

# Using Social and Emotional Learning to Develop Mathematically Proficient Students:

## An instructional guide for use with MARS Task: “Swimming Pool”

This instructional guide focuses on the distinct areas of intersection between the Standards for Mathematical Practice (SMP) and the Social and Emotional Learning (SEL) competencies. The guide is built around one of a series of problem-solving tasks—developed by the Mathematics Assessment Resource Service (MARS)—that call for students to engage in the SMP. By making these competencies explicit, the guide supports your monitoring and encouraging the social and emotional learning competencies called for by the SMP. It also provides you with suggestions for facilitation that promotes students' social and emotional learning competencies and thus supports students' engagement in the SMP. The next page of this instructional guide provides a **template key** annotating the parts and purpose of each facilitation step in this guide.

The CCSS-SMP call for basic social and emotional skills necessary for students to successfully apply the mathematical practices. For example, the first mathematical practice standard, “*Make sense of problems and persevere in solving them,*” requires that students apply *self-management*, *self-awareness*, and *social awareness* skills as they engage with challenging problems (see the companion table “Connections between the CCSS-SMP and SEL competencies” for more details).

Common Core State Standards for Mathematical Practice*	Social and Emotional Learning Competencies <sup>1</sup>
<ol style="list-style-type: none"> <li>1. Make sense of problems and persevere in solving them.</li> <li>2. Reason abstractly and computationally.</li> <li>3. Construct viable arguments and critique the reasoning of others.</li> <li>4. Model with mathematics.</li> <li>5. Use appropriate tools strategically.</li> <li>6. Attend to precision.</li> <li>7. Look for and make use of structure.</li> <li>8. Look for and express regularity in repeated reasoning.</li> </ol> <p>*For additional detail, see the Common Core State Standards for Mathematical Practice, at <a href="http://www.corestandards.org/Math/Practice">http://www.corestandards.org/Math/Practice</a></p>	<p><b>Self-awareness:</b> The ability to accurately recognize one’s emotions and thoughts and their influence on behavior. This includes accurately assessing one’s strengths and limitations and possessing a well-grounded sense of confidence and optimism.</p> <p><b>Self-management:</b> The ability to regulate one’s emotions, thoughts, and behaviors effectively in different situations. This includes managing stress, controlling impulses, motivating oneself, and setting and working toward achieving personal and academic goals.</p> <p><b>Social awareness:</b> The ability to take the perspective of and empathize with others from diverse backgrounds and cultures, to understand social and ethical norms for behavior, and to recognize family, school, and community resources and supports.</p> <p><b>Relationship skills:</b> The ability to establish and maintain healthy and rewarding relationships with diverse individuals and groups. This includes communicating clearly, listening actively, cooperating, resisting inappropriate social pressure, negotiating conflict constructively, and seeking and offering help when needed.</p> <p><b>Responsible decision making:</b> The ability to make constructive and respectful choices about personal behavior and social interactions based on consideration of ethical standards, safety concerns, social norms, the realistic evaluation of consequences of various actions, and the well-being of self and others.</p>

<sup>1</sup> Quoted from CASEL: Collaborative for Academic, Social, and Emotional Learning. Social and Emotional Learning Core Competencies. <http://www.casel.org/social-and-emotional-learning/core-competencies>

## Template key: The parts and purpose of each facilitation step

Step #: [name of step]	
<p><i>[These instructional guides are built around a four-step lesson facilitation process.</i></p> <p><i>Step 1: Launch the task</i></p> <p><i>Step 2: Promote initial collaboration</i></p> <p><i>Step 3: Monitor progress</i></p> <p><i>Step 4: Share and discuss solutions and strategies</i></p> <p><i>Each step kicks off with an overview of the lesson facilitation for that step, including suggestions for cueing students to the relevant social and emotional learning competencies.]</i></p>	
<p><u>Connecting mathematical practices and social-emotional competencies</u></p> <p><i>[This section describes the relevant connections between the Common Core State Standards for Mathematical Practice and the social and emotional learning competencies.]</i></p>	
<p><u>Assessing social and emotional learning</u></p> <p><i>[This section briefly describes, for the social and emotional learning competencies addressed in this facilitation step, what teachers can look for and listen for to assess whether their students are demonstrating the relevant social and emotional learning competencies.]</i></p>	<p><u>Facilitation suggestions</u></p> <p><i>[This section describes suggestions to help teachers attend to and promote students' application of the Standards for Mathematical Practice or the social and emotional learning competencies as students engage with the mathematical task. These suggestions may include possible scaffolding or extension questions.]</i></p>

## Instructional Guide: MARS Task “Swimming Pool”<sup>2</sup>

### Step 1: Launch the task

Orient students to the task and clarify the expected work products. Let students know the task will be both interesting and challenging—and that it will be fun, because they can solve it any way they want, and they will work with a partner.

Explain to students that answering the questions on the task handout is only part of the challenge, and that you as their instructor will also be looking to see that students can describe and justify their own work and ideas as well as understand and explain the work and ideas of others. Alerting students of these expectations ahead of time can help them see why they need to put effort into working with their partner.

Start by having students read over all parts of the task on their own and prepare themselves to describe in their own words the set up of the problem and what is being asked for in each part of the problem.

#### Connecting mathematical practices and social-emotional competencies

- Students analyze the problem and explain to themselves the diagram and other given information (**Make sense of problems and persevere in solving them**).
- Students may also consider ways in which the mathematics they know can apply to the situation (**Model with mathematics**).
- As students engage with these mathematical practices, they assess their own thoughts, strengths, and limitations (**self-awareness**) and regulate their emotions, thoughts, and behaviors (**self-management**).

#### Assessing social and emotional learning

When students apply **self-awareness** and **self-management**, they

- May be scanning the text for clues and/or listing questions to ask the teacher (**self-management**), and having confidence to persevere through challenges (**self-awareness**).
- Are attentive and focused on their work (**self-management**).
- Manage stress and show minimal signs of frustration, such as head down, slouching, negative facial expressions, and/or distractibility (**self-management**).
- Organize thoughts and information on their paper, such as relevant rules from memory or clues found in the problem (**self-management**).

#### Facilitation suggestions

- Encourage students to articulate their thoughts by restating the problem in their own words or by describing to you what they know about the scenario and the question(s) being asked.
- Acknowledge any student feelings (e.g., frustration) with the task and remind them that their feelings are normal when working on challenging tasks.
- Encourage students to consider what they’ve already learned, by asking them:
  - *How is this task like other scenarios you have investigated before? How does it differ?*
  - *What questions do you have about the scenario?*
  - *What formulas from previous courses can you use?*
- Encourage students to persevere through challenges by asking them:
  - *What do you know about the shape of the swimming pool?*
  - *If you don’t know how to find the volume of the shape, can you decompose the shape into shapes you can find the volume of?*

<sup>2</sup> Available at <http://www.insidemathematics.org/assets/common-core-math-tasks/swimming-pool.pdf>

## Step 2: Promote initial collaboration

As you transition students to working in pairs, tell them that they will start by explaining to one another their initial ideas and approaches to the problem and that they should be prepared to restate the ideas of their partner. Remind them that you will be looking to see that they communicate their own ideas clearly and that they seek to understand the points of view of their classmates by asking clarifying questions.

### About the mathematics

*Listen for students describing the shape of the swimming pool as a prism with trapezoidal bases. Also, listen for students considering using division when converting seconds to hours and minutes. As students discuss the last part of the problem—involving the graphs—listen for students describing the rate given that the pool is filling as a constant rate, but noting a difference in the rate at which the depth of water will change.*

### Connecting mathematical practices and social-emotional competencies

- As students seek to understand one another’s approaches, they identify correspondences between different approaches, and work together toward a solution (**Make sense of problems and persevere in solving them**). As pairs share their approaches to the task, they assist one another in making sense of the diagram and relationships in the problem (**Reason abstractly and quantitatively**).
- As students engage with a partner in these practices, they will apply **social awareness**, in taking the perspective of their partner, and key **relationship skills**, such as active listening and respectful rebuttals.

### Assessing social and emotional learning

When students apply **relationship skills** and **social awareness**, they

- Communicate and listen actively by maintaining eye contact, nodding or showing understanding, and asking follow-up questions (**relationship skills**).
- Disagree respectfully by showing they understand others’ perspectives (**social awareness**) and asking follow-up questions (**relationship skills**).
- Show respect for their partners by allowing them to communicate without interruption (**relationship skills**).

### Facilitation suggestions

- Ask students to explain their partner’s reasoning to you; frequent checking-in with students establishes “perspective-taking” as a classroom norm.
- Model and encourage active listening by providing examples of good clarifying questions.
- Encourage students to begin a rebuttal with a restatement of their partner’s viewpoint or argument. If needed, provided sample stems, such as “I understand your ideas are \_\_\_\_, and I think \_\_\_\_ because \_\_\_\_.”
- Remind students that allowing others to complete their sharing without interruption communicates interest and respect.

### Step 3: Monitor progress

Continue to monitor students' progress by attending to the ways they interact with their partners and the methods they are using to solve the problem. While they are working, select up to six different pairs (two pairs for each question) to write up solutions to the different parts of the task to be shared with the whole class (time limits may require you to limit the actual presentations to two or three student pairs). Choose pairs who approached the task in very different ways.

#### About the mathematics

*As students determine the volume of the swimming pool, they may notice that the pool could hold more water, but that the dimensions given define the volume of water shown. Students may recognize the bases of the prism as trapezoids and use formulas to determine the area, or they may decompose the prism into shapes they are more familiar with. Students may use a variety of strategies to convert seconds to minutes. As students discuss their approaches to the problem and their solutions, listen for clear explanations of their reasoning.*

#### Connecting mathematical practices and social-emotional competencies

- As students continue to work on the task, they will construct viable arguments supporting their answers and strategies (**Construct viable arguments and critique the reasoning of others**) and share these with their partner. As they communicate, they will need to use precise language to express their reasoning and be careful about the units of measure being used in their explanations. They will also need to calculate accurately and efficiently (**Attend to precision**).
- As students engage with these practices, they must have self-confidence (**self-awareness**) and be able to organize their own thoughts and ideas related to the problem solutions (**self-management**). As students work together toward solutions they cooperate, negotiate conflict constructively, and help one another through confusion and frustration (**relationship skills**).

#### Assessing social and emotional learning

When students apply **self-management**, they

- Seek help from peers or teachers as needed.
- Use organizational strategies as needed.
- Organize thoughts and information on paper, such as relevant rules from memory or clues found in the problem.

When students apply **relationship skills**, they

- Ask clarifying questions.

#### Facilitation suggestions

- Allow students to practice self-management by working through challenges on their own. If students become stuck on a problem, ask questions that might jumpstart their problem solving process, such as:
  - *What shape is the pool?*
  - *What do the dimensions on the diagram represent and how can they help you find area or volume?*
  - *How will the surface area of the water affect how fast the depth of the pool is changing as it fills?*
  - *Can you model the action of filling the pool with filling a cup? What is different about filling this pool that filling a cup with straight sides and bottom?*
- Encourage students to practice summarizing their solutions with their partner, helping each other learn to communicate their logic and their work.
- If you observe conflict, support students' attempts to work through it with questions such as:

<ul style="list-style-type: none"><li>• Actively listen to their peers.</li><li>• Communicate clearly and effectively.</li><li>• Negotiate conflict appropriately.</li><li>• Are comfortable seeking help when needed.</li></ul>	<ul style="list-style-type: none"><li>○ <i>Will each of you explain your perspective on why you think you and your partner are stuck?</i></li><li>○ <i>Has either of you asked for help? What help do you think you need as a team to solve this problem?</i></li><li>○ <i>What resources can you use to help you resolve your disagreement?</i></li><li>• As students prepare their arguments, encourage them to anticipate the feedback and questions they are likely to receive and to think about how they will respond.</li></ul>
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### Step 4: Share and discuss solutions and strategies

Ask the student pairs you selected in step 3 to post their solutions and reasoning for the class to review. As suggested in step 3, make sure that the two solutions presented for each part of the problem represent different approaches to the problem with the same end result. Give the class time to review and reflect on the solutions presented. Then allow for the class to ask questions of the students who posted their work. If no questions are asked, ask different pairs of students to state the differences and similarities in the pairs of posters for each part of the problem.

#### Connecting mathematical practices and social-emotional competencies

- As students listen effectively to the arguments of others and share logical progressions of their own thinking, they apply the mathematical practice of **Construct viable arguments and critique the reasoning of others**. As they analyze the solutions to the graphs and the explanations presented, they are interpreting the mathematics of the explanations in the context of the situation and reflecting on whether the explanation makes sense (**Model with mathematics**).
- As students compare and analyze the reasoning of others and compare that to their own thinking, they engage in perspective taking (**social awareness**). As students evaluate others' arguments and ask questions to respectfully critique one another's mathematical arguments, they engage in active listening, clear communication, and constructive negotiation of disagreements about answers or approaches to the task (**relationship skills**).

#### Assessing social and emotional learning

When students apply **social awareness** and **relationship skills**, they

- Recognize (**social awareness**) and validate (**relationship skills**) other positions and arguments.
- Challenge peers in a respectful manner by constructing respectful rebuttals (**relationship skills**).
- Ask clarifying questions, actively listen to their peers, negotiate conflict appropriately, accept feedback graciously, and are comfortable seeking help when it is needed (**relationship skills**).
- Show interest in another group's perspectives by asking respectful follow-up questions, especially when their perspectives differ (**relationship skills**).

#### Facilitation suggestions

- Remind students that all mistakes provide opportunities for learning for themselves and their peers.
- Encourage students to ask clarifying questions of the student pair who posted solutions. This practice will help students build their proficiency in making and understanding mathematical arguments while also promoting and supporting social awareness and relationship skills.
- Encourage students' to show interest and understanding in others' perspectives by asking presenters to restate their reasoning in a posted solution that differs from their own solution.
- Praise and encourage students when they ask clarifying questions, highlighting when they do this respectfully. Encourage students to challenge each other in a respectful manner, providing praise or acknowledgement when criticism is paired with praise (i.e. feedback sandwich).
- Ask for approaches to finding the solution to any of the three parts that are not represented in the posted work. This will continue to expose students to different approaches, build confidence in a student who was not selected to post their work, enhance relationship skills, and help them build flexibility in their thinking about different ways to solve problems.

## About these resources

This document is one of five interrelated resources that articulate correlations and mutually reinforcing commonalities between the social and emotional learning competencies (as described by CASEL) and the Standards for Mathematical Practice (as described in the *Common Core State Standards for Mathematics*).

These resources consist of a whitepaper focused on **making the case** for integrating social and emotional learning with the Standards for Mathematical Practice; a vision **describing an ideal classroom** exemplifying such an integration; and three **instructional guides** for using selected MARS tasks, with special attention to the CCSS Standards for Mathematical Practice and the social and emotional learning competencies. (These MARS tasks can be found on the Inside Mathematics website at <http://www.insidemathematics.org/performance-assessment-tasks>.)

The resources are:

- Integrating Social and Emotional Learning and the Common Core State Standards for Mathematics: **Making the case**
- Integrating Social and Emotional Learning and the Common Core State Standards for Mathematics: **Describing an ideal classroom**
- Using Social and Emotional Learning to Develop Mathematically Proficient Students: An **instructional guide** for use with **MARS Task: “Conference Tables”**
- Using Social and Emotional Learning to Develop Mathematically Proficient Students: An **instructional guide** for use with **MARS Task: “Printing Tickets”**
- Using Social and Emotional Learning to Develop Mathematically Proficient Students: An **instructional guide** for use with **MARS Task: “Swimming Pool”**

This work was funded by a grant from the Noyce Foundation, founded in 1990 to honor the memory and legacy of Dr. Robert N. Noyce, cofounder of Intel and inventor of the integrated circuit—which fueled the personal computer revolution and gave Silicon Valley its name.

While the Noyce Foundation concluded its operations in 2015, its mission—to help young people become curious, thoughtful, and engaged learners—continues through the work of this project and others like it, including the Inside Mathematics website (<http://www.insidemathematics.org>), which has joined the Dana Center’s portfolio of services.

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### About CASEL

Collaborative for Academic, Social, and Emotional Learning (CASEL) is the nation’s leading organization advancing social and emotional learning (SEL). Our mission is to make social and emotional learning an integral part of education from preschool through high school. Through research, practice, and policy, CASEL collaborates to ensure all students become knowledgeable, responsible, caring, and contributing members of society.

Learn more about our work at [www.casel.org](http://www.casel.org).

The Dana Center develops and scales math and science education innovations to support educators, administrators, and policy makers in creating seamless transitions throughout the K–14 system for all students, especially those who have historically been underserved.

We focus in particular on strategies for improving student engagement, motivation, persistence, and achievement.

The Center was founded in 1991 at The University of Texas at Austin. Our staff members have expertise in leadership, literacy, research, program evaluation, mathematics and science education, policy and systemic reform, and services to high-need populations.

For more information, see our website at [www.utdanacenter.org](http://www.utdanacenter.org).

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