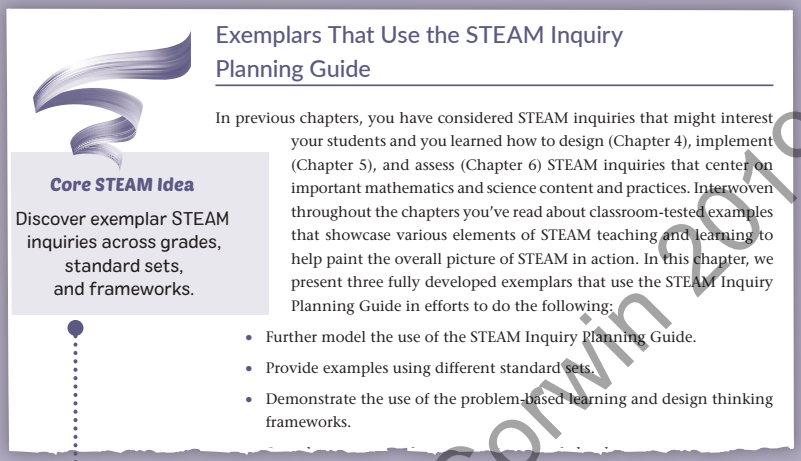
Step Into STEAM, Grades K–5 at a Glance



Exemplars That Use the STEAM Inquiry Planning Guide

Core STEAM Idea

Discover exemplar STEAM inquiries across grades, standard sets, and frameworks.

In previous chapters, you have considered STEAM inquiries that might interest your students and you learned how to design (Chapter 4), implement (Chapter 5), and assess (Chapter 6) STEAM inquiries that center on important mathematics and science content and practices. Interwoven throughout the chapters you've read about classroom-tested examples that showcase various elements of STEAM teaching and learning to help paint the overall picture of STEAM in action. In this chapter, we present three fully developed exemplars that use the STEAM Inquiry Planning Guide in efforts to do the following:

- Further model the use of the STEAM Inquiry Planning Guide.
- Provide examples using different standard sets.
- Demonstrate the use of the problem-based learning and design thinking frameworks.

Core STEAM Ideas provide anchoring tips and questions to focus your reading and guide instructional steps.

Teaching Takeaways highlight key points for consideration.

mathematics and science they are learning. Does your school departmentalize mathematics and science instruction or does each elementary teacher teach all subjects? Do you have established time blocks for each subject area you are expected to teach? How much time do you have devoted to each mathematics and science instruction, and how can you flexibly use that time to incorporate STEAM? Does/will your school have time set aside for STEAM learning (such as a specials rotation in a STEAM lab)? These are important questions to consider with your fellow colleagues and administrators. STEAM teaching requires a degree of flexibility with time dedicated to classroom explorations as well as time for colleagues to co-plan, co-teach, and reflect together. Depending on the available space in your school and current infrastructures, your STEAM physical space might be a regular classroom setting, a STEAM lab, or another available space in your school.

Teaching Takeaway

STEAM physical spaces are unique to each and every school based on available space, resources, school culture, and student needs!

When students engage in STEAM learning, they engage in researching, designing and fabricating, testing prototypes, using technology, and much more. Because of the hands-on, inquiry-based nature of STEAM, the physical space of the STEAM setting necessitates flexible spacing that serves different purposes within the classroom. For example, teachers might have a section of organized household materials in labeled bins on a shelf for students to do rapid prototyping (see Figure 8.1). Teachers might also have a computer or tablet station where students can conduct online research or record their thinking. Relevant physical text resources for researching could be organized into a mini library for the classroom. James Biehle, an architect and co-author of the *NSTA Guide to*

Pause and Reflect

What resources have you found most effective in your teaching of mathematics and science? What art or technology resources have been most useful to you? How can you use these resources in your STEAM learning space?

Where do you store resources currently, and what is your plan for storing any additional STEAM resources you might acquire?

List three strategies you can use for acquiring new STEAM resources.

1.

2.

3.

Pause and Reflect sections provide critical questions and space for reflecting and mapping out next steps.

Practical, proven, and ready-made classroom inquiries can be found in the **Classroom-Tested Example** sections.

Classroom-Tested Example

Mr. Gonzales and Ms. May are first-grade teachers implementing a STEAM inquiry together. They are implementing a STEAM inquiry where students must design a portable telephone, aligning to the science content of sound waves and the mathematics content of length measurement.

Ahead of conducting this inquiry, Mr. Gonzales and Ms. May planned Section III of the STEAM Inquiry Planning Guide together and discussed where they anticipated students might struggle. As a result of this conversation, they created specific prompts that modeled three types of questions: *exploring, probing*, and *generating* (as outlined in Smith & Stein, 2011, 2018). As described by Smith and Stein, exploring questions address mathematical relationships and meanings and also make connections between ideas. Probing questions focus on having students clarify, articulate, or expand upon ideas. Generating questions are used to solicit ideas from additional students in the class. Exploring questions were planned to make key points about the mathematics and science under investigation and to create links between students' content learning and the STEAM context. They planned probing questions as a way to have students further elaborate or clarify their thinking and ideas. Finally, they used generating questions as a way to get each and every student involved and contributing to the conversation. We provide an example of each of these question types.

Formative Assessment Prompts Aligned to the Portable Telephone Inquiry

Item to Assess	Specific Prompts
Mathematics Content	Can someone tell me another strategy they used to measure the lengths? *(probing)*

Try It Out!

Now it's time for you to brainstorm how you will implement STEAM inquiries in your setting through the lens of the mathematics and science and engineering student practices as well as the NCTM Mathematics Teaching Practices. Using the STEAM inquiry you created in Chapter 4, brainstorm ideas for infusing the practices using Table 5.3 to record your ideas. Don't try to focus on every practice—just the ones that make the most sense to incorporate meaningfully into your STEAM inquiry!

Table 5.3
Brainstorming Implementation of Student and Teaching Practices

Standards	Ideas for Implementation
STANDARDS FOR MATHEMATICAL PRACTICE	
Make Sense of Problems and Persevere in Solving Them	
Reason Abstractly and Quantitatively	
Construct Viable Arguments and Critique the Reasoning of Others	
Model With Mathematics	
Use Appropriate Tools Strategically	
Attend to Precision	
Look for and Make Use of Structure	
Look for and Express Regularity in Repeated Reasoning	
SCIENCE AND ENGINEERING PRACTICES	
Asking Questions and Defining Problems	
Developing and Using Models	
Planning and Carrying Out Investigations	
Analyzing and Interpreting Data	
Using Mathematics and Computational Thinking	
Constructing Explanations and Designing Solutions	

Try It Out! features help you shift into get-it-done mode with practical templates and tools for putting your instructional plans into action.

Instructional Strategies provide a deeper dive into implementing specific strategies and instructional moves tied to the topic at hand.

Section III: STEAM Core Instructional Strategies (Exploration, Explanation, Elaboration)

Exploration strategies:

Formative assessment plan:

Item to Assess	Specific Prompts	Assessment Type
Mathematics Content		
Mathematics Practices/Processes		
Science Content		
Science and Engineering Practices/Processes		

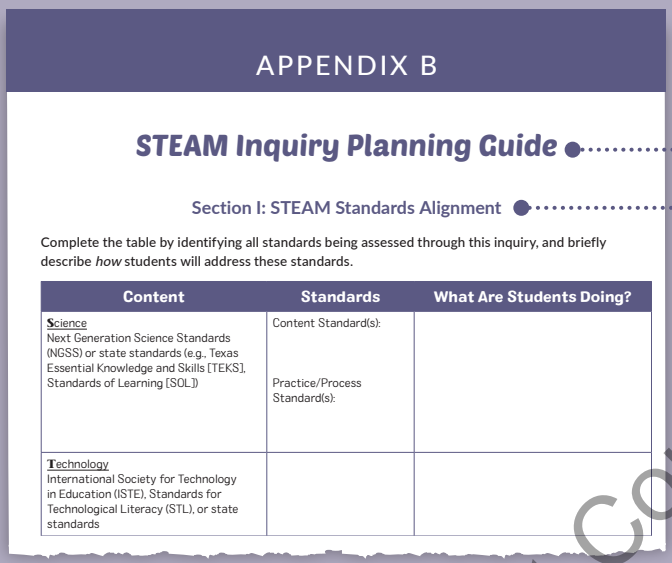
Explanation strategies:

Reaching Each and Every Learner Considerations

Differentiation strategies for students with unfinished learning:

Variations to celebrate learning differences and/or preferences:

A comprehensive **STEAM Inquiry Planning Guide** provides you with a single place to capture the design, implementation, and assessment of STEAM inquiries that you have worked on throughout the book. An editable version is also available online as a downloadable resource.



APPENDIX B

STEAM Inquiry Planning Guide

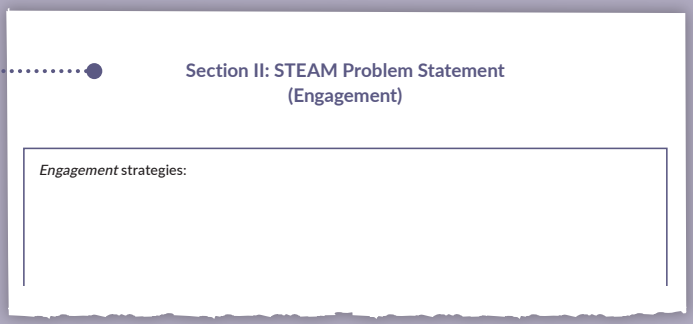
Section I: STEAM Standards Alignment

Complete the table by identifying all standards being assessed through this inquiry, and briefly describe *how* students will address these standards.

Content	Standards	What Are Students Doing?
Science Next Generation Science Standards (NGSS) or state standards (e.g., Texas Essential Knowledge and Skills [TEKS], Standards of Learning [SOL])	Content Standard(s): Practice/Process Standard(s):	
Technology International Society for Technology in Education (ISTE), Standards for Technological Literacy (STL), or state standards		

Section I of the guide focuses on standards alignment.

Section II of the guide helps you articulate the problem statement of your STEAM inquiry.



Section II: STEAM Problem Statement (Engagement)

Engagement strategies:

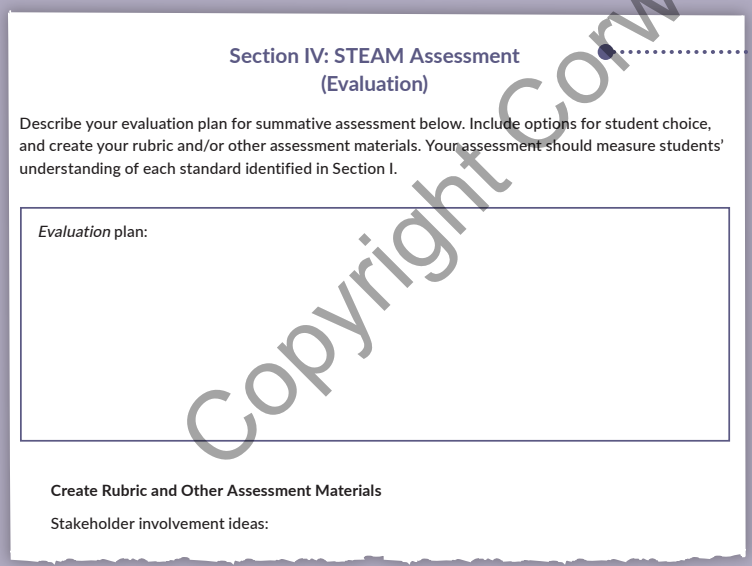
Section III focuses on strategy selection and the formulation of a formative assessment plan.

Section III: STEAM Core Instructional Strategies (Exploration, Explanation, Elaboration)

Exploration strategies:

Formative assessment plan:

Item to Assess	Specific Prompts	Assessment Type
Mathematics Content		
Mathematics Practices/Processes		
Science Content		



Section IV: STEAM Assessment (Evaluation)

Describe your evaluation plan for summative assessment below. Include options for student choice, and create your rubric and/or other assessment materials. Your assessment should measure students' understanding of each standard identified in Section I.

Evaluation plan:

Create Rubric and Other Assessment Materials

Stakeholder involvement ideas:

The final section of the inquiry planning guide, **Section IV,** focuses on fine-tuning your plans for summative assessment.