Smithsonian
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Integrating Social and Emotional Learning into 3-D Science Classrooms

In a fourth-grade classroom, groups of students work together to answer questions about how energy is transferred when two objects collide. When they observe a moving marble collide with a stationary marble, they begin to figure out what causes the stationary marble to move at a particular speed in a particular direction. Using their observations of the phenomenon as a foundation, they make predictions and conduct tests by rolling marbles down a tube, onto a mat, and into a stationary marble. They extend their learning as they research and write about how this knowledge can help someone win in a game of marbles.

Using marbles to investigate the phenomenon of collision, students develop social and emotional skills while doing hands-on science.

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These students are doing hands-on science. But while they're engaged in making sense of a phenomenon and answering questions (self-awareness), they're also learning how to cooperate with one another as they practice teamwork (social awareness), persevere to ensure materials are set up correctly (self-management), collaborate as they problem-solve (relationship skills), and reason from evidence as they organize and communicate their data (responsible decision-making). These are some of the core competencies that are part of social and emotional learning (SEL) and that seamlessly blend into three-dimensional science education.

"Integrating and supporting SEL as part of classroom daily practices is a really important way to build social and emotional skills, which is key for students," Heidi Gibson says. Gibson is a science curriculum developer for the Smithsonian Science Education Center (SSEC) and has led workshops on infusing SEL into Smithsonian curricula. "It's more likely to be persistent if it is practiced habitually, incorporated within our learning experiences, including when learning science."

Through science learning, teachers can incorporate SEL to help students develop and

apply social and emotional skills, which are peppered within practices based on the National Research Council's *A Framework for K–12 Science Education*.

"Science is fundamentally a social enterprise, and scientific knowledge advances through collaboration and in the context of a social system with well-developed norms," the *Framework* states. ". . . In short, scientists constitute a community whose members work together to build a body of evidence and devise and test theories" (NRC 2012, 27). A strong foundation in social and emotional skills prepares students to successfully engage with that community as scientists or engineers, or to interact with it as scientifically aware citizens.

The Value in SEL

For nearly three decades, the Collaborative for Academic, Social, and Emotional Learning (CASEL) has actively supported districts, schools, and states in SEL initiatives by working with leading experts to drive research, guide practice, and inform policy. Research supports that social and emotional skills, one of the many outcomes of SEL, create a foundation for better emotional adjustment and academic performance, leading more than 20 US states to establish K–12 SEL competencies/standards or offer guidance (CASEL, n.d.).

As defined, in part, by CASEL, SEL is "the process through which all young people and adults acquire and apply the knowledge, skills, and attitudes to develop healthy identities, manage emotions and achieve personal and collective goals, feel and show empathy for others, establish and maintain supportive relationships, and make responsible and caring decisions" (CASEL 2020).

CASEL SEL Framework: Core Competencies

- Self-awareness
- Self-management
- Social awareness
- Relationship skills
- Responsible decision-making

(CASEL, n.d.)

CASEL touts evidence that demonstrates how SEL supports students' academic performance as well as their behavior, mental health, and long-term success. Reviews of studies of SEL show positive effects on students, including improved academic achievement, better economic outcomes, and better well-being (CASEL, n.d.).

> "Basically, we need SEL because it makes us better scientists, better researchers, better collaborators, better colleagues, and better global citizens."
>
> — *Heidi Gibson*

Additionally, scientists and scholars say there is an urgency in integrating social, emotional, and academic dimensions of learning, finding that students "who have a sense of belonging and purpose, who can work well with classmates and peers to solve problems, who can plan and set goals, and who can persevere through challenges—in addition to being literate, numerate, and versed in scientific concepts and ideas—are more likely to maximize their opportunities and reach their full potential" (Jones and Kahn 2017, 4). A class immersed in SEL core competencies views each student's unique perspectives as valuable assets, inviting all students to contribute to the goal of shared learning.

SEL integrated into the science classroom also helps develop skills for the future STEM workforce. Scientists, for example, need social and emotional skills and other outcomes of SEL for collaboration; communicating research; asking questions; and the constant iteration, resilience, hard work, and dedication required to do science. "Basically," Gibson explains, "we need SEL because it makes us better scientists, better researchers, better collaborators, better colleagues, and better global citizens."

SEL in the Science Classroom

The National Science Teaching Association reports that science standards influenced by the *Framework* and/or the Next Generation Science Standards* have been adopted in 44 states and the District of Columbia, representing 71% of all US students (NSTA, n.d.).

The *Framework* presents three equally important dimensions: science and engineering practices, disciplinary core ideas, and crosscutting concepts. Science and engineering practices (SEPs)—those behaviors that scientists and engineers engage in as part of their daily work routines—offer multiple opportunities to incorporate SEL. The SEP of engaging in argument from evidence, for example, supports social and emotional skills such as taking initiative, active listening, and respectful communication as students strive to understand a phenomenon or problem.

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"Ideally, we want students to argue about scientific ideas and form their opinions based on evidence while also listening carefully to other's explanations and showing caring, kindness, and respect for one another," Sara Rimm-Kaufman and Eileen Merritt wrote (Rimm-Kaufman and Merritt 2019, 58). This can be achieved where a teacher has established a supportive, inclusive classroom community.

"But there's also another aspect here," Beth Short says. Short is an SSEC curriculum developer who has extensive experience in both formal and informal educational settings. "At the Smithsonian Science Education Center, we design curricula that integrates SEL into the learning environment."

Students draw on their experiences as they consider why a playground surface would get hot.

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There are multiple opportunities for curricula to foster SEL through hands-on, three-dimensional science teaching and learning with the goal of building students' social and emotional competencies.

- **Get students thinking—and talking**. Introduce a real-world phenomenon that engages students and sparks questions, such as "Why is the playground too hot to sit on?" The phenomenon can be introduced through pictures, a video, or a demonstration. As students consider the phenomenon, they have multiple opportunities to reflect on their own personal perspective or the perspectives of others; they can show courage to take initiative as they practice communication skills and develop vocabulary that helps them express their initial ideas.
- **Promote an inclusive classroom that captures students' prior knowledge and experiences**. Look for a curriculum that offers strategies to help students make sense of new information by seeing how it fits with their life experiences. In preparing curricula, Short says, "We give specific tips to teachers to draw on students' lived experiences and the expertise and ways of knowing students come into classrooms with. We encourage teachers to really pull those ideas out of students." This treats students' ideas as robust resources to build on, furthering social

awareness as they consider one another's strengths and perspectives. It also encourages students to develop self-awareness as they integrate their personal and social identities and apply them to their learning. Curricula that support these strategies align with the goals of the *Framework*—to provide all students "with high-quality opportunities to engage in significant science and engineering learning" (NRC 2012, 29).

- **Build students' SEL skills through collaborative, hands-on learning**. When participating in collaborative, hands-on investigations, students need to plan, collect data, and organize information. As they're learning science, they're also building relationship skills that include effective communication, teamwork, problem-solving, constructive conflict resolution, and seeking and offering support when needed. As students

Examples of Integrating SEL into a Science Curriculum

Grade	Investigation*	Science & Engineering Practices (SEPs)	Social & Emotional Learning (SEL) Competency Examples
K	Students are encouraged to share words in their primary (or other) language that sound similar to new vocabulary as they investigate shade device designs that solve the problem of sunlight causing a person to be warm.	• Developing and using models • Designing solutions	• Self-awareness: integrating personal and social identities; identifying personal, cultural, and linguistic assets; having a growth mindset
2	While defining the problem of erosion, students work together to test the effects of wind and water on a sand tower.	• Analyzing and interpreting data • Constructing explanations • Designing solutions • Obtaining, evaluating, and communicating information	• Self-management: managing one's emotions, exhibiting self-discipline and self-motivation • Responsible decision-making: demonstrating curiosity and open-mindedness • Relationship skills: communicating effectively, practicing teamwork and collaborative problem-solving
4	After investigating how electricity powers devices, students suggest ways a family could reduce its electricity bill for their home.	• Developing and using models • Designing solutions • Obtaining, evaluating, and communicating information	• Responsible decision-making: learning how to make a reasoned judgment after analyzing information, data, and facts; recognizing how critical-thinking skills are useful both inside and outside of school; reflecting on one's role to promote personal, family, and community well-being • Relationship skills: communicating effectively, demonstrating cultural competency, practicing teamwork and collaborative problem-solving
6—8	Student pairs use models to describe matter flow from phytoplankton to other organisms in a Pacific Ocean ecosystem.	• Developing and using models • Analyzing and interpreting data • Obtaining, evaluating, and communicating information	• Self-management: using planning and organizational skills • Responsible decision-making: demonstrating curiosity and open-mindedness, learning how to make a reasoned judgement after analyzing information, data, and facts • Relationship skills: communicating effectively, resolving conflicts constructively, practicing teamwork and collaborative problem-solving • Social awareness: taking others' perspectives, recognizing strength in others

**Investigations are from Smithsonian Science for the Classroom™ and STCMS™ curricula.*

develop solutions, they incorporate responsible decision-making that embeds critical thinking, open-mindedness, and making reasoned judgments. In upper elementary grades and middle school, students' work becomes more self-directed, Short explains, requiring additional self-management skills that include planning, organization, and self-motivation.

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- **Keep students' families and caregivers in the know**. Engage them with a family letter about students' learning, and encourage feedback on relevant experiences that foster at-home discussions to support sensemaking. "Family letters help to build that relationship between the triumvirate of child, educator, and family," Gibson says. A family's support in sensemaking can bolster responsible decision-making by highlighting a student's role in promoting family and community well-being and recognizing how critical-thinking skills are useful outside of school. It can also encourage self-awareness as students instill a sense of purpose and integrate personal identities in the investigation.
- **Encourage respectful dialogue**. Scientific argumentation incorporates multiple social and emotional skills. Look for a curriculum that supports teachers in guiding students as they manage their emotions, demonstrate open-mindedness, communicate effectively, take one another's perspectives, and recognize when to seek or offer help.
- **Engage in self-reflection and growth**. Notebooking is an essential science and engineering skill but also supports self-awareness as students write whether their solutions make sense of a phenomenon and how they could improve their ideas, setting the stage for a growth mindset to build resiliency, dedication, and confidence to persevere in future investigations.

The integration of SEL into science education, such as through the use of science and engineering practices, helps set the stage for building confidence and persevering as students make sense of the world both in and out of the classroom. "It's very important to have these skills," Gibson says. "And if we view schools in the broader sense of trying to help and develop good people—good citizens—social and emotional learning is essential to that effort."

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How the Smithsonian Science Education Center Supports Social and Emotional Skills through Science Learning

The Smithsonian Science Education Center (SSEC) is transforming K–12 education through science in collaboration with communities across the globe. One way to achieve this ambitious objective is by designing science curricula that boost supportive, inclusive classroom communities that infuse social and emotional learning (SEL) into the science classroom. Each Smithsonian Science for the Classroom® grades K–5 and Science and Technology Concepts™ Middle School (STCMS) for grades 6–8 module intentionally builds in multiple opportunities for nurturing SEL through collaborative, hands-on learning that supports both teachers and students.

Learn more about Smithsonian Science for the Classroom: www.carolina.com/ssftc
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