Scientific Method vs. Engineering Design Process: Which is used in STEM learning?

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Vivify STEM

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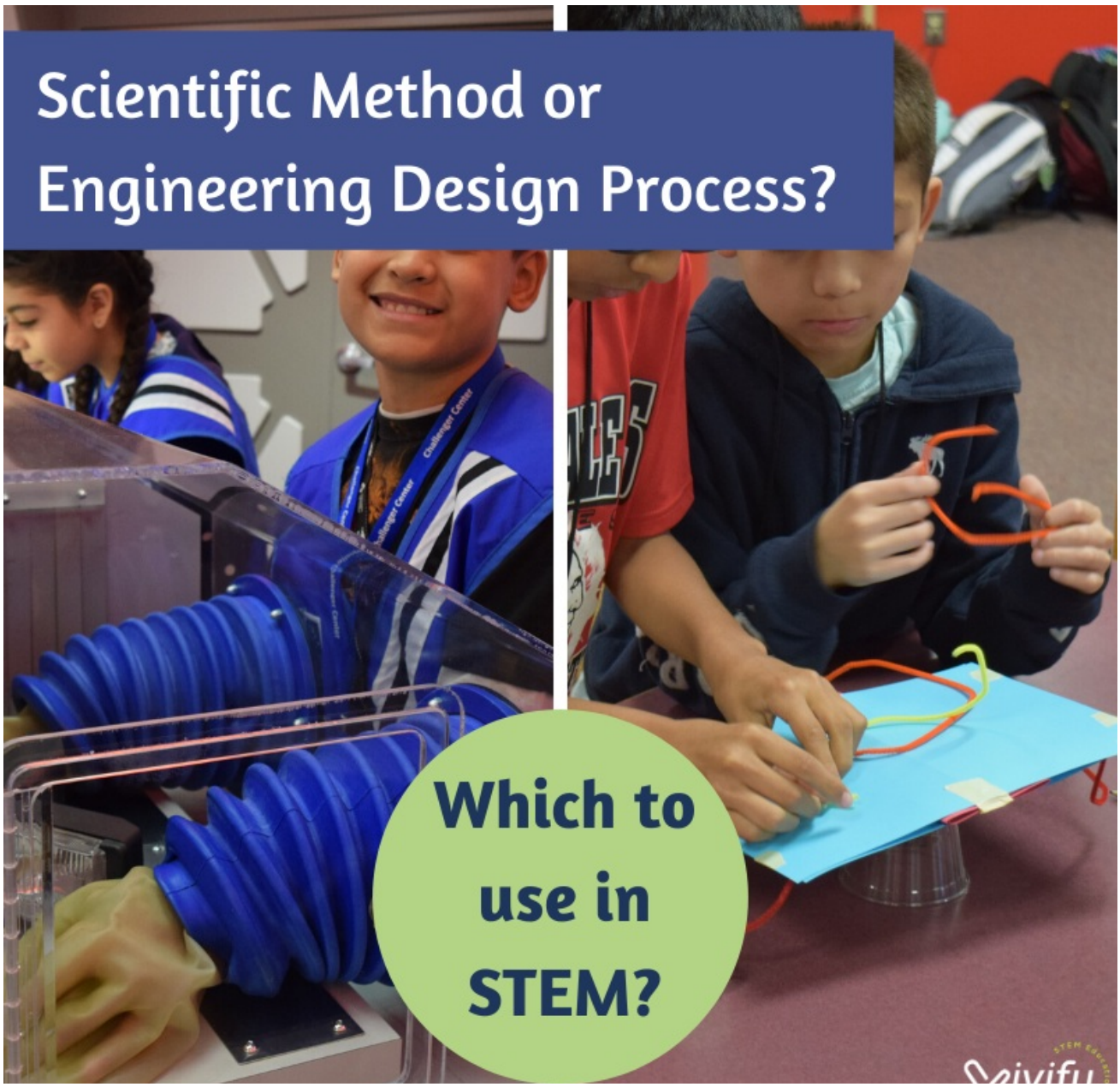
Within STEM education, teachers are often confused on what content to focus on or how to structure a class. Both science and engineering are part of the STEM acronym, but each field has different goals that lead to either the scientific method or the engineering design process. Some teachers mix the two or assume they are basically the same thing. Spoiler alert: they're not!



Are you a STEM teacher? Confused on what process to use in your classroom? Or perhaps you need a refresher on the scientific method versus the engineering design process. Read on for an overview of each, how they are used in the real world, and our view of which process is best for STEM education.

Scientific Method

Most are familiar with the scientific method: you set up a hypothesis, conduct an experiment, analyze results, and learn something about the natural world. It's a

commonly used method to help scientists understand the world around us and what makes it work the way it does. For example, maybe you are curious to know why some flowers in your backyard grow taller than others. You can set-up an experiment to see how changing the location, amount of water, sunlight, and other factors impact the height of plant growth.

Engineering Design Process

The engineering design process is a whole different animal. Where a scientist seeks to understand what is what and how the natural world works, an engineer asks "ok

to understand what is what and how the natural world works, an engineer asks "ok, what next? *How* do I make this better?". In our example, perhaps you notice that increasing the soil's ability to drain made the flowers grow taller. So, you apply the engineering design process to create a raised flower bed that allows for good drainage without soil loss. You use the scientific method to come up with the reason *why* your flowers are growing tall, then use the engineering design process to *solve the problem* of *how* to help your flowers grow taller!

The way I like to think of it is this: if you're asking "what is this? What makes it work?" you're thinking like a scientist. If you're asking "How do I solve this? What could make this better?" you're thinking like an engineer.

STEM Careers in Action!

Here is a story that helps illustrate how these two processes might be used in the real-world: Joaquin and Miranda went to high school together, and stayed in touch through college. Joaquin is a material scientist who works in a lab at a university, and Miranda is an aerospace engineer with NASA.

As a material scientist, Joaquin has been conducting experiments on different materials. He is hoping to find a new material that is both lightweight and strong, and with each experiment, he learns more about the properties of each material he studies.

Miranda, our aerospace engineer, has been tasked with designing a prototype for a new spacecraft. Guess what kind of material she needs to make it happen? She is looking for a material that is both lightweight and strong, exactly the research Joaquin is doing. Now Miranda is able to reach out to Joaquin to learn more about his research. They can work together to figure out the best material for the spacecraft design.

Joaquin and Miranda may be fictional, they represent thousands of scientists and engineers working together each day. While each process is different, they are used in the real-world to help make new discoveries and products to improve our lives. For more reading on careers in science and engineering, check this out!

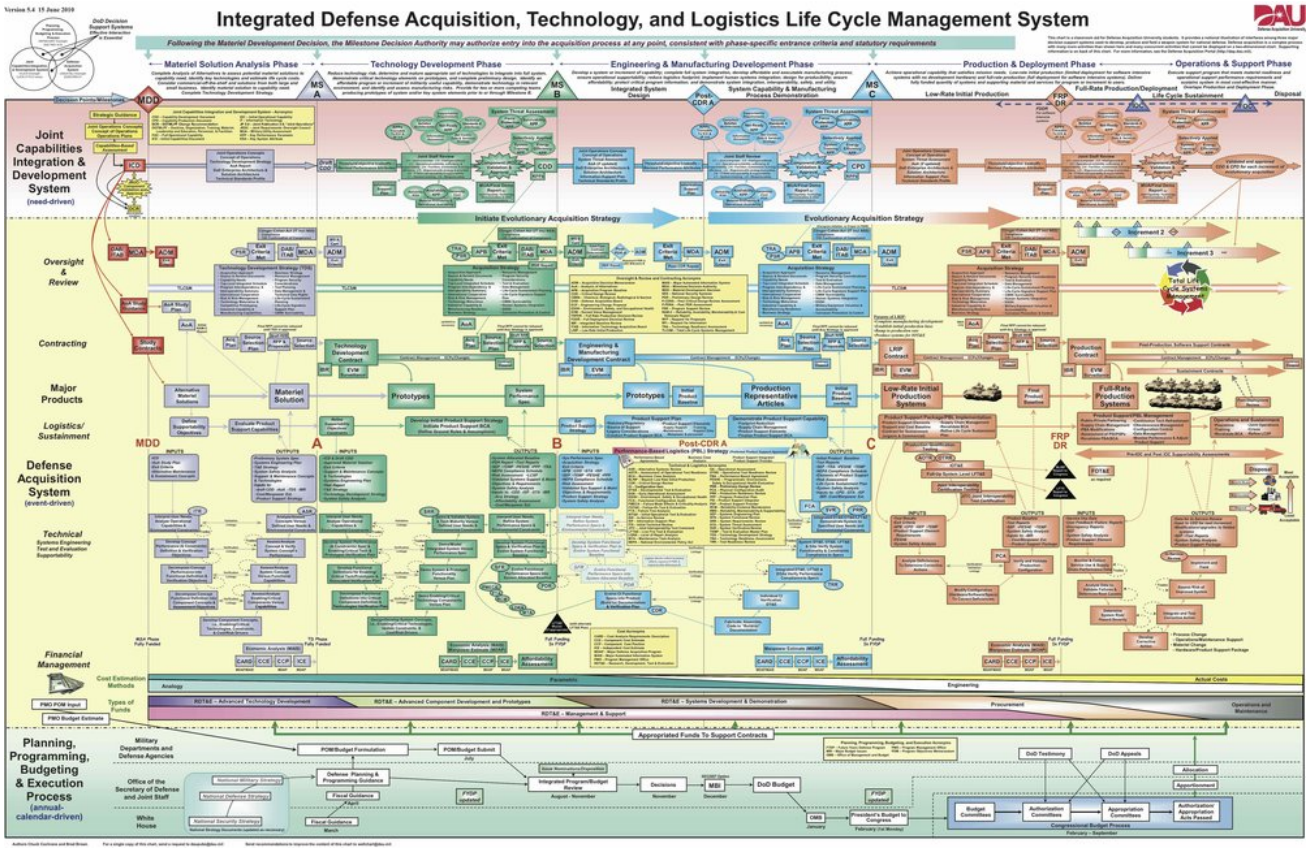
Science and Engineering in the Real-World

As you know, real-life is always messy. The engineering and science processes described above for K-12 students are a simplified version of how real science and

engineering work is done.

For example, let's dig further into the scientific method. Did you know that not all scientific discoveries are made via the scientific method? I love the examples presented in this blog post: What's Wrong with the Scientific Method? Scientists often use observational data to draw conclusions. That's a fancy way to say "let's watch, and see what happens". For example, a biologist wouldn't conduct experiments to learn about the lives of gorillas. Rather, they would observe them in their natural habitat to discover how they live and document their findings. If they wanted to learn about how humans impact their environment, they would take detailed notes on the differences in gorilla habitats that are and are not in close proximity to human populations. There are no controlled experiments in this case.

As for engineering, you need to check out this real diagram of the engineering process for the Department of Defense. I (Natasha) worked for the Navy, and we really did use this process! Engineering in the real-world also involves budgets, risk management, lots of paperwork, meetings, deadlines, presentations, regulations, convincing your boss you are right, and more paperwork. And kids probably don't need to know all about that yet!



Department of Defense Engineering Design Process

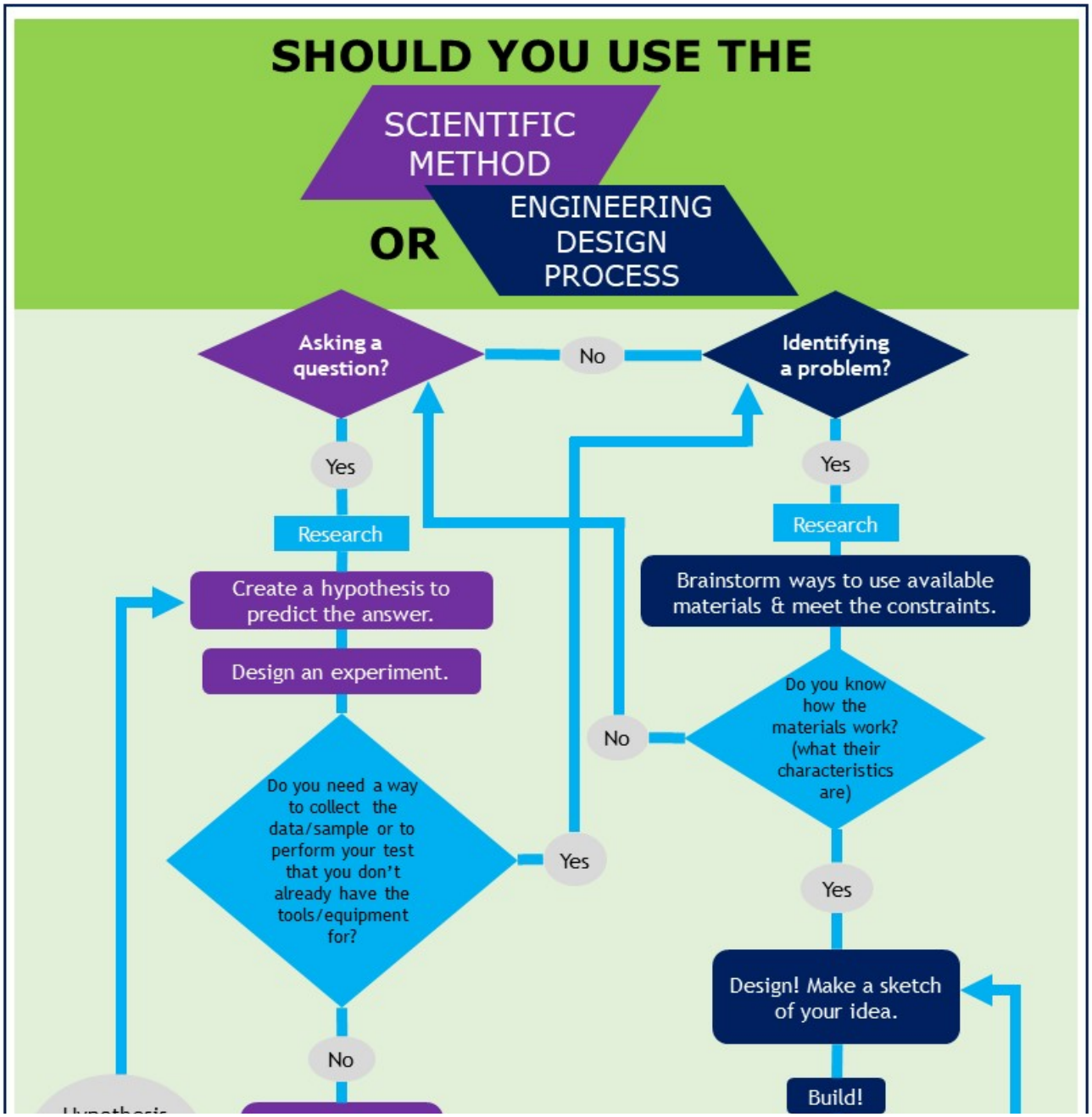
Furthermore, in the engineering design process, we always ask our students to build a prototype. This often leads to the misconception that engineers are responsible for building the final product like a bridge, car, or computer. Not so! A civil engineer will design a bridge, yes. But it takes a contractor and a construction crew to buy the equipment and actually build the bridge. The engineer gives us the instructions, and makes sure the contractor understands what to do; the crew makes it happen.

What process do I use in STEM education?

In our definition of STEM learning, **students apply math and science classroom**

concepts to solve an engineering problem using technology. Read more here. This means that STEM is centered around the engineering design process. Students are given a mission like "design a catapult to launch an object to knock over a tower", and they apply the process to brainstorm, design, test, and redesign until they arrive at a solution for their problem. The scientific method is a different thing altogether.

The scientific method helps to provide the necessary information to engineers so that they are able to efficiently and effectively solve problems. We have created the following flowchart to help illustrate how the scientific method and engineering design process differs, yet, interact! This serves as a great resource for students in utilizing both. For a PDF of this infographic, visit our Free Resource Library!



Do you know when to use the Scientific Method or the Engineering Design Process? They can work hand-in-hand. Let Vivify STEM show you how.

Ready to test it out?

Want to test out your own use of the Scientific method? Try ourMentos and Diet Coke Experiment. You may want to perform this experiment outside, so that young scientists can delight in the diet coke geyser without worrying about making a sticky mess in the classroom.

Ready to put your own Engineering Design Process to use? Try ourSTEM Catapult Challenge. during this Vivify favorite, students will work together to build two different catapult designs. We also have space landers, volcano shelters, sailboats, and more here!

Let us see your work in action! Send us pictures of your adventures, and you might just be featured on our instagram.