BARNABAS ROBOTICS

BARNABAS TINKER SERIES

CRITTER BOT

AAA Rev. 1.00

FOR GRADES K - 5

LICENSE

REVISION HISTORY

Revision AAA 1.0
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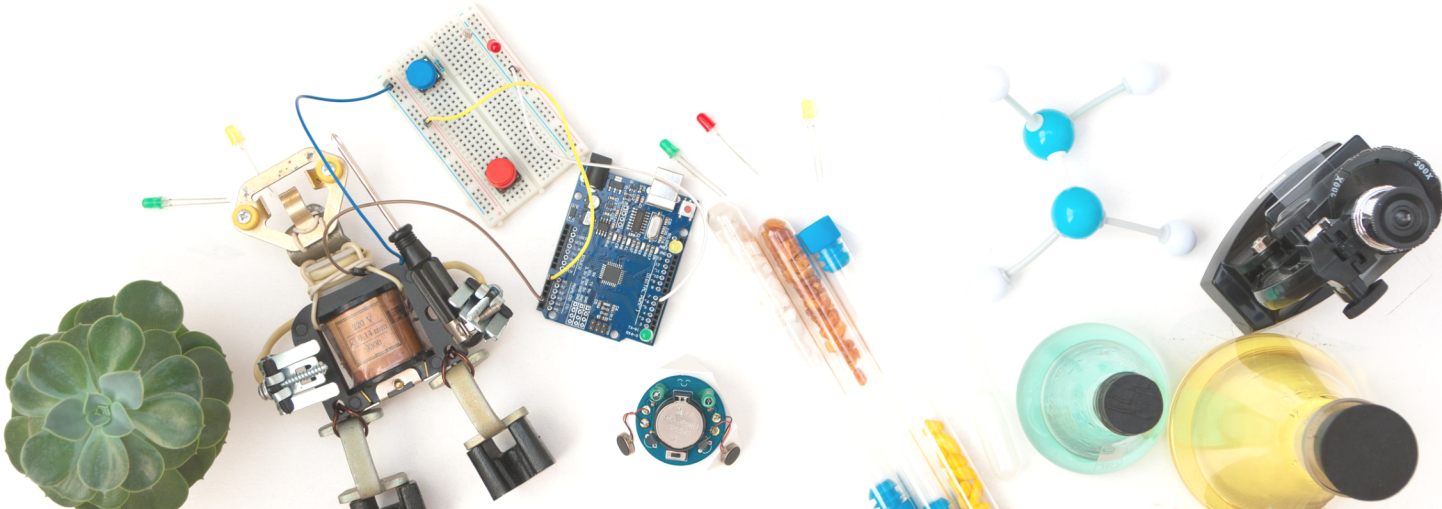

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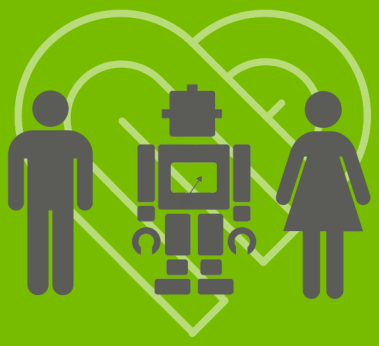

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Barnabas Robotics is a community collaborative of engineers and educators dedicated to creating free S.T.E.A.M. curricula that is:

- ☑ ACCESSIBLE
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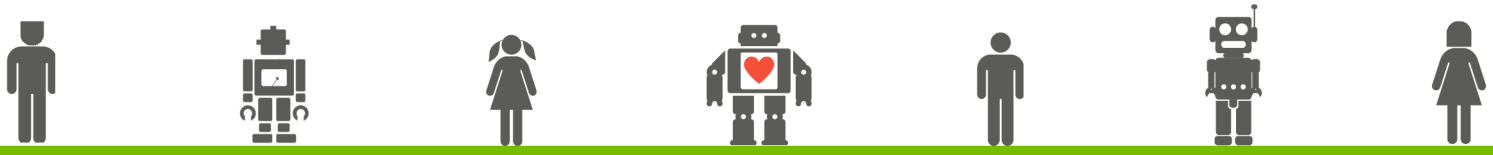
- ☑ CROSS-DISCIPLINARY

By teaching our content, you are playing an important role in our mission to positively impact the hearts and minds of young learners all around the world.



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BARNABAS TINKER SERIES

CRITTER BOT

PROJECT SUMMARY

Critter Bot is a fun project that teaches young learners the basics of robot-building, engineering design, and circuits.

Learners will create a playful, moving robot out of a motor, battery. and simple craft materials.

Appropriate for ages 6-11.

DIFFICULTY

- Beginner

SKILLS REQUIRED

- Drawing/Coloring
- Using scissors
- Using tape
- Fine motor skills

PROJECT DURATION

- Single workshop (45-60 minutes)

FULL PROJECT MATERIALS LIST

Materials required to build one robot.

ROBOTICS PARTS

1 X — DC VIBRATION MOTOR
This is what helps the robot move.

1 X — AAA BATTERY (1.5V)
This is the heart of the robot.

1 X — AAA BATTERY HOLDER
This houses the heart of the robot.

CRAFT MATERIALS

3 X — DOUBLE-STICK FOAM
For attaching the motor and battery holder to the robot.

1 X — BODY & HEAD TEMPLATES
Printable versions are also available at shop.barnabasrobotics.com.

1 X — MINI CUP
For the robot's body

1 X — SCISSORS
For cutting paper.

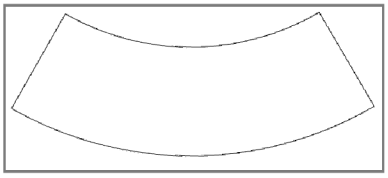
1 X — GLUE STICK OR TAPE
For adhering decorative parts to robot.

MISC — CONSTRUCTION PAPER
For designing and decorating the robot.

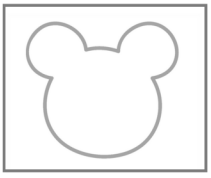
MISC — COLORED MARKERS, PENCILS, CRAYONS
For designing and decorating the robot.

PROJECT MATERIALS LIST

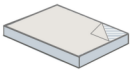
KIT CONTENTS



ROBOT TORSO
paper template to decorate



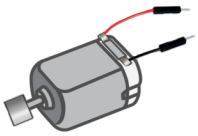
ROBOT HEAD
paper template to decorate



DOUBLE-STICK FOAM
adhesive on both sides

MINI CUP
with 2 stickers on sides

AAA BATTERY HOLDER
1.5 volts; socket-type



VIBRATION MOTOR
130 DC motor with flying leads

EXTRA SUPPLIES YOU'LL NEED

- 1 x AAA BATTERY **per robot**
- SCISSORS
- CONSTRUCTION PAPER
- MARKERS, CRAYONS, PENCILS
- GLUE
- TAPE

LESSON OVERVIEW

BARNABAS TINKER SERIES

CRITTER BOT

TOPICS COVERED

- Industrial Design
- Electricity
- Circuits

DISCIPLINARY CORE IDEAS

- K-2-ETS1 Engineering Design
- 3-5-ETS1-1 Engineering Design
- 4-PS3-4 Energy

KEY VOCABULARY

- Mechanical Engineer
- Design
- Build
- Electricity
- Circuit
- Closed Circuit
- Open Circuit
- Switch

LEARNING TARGETS

Technical Skills

- Mechanical-Building
- Understanding how circuits work
- Turning robots on/off

Life Skills

- Following directions
- Creativity
- Making decisions
- Experimentation

BARNABAS TINKER SERIES

CRITTER BOT

LESSON OBJECTIVE

Learners will explore how robots are designed and powered. They will also learn about circuits and how robots move.

LEADER MINDSET

For some learners, this may be their first experience with robotics. Be mindful to emphasize the names of parts and vocabulary words.

LESSON PLAN

LESSON OPENING

ATTENTION GRABBER

Introduce the Critter Bot project as a robot that shakes or vibrates.

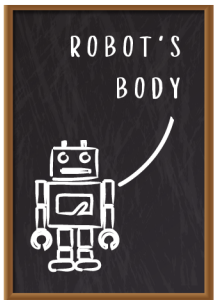
Ask learners: "Can you think of something that shakes or vibrates?" Some examples are electric toothbrushes, cell phones, alarm clocks, video game joysticks, smart watches, toys, etc.

LESSON ROADMAP

- A Design the robot's body
- B Build the robot's heart (circuit)
- C Make the robot move
- D Turn the robot on/off (switch)

STEP 1: DESIGNING THE ROBOT'S BODY

5 MINUTES

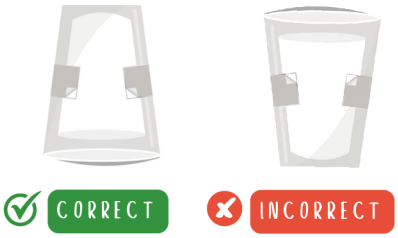


- All robots have bodies. Draw a robot on the board. It can be a cartoon robot or a well-known robot from a movie. Highlight the "body" of the robot drawing for learners to see.
- Instruct learners to draw their own favorite robot on their Critter Bot worksheet.

VOCABULARY **MECHANICAL ENGINEER**

A person who designs and builds the body of a robot.

- Explain to learners that they will be functioning as **mechanical engineers**. They will get to design and build their very own robot's body.
- Learners will be using a mini cup as the building block for their robot's torso.
  - Demonstrate for learners that the mini cup will be oriented upside-down for this particular robot's design.



STEP 2: DECORATING THE ROBOT'S BODY

10-15 MINUTES

- Show learners a sample of a completed Critter Bot.

VOCABULARY **DESIGN**

Using your imagination to think of an idea, then writing it down using words and/or pictures.

VOCABULARY **BUILD**

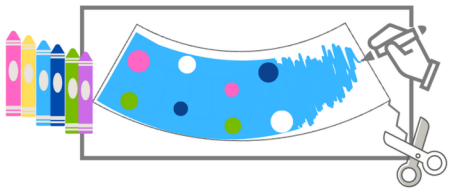
To construct something by putting parts together based on a design.

- Explain the difference between **designing** versus **building** robots and how engineers design their robots before actually building them.

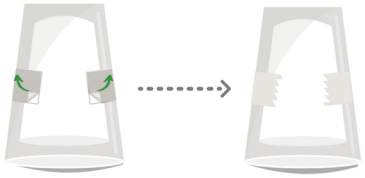
- **Design**: Learners will have the opportunity to design what their own robots will look like. On their Critter Bot worksheets, instruct learners to sketch a simple design of what their robots will look like. Remind learners that their designs should show the body of their robot as an upside-down cup. That way when they start decorating the torso, they will already have an idea of how to decorate it.
- **Build**: Once learners are finished designing their robots on paper, they are ready to begin building using the paper templates, mini cup, and craft materials. Guide learners through the following build steps:

PART A: CREATING YOUR ROBOT'S TORSO

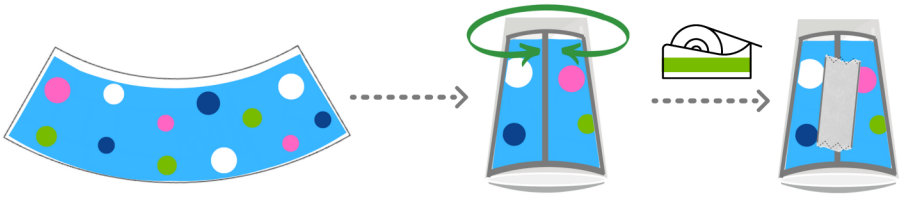
A-1. Decorate a "Robot Torso" shape. Cut it out with scissors.



A-2. Remove the paper backing from the 2 stickers on the mini cup.

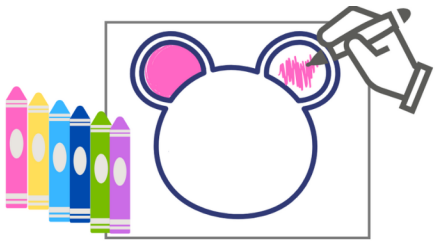


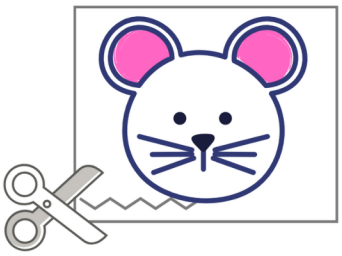
A-3. Wrap the "Robot Torso" around the mini cup. Tape down the ends.



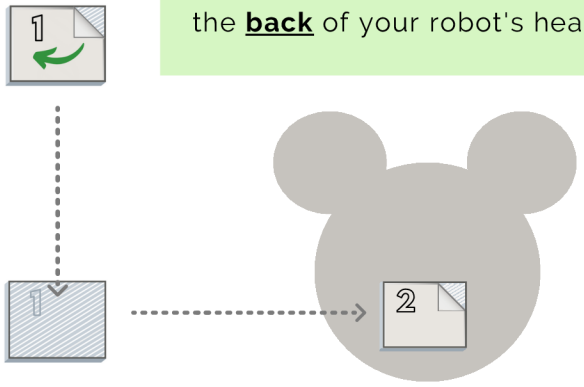
PART B: CREATING YOUR ROBOT'S HEAD

B-1. Choose any "Robot Head" shape and decorate it. Cut it out.



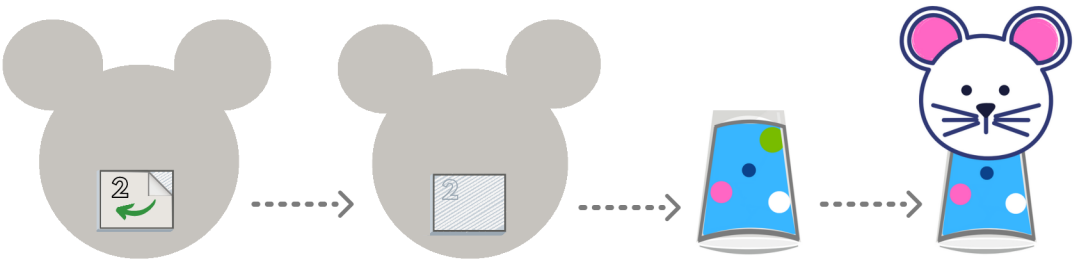


B-2. Remove the paper backing from 1 side of the double-stick foam.

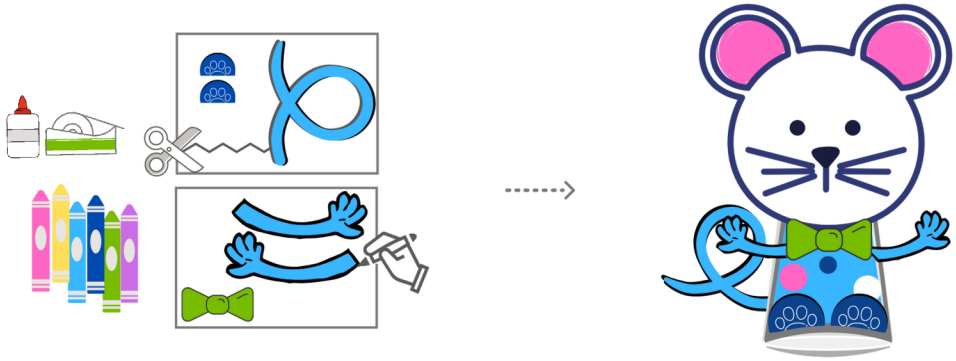


B-3. Attach the double-stick foam to the **back** of your robot's head.

B-4. Remove the paper backing from side 2 of the double-stick foam. Attach your robot's head to the cup.



B-5. Use extra craft supplies to give your robot arms, feet, a tail, and clothes.

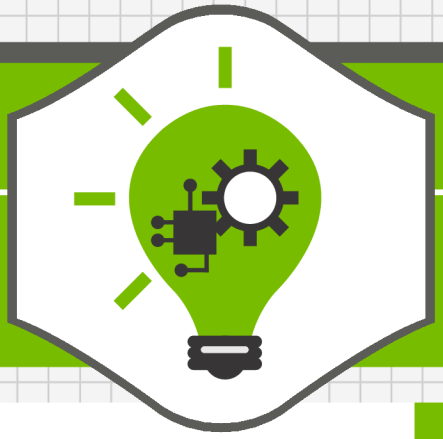


- Once learners are finished decorating their robots' bodies, they will ready for the next steps:
  - Learning about a robot's heart
  - Making their robots move

LEARNING MODULE

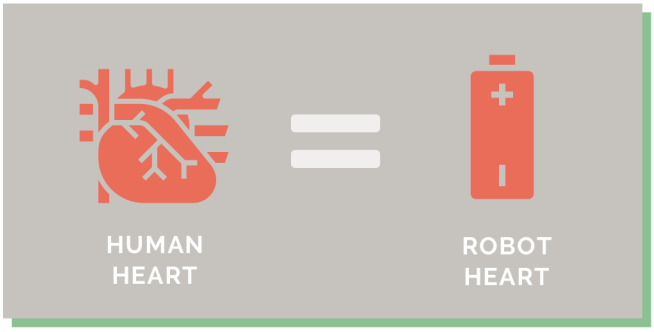
CIRCUITS & ELECTRICITY

GRADES K-5



LEARNING ABOUT THE ROBOT'S HEART

The battery is the robot's heart. Just as the human heart pumps blood to the body's organs, the robot's battery pumps **electricity** to the essential parts of the robot.



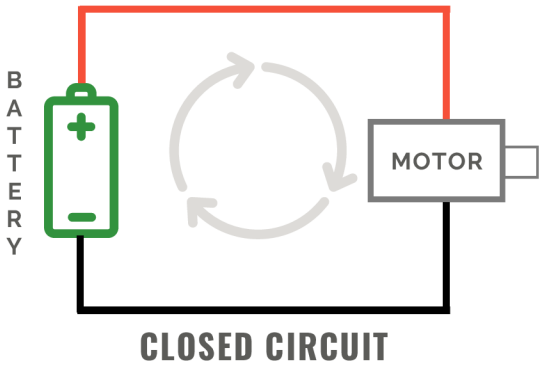
VOCABULARY **ELECTRICITY**

A form of energy that can give things the ability to move or function.

VOCABULARY **CIRCUIT**

A path along which electricity can flow.

Circuits are like the robot's veins. For electricity to travel through a robot, there must be a continuous loop so that electricity can flow from the positive end of the battery all the way around to the negative end of the battery. This continuous loop is called a **closed circuit**.



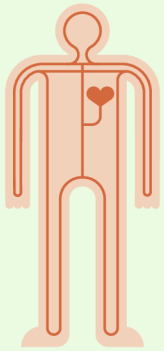
CLOSED CIRCUIT

VOCABULARY **CLOSED CIRCUIT**

A circuit with a continuous, uninterrupted path along which electricity can flow.

Draw the diagram above of a closed circuit with a battery connected to a motor on the board for learners to see. In this case, a closed circuit means that electricity is flowing and will cause the robot's motor to turn on. We want a closed circuit when we want our robots to be on and moving. Instruct learners to draw a closed circuit diagram on their worksheet.

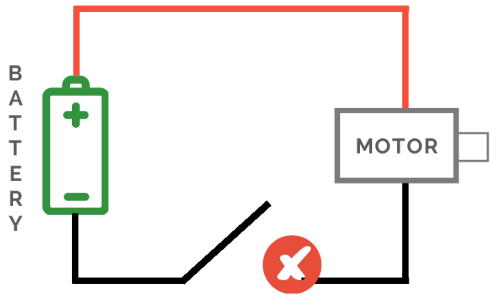
HUMAN VERSUS ROBOT



Similar to working robots, the human circulatory system is also made up of a closed loop of blood vessels to circulate blood from our heart to the rest of our organs and back to the heart again. For humans, we always want this circulation loop to be continuous and uninterrupted to keep our bodies functioning.

In contrast, for robots, we sometimes want a break or interruption in a circuit's path in order to turn off and conserve batteries.

When a circuit's loop is broken or incomplete, electricity will not flow from the battery. This is called an **open circuit**.



OPEN CIRCUIT

VOCABULARY **OPEN CIRCUIT**

A circuit with an interrupted path, along which electricity cannot flow.

Edit your original circuit diagram to demonstrate a broken connection in the circuit. Explain to learners that an open circuit means that the robot's motor cannot turn on. Instruct learners to draw an open circuit diagram on their worksheet.

STEP 3: BUILDING THE ROBOT'S HEART

10 MINUTES

- Reinforce learners' understanding of circuits and how electricity flows:
  - Draw a heart on your original robot drawing and explain that all robots have a heart. For our robots, the heart is a battery. Instruct learners to also draw this on their Critter Bot worksheets.
  - Next, draw a motor directly across from the heart. Then draw a continuous loop connecting the heart and motor.
  - Emphasize the flow of electricity using your finger to motion the flow in a clockwise direction. Explain that the flow of electricity is continuous in this instance, meaning that it is a "closed" circuit.

CLOSED CIRCUIT

EXPERIMENTATION

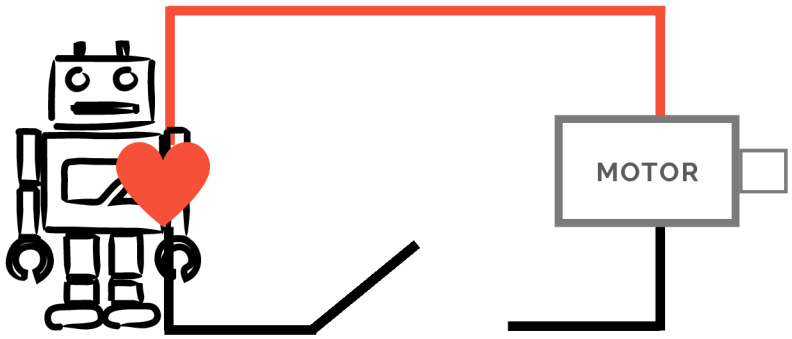
Pass out 1 AAA battery, 1 battery holder, and 1 vibration motor to each learner.

- Encourage learners to closely observe the AAA battery. Ask them, "What do you notice about the battery? Do you see the plus sign (+) on one end?" Clarify that this plus sign indicates the "positive" (+) side of the battery, while the opposite end represents the "negative" (-) side. The battery holder also has a positive (+) and negative (-) end. Notice the negative (-) end has a spring and a black wire. But the positive (+) end does not have a spring and has a red wire.
- Direct learners to carefully insert the AAA battery into the battery holder, aligning the positive (+) end of the battery with the positive (+) end of the holder. The negative (-) ends of both components should also be properly aligned.
- Ask learners to take a look at the vibration motor. Pose the question: "What do you notice about the wires attached to the motor?"
  - Possible response: It has a black wire and a red wire. Explain that the red wire signifies the positive (+) side, while the black wire denotes the negative (-) side.
- Remind learners that it is crucial to remember the significance of positives and negatives when connecting the battery to the motor. Positive (+) should connect to positive (+), and negative (-) should connect to negative (-).

CLOSED CIRCUIT CHALLENGE

- Challenge learners to construct a functional **closed circuit** using the battery, battery holder, and motor.
  - Important: Make sure the AAA battery is inserted correctly into the battery holder, aligning the positive (+) ends properly. The negative (-) ends must also be matched accurately.

- Using the diagram of a closed circuit, erase a section of the path to illustrate a break in the flow of electricity. Remind learners that this is called an **open circuit** because the loop is incomplete. You can compare it to a hole in a road, which prevents cars from traveling on it. Instruct learners to also depict this break in their circuit on their Critter Bot worksheets.
- Inform students that an open circuit can be transformed into a closed circuit by repairing the break in the path. This is akin to filling in the hole in the road, allowing cars to travel smoothly along the path again.



OPEN CIRCUIT

OPEN CIRCUIT CHALLENGE

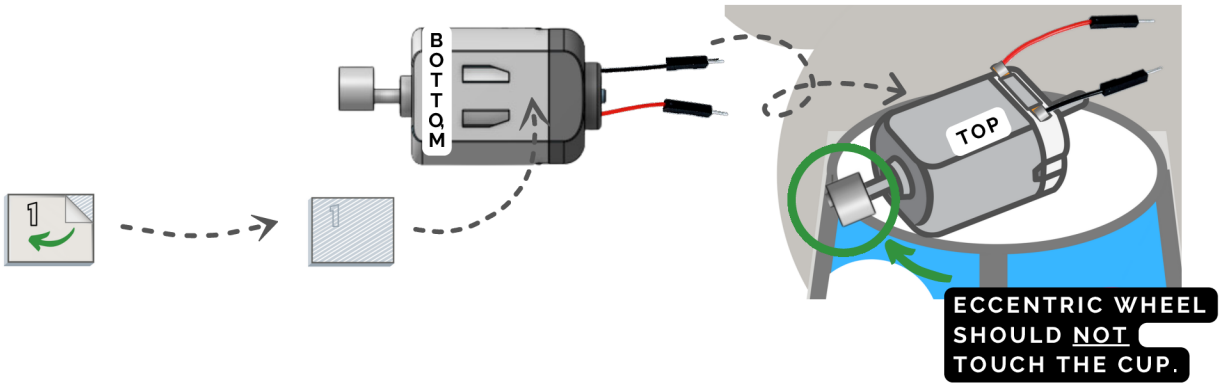
- Give students the opportunity to once again experiment with their battery and motor to increase their understanding of an open versus closed circuit.
  - Challenge students to again create a closed circuit with their vibration motor and battery (with battery holder). Then ask them to create an open circuit. The motor should stop vibrating once the circuit is open.
    - Ask: "What is happening to their motor when there is an open circuit?" Answer: The motor's wire is not touching the battery. Therefore, the electrical path is broken.

STEP 4: ADDING THE ROBOT'S HEART TO THE BODY

5 MINUTES

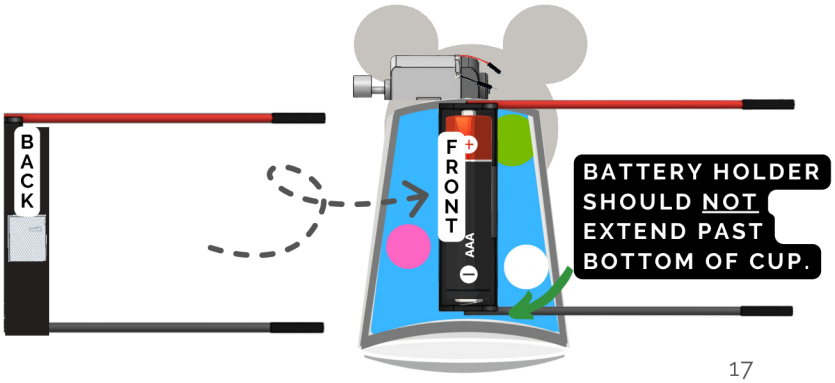
PART C: MAKING YOUR ROBOT MOVE

C-1. Place a piece of double-stick foam on the **bottom** of the vibration motor. Attach the vibration motor to the top of the mini cup. Make sure the eccentric wheel of the motor can freely spin without hitting the cup.



C-2. Insert an AAA battery (not included) into the battery holder. Match up the red wire to the **positive (+)** end of the battery and the black wire to the **negative (-)** end of the battery.

C-3. Place a piece of double-stick foam on the **back** of the battery holder. Attach the battery holder to the side of the cup.



STEP 5: MAKING THE ROBOT'S SWITCH

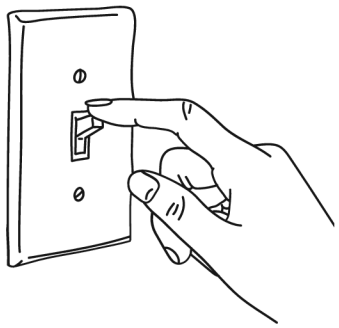
5 MINUTES

- Explain to learners that a **switch** helps us alternate between a closed circuit and an open circuit.

VOCABULARY **SWITCH**

A device that allows a circuit's path of electricity to open or close.

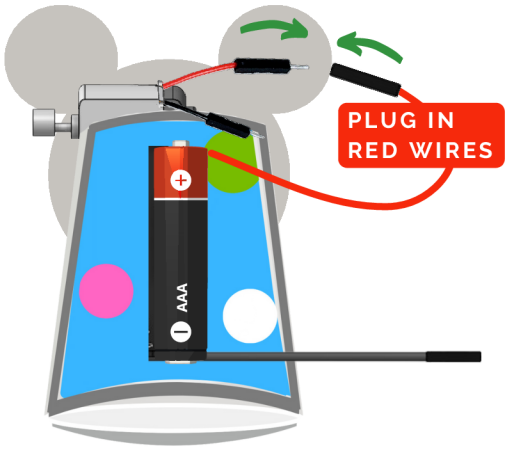
- **ACTIVITY**: Use the example of a light switch that controls electricity in the light. Explain that when the light switch is turned on, this creates a closed circuit and the light bulb will illuminate. In contrast, when the light switch is turned off, this creates an open circuit and the light bulb with go dark.
  - Use the light switch of your classroom to test your learners' understanding of open and closed circuits. Turn on/off the lights and ask learners if this an open or closed circuit.



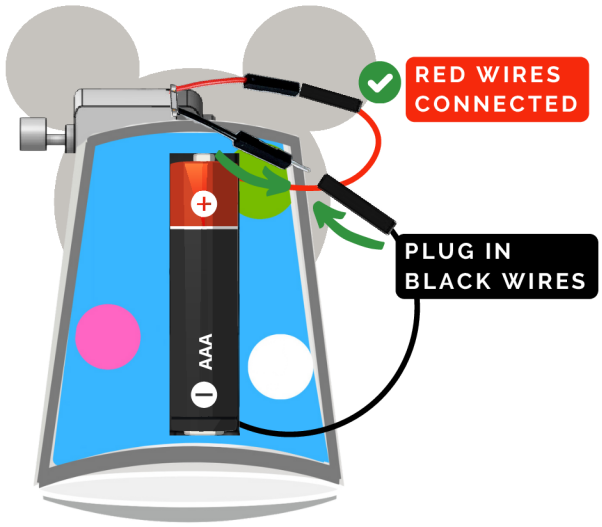
- Each learner's robot can be switched on/off by connecting or disconnecting the pair of red and black wires. Connecting the pair of red wires and the pair of black wires creates a closed circuit, which will turn the robot on. However, if either pair of wires is disconnected, this creates an open circuit and will turn off the robot. We will be using the 2 black wires to be our switch. (But you can also use the red wires to make the switch too.)

PART D: MAKING A SWITCH

D-1. Insert the **red** wire of the motor into the **red** wire of the battery holder.

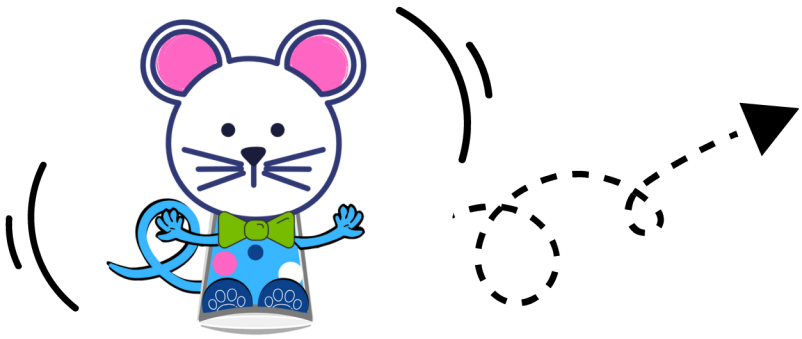


D-2. Insert the **black** wire of the motor into the **black** wire of the battery holder. You should feel your robot move!



D-3. To turn off your robot, unplug the black wires.

To turn your robot back on, repeat step **D-2** above.



HOORAY! YOU'VE FINISHED BUILDING YOUR CRITTERBOT!

LESSON DEBRIEF

5-10 MINUTES

UNDERSTANDING

- What is the difference between a closed circuit versus an open circuit?
- When a light bulb is on, is that an open or closed circuit?
- What is the difference between "designing" versus "building"?

GOING FURTHER

- On what type of surface would your robot move faster: sand, a smooth table, or mud?
  - Sample Answer: A smooth table because the robot's torso would not get stuck, whereas it could get stuck on sand or mud.
- If I gave you a battery that was smaller and with less electricity, would your motor shake faster or slower?
  - Sample Answer: A smaller battery with less electricity would cause your motor to shake less because there would be less electricity going through the motor. This is why your robot will be slower when your battery starts to drain.
- If I gave you a battery that was larger and with more electricity, would it cause your motor to shake more or less?
  - Sample Answer: A larger, more powerful motor would make your motor shake more.

PROJECT REFLECTION

- What do you like about your robot's design? Would you change anything?
- What was the hardest part about designing and building your robot?
- Now that you know how to build a Critter Bot robot, what robot would you build next?

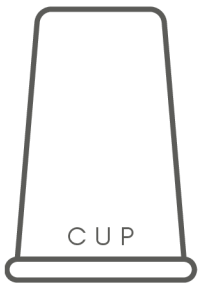
CRITTER BOT
WORKSHEET

NAME: _____

DATE: _____

1 DRAW A ROBOT

2 MY ROBOT DESIGN



3 CLOSED CIRCUIT

4 OPEN CIRCUIT

VOCABULARY

MATCHING

Draw a line matching the vocabulary word to its definition.

MECHANICAL ENGINEER	To construct something by putting parts together based on a design.
DESIGN	A path along which electricity can flow.
BUILD	Using your imagination to think of an idea, then writing it down using words and/or pictures.
ELECTRICITY	A circuit with a continuous, uninterrupted path along which electricity can flow.
CIRCUIT	A person who designs and builds the body of a robot.
CLOSED CIRCUIT	A form of energy that can give things the ability to move or function.