

MAKEngineering Kit

Instructions:

Indoor Game: Soccer
Bot

ENGINEERING TASK

You have been asked by a popular game company to develop handheld soccer bots for a new indoor game for two players. A soccer bot is a robot that plays soccer. For this game, players score goals by hitting a small ball into the opposing "net". (Psst. You are Player 1. Who is Player 2?) Check out this video to see the game being played:
<https://youtu.be/9NViVG80CHI>

DID YOU KNOW...?

Engineers play an important role in sports, specifically in the design of equipment (e.g., badminton rackets, shin guards, baseball bats) and attire (e.g., swimsuits, socks). Here is a video to learn more

<https://youtu.be/r3FUMwA1ahY?t=105>

The next time you play your favorite sport, think about how an engineer might have been involved in designing the equipment you are using!

MATERIALS IN KIT

Each player will have the following:

- 1 Motor
- 1 AA battery
- 1 Battery holder
- 1 Push button switch
- 1 Sheet of cardstock
- 10 Popsicle sticks
- 5 Rubber bands
- 2 Binder clips

Two players will share:

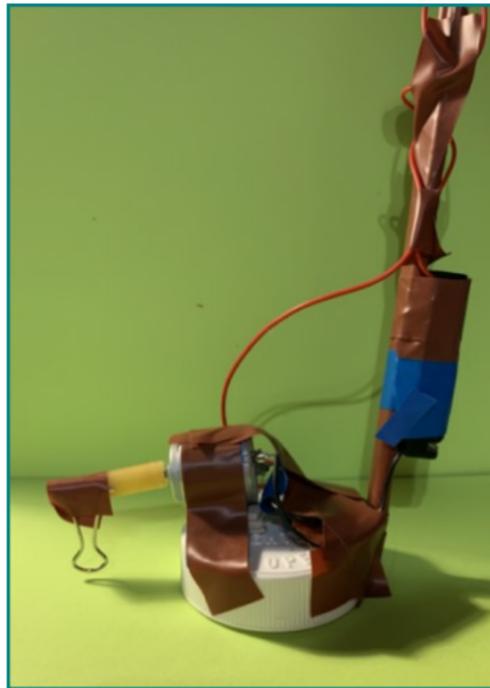
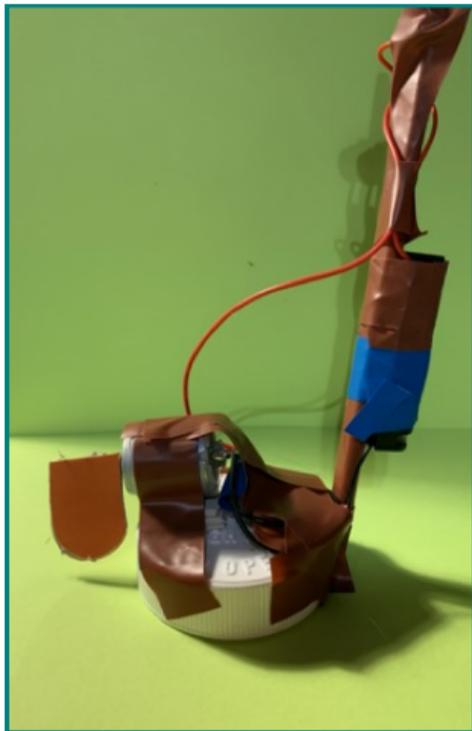
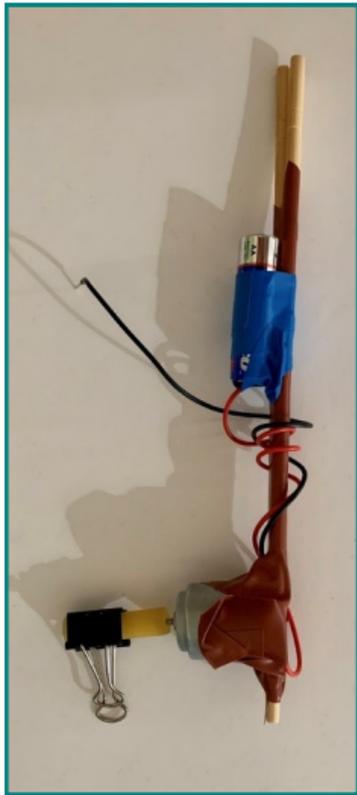
- Electrical tape
- 1 Ping Pong ball
- Hot glue gun
- 2 Hot glue sticks

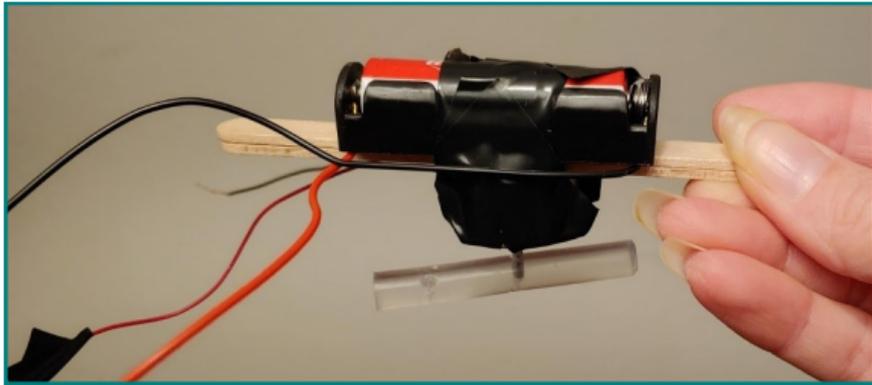


STEP 1—RESEARCH

What comes to mind when you hear “research”? As an engineer, sometimes research includes examining products that already exist. On the following pages, we have included images of soccer bots for you to “research.”

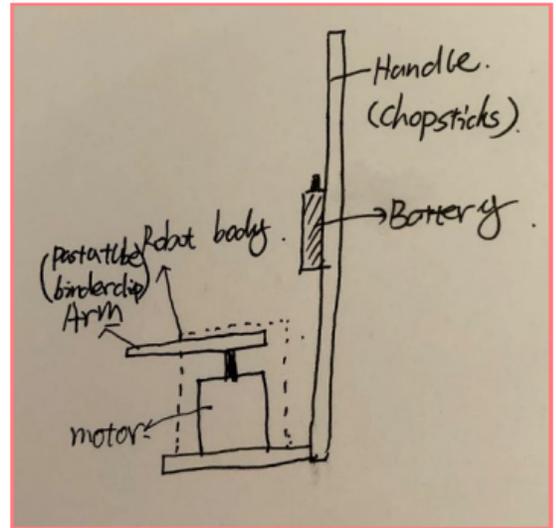
- * What are the key characteristics of the soccer bots?
- * What materials are used? How are the material used?
- * How do you think the soccer bot works?
- * Where might the soccer bot player place their hand?





STEP 2—PLAN

Sketch 2-3 different designs of soccer bots and make a list of material for each design. How are your designs based on your research? What new characteristics did you include in your designs?

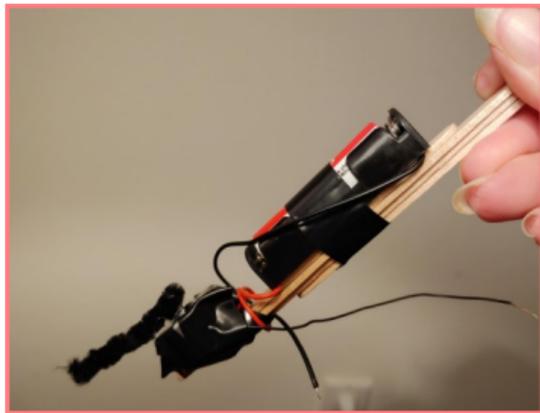


STEP 3—EXPLORE

Let's explore! Use what you learned from the previous low-tech kit to test your motor.

- * Explain how to connect the battery pack to the motor. How would you explain this someone six-years old?
- * What kind of motion does the motor create? How can you use this motion to kick a ball?
- * Now let's think about the button switch. What do you think is the purpose of the switch? How might you include the switch into your simple circuit?

STEP 4—CREATE



Pick one of your designs from Step 2 and build the soccer bot.

You can only use materials in the kit or anything around your home. This video shows how to connect arms to the motor—

<https://youtu.be/yjnzAJgES2M>.

How is your prototype different from Player 2?

STEP 5—PREPARE THE SOCCER FIELD

Use electrical tape to mark the position of the midfield and place the two nets at the end. How far apart will you make the two nets? How did you make this decision? How will prevent the ball from flying across the room?



STEP 5—PREPARE THE SOCCER FIELD

Design a net for the bot to “kick” a ping pong ball through. How big should the net be?



BE CREATIVE!

STEP 6—TEST & IMPROVE (EACH PLAYER)

Use your soccer bot to kick a ping pong ball from one net to the other (see https://youtu.be/d4ab_09rljs for an example).

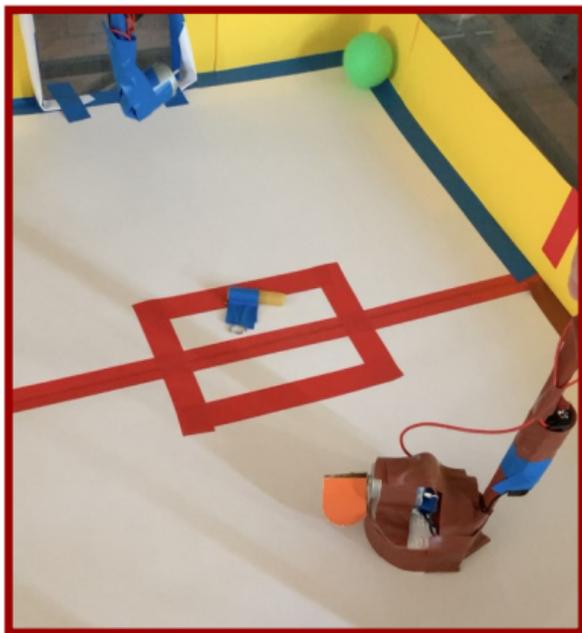
- * Is your bot able to kick the ball into the opposite net? Why or why not?
- * Did the ball roll straight? Does that matter? Explain.
- * What changes may be needed? Why?

Make any changes and continue to test your bot until you are satisfied with how the bot kicks the ball.

SOCCER BOT GAME RULES

Watch this video for the first two rules
<https://youtu.be/9S23TBfa9j0>

1. Only the bots' "arms" can touch the ball.
2. Players can hold and pass the ball, but not swing the bot to hit the ball.
3. Players score goals by hitting a ball into the opposing net with the handheld soccer bot.
4. Game play starts with the ball at the midfield.
5. The first play to score 5 goals wins.



STEP 7

**GAME
TIME!**

STEP 8—REDESIGN

Is your bot able to kick the ball into the opposite net when another player is present? What improvements might be made? Why do you think this? Make any changes and test your bot again through playing the game. (Psst. The soccer bot can have multiple arms.)

STEP 9—GAME RULES

The game company would like for you to develop additional games that can be played with the handheld soccer bots. Develop at least one new game with different rules from the one you just played. Is this game fair? Be sure to test the game. Would you change the rules after playing the game? Explain.



DID YOU KNOW...?

Sports engineering is a newer engineering field. They are concerned with the research and development of technologies for the sports industry—equipment and environment. A common trait of sports engineers are their love for sports and passion for science and technology. Many sports engineers have a background as a mechanical or materials engineer. Sports engineers earn about \$53.98 per hour. How much do they earn in a year?

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 soccer bot. 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.