Study Guide

Cultivating STEM Identities:

Strengthening Student and Teacher Mindsets in Math and Science

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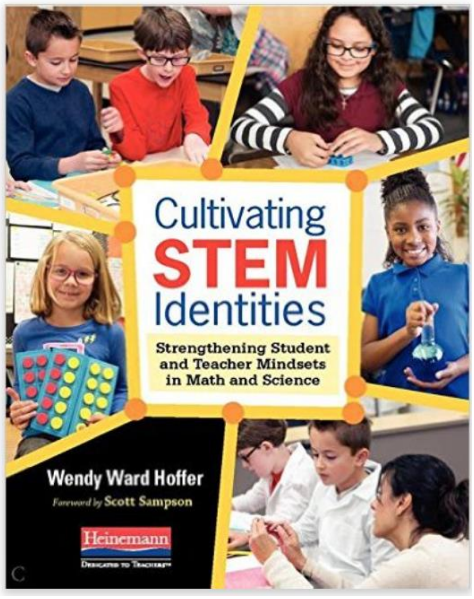
The purpose of the book, *Cultivating STEM Identities*, is to deepen educators' understandings of why STEM identity is important and how, through our behavior and pedagogy, we can elevate learners' confidence and competence as mathematicians and scientists. The purpose of this study guide is to support educators in exploring the ideas in the text to design and facilitate engaging, effective and identity-enhancing STEM learning for all.



Before Reading

Discussion Questions:

- How do you feel about yourself as a mathematician? Scientist?
- For you, what does it mean to be a STEM teacher?
- What are your hopes for your students as mathematicians? Scientists? Engineers?
- Why do you believe STEM education is important?
- What barriers do you see impeding learners' STEM success?
- What do you hope to gain from reading this book?

Activities:

- Notice your own mindsets about math and science as you encounter them in your life outside the classroom. Notice how you feel about yourself as a mathematician and scientist. What patterns emerge?
- Challenge yourself to learn a new math concept or solve a STEM puzzle. Observe your own mindset throughout.
- Notice how you feel about teaching math and science. What aspects do you enjoy? Where would you like to grow?
- What forces shaped your STEM identity and how?
- Write a letter to your students and their families about your beliefs on the importance STEM identity and STEM learning.

During Reading

Chapter 1: We Teach Who We Are

Discussion Questions
- What is your earliest memory of yourself as a mathematician or scientist?
- What messages did you receive or infer about STEM as a child?
- How have your early impressions about STEM impacted your life?
- What is your experience with curiosity, persistence and flexibility?
- In what ways do you engage as a STEM learner outside of school?
- What do you see as the relationship between your beliefs, behavior, learners' experiences and STEM identities? Cite specific examples.

Activities
- Talk to folks your age about their STEM identities, what they experienced as students and how that has impacted their lives. Look for patterns.
- Interview a few students about how they feel about themselves as mathematicians or scientists. What relationships do you notice between their confidence and their achievement?
- From the chart on page 5, select one area of growth for yourself and make a concrete plan for how you will pursue that.
- Consider the growth-promoting language on page 8 and make an effort to integrate that into your classroom conversations daily.
- Select a new STEM book to read (some ideas are offered on page 9), and invite a friend or group to join you in doing so. Then, meet to share your thinking.
- Level with your students about what STEM identity is, why it matters. Hear their ideas.

Chapter 2: Beliefs: We Are All Scientists

Discussion Questions
- Where do you experience or observe STEM stereotypes?
- How have STEM biases impacted your life?
- What sorts of messages do you notice your students receiving from the media

about STEM content, STEM professionals and who belongs in those fields?
• How does your school – through policies, programs or teacher beliefs – support all learners' STEM confidence and competence?
• What are your beliefs about STEM, and what specific behaviors of yours demonstrate those beliefs to learners?
• How do you respond to stereotype-enforcing statements and behavior?
• How do you model and teach the belief that we are all scientists?

Activities
• Notice and document incidents of stereotyping and bias in your school or community. Bring these to the attention of colleagues and concerned friends; seek solutions.
• Invite students to examine STEM stereotypes in the media, and support them in writing letters about how and why those need to be changed.
• Be on the lookout for STEM bias in your school and look for ways to address it.
• Lead a faculty discussion about STEM identities and beliefs.
• With colleagues, form an action research group to experiment with interventions that promote STEM equity.

Chapter 3: Mindset: Scientists Persevere

Discussion Questions
• What helps you to persevere in the face of challenges?
• What upholds your students' stamina?
• How do you support learners in developing determination?
• What mindsets do you observe among your students?
• What relationships do you see between mindset and learning?
• How does your background knowledge about growth mindset jive with your learning about STEM identity?

Activities
• Engage learners in an open conversation about mindsets and their importance to our STEM learning.
• With your students, brainstorm a list of strategies for getting unstuck; post those.
• Partner with a colleague to conduct peer observations, paying attention to the sorts of feedback you are giving learners. Discuss how your feedback is

impacting mindsets.
• After engaging in challenging learning, debrief with students about how they managed their mindsets and persevered. Remind them that these are life skills.

Chapter 4: Community: Scientists are Interdependent

Discussion Questions
• What is the relationship between community and learning?
• What does it mean to be an interdependent learner?
• In what ways do you see your students successful as a community of STEM thinkers? How do they struggle?
• What messages does the environment of your classroom send learners?
• What agreements do you have with students and how did you arrive at those?
• How do you group learners and why?
• In what ways do you weave STEM into your class's daily rituals and routines?

Activities
• With colleagues, engage in walk-throughs observing one another's classroom environments and noting features that promote STEM identity and equity.
• Review your class agreements and consider whether there are any you'd like to add.
• Challenge yourself to experiment with new ways of grouping students; try each more than once. Reflect on the advantages and disadvantages of each.
• Try out a couple of new routines or change existing ones (say, bring science into calendar math) to draw STEM to the forefront of your class. Reflect on which are the best use of learners' time.

Chapter 5: Content: STEM is Interconnected

Discussion Questions
• Share examples of how you have integrated math or science with other content areas. What opportunities does integration afford? What challenges?
• How is STEM content (science, technology, engineering and mathematics) interrelated?
• How do you support learners in making connections between new learning and prior knowledge?
• Which of the NGSS Crosscutting Concepts on page 47 come to life in your

grade level curriculum? How?
• How does teaching STEM as interconnected scaffold learners' STEM identity development?

Activities
• Create a table like the one on page 50, and consider how to best sort topics from your own STEM curriculum.
• With a colleague, plan a STEM unit that intentionally targets a crosscutting concept. Design ways to bring that concept to life daily, using the suggestions on page 52 as ideas.

Chapter 6: Tasks: Scientists Grapple

Discussion Questions
• What is the role of challenge in learning?
• What is the role of challenge in STEM identity development?
• What sorts of problems do you invite learners to solve?
• How do you feel when you watch students struggle?
• What relationship do you see between the "what" and the "how" of STEM learning?
• What is your experience striving to integrate the NGSS and NCTM Practices into your instruction?
• What do you believe are the attributes of a rich STEM task?

Activities
• Using the graphic organizer on page 63, start from scratch and plan a rich task. Test drive it with students and reflect on its effectiveness.
• With a colleague, take time to pull apart a science kit. With an eye on the learning targets, discuss which tasks are worthy and which might be dispensed.
• From your curriculum, select a typical hands-on task from your curriculum and adjust it to become a minds-on task. Consider the examples of page 70 as a resource.

Chapter 7: Thinking: Scientists Are Thinkers

Discussion Questions

• What does it mean to be a STEM thinker?
• In what ways do you intentionally scaffold and promote students' STEM thinking?
• What is your experience integrating thinking strategies into your instruction?
• What value do you see in integrating thinking strategies into STEM learning experiences?
• How do you integrate discourse into students' learning? What challenges have you overcome in facilitating effective discourse? How?
• How might explicit thinking strategy instruction in STEM support students' STEM identity development?

Activities
• Intentionally match a thinking strategy to an upcoming STEM learning experience. Plan how you will introduce and model it, invite learners to hold their thinking and reflect on how the strategy supported their understanding.
• Drawing from the table on page 77, integrate one or more thinking strategy prompts into an upcoming small group STEM discussion. Notice how this scaffolds' learners' conversations.
• Talk with your students about how scientists across centuries have respectfully disagreed with one another and how you can do so in class as well. Practice.

Chapter 8: Workshop: Understanding Takes Time

Discussion Questions
• How do your students spend their STEM learning time?
• How do you support students in understanding and remembering?
• Who does the majority of the work during your STEM instruction?
• What is your experience with workshop model instruction in general? In math and science?
• How do you support effective collaborative learning?
• In what ways do you invite learners to reflect? How do you use the data gathered?
• How might workshop model instruction cultivate STEM identities?

Activities
• Using the graphic organizer on page 91, plan a workshop model lesson. Teach it, and reflect on what went well and where you might adjust.
• Observe a colleague teaching a workshop model literacy lesson, then a

workshop model STEM lesson. Debrief together and discuss the similarities and differences in implementing workshop with different content.

Chapter 9: Assessment: Scientists Share

Discussion Questions

- What do you find to be the most useful assessments of STEM learning?
- What is your experience with conferring?
- How have you used notebooks as records of student thinking?
- How might additive rubrics support STEM identity development?
- What new ideas for STEM assessment are you considering?

Activities

- Using the suggestions at the bottom of page 95 as a starting place, experiment with responding to learners' questions with questions of your own. What do you notice?
- Create an additive rubric for an upcoming project. Test drive it on student work, and see what adjustments you might make.
- Intentionally consider learners' identity development when designing STEM assessments and offering feedback.

After Reading

Discussion Questions

- How do you want learners to think of themselves as scientists and mathematicians?
- To this end, what teacher beliefs and behaviors are most important?
- What sorts of learning experiences do you feel inspired to integrate into your instruction? How will you begin? What support will you need, and how will you secure that?
- Imagine one of your students today as a successful scientist twenty years from now writes a letter to you about how you impacted her STEM identity. What do you hope that letter might say?

Activities

- Set goals for adjusting your instructional practice to more intentionally integrate STEM identity development. Gather pre- and post- data – student interviews, reflections, work - to determine if your new strategies are having the sought-after impact.
- Create a place in your building or online to share your and your students' identities as scientists.
- Educate colleagues, parents, friends about the importance of STEM identity.

As a study group, compile your comments and questions and send those to the author, Wendy Ward Hoffer whoffer@pebc.org. She will write back!