# Maker Methodology for Students

To innovate and tackle challenges effectively and efficiently, people follow a design process. Proven processes are *Design Thinking* and the *Engineering Design Process*, both of which work in any discipline, not just engineering. These methods take the designer through a series of steps that help ensure they haven't missed an important issue.

As humans eager to solve problems, we are drawn to challenges, get excited by our initial ideas, and want to try them out right away. We start planning or building, and expect to resolve issues "later". Pretty soon, much of the work is making this initial idea succeed, and not really addressing or maybe even understanding the actual challenge. This trial-and-error method can work, but it may take a long time and not yield the best solution. A good design process provides a clear roadmap, helping the designer avoid dead ends and get to a good solution the fastest way.
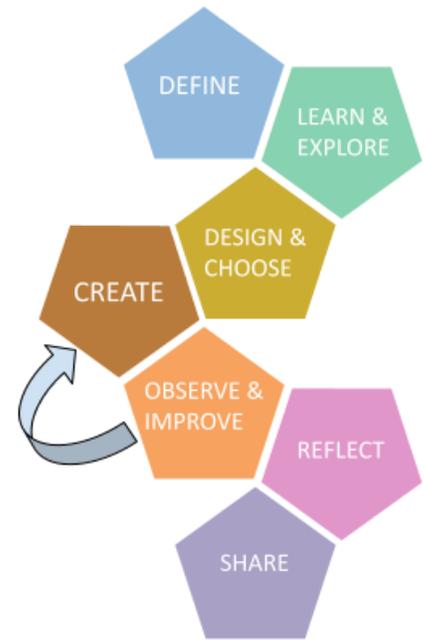
First, designers **Define** the challenge they are facing, then **Learn** more about the problem and **Explore** existing solutions. It's tempting to skip these first few steps and head straight into brainstorming, but don't! When designers take the time to understand the problem clearly, they come up with much better solutions.

The **Design & Choose** phase is where ideation happens and the most promising idea is selected for follow up. Designers brainstorm multiple possible solutions, then develop a few of them into more detailed proposals. Encourage students to outline at least 3 of their potential ideas before choosing a design direction. Next they will **Create** a product based on their chosen design. If they hit any roadblocks trying to create their first design choice, they'll be able to revisit their alternate designs and create a new plan - without starting from scratch.

Designers then take time to carefully **Observe** their design and see how they can **Improve** it. *We strongly recommend that students have an opportunity for at least 2 Create-Observe-Improve cycles.* When students feel they have to "get it right the first time," they are less willing to take risks and be creative. By repeating the cycle, they have a chance to fix flaws and adapt successful ideas from classmates, and in fact, they're practicing what professional designers really do. You can build cycles into the project by using simple tools and materials for the first prototype - for example: cardboard models before CAD and 3D printing , hand sketches before graphics apps, flowcharts or "pseudo-code" before coding. Also consider changing or adding the constraints/criteria for successive iterations.

A good design cycle builds in time for the designer to **Reflect** on their product and the process of making it, looking for learning habits and insights that will help in future challenges. When the work is complete, designers are ready to **Share**. They bring their work into the real world, by posting, publishing, presenting, or exhibiting what they have made, maybe giving or selling if appropriate. For students working through a design process, an audience outside the classroom can helps students connect their school experiences to the rest of their lives, building confidence and helping them see themselves as part of a bigger community.

EDGERTON CENTER

MAKE
k12maker.mit.edu