* | Individual | Formative | • Demonstrate ability to locate various U.S. locations on a map and identify geographic features of those areas. |
| 2 | Magnificent Magnet Match *boat design* | Group | Formative | • Apply understanding of magnetism and the EDP to a group design challenge. |
| 2 | Magnificent Magnet Match *EDP handouts* | Individual | Formative | • Apply understanding of magnetism to a group design challenge.<br>• Demonstrate understanding of the EDP. |
| 2 | Evidence of collaboration *collaboration rubric* | Individual | Formative | • Use the EDP to work collaboratively. |
| 2 | STEM Research Notebook *prompt* | Individual | Formative | • Identify and discuss various features and uses of maps. |
| 3 | Planes, Trains, and Automobiles *graphic organizer* | Individual | Formative | • Use understanding of the advantages and disadvantages of various modes of transportation to make recommendations about the preferred method of travel to a particular destination. |

| Lesson | Assessment | Group/ Individual | Formative/ Summative | Lesson Objective Assessed |
|---|---|---|---|---|
| 3 | Let's Go! *presentation and budget* | Group | Summative | • Use understanding of geography and maps to predict climate conditions in various locations around the United States.<br>• Apply understanding of budgets to create a travel budget.<br>• Apply findings from research to calculate costs per mile.<br>• Create a compelling presentation using technology to highlight students' findings.<br>• Create a persuasive argument for visiting the chosen vacation destination. |
| 3 | Let's Go! *handouts and graphic organizer* | Individual | Summative | • Use understanding of geography and maps to predict climate conditions in various locations around the United States.<br>• Apply understanding of budgets to create a travel budget.<br>• Create a persuasive argument for visiting the chosen vacation destination.<br>• Apply findings from research to calculate costs per mile. |
| 3 | Electromagnetic Demonstration *handouts* | Individual | Formative | • Demonstrate a conceptual understanding of electromagnets.<br>• Identify independent and dependent variables.<br>• Formulate hypotheses and test these hypotheses. |
| 3 | Balloon Car *handouts* | Individual | Formative | • Understand that objects must have a force applied to them to initiate movement.<br>• Understand and demonstrate that the weight of an object affects how much force is needed to initiate motion.<br>• Formulate hypotheses and test these hypotheses. |

(*continued*)

**Table 3.5. (*continued*)**

| Lesson | Assessment | Group/ Individual | Formative/ Summative | Lesson Objective Assessed |
|---|---|---|---|---|
| 3 | STEM Research Notebook *prompt* | Individual | Formative | • Understand that objects must have a force applied to them to initiate movement and demonstrate this understanding by creating a vehicle propelled by air leaving a balloon.<br>• Discuss how magnets are used in maglev trains and predict how this could be used to create student's own prototype maglev vehicle. |
| 4 | Maglevacation Train Challenge *student packet* | Individual | Summative | • Apply understanding of mapping and geography to create a persuasive presentation about a travel destination.<br>• Apply understanding of how speed and weight affect acceleration to create the fastest speeds possible over a short distance. |
| 4 | Prototype design *rubric* | Group | Summative | • Apply understanding of speed and how weight affects acceleration to create the fastest speeds possible over a short distance.<br>• Apply understanding of magnetism to create a prototype maglev train. |
| 4 | Video presentation *rubric* | Group | Summative | • Synthesize learning throughout the module to create a presentation appropriate for the audience. |
| 4 | Collaboration *rubric* | Individual | Summative | • Apply understanding of the EDP to work collaboratively to create a solution to a challenge. |

## MODULE TIMELINE

Tables 3.6–3.10 (pp. 39–40) 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: Maglevs, Maps, and Magnets*<br>• Launch the module. Activate student prior knowledge of trains through discussions and video clips.<br>• Conduct preassessment on magnets and magnetism. | *Lesson 1: Maglevs, Maps, and Magnets*<br>• Students form design teams and formulate a list of potential destinations, practice map reading skills, and begin Map Me! activity.<br>• Introduce physical properties of matter. | *Lesson 1: Maglevs, Maps, and Magnets*<br>• Continue mapping activities.<br>• Introduce magnetism Magnetic or Not? activity. | *Lesson 1: Maglevs, Maps, and Magnets*<br>• Continue mapping and map reading activities.<br>• Introduce Magnet Magic activity. | *Lesson 2: Trains Through Time*<br>• Introduce Transcontinental Railroad.<br>• Introduce Riding the Rails activity.<br>• Introduce testable questions (My Magnetic Question). |

**Table 3.7.** STEM Road Map Module Schedule for Week Two

| Day 6 | Day 7 | Day 8 | Day 9 | Day 10 |
|---|---|---|---|---|
| *Lesson 2: Trains Through Time*<br>• Continue Riding the Rails activity.<br>• Do My Magnetic Question activity.<br>• Introduce biomimicry. | *Lesson 2: Trains Through Time*<br>• Introduce EDP.<br>• Begin Magnificent Magnet Match activity.<br>• Introduce timetables and elapsed time. | *Lesson 2: Trains Through Time*<br>• Continue Magnificent Magnet Match.<br>• Investigate availability of passenger rail travel and time zones. | *Lesson 3: Portable People*<br>• Explore various forms of transportation and locations of maglev trains.<br>• Explore budgeting.<br>• Conduct Electromagnetic Demonstration. | *Lesson 3: Portable People*<br>• Students form expert groups to investigate a travel topic across three modes of transportation in the Planes, Trains, and Automobiles activity. |

**Table 3.8.** STEM Road Map Module Schedule for Week Three

| Day 11 | Day 12 | Day 13 | Day 14 | Day 15 |
|---|---|---|---|---|
| *Lesson 3: Portable People*<br>• Continue Planes, Trains, and Automobiles activity.<br>• Introduce Balloon Car activity. | *Lesson 3: Portable People*<br>• Design Teams begin Let's Go! activity (background research).<br>• Complete Balloon Car activity. | *Lesson 3: Portable People*<br>• Continue Let's Go! activity (construct budget). | *Lesson 3: Portable People*<br>• Continue Let's Go! activity. | *Lesson 3: Portable People*<br>• Finish Let's Go! activity (share student presentations). |

**Table 3.9.** STEM Road Map Module Schedule for Week Four

| Day 16 | Day 17 | Day 18 | Day 19 | Day 20 |
|---|---|---|---|---|
| *Lesson 4: Speeding Ahead—The Maglevacation Train Challenge*<br>• Introduce challenge and challenge parameters.<br>• Begin prototype design. | *Lesson 4: Speeding Ahead—The Maglevacation Train Challenge*<br>• Complete prototype maglev train design and build. | *Lesson 4: Speeding Ahead—The Maglevacation Train Challenge*<br>• Test and redesign prototype.<br>• Record speeds. | *Lesson 4: Speeding Ahead—The Maglevacation Train Challenge*<br>• Compile and organize information for presentation. | *Lesson 4: Speeding Ahead—The Maglevacation Train Challenge*<br>• Compile and organize information for presentation. |

**Table 3.10.** STEM Road Map Module Schedule for Week Five

| Day 21 | Day 22 | Day 23 | Day 24 | Day 25 |
|---|---|---|---|---|
| *Lesson 4: Speeding Ahead—The Maglevacation Train Challenge*<br>• Complete organization of presentation and practice. | *Lesson 4: Speeding Ahead—The Maglevacation Train Challenge*<br>• Create videos. | *Lesson 4: Speeding Ahead—The Maglevacation Train Challenge*<br>• Share videos with audience. | • These days are left open to accommodate any lessons that may have taken longer than anticipated. If the module is completed by Day23, options include taking a field trip to a local train station or museum, having a railway worker visit the classroom, or showing student videos to other classes in the school. | |

## RESOURCES

Teachers have the option to co-teach portions of this unit and may want to combine classes for activities such as mathematical modeling, geometric investigations, discussing social influences, or conducting research. The media specialist can help teachers locate resources for students to view and read about the history of transportation and provide technical help with spreadsheets, timeline software, 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 travel agents, engineers, school administrators, and parents.

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Grade 3

# STEM Road Map for Elementary School

# Transportation in the Future

What if you could challenge your third graders to design the train of the future? With this volume in the *STEM Road Map Curriculum Series*, you can!

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- Develop conceptual understanding of innovations in train technology, with a focus on maglev (magnetic levitation) trains.
- Use inquiry activities in science to learn about magnetic interactions and use mathematics to calculate distances and time intervals.
- Apply this knowledge in the Maglevacation Train Challenge, working collaboratively while using the engineering design process. Your students will create a prototype train to safely carry passengers a given distance and then prepare a presentation about their destination and their train's design features.

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