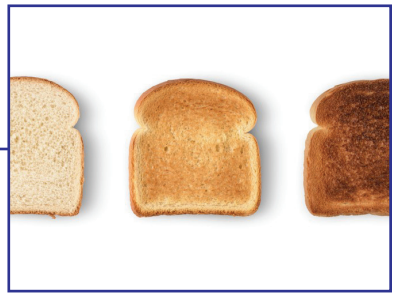
Time
45 Minutes or Less

Grades
3–5 • 6–8 • 9–12

Topic
Design Challenge

Making Toast



Making toast seems simple enough. However, when students are asked to draw out the process, it becomes a digestible way to introduce the steps of the engineering design process.

Introduction

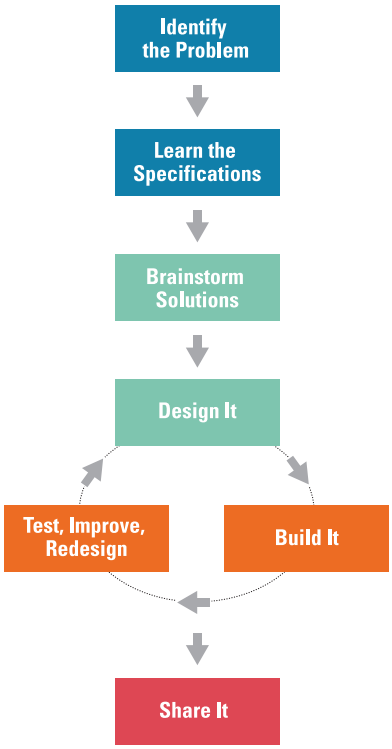
In this activity, students will be introduced to the engineering design process within the context of drawing out the process of making toast. Making toast seems like a straightforward task; however, there are many factors to consider to ensure success.

Preparation

1. Review these Leader Notes and gather the materials.
2. Decide how you will share the Engineering Design Process graphic. You can use a projector to display it for the whole group or make copies for individual students or pairs.

Materials

- Engineering Design Process graphic
- Blank white paper
- Pencils with erasers



Engineering Design Process

Activity: How to Make Toast

1. Explain that students will be doing a quick sketching activity. Tell them: Draw the steps to make toast.

2. It may be tempting to lead a discussion about the steps before they start drawing, but the objective is to be a bit vague. This gives students a wide variety of starting and ending points for their toast-making processes.

3. Tell students they will have a few minutes to draw the steps to make toast. Their illustrations should be quick sketches that communicate their ideas and actions. Remind them to draw as many steps in the process as they can. Distribute a piece of blank paper and a pencil to each student.

4. Create groups of three to four students and have them share their drawings and explain their steps.

5. Gather the larger group for a discussion. Ask questions about the similarities and differences in their processes, such as:
   - Did everyone in your group draw the same steps to make toast? Which steps were similar? Which were different?
   - Did the toast-making processes start at the same place?
     - Did anyone start with building a toaster?
     - Did anyone start by baking the bread or even further back to growing the wheat?
   - How was the toast made? In a toaster or oven? Did anyone cook it in a pan over a fire?
   - Did the toast-making processes end at the same place? How far into the toast experience did you go?
     - Did you put butter, jelly, or another spread on the toast?
   - What could go wrong when making toast? Did anyone add warnings to their steps (such as burning the toast)?
   - Did you learn anything new about making toast? What did you learn?

Introduce the Design Process

1. Explain that making toast is a simple example of the engineering design process.

2. Show the Engineering Design Process graphic and connect it to the steps to make toast. Explain that the first step in the process is to **Identify the Problem**. A problem is a need, issue, or challenge that you want to address in your design. In our example, the problem is that you need to make toast.

3. Next, **Learn the Specifications**. The specs are all the information you need to know to solve or address the problem, including the success criteria and engineering constraints. People often think they know the problem they're trying to solve, but they can't be sure without understanding the specifications.

   A. Define the *success criteria*. The success criteria are the things you need to include to meet the goal. The user defines the success criteria. In our example, there isn't an end user who will eat the toast, so we can't know what success looks like. However, some examples of success could include: it tastes good, it has a spread, it's crisp but not burnt, etc.

   B. Define the *engineering constraints*. Explain that constraints are any rules that must be followed as you try to solve the problem. Our example is vague, and there aren't any constraints. However, some constraints could include: having just three minutes to make the toast, not having a toaster, only having bagels, etc.

   C. Explain that in our example, neither the success criteria nor engineering constraints were defined. Since it was completely open-ended, it may have been difficult to know what steps to take. Ask students to consider how the activity would have been different if they knew the answers to questions such as:
   - Who will be eating the toast?
   - How does the person like their toast?
   - What resources do I have available?
   - What if I only have the ingredients to make bread (flour, yeast, water, sugar, and salt)?

   D. Talk about the other specifications that students pondered when sketching their process. They may have considered:
   - Do I have everything I need?
   - When does the person want the toast?
   - What could go wrong when making toast?
   - How do I know if the person is satisfied with their toast?
   - Are there any guidelines or rules I need to follow when making it?

4. The next step in the engineering design process is to **Brainstorm Solutions**, or consider the many possible ways to solve the problem. As you brainstorm, it's important to understand the success criteria and engineering constraints; otherwise, you might waste time on the wrong path. In our example, your brainstorm might include all the ways you can make toast: in a toaster, an oven, a pan, a grill, or a different way. You might also decide the type of bread, the spreads to use, and how long to cook it.

5. In the **Design/Build/Test** steps, you choose your best solution and make it. Then you decide if it came out the way you expected, or if you need to make changes and test it again. Perhaps the toast burned and you need to start over. Or there wasn't enough peanut butter and you need to add more.

6. The final step is to **Share It**. You share your solution with others and reflect on the toast-making process. What worked well? What didn't work? What would you do differently next time?

7. Tell students that everyone can participate in engineering design, and even small tasks, like making toast, require thought and planning. Challenge them to practice using the engineering design process at home the next time they make toast or something else.

Extensions

Visit the DiscoverE website to find additional engineering design activities to do with your students. Search by grade level, topic, or scientific discipline to find activities that integrate into your curriculum or capture your students' interests.

NGSS Standards

Grades 3–5

3-5ETS1-1 Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

3-5ETS1-2 Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

3-5ETS1-3 Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Grades 6–8

MS-ETS1-1 Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

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