GSK Science in the Summer™

Be a Biomedical Engineer

This summer, your child is invited to play the role of a scientist—a biomedical engineer—to explore basic concepts of engineering and solve a real-world problem.

Welcome to *GSK Science in the Summer*, brought to you in partnership between GSK and The Franklin Institute.

This free summer science program aims to inspire the next generation of scientists and engineers by inviting children to experience real science careers by practicing science skills and using real science tools—all while having fun!

This at-home science activity is supported by a series of online resources, including videos and a live, interactive virtual experience. Here is the recommended sequence for your *GSK Science in the Summer* Be an Engineer experience:

1. Start by watching **short introductory videos** to help your child set up their lab and learn about their engineering project.
2. Do your **at-home experiments**, using the guide in this booklet and the provided science materials. Remember to follow the safety guidelines during all activities.
3. Join a live **Biomedical Engineer Team Meeting** to share the results of your research with other *GSK Science in the Summer* participants.

Find all the videos, resources, and event registration information at scienceinthesummer.fi.edu/be-an-engineer.

Are you ready to be an engineer? It's time to set up your lab and get started on your research!

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THE FRANKLIN INSTITUTE

Biomedical Engineer

You work for a company that develops **assistive technology**—tools and devices to help people with limited range of motion. Your job is to design a reaching tool for a customer who has difficulty standing up or raising their arms, to help them reach faraway objects.

The tool needs to help your customer pick up a piece of paper from a table, by allowing them to reach the same distance as someone who can bend over and raise their arms.

MATERIALS

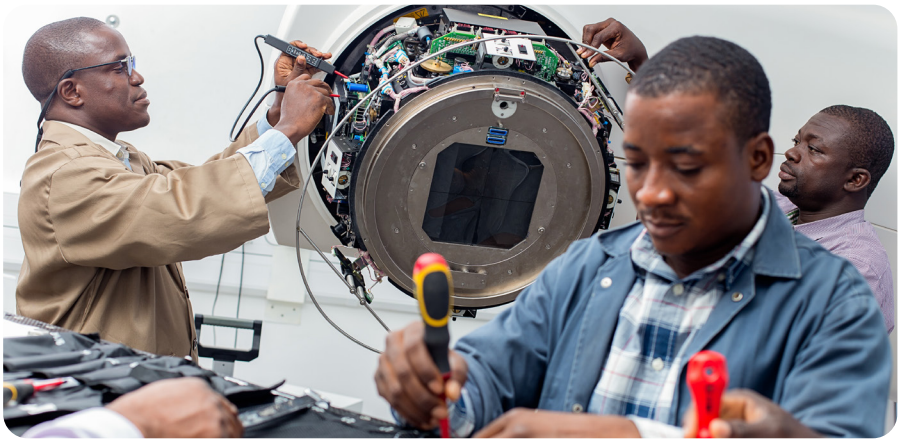
- Cardboard
- Wooden craft sticks
- Skewers
- Paint stir sticks
- Rubber bands
- String
- Pipe cleaners
- Masking tape
- Ruler
- Lab notebook
- Pencil

ADDITIONAL MATERIALS:

- Scissors
- A chair near a table or desk
- (Optional) other building materials like paper clips, paper fasteners, or aluminum foil

LAB SET-UP AND SAFETY

1. Gather your supplies. Make sure you have all your science tools and materials from the list above in one place.
2. Find a flat, hard surface like a table or desk to use as your lab bench. You'll need plenty of work space for building your designs and storing your materials.



Part 1: Research

Find out how far people with different reaching abilities can reach with their arms and bodies.

1. Start by thinking about the requirements of the reaching tool. Make some notes on page 4 of your lab notebook:
   - *What should the tool be able to do? What should it not do? What other limits does it have?*
   - *For example, does it need to be a particular size or shape? Are there any materials it can or can't be made of?*
2. Next, find out how far a person with full range of motion can reach. Sit in a chair near a table or desk, or have someone else do so and measure their reach. Move the chair closer or further from the table until you find the distance where you can just touch the tabletop with your fingers by bending forward and reaching out your arm (but not lifting your body off the chair).

3. Use a piece of tape to mark on the floor where the front of the chair is. Use the ruler to measure the distance between the chair and the table. This is your reach length—how far away you can be from the table and still reach something on it.

4. Now find out how far your customer can reach. Put the chair in the spot you marked for your reach length. To model your customer's limited movement, sit straight up in the chair with your elbows touching your sides. See how far you can reach without leaning over or taking your upper arms away from your sides. (In other words, you can only bend your elbows and wrists.)

– *Can you reach the table from this distance?*
– *How much closer to the table does the chair need to be before you can reach it with this limited movement?*

5. Move the chair until you can reach the table with this limited movement, then mark or measure this distance like you did in step 3.

6. Notice the difference between the distance you reached with full body movement and the distance you reached with limited movement.

   – *How far will your reaching tool need to reach in order to help your customer reach the table from the same distance as someone with full movement?*

7. Look again at the list of requirements you made in your notebook.

   – *Do you need to add or change anything based on this research?*

Ask other people in your home to measure their reach in the same way. What is the longest distance anyone in your home can reach?

Part 2: Design

Create a plan for making a reaching tool that will help your customer pick up a piece of paper on the table from a longer distance.

1. Brainstorm different ways you could make a reaching tool that will meet the requirements listed in your notebook. Look at the photos on p. 5 of your notebook for ideas. Write or draw as many different ideas as you can for what the reaching tool could look like. What parts will the tool need to help your customer reach farther?

   – *What parts will help your customer pick up a piece of paper?*
   – *How will your customer hold or use the tool?*

2. Choose one idea that you think will work the best. Think about exactly which materials you will use and how you will connect them together. Draw a new picture of your design or circle it in your notebook.

Part 3: Build, Test, Redesign

Build your reaching tool and see if it works. Improve it until it works as well as it can.

1. Start building your reaching tool based on your plan. Test it by using it the way your customer might use it. Sit in the chair and use your tool to reach the table without bending over or taking your elbows away from your sides.

   – Does the tool reach the table when your chair is at the distance you marked as your farthest reach?
   – Can you pick up a piece of paper with the tool?

2. Notice which parts of your design worked well, and which parts you could change to make it better. Use page 6 of your notebook to record your observations and ideas.

3. Make changes to your design and test it again. How well did it work this time?

4. Keep changing, testing, and trying new ideas until your reaching tool is as close as possible to matching all the requirements you listed. (It might take a lot of tries! Engineers often test many ideas before finding the one that works best.)

5. Draw a picture or take a photo of your final, best design for a reaching tool.

Part 4: Reflect

1. Think about the results of your research to create a reaching tool for someone with limited movement.

   – What suggestions would you give to your company for how to design a reaching tool?
   – What parts does your reaching tool have? What does each part do?
   – How did your design change between the beginning of your research and the final version?

2. Think about how you were like a biomedical engineer in this activity. Use p. 7 in your lab notebook to draw or write about your ideas. Add some skill stickers from the sticker sheet to show some of the science skills you used in this activity.

   – What did you do that might be like what a biomedical engineer does?
   – What science skills did you use?

3. Find out more about being an engineer! Try out the three other engineer activities featured in your lab notebook using the other Be an Engineer videos and activities found at scienceinthesummer.fi.edu/be-an-engineer. Or check out some of the books and websites listed on the back of your lab notebook.