**Marker Robots**

Grade 5

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**Materials:**

I plastic cup per group

Many plastic markers (about 1 pack for every 1-2 groups)

Small piece of uneven plastic for a “fan blade” (1 of each size per group)

Small rotating motor (from radio shack, 1 per group)

Duct tape (a few rolls to share)

AA and AA Batteries

Battery holders for AA and AAA batteries

Alligator clips

Large sheets of white paper for the robot to draw on

**Introduction:**

Divide the class into as many groups as there are volunteers. Make sure there is at least ONE VOLUNTEER PER GROUP.

Begin by introducing yourself to the students in your group. Tell them a little bit about what you study and give them an opportunity to ask you questions. Allot 5-10 minutes for this.

Now tell that that we are going to work together to make a robot.

1. Show them all the supplies they will be working with. Our challenge is to build a robot that draws on a piece of paper with markers—without anyone touching it. What components will be important for this robot? What do they think we’re going to use the (battery/motor/piece of plastic/cup) for?
2. We will follow a bit of a predetermined plan for this, but there will be room for adjustments and variations after it is built. Here’s what to do (have the students do most of this, but help them out. Call up a volunteer for each part!
	1. Tape 3 or 4 markers to the cup, with the cup upside down and tips pointing down. (Leave them closed for now).
	2. Tape the motor to the top with the tiny cylinder sticking away from the cup. Work the plastic blade onto that. Make sure it won’t hit the cup when it spins. Put a piece of tape on the end to keep it from flying off of the motor.
	3. Now you’ll need to connect the motor to something that will make it spin. Ask the kids what that might be (battery). Then ask them how you connect a battery to something to power it (connect the wires to the positive and negative terminals. Once they have discussed that, go ahead and tape the battery in the holder to the top and clip the wires to it.
		1. It will start spinning immediately and hopefully shaking and moving around the desk! Unclip an alligator clip anytime you want to stop it.
	4. If it worked well, take the marker caps off and let your robot draw a picture on the white sheet of paper!
3. Now, tell the students you’re going to try one of the other sizes of fan blades. Ask the students what they think will happen when you attach a larger (smaller) fan blade. Once they have made their hypotheses, test it out! Were their hypotheses correct? What did they learn?

Based on what happened there, hypothesize and try the third fan blade.

1. What do they think would happen if you used a smaller battery? Why?
2. Now they have a writing assignment. Tell them to use one sentence to describe what they did. Then, they should write what they would add to (or subtract from) the design if they were in charge of building a better marker robot. Talk to the kids about their ideas and make sure they discuss (out loud and on their worksheets) how they think they would implement these design changes.

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_

Describe what you made today: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

If you were in charge of **improving** this robot, what design changes would you make? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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