



Why should students learn to plan and carry out investigations in science and engineering?

What Is The Issue?

The NRC *Framework for K-12 Science Education* specifies eight science and engineering practices to be incorporated into science education from kindergarten through twelfth grade. One of these is planning and carrying out investigations. Although many existing instructional models and curricula involve engaging students in planned investigations, this tool will help you think about ways you can promote student agency by having them plan and conduct science investigations.

WHY IT MATTERS TO YOU

- **Teachers** should help students make sense of the natural world by designing and carrying out authentic, student driven investigations.
- **District staff & PD providers** should focus on curricular models and classroom arrangements that foster student inquiry, from a controlled experiment to other forms of research.
- **School leaders** should think across the various curricula they support in order to offer multiple opportunities for students to investigate topics based on questions they have.

Things To Consider

- Students should have opportunities to plan and conduct investigations where scientific findings are used to solve real (or realistic) everyday problems. For example, they can design [stream table experiments to understand where the best place is to construct a building in a floodplain](#). These self-designed investigations for real purposes help students learn how to engage in the science and engineering practices and help them understand and identify with science as a way of improving the world.
- Planning and carrying out an investigation should not be limited to controlled experiments, since [scientists use myriad methods to answer their questions](#). Scientists and engineers use observational methods, case control studies, failure analysis, and other methods to explain how the world works. Students should as well.
- [Planning and carrying out an investigation does not mean “stepping through” the scientific method](#). In fact, scientists themselves rarely follow “steps” of inquiry as they pursue answers to questions. Students should be encouraged to [argue for specific sequences of scientific practices](#) that allow them to engage in their research.
- [Engineering also involves planning and carrying out investigations to specify design criteria and to test designs](#). For example, a civil engineer might investigate how many people use a road before deciding if an overpass is needed. In the classroom, engineering design investigations might include conducting “fair tests” to determine the durability of building materials—or surveys of potential users or consumers of a specific design.
- Ultimately, students should be learning *when* to be engaging in the science and engineering practices. This is best done while they’re pursuing a question that matters to them or when they are working through uncertainties that come up during investigations.

Attending To Equity

- Young people’s experiential knowledge is deep, and this can help them design compelling investigations that are of interest to them. [Students make great gains when science class time incorporates the resources they bring to class from across their lives and communities](#). Be sure to [draw on these resources actively](#) by making students’ knowledge public to their peers and the community.
- As students learn about new methods of investigation, they should also be asked to leverage *their* understanding of how to make sense of the world. Not all cultural groups investigate the world in the same way, and this variety of methods can be a tremendous asset to both the classroom and the world (see [this important case](#)).

REFLECTION QUESTIONS

- How often do your students feel that the investigations they are doing are “their” investigations? Feeling ownership in the work deepens engagement.
- Think about your curriculum. Where can you support students to devise and investigate their own interests and questions?
- What are some ways you can manage having student groups doing different investigations?

Recommended Actions You Can Take

- Read more about the practice of [planning and carrying out investigations](#), review [the grade-band criteria for it](#), and [watch this webinar on it](#) (perhaps with a colleague). [Read about an instructional model for this practice](#).
- Have students [use the eight science and engineering practices as “building blocks”](#) to develop their own investigations to conduct—and [don’t use “the scientific method”](#) as a way structuring inquiry.
- As students explore topics for which you do not know the outcome, adopt the stance of a *scientifically literate learner* and model how you think and make sense of students’ issues and results.
- Encourage students to track their science-related questions as they go about their lives, and support them to investigate some of these questions. Some student choice is better than none.

ALSO SEE STEM TEACHING TOOLS:

- #2 [Contemporary Science](#)
- #3 [Cascades of Practices](#)
- #16 [Formative Assessment Cycle](#)
- #32 [Why Practices?](#)

