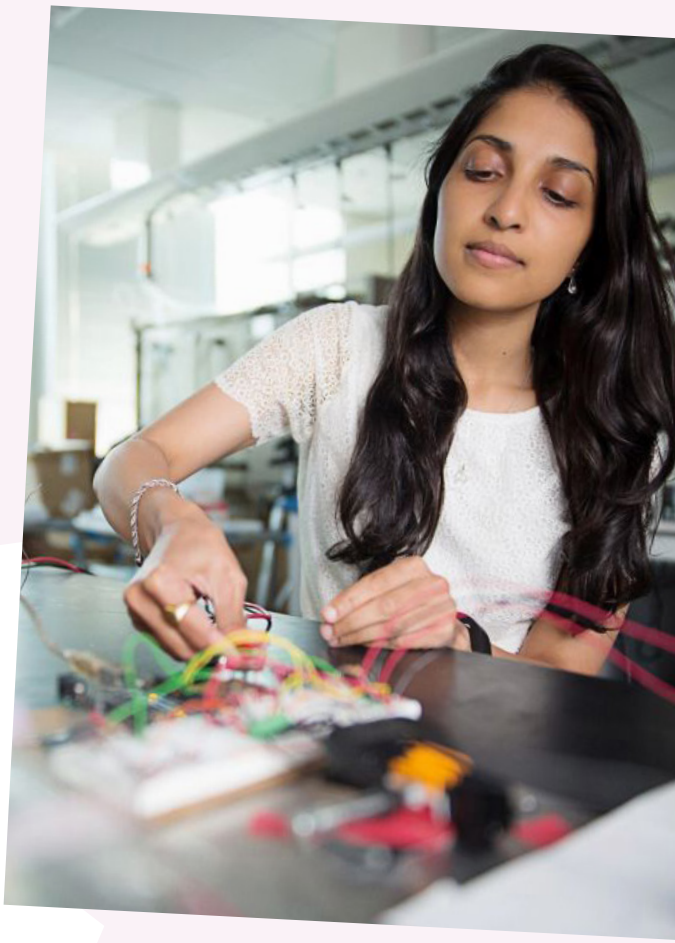
GSK Science in the Summer™

Be an Electrical Engineer

This summer, your child is invited to play the role of a scientist—an electrical 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 **Electrical 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

Electrical Engineer

You are an electrical engineer working for a company that designs electronic bells and alarm systems. Your company is working with a hospital that gives their patients buzzers to alert a nurse when they need help. The hospital says that some of their patients have trouble using the buzzers because they are too hard to turn on and off. **Your job is to improve the design of the buzzer's on/off switch so that the buzzer can be turned on easily using only one finger and turned off by letting go or removing the finger.**

MATERIALS

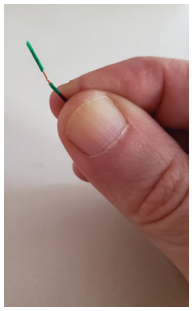
- Buzzer
- Electrical wire
- AA battery
- Masking tape
- Cardboard
- Brass paper fasteners
- Ruler
- Lab notebook
- Pencil

ADDITIONAL MATERIALS:

- Scissors
- (Optional) other building materials like metal washers or screws, paper clips, 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 space for building your designs and storing your materials.
3. Cut a piece of electrical wire about 12.5 centimeters (5 inches) long. You may need an adult to help you strip the plastic coating off the ends of the wire using scissors. Grip the wire between the scissors blades, about 1 cm (½ in) from the end. Cut gently to break the plastic coating without cutting the wire inside. Keep pressing down gently with the scissors while pulling the end of the wire through the blades. This should push the end of the plastic coating off the wire, leaving the bare metal wire behind.



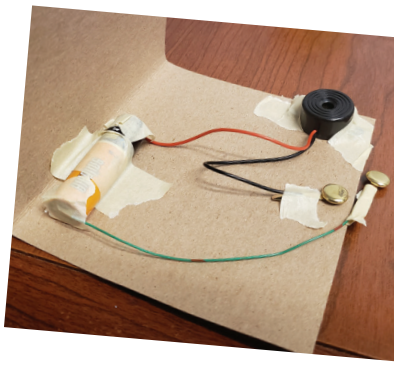
4. **Safety note:** You will be using electricity during this experiment. It is not strong enough to hurt you, but it could damage the battery if wires are connected in the wrong way. **If the wires or battery begin to feel hot to the touch, separate the battery from any wires right away and wait for it to cool down before trying again.** Make sure your circuit is disconnected (turned off) any time you will be away from it. Remove the battery from the circuit completely if you won't be using it for a long time.

Part 1: Research

Build a model of the hospital's current buzzer system to find out which parts work well, and which parts need improvement.

1. Start by thinking about the requirements of the buzzer switch. Make some notes on page 8 of your lab notebook:
   - *What should it be able to do when it is working correctly? (In other words, what do the hospital patients need or want the buzzer to do, or 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, make a model of the hospital's buzzer. Use the diagram on page 9 of your lab notebook to help you.



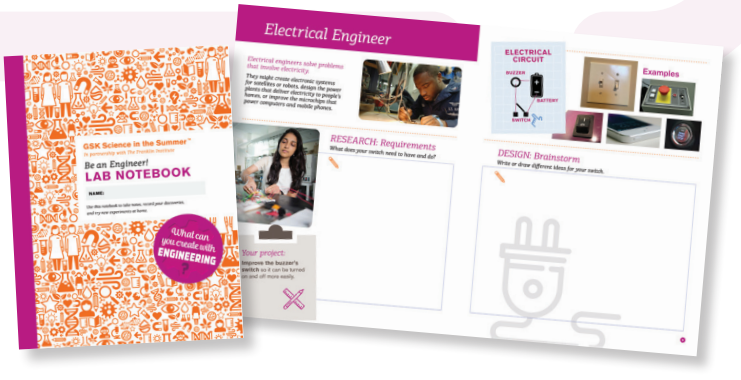
- Tape the end of the buzzer's red wire to the positive (+) end of the battery. Make sure the metal end of the wire firmly touches the metal of the battery.
- Test the buzzer by completing the circuit: touch the metal end of the black wire to the negative (-) end of the battery. What happens? (If nothing happens, check the connection between the red wire and the other side of the battery and try again.)
- Cut a piece of cardboard 12.5 cm (5 in) by 20 cm (8 in) and fold it in half along the longer edge, like a book.
- On the inside of the cardboard "book," tape down the battery near the fold. Tape down the buzzer near one corner.
- Tape the end of the black buzzer wire to the pointed ends of a paper fastener. Tape the paper fastener to the cardboard so the round end sits near one edge of the cardboard.
- Using the wire piece you prepared, tape one bare end of the wire to the negative (-) end of the battery. Tape the other bare end of the wire to the pointed end of a paper fastener. This paper fastener should be able to hang off the edge of the cardboard.
- The two paper fasteners form the switch that turns the circuit on and off. Test it by touching the two round ends of the paper fasteners to each other to complete the circuit. What happens? (If nothing happens, check all the connections to make sure the metal end of each wire firmly touches the metal of the battery or paper fastener. It might take a few tries!)
- To find out how a hospital patient would use the buzzer, fold over the empty half of the cardboard to cover the circuit. You might want to use a piece of tape to hold the cover shut. Leave the second paper fastener hanging outside the cardboard. This is part of the switch the patient uses to turn the buzzer on and off.
- Try to turn the buzzer on and off using the paper fastener switch. How easy or hard is it to turn on and off? Does it work every time, or just sometimes? How well does it match the requirements you listed in your notebook? Can you turn it on with one finger? Does it turn off as soon as you let go?

Part 2: Design

Create a plan for improving the buzzer switch so that it better meets the needs of the hospital patients.

1. Brainstorm different ways you could change the switch part of the buzzer to help it meet the requirements listed in your notebook. Look at the photos on p. 9 of your notebook for ideas. Write or draw as many different ideas as you can for how the switch could work better. Could the parts of the switch be in different places? Could you use a different shape or type of material for the switch? What else could you change?

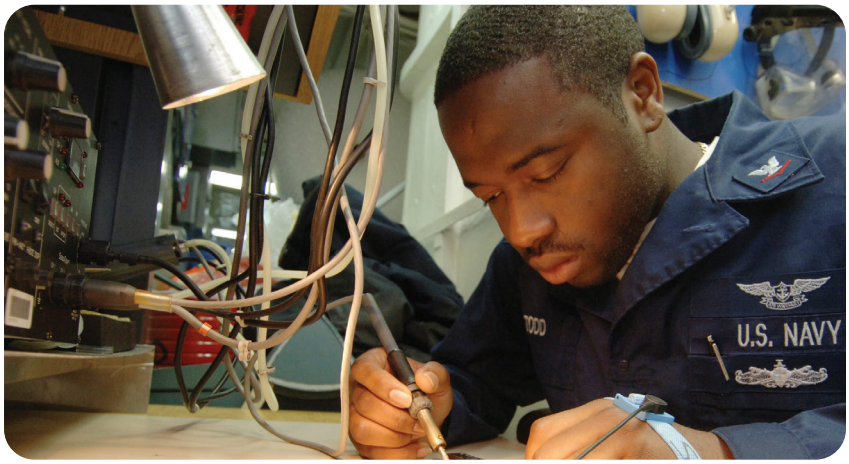
2. Choose one idea that you think will work the best. Think about which materials you will need and what changes you will make. Draw a new picture of your design or circle it in your notebook.



Part 3: Build, Test, Redesign

Try your new switch design and improve it until it works as well as it can.

1. Open the cardboard cover of the buzzer and change parts of the buzzer circuit to create your new switch design.
2. Test your design to see how the buzzer works. Does it meet all the requirements you listed for the buzzer, like turning on with one finger? Does it work every time, or just sometimes?
3. Notice what parts of your design worked well, and what parts you could change to make it better. Use page 10 of your notebook to record your observations and ideas.
4. Make changes to your design and test it again. How well did it work this time?
5. Keep changing, testing, and trying new ideas until your switch 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.)
6. Draw a picture or take a photo of your final, best design.



Part 4: Reflect

1. Think about the results of your research to create a better switch for the hospital's alert buzzer.
   - *What suggestions would you give to your company for how to build a better buzzer for the hospital? What changes did you make to the buzzer design?*
   - *What makes your new design better or easier to use than the first one? Are there any changes you wanted to make but couldn't?*
2. Think about how you were like an electrical engineer in this activity. Use page 11 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 an electrical 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.

Want even more science? The Franklin Institute has created Franklin@Home (fi.edu/franklin-at-home), a series of science videos, do-at-home experiments, and live virtual science experiences that allow you and your family to continue discovering, exploring, and experimenting at home all summer long!