

# Engineering Mindset:

## Apply Science and Mathematics



Taking existing scientific knowledge and applying it to solve real-world problems is the hallmark of engineering work. In engineering (as well as in other applied sciences such as medicine and architecture) science and mathematics are essential tools used to help achieve practical and useful results.

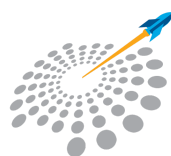
Engineers use the tools of both math and science in all phases of the engineering design process. As they describe and scope a problem, engineers familiarize themselves with mathematical and science processes that might inform their design. They also consider what types of science and mathematical knowledge could help generate better solutions. For example, a biomedical engineer who is working to develop a new type of bandage draws upon what she already knows about how the human body heals wounds. She might also identify other scientific areas that could inform her work such as what external factors either inhibit or promote healing. As part of her literature review, she might come across mathematical equations that describe how quickly wounds heal and realize those equations will help her define the success of whatever bandage she develops.

As engineers brainstorm possible solutions to a problem, they anchor their ideas in scientific or mathematical realities. Winnowing possible designs often involves considering scientific principles or applying mathematic models to see which designs best meet specifications.

Scientific and mathematical tools are also used by engineers when creating, testing, and analyzing designs. Engineers construct physical and computer models that allow them to explore relationships between variables and recognize patterns in their data. Systematic testing and analysis of how well a technology performs is one feature that distinguishes engineering from making or tinkering. To understand and optimize how a design functions, engineers must think carefully about the science underlying it.

As they engineer, youth should have many opportunities to realize that applying science and mathematics can strengthen engineering solutions. Asking youth to think about the science they know before they begin an engineering challenge can help them surface their understandings. Encouraging youth to engage in actual science exploration before asking them to use such knowledge in a design challenge can also result in better designs. While youth create and analyze their designs, prompting them to measure, estimate, and display their data in charts or graphs can help them use mathematical tools in the same way that engineers do. Effective use of math and science are critical to the development of high-quality solutions, and youth should be encouraged to apply all of their of math and science knowledge to the engineering process.

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