

MAKEngineering Kit Facilitation Guide: DIY Grabbers

Task adapted from Try Engineering as part of IEEE and DIY Grabber from CoBuild 19.

ENGINEERING TASK

Grabbers are handheld tools that can be used to retrieve items from a distance. Watch the following video for more information:

https://youtu.be/_gw6FILANtA

Design a prototype of a grabber that can pick up three different objects from at least two feet away without damaging or dropping them.

MATERIALS IN KIT

- * Scissors
- * Electrical Tape
- * ~3 feet of cotton twine
- * 10 rubber bands
- * 4 binder clips
- * 4 straws
- * 4 pipe cleaners
- * 5 jumbo popsicle sticks
- * 2 hair ties
- * 6 large fasteners



<https://intentergy.com/>

PROTOTYPE

Prototype is a term we will use often, so what does it mean? One way to think of a prototype is a rough draft on a paper. Here are two videos that explain a prototype in engineering.

https://youtu.be/_1bOaNSy5XY

https://youtu.be/k_9Q-KDSb9o

After watching the videos, how would you describe a prototype?

STEP 1—RESEARCH

Did you know engineers design robotic grabber arms for individuals who are not able to use their arms to pick up objects or for garbage trucks to pick up garbage bins? How do they do that?



www.cnn.com



STEP 1—RESEARCH

As a family, search for news stories and videos using such phrases as “engineers that develop robotic arms”, “mechanical arm for garbage truck”, or “robotic hand for humans.” Here is one video to get you started.

<https://youtu.be/WxCDZquT2Yk>

Take notes on what you notice about the design of the arms and/or hands.

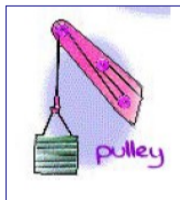
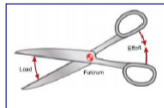
STEP 1—SUPPORT

To build upon your research, here are a few images to discuss and think about other ways for the grabber to grab (i.e., hand) and reach objects (i.e., arm).

GRAB



REACH



MATERIALS IN YOUR HOME—SCAVENGER HUNT

Now you need materials for the “body” of the grabber. As a family, find items around your house that start with the letters below. Only one object per letter, but you can have more than one of that object. For example, for the letter P, you can use 5 plastic bottles. Be strategic. We suggest recyclable materials.

B D E H L N P S T W

SCAVENGER HUNT—SUPPORT

Potential questions to ask before, during, and/or after gathering materials in your home:

- ◆ How are you thinking this will be used?
- ◆ Let's think about our research notes. What object(s) would we use for _____.
- ◆ Do you think _____ (e.g., toilet paper rolls) will be able to grab and lift 3 pounds? Why or why not? (If not—What might we do if we want to use the object then?)

STEP 2—PLAN

Who is your user? What do you want your grabber to grab? Think about at least 3 items in your home and consider the texture, size, weight, and shape of the objects.

Next, using your research notes, draw 3 different designs of grabbers. For each design, list or label the materials you will use. You can only use the materials in the kit and from the scavenger hunt.

STEP 2—SUPPORT

Potential questions to ask:

- ◆ Why is _____ your user? What purpose will the grabber serve for this user?
- ◆ Tell me more about how you are thinking about the part of the grabber that will “grab” the objects.
- ◆ Can I make a suggestion? Have you considered using _____ instead? (ask for permission) How might this change your design?
- ◆ How are your 3 designs based on our research?
- ◆ Which one do you think will be easiest for the user to use? Why? How should they hold the grabber to use it while sitting and/or standing?



COMMUNICATE

Have a conversation around the research and planning process. The camera can be focused on the three grabber designs.

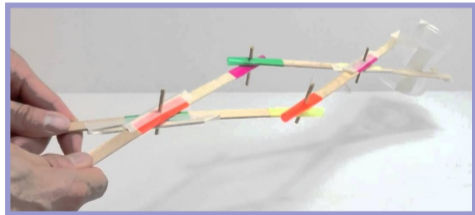
1. What did you learn from your research?
2. How did you use this information in your plans?
3. Do you think you can pick up the 3 different objects with one of your designs from two feet away? Which one? Why do you think this? Consider the objects texture, size, weight, and shape in your explanation.

STEP 3—CREATE

Pick one of your designs from Step 2 and **CREATE** a prototype. What is an appropriate name for your grabber? Think about the purpose of the grabber.



The Hook



The Scissor

STEP 4—TEST

Use your grabber to pick up three items in your home from at least two feet away. Since your grabber may be long, make sure you test in a space that has plenty of room. You don't want to accidentally hit other or knock things over!! Don't lift breakable items or any hot/dangerous objects.



STEP 4—SUPPORT

Potential questions to ask:

- ◆ Would you consider this test a success or failure? Explain.
- ◆ What change(s) should we make in the next step (i.e., redesign)? What happened in the test that makes you think this?
- ◆ Let's try the test from different sitting and standing positions to see how it works. What do you notice? Do you have to hold the grabber differently? Why?
- ◆ Describe how to use the grabber.
- ◆ Based on the test, what other objects might we be able to grab?

STEP 5—IMPROVE

How well did your grabber pick up three items in your home from at least two feet away?

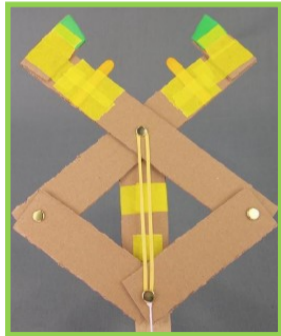
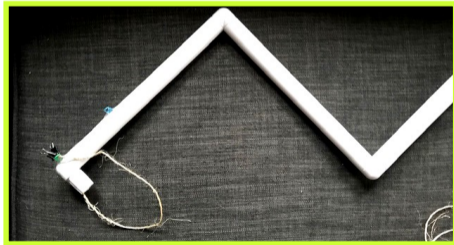


1. Can others in your family use the grabber?
2. What improvements might be made? Why do you think this?

Make any changes and test your grabber again. Continue to test and redesign until you are happy with your grabber.

STEP 6—PARALLEL PROTOTYPE

Try another design from Step 2. Do each step again—Create, Test, and Improve.





COMMUNICATE

Have a conversation. The camera can be focused on the prototype.

1. Suppose you have been asked to create a commercial for your prototype. Show how the grabber works and why customers should purchase it. Keep your user in mind.
2. What was your greatest failure while testing? What did you do next?
3. How did you work together as a team of engineers?

STEP 6—CHALLENGES

We also have a few challenges for you to consider:

- How many different types of items can one of your grabbers pick up? What do these items have in common?
- Design a grabber that can hand someone a water bottle across the room while you are both sitting.
- Combine elements of your three designs from Step 2 into a mega-grabber.
- Make up your own challenge. Don't forget to start with planning your design.

DID YOU KNOW?

Different types of engineers are needed to plan, create, test, and improve robots including robotic arms—mechanical engineers work on the body, electrical engineers work on the nervous system or the electrical components (e.g., circuits), and computer science engineers work on the brain or the computer program that tells the robot what to do. If you are interested in learning more, check out this video.

<https://youtu.be/A1V-QQ5wFU4>

WHAT TYPE OF ENGINEER ARE YOU?

Add a sticker to your Engineering Passport that identifies the type of engineer you were most like in the design of a grabber. Don't forget to write why you chose the type of engineer.



This engineering kit would not have been possible without funding and support from the National Science Foundation.