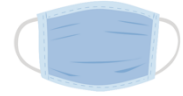# Engineer a Coronavirus Mask Pack

In this activity, youth engineer a pouch designed to conveniently hold a coronavirus face mask. Using a simple engineering design process, they establish the criteria for their design and use readily available materials to design and test it.

Timing: 90 minutes, divided into 12 distinct steps.
This lesson can easily be broken into multiple sessions.

Materials:
    1 Face mask
    Assorted household supplies (materials can vary)
    Engineering Journal

Step 1: What is Engineering? (5 min.)
Engineers solve problems by designing objects and processes.

- *What are some engineering challenges that have emerged from the COVID-19 pandemic? (mask design, hand sanitizer recipes, supply chain issues, flow of people through stores)*

Engineers often use an engineering design process (EDP) like the one shown in your Engineering Journal.

- *Why do you think engineers use this tool?*

When you solve problems what kind of processes do you use?

- *Are there phases that are similar to the EDP?*

Step 2: Learn about masks (5 min.)
Engineers think about problems, various solutions, and how their inventions might work. Look at the types of masks in your Engineering Journal.

- *Why are some of the features of each mask?*
- *What problems was this feature designed to solve?*
- *What limitation does this mask design have?*
- *Which mask would you choose to wear if you were. . .?*
  - *Meeting a friend*
  - *Treating a COVID patient in a hospital*
  - *Working in a hot building*
  - *Teaching someone who was deaf or hard of hearing*

Step 3: Decide on mask criteria (5 min.)
Your engineering challenge is to design a pack for a mask that attaches to a bag from materials you have readily available.

The pack design has two parts:
- The pack
- The mechanism to attach it to the bag

To solve any problem, engineers need to know what the end product needs to do. Look at the *Design Criteria and Testing Results* table in your Engineering Journal. It shows that your mask pack must:
- hold at least one mask AND
- attach to a backpack, bag, or purse.

In addition, you must choose one other feature your mask pack will have. Choose one criterion from the list below (or make up your own) and add it to the criteria column in your Engineering Journal.
- o Keep the mask dry
- o Include an additional pocket for hand sanitizer
- o Communicate who owns it
- o Is environmentally friendly (made of recycled/recyclable materials)
- o Stays in the same place on the bag (so does not move)
- o Is easily transferred from bag to bag
- o Holds masks for a family of 4
- o Coordinates with your bag (or mask)
- o Other: A criteria you identify: My mask pack will: _____.

Step 4: Prepare for testing (5 min.)
Engineers use tests to determine whether their designs meet the goals they set. Thinking about these tests early in the engineering process helps engineers brainstorm solutions that will be successful.

The second column of the *Design Criteria and Testing Results* table shows how you will test your mask pack to make sure it holds the mask and attaches to a bag.
- *How you might test the third criterion you selected? Add your ideas to the table in the Engineering Journal.*

Step 5: Think about materials (5 min.)
Engineers carefully choose materials that will help them design a product that meets all the requirements. Based on the mask you chose and your design criteria:
- *What materials might work well for the pack?*
- *For the attachment?*

Discuss your ideas with a partner, group, or instructor.
- *Why do you think the materials you chose will work well?*
- *What properties do they have?*
- *What other materials could you use to create this design?*

Step 6: Collect your materials (10 min.)

Based on the properties you described, gather materials that could be used to make your mask pack. If you can't find the exact material, look for one with similar properties. Share the materials you found with a partner, group, or instructor.

Be sure to:
- Make sure it's OK to use them! (Ask permission if you need to.)
- Gather any tools you might need to build the mask pack (for example, scissors, tape, glue, stapler, needle and thread etc.)

Step 7: Brainstorm ideas (10 min.)

Engineers come up with creative ways to solve problems by considering many different ideas before deciding what to make. They talk with their teammates to get even more ideas. All designs are strengthened by feedback from others.

Using your Engineering Journal, sketch out at least 2 possible designs for your mask pack. Sketch your mask pack and show how it attaches to a backpack. Think creatively!

Share both of your design ideas with a partner or the group. Make tweaks to your designs based on others' ideas (resketch if necessary).

If you don't have time to complete this activity in one session, take a break here and come back later! Put the materials you collected and your Engineering Journal in a safe place until next time.

Step 8: Choose one design to try out (10 min.)

After brainstorming many different ideas, engineers choose one design that they will build and test. The chosen design combines the best elements of all their ideas. Before starting to build, they draw a detailed plan of their design, and list or label the materials they will use.

Using your Engineering Journal, draw a final plan for the design you want to build and test. Be sure to label your drawing and write down how much of each material you will need.

Step 9: Build and test your Mask Pack (15 min.)
Follow your plan and create your mask pack!

When you are finished, test how well your mask pack works by using the testing methods in your Engineering Journal. Be sure to log the results of your tests in the third column of the table.
- *How did it work?*

Step 10: Communicate and participate (5 min.)
Engineers communicate their designs with others. They share their work with other engineers, with the clients that ordered their products, or with the general public.

Take turns presenting the results of your engineering work to a partner, group, or instructor.
- *Describe your design and the criteria you were trying to meet.*
- *Perform your test sequence to show how it works.*
- *Ask others to provide feedback on your design.*

Think about how you can provide good feedback to your peers.
- *I like how your design _____.*
- *One thing you might try is _____.*

Step 11: Try again! (10 min.)
Engineers are always striving to make their designs better. They go through the phases of the EDP over and over again because they learn something new every time they design.
- *Think about how you can make your mask pack better based on the feedback from others.*
- *Redesign, test, and share your modifications.*
- *Did it perform better?*
- *If you had the opportunity make another Mask Pack, what new features might you include in your design?*

Step 12: This is Engineering! (5 min.)
As engineers solve problems by designing objects and processes, they use an engineering design process (EDP) like the one shown here. You are an engineer!
- *Looking at the EDP, reflect on process you used to create the Mask Pack.*
- *What did you do during each phase? (Ask, Imagine, Plan, Create, Test, Improve)*
- *How did using a process help you engineer?*

Developed by: Christine M. Cunningham, Martha Davis, and Shannon McManus