STEM Careers Coalition

SOLUTION SEEKER ACTIVITY

Flexible Fixes

LEARNING OBJECTIVES

Students will:

- *Analyze* the customer flow system in a restaurant
- *Apply* the engineering design process to devise a new, socially-distanced layout
- *Create* a store map that demonstrates how the restaurant can operate safely for employees and customers

OVERARCHING QUESTION:

How can businesses adapt to operate safely during COVID-19?

STANDARDS:

Next Generation Science Standards

- Engineering Design
    - 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.

C3 Framework for Social Studies Standards

- D2.Eco.3.3-5. Identify examples of the variety of resources (human capital, physical capital, and natural resources) that are used to produce goods and services.

Common Core English Language Arts

- Writing:
    - W.4: Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
- Speaking and Listening:
    - SL.1: Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.
    - SL.2: Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.

Instructional Note:

The following activity has been designed so you can tailor it to your current mode of instruction.

- The *Introduce, View* & *Reflect*, and Conclude sections can be presented virtually, by video, or through a shared document.
- The *Challenge* section is designed for students to complete independently at home. Students can either complete their maps on paper or by using online applications such as **Google Docs** or **SketchUp**.

ACTIVITY OVERVIEW:

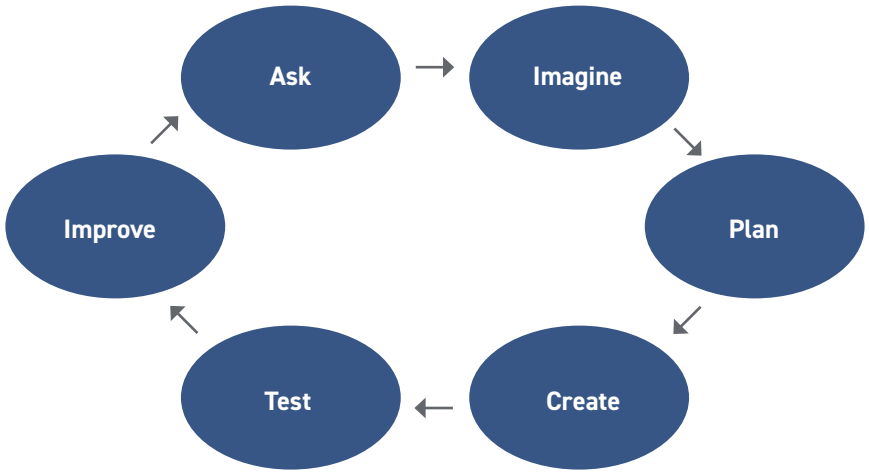
Introduce

- Begin by introducing students to the general concept of the engineering design cycle[1]:
    - The engineering design cycle is a process that engineers use to help them solve problems. Many organizations, including NASA, use the engineering design cycle.
    - The engineering design cycle includes 6 steps:
        - *Ask*: identify the problem, requirements, and constraints
        - *Imagine*: brainstorm solutions and ideas
        - *Plan*: choose the best ideas and sketch possible designs
        - *Create*: build a working model or prototype
        - *Test*: test the prototype to find strengths and weaknesses
        - *Improve*: as a result of testing, identify what changes you need to make to your prototype and implement your changes
- Inform students that the engineering design cycle is helpful in developing new products, but it is also a good way to develop new processes or workflows. Ask students to think of different industries where the engineering design cycle is a useful tool. These might include manufacturing and construction, but also less obvious applications like healthcare and retail. As students provide answers, write them in a centrally viewable place.
- Select 3–4 industries from the list and have students work in pairs to identify ways the engineering design cycle can be used for problem solving in each different context. For example:
    - Healthcare: The engineering design cycle can be used to help develop a better patient check-in system for a doctor's office.
    - Retail: The engineering design cycle can be used to determine the best layout for a store.
    - Construction: The engineering design cycle can be used to determine the optimal roof design for a building.
    - Manufacturing: The engineering design cycle can be used to come up with a new product.

- Invite students to share their responses.
- Explain that students are about to watch a short video that highlights how one company—GAF—is problem solving in order to keep its manufacturing plants open and safe amid COVID-19.

View & Reflect

- After students have watched the GAF video, divide them into six groups—one for each step of the engineering design cycle.
- Play the video one more time. This time, while working in their groups, ask students to identify how GAF used their assigned stage of the engineering design cycle to problem solve how to keep their manufacturing plants open.
- When each group has developed a response, instruct each group to input their response into the appropriate space on the engineering design cycle graphic:



- Summarize by asking students to respond to the following critical thinking questions:
    - Why is it called the "engineering design cycle?" Why would you need to return to "Ask" after "Test" and "Improve"?
    - Why do companies like GAF hire process engineers like Lauren?
    - Why are construction and roofing essential services during the pandemic?
    - What other careers and jobs are involved in helping the GAF plants to operate safely?

CHALLENGE

- Explain that the class will now be challenged to use the engineering design cycle to implement a new workflow for a fast-casual restaurant that is trying to shift its layout in order to operate safely during COVID-19.

  To do this, students will begin by reading the *Challenge* prompt and identify the criteria and constraints.

  Then, students will work through the six steps of the engineering design cycle and record their thinking on the capture sheet.

  Next, students will sketch their workflow on the Challenge diagram and identify how their proposed workflow addresses the criteria and constraints.

  Finally, students will share their designs and work with partners to improve and iterate.

- Share the *Challenge* handout and review the instructions before encouraging students to work independently.
- When students have completed their workflows, instruct them to pair off and work with their partner to revise their design.

CONCLUDE

- Once the *Challenge* activity is complete, invite students to share their workflows and revision ideas with the class.
- Encourage students to compare and contrast the solutions they developed and consider how they could optimize their solutions based on the ideas of their peers.
- Wrap-up by encouraging students to keep the engineering design cycle in mind as a problem-solving tool. It has many applications in STEM and beyond.

CHALLENGE

FLEXIBLE FIXES

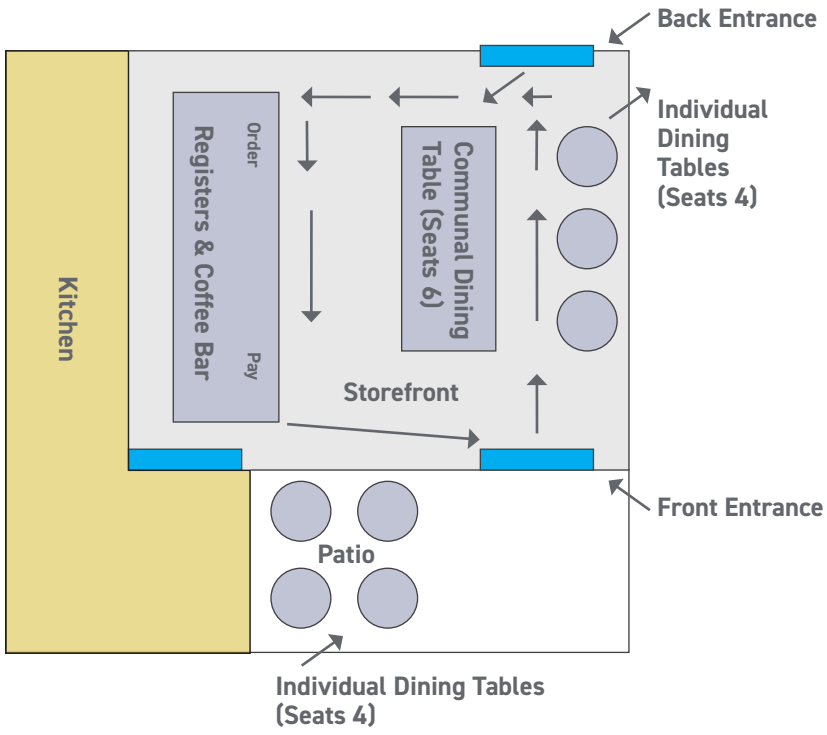
Challenge Handout

Read the prompt below. Then, walk through the steps of the engineering design cycle in order to devise a solution to the problem. For the *create* step, you'll map out your devised layout on the map provided. Finally, pair up with a partner in order to brainstorm process improvements.

Imagine that you're an industrial engineer that has been hired by a fast-casual restaurant chain to help them figure out how to operate their restaurants safely during the COVID-19 pandemic. The restaurant primarily serves sandwiches, coffee, and prepared foods that customers can take home and cook. All food is made in a small open kitchen and the coffee is made and served to customers from the register. There is limited dine-in and some dine-out seating available to customers. The restaurant is very busy on weekend mornings, with top-performing sites usually serving about 50 customers an hour. In order to remain profitable, the restaurant needs to maintain the same level of orders (50/hour, 400 per day). However, they must do this while implementing the following safety guidelines:

- there cannot be more than 50 people in the restaurant at a given time (there are 10 staff members working each shift, so only 40 customers can be in the store at once)
- all staff and customers must maintain at least six feet of distance
- masks must be worn by staff and customers at all times
- the kitchen and public surfaces must be sanitized at least once an hour

It is your job to help the restaurant develop a new layout that maximizes efficiency while also taking social distancing into account.



Step 1—Ask

Identify the problem you need to solve:

_____

_____

Criteria	Constraints

Step 2—Imagine

Write five ideas for how to implement safety guidelines or change the restaurant's procedures:

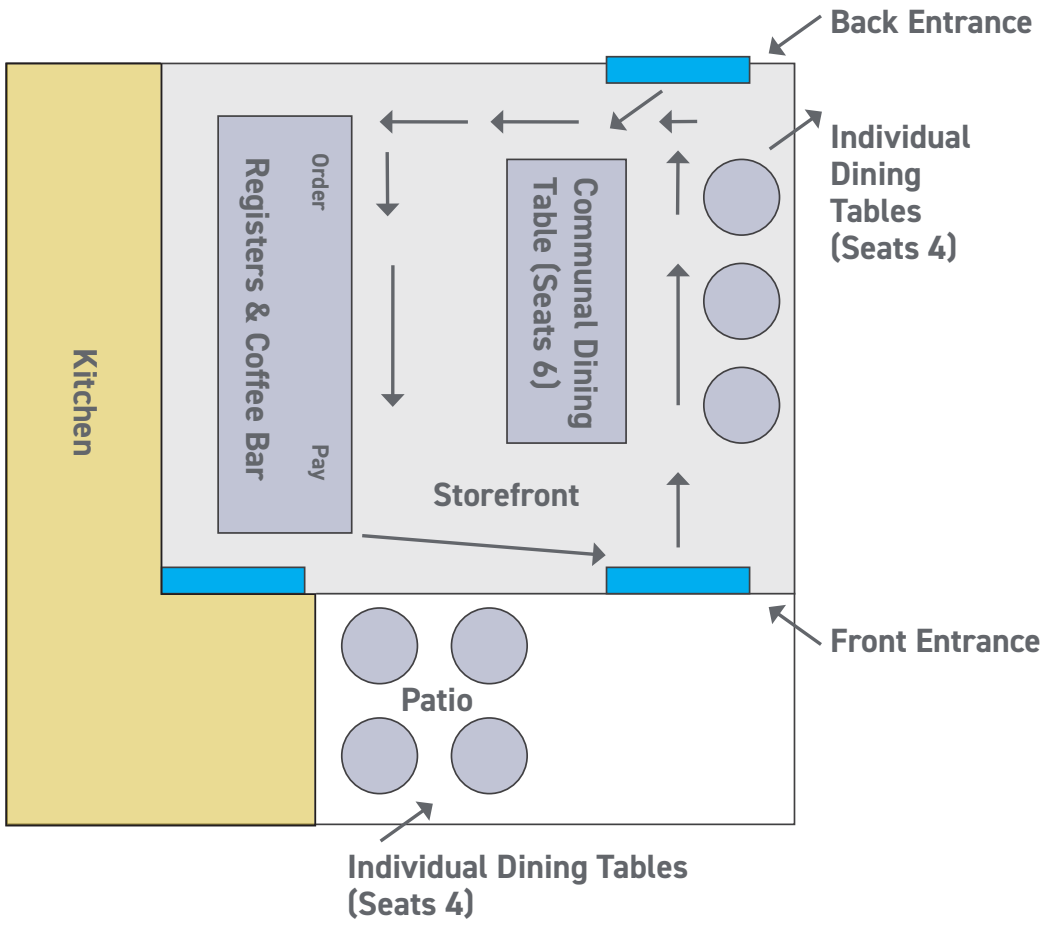
1. Idea:
2. Idea:
3. Idea:
4. Idea:
5. Idea:

Step 3—Plan

Circle three ideas from above to implement in your design.

Step 4—Create

Sketch your ideas in the diagram. Be sure to highlight the changes you've made and how they adhere to the criteria and constraints provided.



Step 5—Test

Share your design with a partner. Critique one another's work. Identify three ways the design meets the criteria provided and three opportunities for improvement.

Criteria met:	Opportunities for improvement:
1.	1.
2.	2.
3	3.

Step 6—Improve

Implement the three suggested improvements on the diagram below: