STEM ON A DIME

ROBO ART

Activity from 4-H at Home: Can-Can Robot

Activity Updated August 2021

SKILL LEVEL

Ages 6-18

KEY TERMS

Circuits, DC Motor, Conductor, Insulator

EDUCATION STANDARDS

South Dakota Science:

- 4-PS3-2

TIME NEEDED

45 minutes

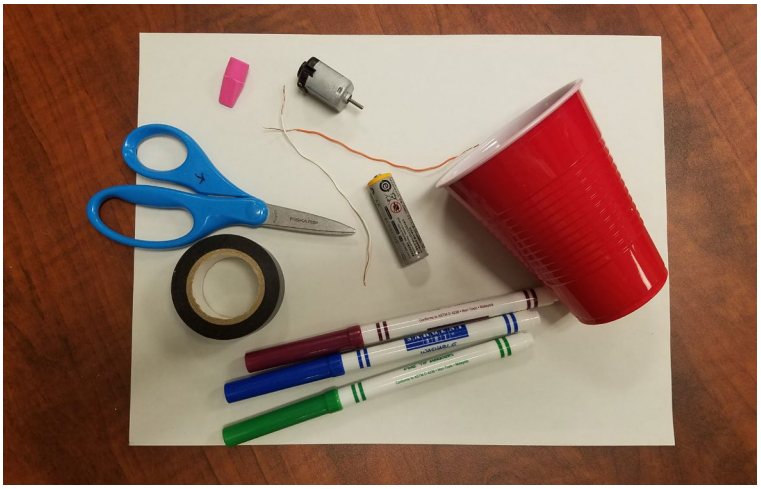
MATERIAL LIST

Materials needed per robo art:

- One AA battery
- Three Washable Markers
- One Pencil Eraser (see Activity Preparation for alternatives)
- Paper
- One Rubber Bands
- One Toy DC Motor (1.5-3V)
- Two 8-inch Copper Wires (18-22 gauge)
- Plastic Cup

Materials to be shared by group:

- Tape
- Scissors
- Wire strippers



EXPECTED LEARNER OUTCOMES

OBJECTIVE 1 – Youth will learn the basics of electrical wiring and complete an electrical circuit that will power a motor.

OBJECTIVE 2 – Youth will construct a robot capable of drawing on paper.

BACKGROUND

Activities that combine science content with art and engineering are always a hit in any making and tinkering environment. In this activity, youth have the opportunity to explore electrical circuits as they build their very own coloring machine. Youth are encouraged to experiment with different designs to change how their robot will move and what type of drawing it will create.

These robots are constructed using a simple circuit formed with wire, a toy motor and a battery. For this activity, a small DC motor will be utilized. The DC motor can turn either clockwise or counter-clockwise depending on how the battery is connected to it. When a motor is attached to the robot, it doesn't provide much movement. However, by off-balancing the motor, youth can create vibrations and movement.

VOCABULARY

Circuit – The physical pathway that allows electricity to flow from the power source (out of the + side) to the item being powered (light, motor, etc.) and then back to the power source (into the – side).

DC Motor – A rotary electric motor that converts electrical energy into mechanical energy.

Conductor – A material that allows electricity to flow easily through it (metals, graphite, etc.).

Insulator – A material that stops electricity from flowing through it (plastic, glass, rubber, etc.).

ACTIVITY PREPARATION

1. Gather the following materials for each youth or group of youth:
   a. AA Battery
   b. Three Washable Markers – You can provide additional makers for youth to use; however, a minimum of three works best for balancing the robot.
   c. Pencil Eraser – The small pencil top erasers work well; however, you can use a larger brick eraser, modeling clay or similar material that can be used to off-balance the motor.
   d. Paper – This will be used for testing the robot. An 8x10 sheet of paper would be fine; however, if you have the ability to lay a paper down over the entire surface (newspaper, bulletin board paper, etc.) you may choose to utilize that to minimize the chances of the robot drawing on tabletops.
   e. Rubber Bands – These can be used to hold the markers, motor or other items onto the cup. If you don't have rubber bands, you can using masking or scotch tape instead.
   f. Motor – a 1.5-3 Volt hoppy motor is perfect. This voltage will allow it to work well with either one or two AA batteries.
   g. Copper Wire – 18- to 22-gauge insulated copper wire works well for this. You will want about 8 inches total per youth or group of youth.
   h. Electrical Tape – Masking tape could be an alternative. This will be used to hold the wires onto the battery. Youth may also choose to use to hold the battery, markers or other items onto the body of their robot.
   i. Scissors – When selecting scissors consider both the safety and accessibility.
      i. Do you need safety scissors for the age group you are working with?
      ii. Do you have youth that need left-handed scissors?
   j. Wire Strippers – Make sure the wire stripper you select can be used on the gauge wire you have selected. This may be a tool that youth are not familiar with and so you may need to demonstrate its use and provide additional assistance in using it.
   k. Plastic Cup – An 8 oz. or larger cup works well; however, if you need to use paper or Styrofoam you can, but these tend to be harder to work with as they don't hold up well to multiple modifications. Additionally, you can use a variety of recyclable containers instead of a plastic cup. For example, cottage cheese containers, yogurt containers and berry baskets can be used.
2. Consider the age and capabilities of your youth as well as the amount of time you have for this activity. If you don't feel wire stripping is appropriate for the youth in your group or you are limited on time, consider stripping the wires ahead of time.

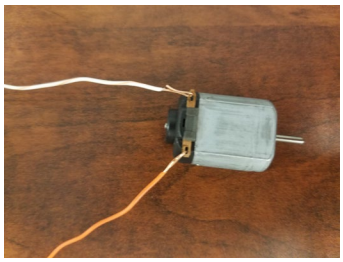
3. To simplify the facilitation of the activity, consider packaging the materials for each group together in a small container or zip lock bag.

ACTIVITY INSTRUCTIONS

1. Introduction to circuits and DC motors
   a. Find out what youth already know about electricity by asking questions like:
      i. What allows our lights to work?
      ii. What is electricity?
      iii. How does the electricity get to the lights? (wires)

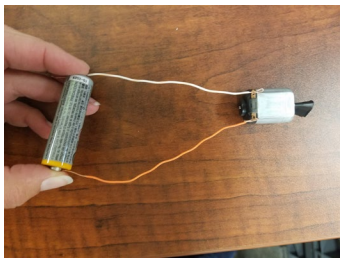
iv. What are the wires made from? (copper) Let them know that this type of material is called a conductor as it allows electricity to flow readily.
v. What are some other conductive materials? (other metals) (Use caution with answers related to water. Pure distilled water should not conduct electricity. However, if water is contaminated with salts and other inorganic materials charged particles form in the water allowing electricity to move through it.)
vi. What keeps the electricity from moving from the copper wires to other things around them? (plastic coating on the wires) Let them know that this type of material is called an insulator and keeps the electricity from flowing beyond the wires to other conductive surfaces.
vii. What are other insulators? (glass, plastic, rubber, etc.)
viii. What is an electric circuit?

b. Create a circuit with the motor and battery.
   i. Have the youth cut their wire into two pieces, approximately 5 inches in length.
   ii. Have youth strip the ends of the wire and expose approximately ½ to ¾ of an inch of wire.
   iii. Attach one wire to each lead on the motor.



   iv. Have youth hold one wire to the negative terminal of the battery and the other wire to the positive terminal of the battery.
      1. What happens?
      2. If the youth identify that the motor is spinning, can they identify which direction?
      3. Does the motor vibrate and move across the table or remain in one spot?
   v. Have the youth add a piece of tape, eraser, clay or other similar material to the motor. Then have them hold the wires to the battery again.

      1. What happens? Why might it happen?
      2. Can they identify which direction the motor is spinning now?
      3. What happens if they flip the battery the other direction? Does the direction of spin change?
      4. What happens when the motor is on the table? Does it stay in one location or does it vibrate and move across the tabletop?



   vi. What happens if you add more tape, more clay or change the way the eraser is attached to the motor? Does it impact the movement of the motor?

2. Creating the Art-Bot
    a. Have the youth attach the motor to their cup (or other item) and connect it to the battery.
        i. How does the cup move?
        ii. What type of a drawing might that produce?
        iii. What happens if they change where the motor is placed (bottom of the cup versus side of the cup, etc.)?
    b. Have the youth add the eraser or clay to their motor to see how that impacts the movement.
    c. Have the youth add markers to their cup to see how that changes the movement.
    d. Encourage them to play with different configurations until they are satisfied with their robots' drawing ability. Their robots may have right side up, upside down or sideways cups. The motors may be on the top, side, bottom or otherwise. There is NO 'right' way to design this. The key is that they are able to explore how changing the balance of the motor on the robot changes its movement.

REFLECTION

As you wrap up the activity, try to create an opportunity for some group sharing. Facilitate discussion by encouraging the youth to consider:

- What similarities exist between designs?
- What differences?
- What was the most challenging part of designing and building it?
- What was the most exciting?
- What might they do differently/what other materials might they use if they were to do this again?

EXTENDED LEARNING

This activity is similar to the Can-Can Robot from the 4-H Junk Drawer Robotics: Robots on the Move Activities G and H. Youth can continue exploring this content and learn about circuits, gears and designing robots through the Robots on the Move activities. The Junk Drawer curriculum can be found at the 4-H mall at https://shop4-h.org/.

These ideas and skills can be further developed through the exploration of other electricity-based STEM on a Dime lessons like Basic Bread Boards, Circuit Bugs and Glowing Chromatography Flowers; as well as through exploring the South Dakota 4-H Electricity Project (https://extension.sdstate.edu/4-h-electricity-project).