DISCUSSION GUIDE

STEM by Design: Tools and Strategies to Help Students in Grades 4–8 Solve Real-World Problems (Second Edition. Routledge/MiddleWeb, 2025)

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You can use these study questions as you read [STEM by Design](Routledge, 2025) individually or with a team. Often team studies surface more ideas, generate more discussion, and drive learning deeper. In either case, spend time with those questions that you believe will generate the most learning for you.

Grab a journal or tablet to jot down ideas and information as you read this book. If you are working with others, use your notes to discuss the answers to these questions together. If working alone, you might record your answers and share them on my book website at the [book study webpage](). I will be responding to comments and questions. And thank you for your interest in my book!

Chapter 1: Why Teach STEM?

This may be one of the most frequently asked questions you will hear from parents, students, and even other educators. How will you answer it?

1. Before reading the chapter, suggest an answer for the question asked in the title – *Why Teach STEM?* How could you explain the importance in 30 seconds?
2. Briefly describe your STEM journey. How did you wind up in a STEM classroom? If you are working with other teachers to study this book, take time to listen to others share as well.

Consider some things you learned about why STEM is important. Please jot down a few thoughts or questions and [share in comments at the book website]().

Chapter 2: What Is STEM Education?

This chapter describes integrated STEM education and how it looks in real classrooms.

1. What is your current definition of STEM?
2. Pages 6 and 4 contain a story titled *Ms. Rizzo's STEM Class: A True Story*. Take a moment to thoughtfully analyze what is happening in the classroom during this STEM lesson.
3. What are your takeaways? Jot down your thoughts about what goes on in a STEM class.
4. The four components of STEM are explained in the section titled *What is STEM?* As you read this section, what new thoughts about science, technology, engineering, and math jump out at you?

5. Watch the helpful 4-minute video: *STEM Integration in K-12 Education*. How can you use this video?
6. One important takeaway from this chapter is the idea of *integrated STEM*. What does integrated STEM require in terms of how we teach STEM students?

Consider some things you learned about STEM education and application in the classroom. Please jot down a few thoughts or questions and share in comments at the book website.

Chapter 3: STEM Program Variations

Many different kinds of education programs are currently flying under the STEM banner. This chapter will help you analyze these programs in terms of specific STEM criteria and determine if they actually meet STEM requirements.

1. To evaluate whether or not a particular program is truly a STEM program you need some criteria to define what a STEM program looks like. Authentic STEM programs meet most of the criteria on page 20. Jot down questions that come to mind as you read them.
2. After reading the sections titled "STEM Minus Schools" and "STEM Plus Schools" do other types of programs come to mind? How do those stack up against STEM criteria?
3. You may already have an opinion on the STEM/STEAM issue. What did you read in this chapter that confirms or challenges your opinion, or gives you new ideas to consider?
4. Design Tool 3.3: *STEM School – Yes or No?* asks you to evaluate 10 programs claiming to be STEM programs according to ten STEM criteria.
5. If you currently teach STEM, how well does that model dovetail with STEM criteria?

Think about some things you learned about authentic STEM programs. Please jot down a few of your thoughts or questions on the book website: www.stem-by-design.com.

Chapter 4: Designing a STEM Project

When designing STEM projects, you need to think about a number of important details. This chapter spells out the major considerations and links you to other chapters for additional help in each area.

1. So you're going to plan a STEM project! Begin by thinking about the eleven important considerations that this chapter identified. Use Design Tool 4.2 to guide you in reading this chapter.
2. Which of these design questions are you already the most comfortable with?
3. Which of these considerations will require new planning and thought in designing your STEM projects? Where in the book can you get additional information about these?
4. What pitfalls will you need to watch out for when you design a STEM project?
5. Which ideas about STEM projects may be new to your students? Which ideas, if any, are new to you?

Please consider some things you learned about designing STEM projects. Jot down a few thoughts or questions and [share in comments at the book website](#).

Chapter 5: Evaluating and Adapting Existing STEM Lessons

There's no need to reinvent the wheel, but if you choose to use an existing STEM lesson, how will you know if it's authentically STEM? Or how can you adapt it to meet your needs?

1. This chapter suggests 11 specifications that quality STEM lessons should meet. Which of these specifications do the lessons you are considering meet? Does each STEM lesson have to meet all of these specifications? Explain.
2. How can using STEM launchers (p. 52) help you prepare your students for a STEM project?
3. As you study the analysis of the "Touchdown on the Moon" lesson on pages 53-57, discuss (or journal) whether you would have arrived at the same conclusions about the lesson. Would you make the same modifications as those suggested? Offer different modifications?
4. Think about Lesson Example 2 on pages 58-59. What STEM features does the lesson have? What does it lack? What did you learn from studying this?
5. By the time you analyze Lesson Example 3 (pp.59-60) you're probably getting the hang of how to look for the STEM features needed to make a quality STEM lesson. Take a moment to analyze the two short sample lessons in Design Tool 5.2.
6. Take some time to think about what the chapter says about quality STEM lessons. As you mentally click through the 11 specifications listed, discuss or journal how you feel about these. What concerns do they present, if any? What implications do they have for your current and future lessons?

Please consider some things you learned in this chapter about how to adapt existing STEM lessons. Jot down a few thoughts or questions and [share in comments at the book website](#).

Chapter 6: Including Diverse Students in STEM

This chapter discusses the importance of diversity and inclusion in STEM education and provides strategies to help you guarantee equal access to STEM education for all students, regardless of their background.

1. What students with different ethnicities and special needs do you teach? These are high-needs areas in STEM fields. In your opinion, are there obstacles or barriers that might discourage these students from pursuing STEM careers?
2. Imagine that you could magically create conditions to successfully involve these diverse students in your STEM lessons and projects. How can you go about doing that in the real world?

3. Could you (or any of your students) relate to the story, The Students No One Believed in? Discuss or journal your thoughts.
4. Consider the races, ethnicities, customs, and special needs of the STEM students you will be teaching. Which tips for encouraging diverse students in STEM work will be valuable to you as you encourage *your* diverse students in STEM projects? Discuss or journal your thinking about this.

What did you learn in this chapter about including diverse students in your STEM projects? Jot down a few thoughts or questions and [share in comments at the book website](#).

Chapter 7: Leading a STEM project

This chapter highlights the importance of STEM projects in fostering student engagement, learning, and readiness for future challenges. It then offers a list of teaching tips and highlights a familiar teaching approach for conducting STEM projects.

1. This chapter suggests that project based learning (PBL) has the right stuff to be the process for leading STEM projects. Take a moment to discuss or journal some reasons this approach would be an effective method for teaching STEM.
2. What problems have you encountered (or heard about) when leading PBL projects? How might you respond to these?
3. What do you think about the STEM Quick-List for leading STEM projects? Which of these suggestions do you find the most valuable? The most challenging? What suggestions would you add to these?
4. Discuss or write your own quick-list for planning and facilitating your next STEM project.

Think about some things you learned in this chapter about leading STEM projects. Jot down a few thoughts or questions and [share in comments at the book website](#).

Chapter 8: The Engineering Design Process

The engineering design process (EDP) is at the core of all STEM projects and teaches students to solve open-ended problems and learn from failure. This chapter provides a step-by-step description of a middle level engineering design process.

1. This chapter pictures and describes the engineering design process I use with middle level students. The one described by NASA in this video is similar to the one I use. Begin studying Chapter 8 by watching this quick, 2-minute video for kids by NASA, *Intro to Engineering* <https://tinyurl.com/5abve9hx>. Decide when to show this video to your students to introduce them to the idea of using a systematic approach to solving a problem.

2. The EDP I use is described in the chapter and in Design Tools 8.1, 8.2, and 8.3. If you have used another EDP design process in teaching, briefly list or discuss those steps now. What similarities and differences do you notice?

3. Since the EDP is a necessary component of STEM projects, how will you explain it and focus students' attention on it as they work on STEM challenges? Just as important, how can you help them understand that this process is iterative and not necessarily sequential? The design tools in this chapter can help you with this.

Please consider the EDP steps described in this chapter and jot down a few thoughts or questions and share in comments at the book website.

Chapter 9: Selecting a STEM Challenge

This chapter provides guidance for teachers on selecting a STEM challenge for their students. It emphasizes real-world problems that are relevant and engaging for students, and doable within the time frame and available resources.

1. Your STEM project should address a meaningful and relevant real-life challenge. Such challenges include global problems happening in the world right now as well as those problems that affect students and their communities personally. What real-world challenges immediately come to mind? Where can you locate ideas for challenges for your STEM project?

2. The chapter gives examples of global challenges that middle-level kids might work on. Think carefully about each one and discuss or list the ones you think are doable for your students.

3. The chapter suggests that you involve your students in identifying or selecting a challenge. What videos, questions, or prompts could you use to help them do this? Brainstorm and list some of these.

4. The Chapter 9.1 Design Tool is not a list of what middle school students should be able to do currently – it features a list of current local and global needs written in a language that middle school students should be able to understand. The original list is found under the National Academy of Engineering Grand Challenges for Engineering <https://www.engineeringchallenges.org/challenges.aspx>. You can locate more information about each one by going to the website and clicking on the icon by each challenge.

Please consider some ideas discussed in this chapter on how to select STEM challenges. Jot down a few thoughts or questions and share in comments at the book website.

Chapter 10: Preparing Students for Project Success

This brief chapter describes the importance of equipping students with prior knowledge and skills they need to do the necessary work during their STEM project and offers suggestions for doing so.

1. Why do you think it's important to prepare students for their project before they begin?
2. If you've been leading STEM projects, you may have already encountered some things students needed more information about before they started. If so, share some things they needed to know.
3. As you read each suggestion on preparing students for STEM work, thoughtfully discuss or note your comments about each. What additional suggestions do you have?
4. Now think about your next STEM project and individually or as a team decide how students will gain the prior knowledge they need for the project. Design Tool 10.1 can help you with this.
5. You probably have additional ideas for things your students will need to know.

Think about the importance of preparing students to be successful in their STEM work. Jot down a few thoughts or questions and share in comments at the book website.

Chapter 11: Successful Student Teaming

This chapter focuses on the importance of teamwork for STEM students and provides seven specific steps to guide teachers in establishing and supporting successful student teams.

1. Teaching students to work together successfully as a team can be tough. Share some obstacles and successes you encounter when placing students in teams to accomplish a task.
2. When organizing your STEM teams, what specific arrangements can you make before starting the teamwork to make the process easier?
3. Why should students work in teams anyway? Your students may want to know, so what will you tell them about the value and the purpose of their teamwork?
4. Working together with others can be difficult for students. Some may want to take over and do everything, and others may do very little. How are they going to work together smoothly and share responsibilities amicably – especially if they've already been on other teams that work differently?
5. What are some ways you can help your students be successful in their teamwork? Share some ideas from the book and some ideas of your own.

Please consider some things you learned in this chapter about building successful student teams. Jot down a few thoughts or questions and share in comments at the book website.

Chapter 12: Building Life and Leadership Skills

This chapter describes life skills as foundational skills that students practice to help them thrive in school, families, 21st-century workplaces, and their complex, changing world. It gives tips on ways to intentionally incorporate these skills into STEM lessons.

1. Life skills are rapidly becoming the new building blocks of 21st century careers, and this ought to drive changes in the way we teach and educate students. But what changes? How do we go about doing this? Briefly discuss or journal your responses.
2. Consider the life skill categories listed in the chapter. These are by no means comprehensive, but leading businesses and organizations consider them critical for employees. List and discuss ways you address some of these now in your classes.
3. To bring about long-lasting behavioral changes in kids, they must practice these behaviors regularly. What do you think about the ideas listed in Chapter 12 for including life skills in STEM lessons. Do you have additional ideas?
4. Carefully review Design Tools 12.1 and 12.2. Think about your upcoming STEM project and decide on a specific life skill you might emphasize. Then, decide on one or two listed ways a team member might demonstrate that skill. (You might spend the entire project on one specific category, and chose a different way of emphasizing the skill that kids can focus on each day of the project.) Discuss your decisions with your team, or journal them.

Please consider something new you learned in this chapter about regularly and intentionally building life and leadership skills into your STEM projects. Jot down a few thoughts or questions and [share in comments at the book website](#).

Chapter 13: Integrating Technology

Technology gets short shrift in many STEM projects. This chapter focuses on helping teachers effectively use appropriate technology in STEM projects, and on related skills students need when using technology.

1. What do you think about this statement? "The technology you choose to use in a STEM project must be something that directly relates to helping students with their STEM challenge. It must be a necessary part of the project and play an authentic role in helping kids to research, solve and/or report the problem."
2. The six authentic technology tasks for STEM projects list some tools you can use to help with each task. A more comprehensive list of tools is listed here: https://www.middleweb.com/51688/six-ways-to-include-ai-in-your-stem-projects/. Choose a tool to investigate and discuss or share your experience on the book website.
3. Students must be able to use technology appropriately and safely. A number of ways to help them do this are listed in the chapter, along with sites where you can find more

information. After studying these, what additional tips would you add? What experiences do you know about involving kids and technology?

4. Other than safety, what other things do kids need to know about technology?

Discuss and plan to implement some things you learned in this chapter about how to appropriately integrate technology into your STEM program. Jot down a few thoughts or questions and share in comments at the book website.

Chapter 14: Assessing Student Progress

This chapter discusses STEM assessments and suggests ways to assess student progress during and after STEM projects. It focuses on the use of formative assessments to provide ongoing feedback that teachers and students can use to monitor and improve learning.

1. What do you want to learn about your students from your STEM assessments? What specific student data and information would help you to prepare and lead STEM lessons even more effectively? As you read Chapter 14, check to see if any of the assessment practices mentioned gives you ideas for ways to get that information. If you want additional help with that, share your request on the book website.

2. Examine the six areas of STEM formative assessments discussed in the chapter. (Also check out the section titled Some Other Areas You May Want to Assess. What do you think about these assessment ideas? Are any of the ideas discussed new to you? Which ones have you already had experience in using?

3. What are some of your most successful student assessments – the kind that helped you adjust your lesson and improve student learning? How could you adapt one or more of those assessments to use with STEM lessons? Please share your assessment ideas on the book website.

4. What data and information could you gather by using each of these Design Tools at the end of Chapter 14?
   - Design Tool 14.1: Rubric Criteria
   - Design Tool 14.2: What Must Team Members Be Able to Do?
   - Design Tool 14.3: Teamwork Quick Check
   - Design Tool 14.4: Sample EDP Assessment
   - Design Tool 14:5: Think Like an Engineer
   - Design Tool 14.6: How Do I Feel?
   - Design Tool 14.7: Attitudes and Beliefs of Diverse Students
   - Design Tool 14.8: Project Impact on Students

Please consider some things you think are important about how to assess student's progress in their STEM work. Jot down a few thoughts or questions and share in comments at the book website.