

# **MAKEngineering Kit Facilitation Guide: Water Color Bot**

Images and videos from previous participants.

# ENGINEERING TASK

Design a motorized bot that “paints.”

Example: <https://youtu.be/mapCDTTKZI8>



## **DID YOU KNOW?**

There are jobs in which people create robots—robotic engineers. In 2019, robotic engineers in the United States made an average salary of \$99,040 a year. They also like their jobs. They rated their career happiness 4.2 out of 5 stars. Watch the following videos to learn more.

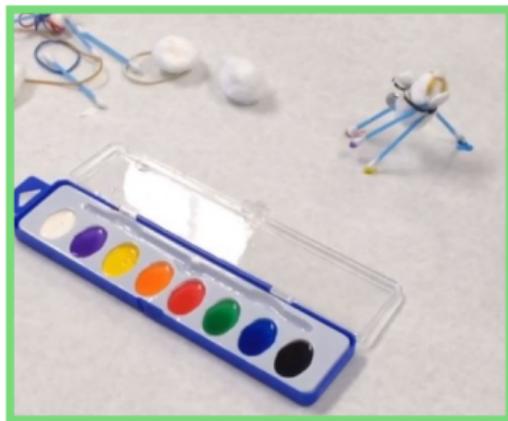
<https://youtu.be/sUOY3JZ-9C4>

<https://youtu.be/7trO3sQzmf8>

# MATERIALS IN KIT

- ◆ ~25 Q-tips
- ◆ ~15 cotton balls
- ◆ ~15 rubber bands
- ◆ 2 cell batteries
- ◆ 2 vibrating motors
- ◆ Clear tape
- ◆ Water color kit
- ◆ Sheets of paper, cereal box, and aluminum foil

You will need a small amount of water.



## STEP 1—RESEARCH

Watch the following video. This video shows examples of previous water color bot designs.

<https://youtu.be/NmOAUy1G3n8>

Stop the video as needed to take notes on what you notice that you might work into your own designs.

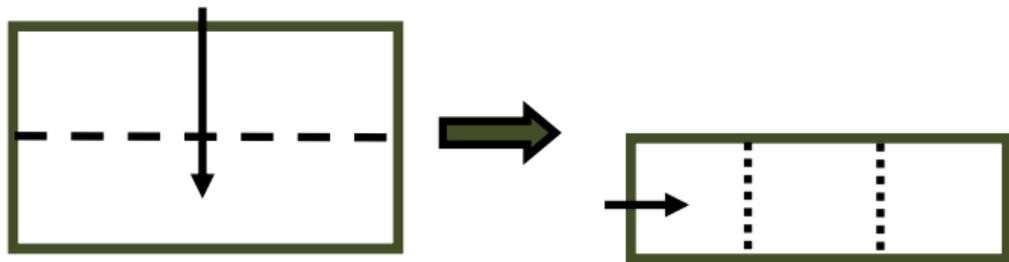
## STEP 1—SUPPORT

Optional questions to ask:

- Tell me things that you noticed about the different bots.
- What design features (e.g., # of q-tips) do you intend to use in your bot designs? Why?
- What are things you wonder about the different bots?
- Tell me what you noticed about the artwork. Circles? Lines? Dots? I wonder how the design of the bot created different artwork.

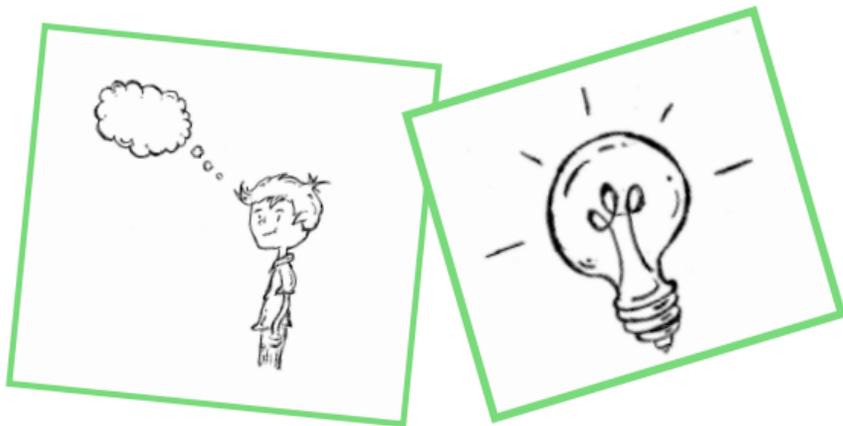
## STEP 2—SUPPORT

Create an organizational tool. Take a sheet of paper (8 1/2 x 11 inches) and make a hotdog fold. Then fold into thirds or three equal-sized parts. Once you unfold, there will be 12 “boxes”, 6 on the front and 6 on the back.



## STEP 2—PLAN

Based on the video and your notes, design/ sketch 3-4 bots and make a list of materials for each design. What makes each of your designs unique?



## STEP 2—SUPPORT

Optional questions to ask during the planning process:

- I think we should name each of the designs. Why did you name this one \_\_\_\_\_?
- What were you thinking when designing/sketching the bots?
- Is there a way to not use so much tape? How might we use the rubber bands?
- What do you imagine the artwork of this bot will create? Explain.



## COMMUNICATE

Have a conversation around the planning process. The camera can be focused on the bot designs/sketches.

- Let's start by explaining each of your designs.
- How are your designs different from those in the video?
- I like this design because \_\_\_\_\_. Which is your favorite design and why?

## STEP 3—CREATE

Pick one of your designs from Step 2. Build the frame or body of your bot using Q-tips, cotton balls, rubber bands and/or tape.



How does the battery connect to the motor?  
Where is a reasonable place to attach the battery and motor?

## STEP 3—SUPPORT

Optional questions to ask:

- What if we placed the battery and motor \_\_\_\_\_ (e.g., here, on top, inside cotton ball)?
- Predict what will happen with the artwork if we move the battery and motor to this new location. Explain.
- How can we make the bot more stable?
- How confident do you feel about this bot?
- What do you think if I \_\_\_\_\_? (ask permission)

## STEP 4—TEST

Try different material as your canvas—paper, empty food boxes (e.g., cereal), and aluminum foil. What other material in your home might you use?

Predict which material will work best. Why?

**Lightly** dip the end of each Q-tip into the water color of your choosing. Time to let you water color bot PAINT! Don't forget to try the different canvases.

## STEP 4—EXTENSION

Be the data collector or engineering assistant and take notes on what your child(ren) says when testing each bot on the different material or canvases. At the end, you can compare and contrast which worked best and why.

	Paper	Cardboard	Aluminum Foil	Other
Bot 1				
Bot 2				

## STEP 5—IMPROVE

Are changes needed to the bot? Why or why not?

If so, what might you do differently? If not, what worked well?

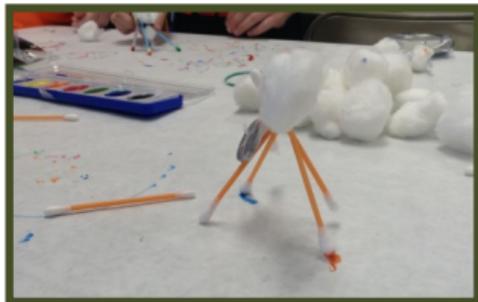


## STEP 6—PARALLEL PROTOTYPE

Try additional designs from Step 1. Do each step again—Build, Test, and Improve if needed.

We also have a few challenges for you to consider:

- no cotton balls.
- no tape.
- use other household objects.
- change the location of the battery and motor to see how it impacts the artwork.



## STEP 6—SUPPORT

Optional questions to ask:

- Based on what you noticed with the first bot, which would you like to try next? Why?
- Why do you think one of the challenges is \_\_\_\_\_ (e.g., no tape)? I think we should try it. Let's start by planning—Step 5 (page 5-B).
- Can you think of another challenge that could be added to the list? Explain why you see this as a challenge.



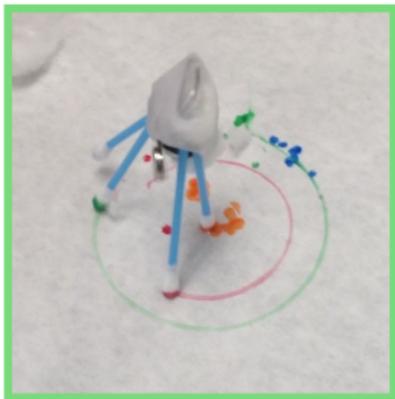
## COMMUNICATE

Have a conversation around the build, test, and iterate process. The camera can be focused on the bots and the artwork.

- Explain any challenges that occurred in testing the bots. What did you do to overcome these challenges?
- How did the position of the battery and motor impact the artwork?
- What can you conclude about the different types of material?

## DID YOU KNOW?

There are individuals who are programming (or teaching) robots to paint.



<https://youtu.be/nDp124yDr14>

<https://youtu.be/qzuEa1Xd12M>

<https://youtu.be/dkTjEi7O4Ic>

## 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 water color 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.