



Science and Engineering for Grades 6-12

Investigation and Design at the Center

A Guide for School Boards

KEY POINTS

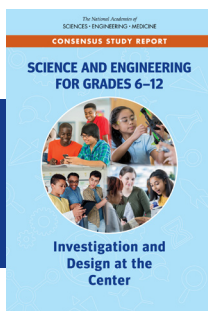
- A fundamental shift in how we teach science and engineering is needed to prepare students for the future. **Making science investigation and engineering design the central approach for teaching and learning science and engineering is a more effective and engaging way** for students to learn.
- Engaging students in science investigation and engineering design helps them develop the STEM knowledge and competencies needed to make informed personal and political decisions and be ready for **college and careers**.
- To implement the improvements teachers need **instructional resources and sustained professional development** that focuses on investigation and design.
- It is critical to actively work to ensure that all students have equitable opportunities to engage in investigation and design

SCHOOL BOARDS CAN

- Learn about investigation and design and share information about the benefits with the community.
- Ensure professional development provides teachers with instructional models and resources, mirrors what should happen in the classroom, and is grounded in science and engineering.
- Advocate for time and structures, such as common planning periods, that allow teachers to work collaboratively to learn and implement new approaches and to reflect upon their own progress.
- Advocate for space and time for students to engage in science investigation and engineering design.
- Develop policies and procedures that ensure **all** students have opportunities to engage in investigation and design.

School boards play an important role in improving science teaching and learning in your district.

The Framework for K-12 Science Education, which guides the science education of many U.S. students, presents a vision for how students can learn more effectively about science and engineering. **Science investigation and engineering design** is a learning strategy that builds on the Framework in which students ask questions, participate in discussions, reason with evidence, and continuously reflect and revise their thinking. The students increase their understanding of foundational concepts of science and engineering, and improve their critical thinking and problem-solving skills. The science investigation and engineering design approach is a major refinement of the idea of inquiry and different from memorizing content or teaching the scientific



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<https://nationalacademies.org/Science-Investigation-and-Design>

method. Teachers have developed many strategies for helping students to remember lots of scientific information, but that is no longer the focus of science and engineering learning. You play a key role in helping teachers receive the support they need to be able to guide students to learn through investigation and design.

Through this common-sense approach, teachers structure instruction and support student learning so that the science content and skills combine and unfold in sequence for students. Science investigation and engineering design requires big changes to classroom practices and to professional development. **You play a critical role in implementing science curriculum and supporting teachers as they take on these effective approaches to learning.** The 2018 National Academies report, *Science and Engineering for Grades 6-12: Investigation and Design at the Center*, provides guidance on how to get started. This brief focuses on ways you can support students, teachers, and administrators in using science investigation and engineering design.

SCIENCE INVESTIGATION AND ENGINEERING DESIGN IN THE CLASSROOM

Because students are at the center of science investigation and engineering design, the classroom has a different structure and students are not all working on the same tasks at the same time. This approach gives the classroom a different energy than a traditional classroom; students talk and interact as they take ownership of their own learning. Students investigate specific observable events, which we call **phenomena**, in laboratory-like settings. They might explore phenomena such as why onions make you cry, or why you can sometimes see the moon during the daytime, or why we have fewer bees now than in the past. The students develop arguments and construct explanations, instead of learning vocabulary words to complete worksheets. As they use data they have collected to answer some of their questions, new questions emerge leading to new phenomena to investigate and new laboratory experiences to conduct. Throughout, students develop arguments and construct explanations, learning vocabulary words, formula, and key scientific ideas in the process.

Putting science investigation and engineering design at the center of the classroom can help students learn about key concepts, strengthen critical thinking skills, and ultimately develop a life-long interest in science. It provides a better path for nearly all students to learn the science they need to be successful in college or careers than the traditional knowledge-transmission modes that have dominated science instruction for decades. Emphasizing phenomena and challenges helps students understand the world around them, and better prepares them for their future. This requires that teachers have integrated sustained meaningful professional learning opportunities grounded in science and engineering that build on carefully chosen instructional resources.

To ensure opportunity and access for all students, school districts must address the deep history of inequities in which not all students have been offered a full and rigorous sequence of science and engineering learning opportunities. Teachers must have the opportunity to learn about and practice implementing inclusive pedagogies that consider the diverse backgrounds and goals of the students. Administrators must examine and address resource gaps in facilities, materials, time for professional learning, and time for science.

School and district policies should support high quality learning opportunities for all students so that a broader spectrum of students are engaged in relevant and motivating approaches to science and engineering. Carefully chosen policies can help improve the teaching of science and engineering in your district, these changes will help all students be more successful in high school, college, or with whatever they choose to do after graduation.

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