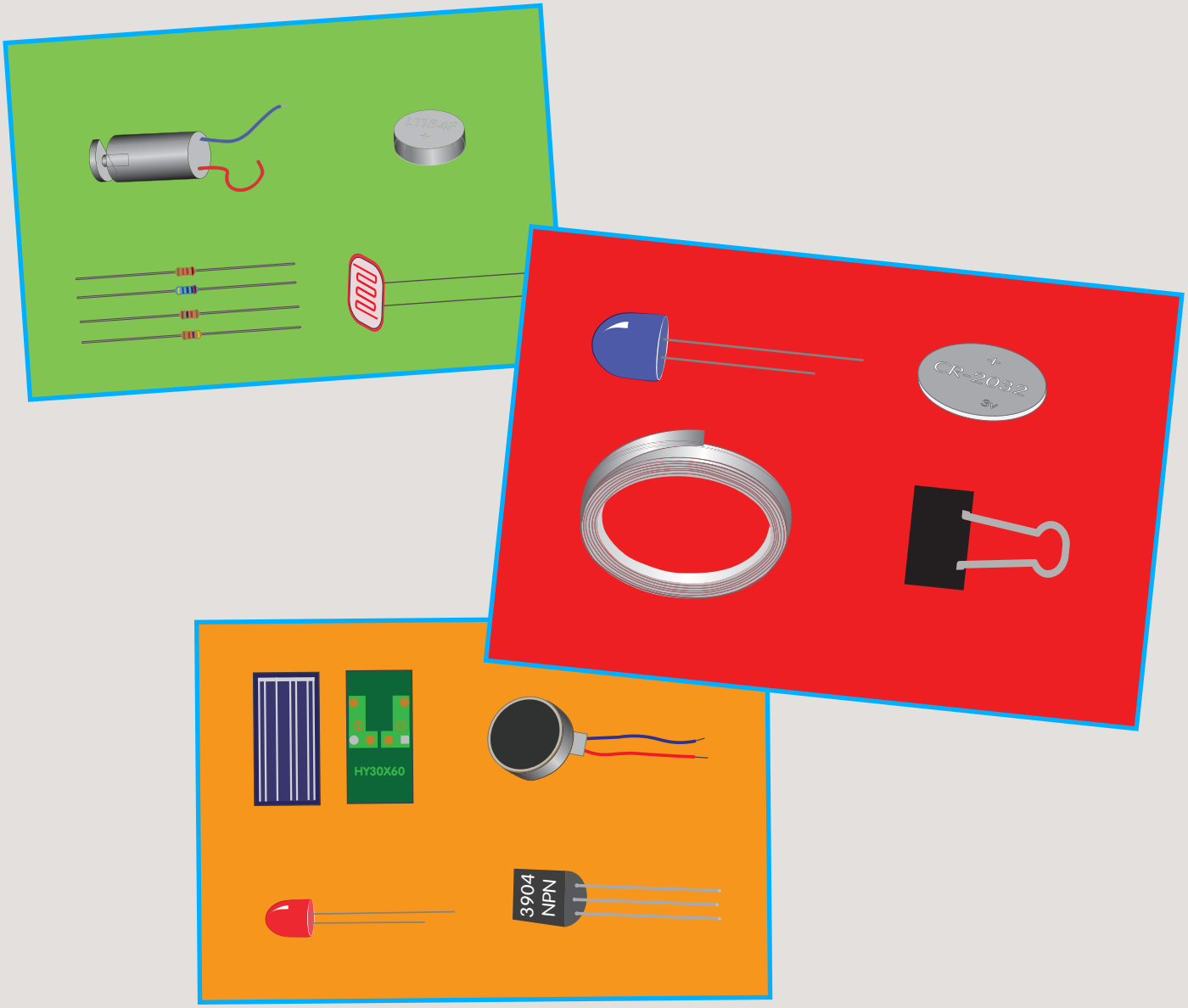
Distance Learning Kit

Student Workbook



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Distance Learning Kit

Student Workbook

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Student Sheet Name: _____

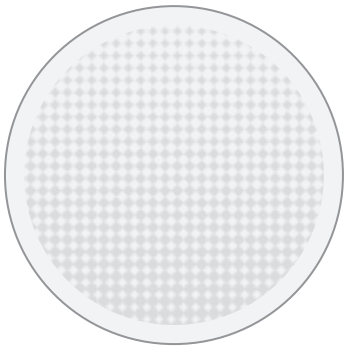
"Where can we find useable electricity & What are its characteristics?"

Battery Investigation

Negative/Positive Side of Battery.

Electricity **leaves/ enters** this side when both sides are connected.

Negative/Positive Side of Battery.



Electricity **leaves/ enters** this side when both sides are connected.

1. The unit used to describe the amount of electricity coming from a source is volts. How is volts abbreviated?

_____

2. How many volts can come from this battery?

_____

Bonus: How many volts can come from a standard US wall outlet?

_____

Unplugging something from the wall and what it tells us about electricity

1. Both the wall outlet and the battery in your kits have a certain amount of electricity that can come from them. Which has a greater number of volts that can come out when connected? **Our battery/The wall outlet**

2. What material is on the OUTSIDE of the cord you unplugged from the wall?
Plastic/Metal

3. What material is on the INSIDE of the cord you unplugged from the wall?
Plastic/Metal

4. Was electricity flowing through the cord when you grabbed it to pull the plug? **Yes/No**

5. What is your evidence?_____

6.Could electricity flow through the material on the OUTSIDE of the cord? **Yes/No**

Examining Your Testing Device

1. The Maker Tape you used in your device is designed to allow electricity to flow through it. **True/ False**

2. Find the path that sits below your battery and try to follow it with your finger all the way back to the top of the battery. Is this path continuous or is there a gap somewhere in that path? **Continuous path/ There is a gap**

3. What material(s) are in the gap?_____

4. When there is a gap, is the LED on or off? **On/Off**

5. Touch the two dangly pieces of Maker Tape together and describe the LED. **On/Off**

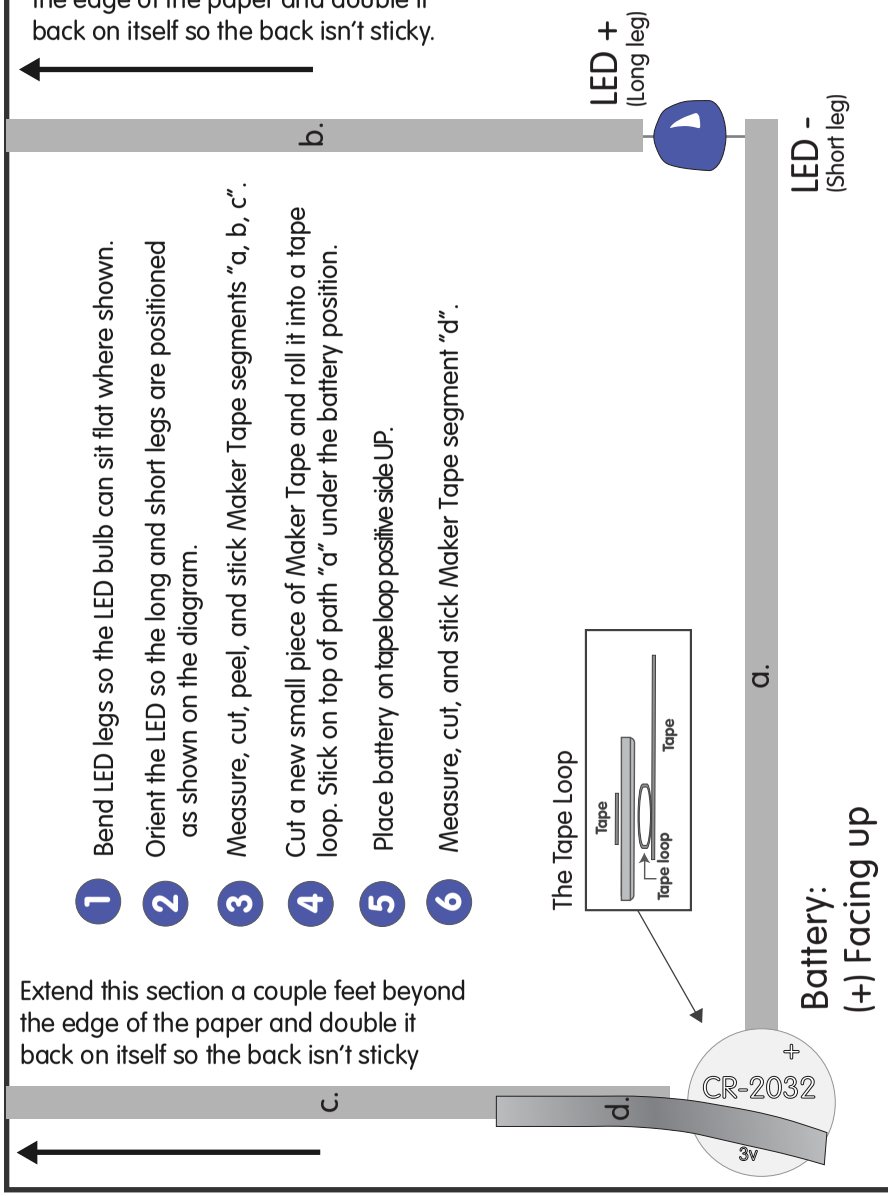
Testing with your device

Choose a variety of materials around your home and test to see if they allow electricity to flow through them. To do this, touch and hold one dangly end in contact with one end of your sample and the other dangly end in contact with the other end of your sample. If your LED lights up, you know that electricity CAN flow through the sample. If the LED remains unlit, you know that electricity CANNOT travel through that material. Chart your findings below. **Remember: A conductor allows electricity to flow through it; an insulator does not.**

Material	LED	Is Electricity Flowing?	Conductor or Insulator
	on/off	yes/no	Conductor/ Insulator
	on/off	yes/no	Conductor/ Insulator
	on/off	yes/no	Conductor/ Insulator
	on/off	yes/no	Conductor/ Insulator
	on/off	yes/no	Conductor/ Insulator
	on/off	yes/no	Conductor/ Insulator
	on/off	yes/no	Conductor/ Insulator

Conductivity Detector

Extend this section a couple feet beyond the edge of the paper and double it back on itself so the back isn't sticky.



1. Bend LED legs so the LED bulb can sit flat where shown.
2. Orient the LED so the long and short legs are positioned as shown on the diagram.
3. Measure, cut, peel, and stick Maker Tape segments "a, b, c".
4. Cut a new small piece of Maker Tape and roll it into a tape loop. Stick on top of path "a" under the battery position.
5. Place battery on tape loop positive side UP.
6. Measure, cut, and stick Maker Tape segment "d".

Extend this section a couple feet beyond the edge of the paper and double it back on itself so the back isn't sticky

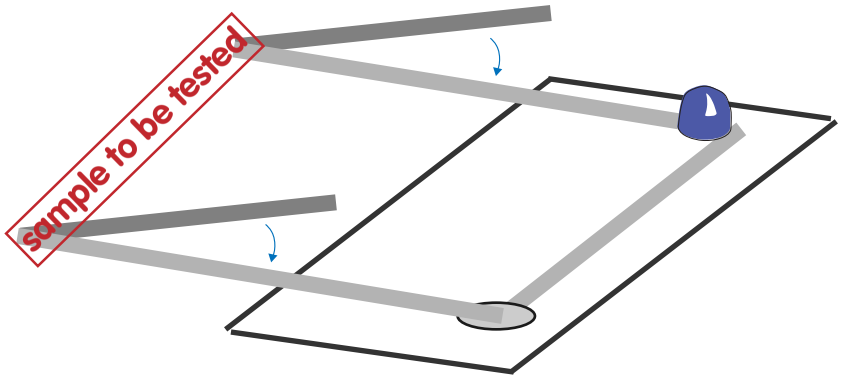
Conductivity

The flow of tiny electrons that we call electricity cannot move across all materials easily. Knowing what they can and cannot travel across helps us control where they go and don't go!

- **Conductors allow electricity to travel**
- **Insulators do not allow electricity to travel**

Testing Conductivity

With the battery connected, touch the two dangly ends to the opposite ends of a sample material. If the LED lights up, that means the pathway is complete and the material between the clips is allowing electricity to travel across it. If the LED is off, the opposite is true. Chart your test results on the printable data sheet!



*Extend tape paths pictured off of circuit card and double back so these lengths do not have sticky backs & hang off the edge.

Student Sheet Name: _____

What is a circuit and what do they need in order to work?

Pan and Stove Exercise

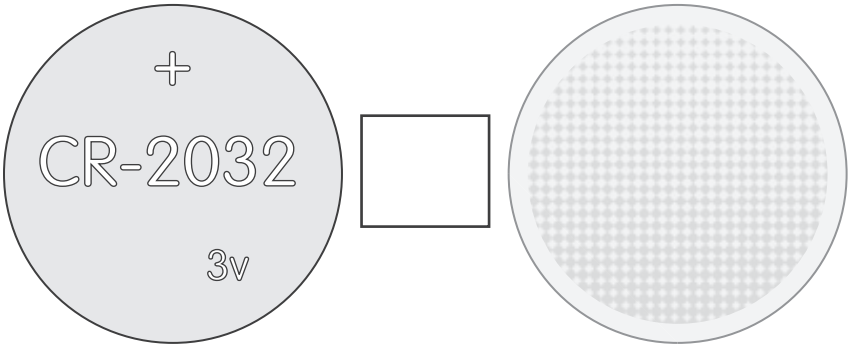
1. Imagine touching a pan straight from the cupboard. What is its temperature?
Hot/Cool

2. Does a turned-on stove burner have more or less heat than that pan? **More/Less**

3. If placed in contact with one another, would the heat energy travel from the stove into the pan material, the opposite, or not at all?
Pan to Stove/ Stove to Pan/ No heat would travel

4. Would the heat energy travel from high concentration to low concentration OR from low to high? **High to Low/ Low to High**

5. If the electrons that make electricity follow the same rules as heat energy, and we know that electricity LEAVES the negative side of our battery and travels TO the Positive side, where are electrons more highly concentrated?



Higher/Lower **Higher/Lower**

6. Draw an arrow in the box between the two sides of the battery sides above to show the direction that electricty flows when the two sides are connected by a conductor.

Parts of a circuit

Circuits are combinations of:
- **A voltage source** (battery, generator, solar panel)
- **Pathways** from and back to the power source made of a material electricity can travel through (conductors)
- **Components that need electricity in order to work** connected TO the pathways.

Disassemble your **conductivity detector** device part-by-part and, as you do, place each part in the appropriate category box below based on the role you think it played in the device.

Voltage Source	Pathways	Components

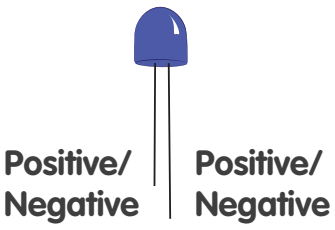
1. Did your conductivity detector have all the parts needed to be a circuit? **yes/no**
2. What is the problem with that circuit if you simply wanted to use that circuit as a light?_____
3. How could you fix this?_____
4. Now, assemble the **One LED Light Circuit** using the diagram and describe how it's different from the Conductivity Detector. _____
_____

Knowing your LED

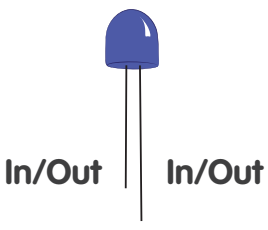
Carefully pull your LED legs out from underneath the tape paths. The circuit worked when the long and short legs of the LED were oriented as shown in the diagram. Now flip the LED around and hold the legs to the same paths that produced a working outcome before.

1. With the LED legs in the opposite orientation, is your LED lit or dark? **Lit/Dark**

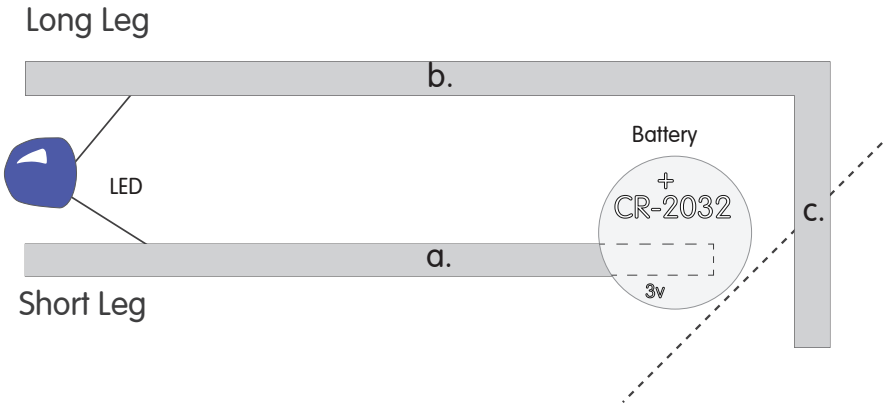
2. LEDs have a negative and positive side. Use the diagram to show which leg is which.



3. Which leg can electricity go into and which leg can electricity come out of?



Electron Flow Map

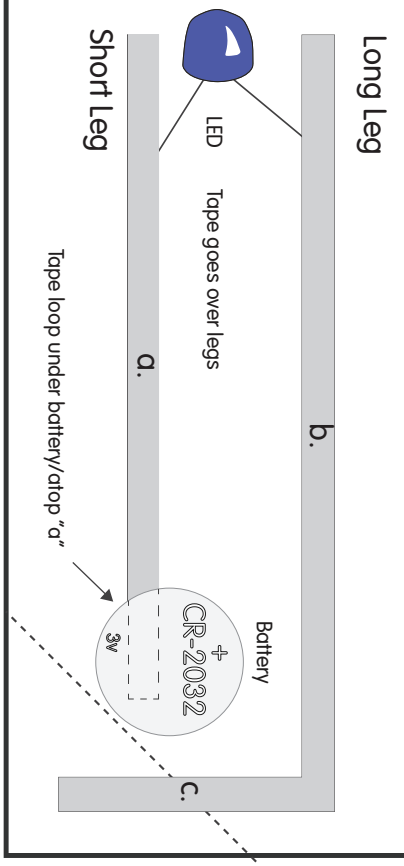


Draw a path with arrows to show the path and direction that electricity travels through your light circuit when the corner is folded over and path "c" is in contact with the top of the battery. **Hint:** Start by asking yourself which side of the battery the electricity comes OUT of.

Single LED Light Circuit

Build Guide

1. Fold corner along the dotted line.
2. Bend LED legs so the LED bulb can sit flat on the circle.
3. Orient the LED so the long and short legs are positioned as shown on the diagram.
4. Measure, cut, peel, and stick Maker Tape segments "a, b, c".
5. Cut one more small piece of Maker Tape and roll it into a tape loop. Stick on top of path "a" where shown on diagram.
6. Place battery positive side UP, fold over the flap and secure with a binder clip.



Student Sheet Name: _____

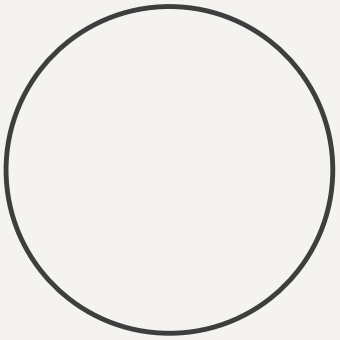
Controlling circuit outcomes with switches

Open and Closed Circles & Circuits!

1. This circle is **closed/open**

2. This resembles a circuit pathway: **with a gap/without a gap**

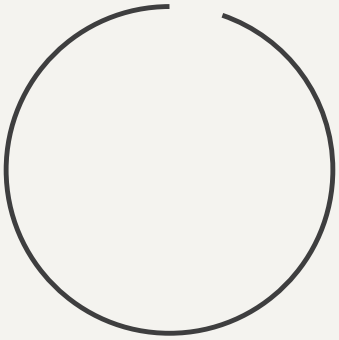
3. These kinds of circuits are **on/off**



4. This circle is **closed/open**

5. This resembles a circuit pathway: **with a gap/without a gap**

6. These kinds of circuits are **on/off**



In other words:

7. Open Circuits **have/don't have** gaps in their path and their intended outcomes are **off/on.**
8. Closed Circuits **have/don't have** gaps in their path and their intended outcomes are **off/on.**

Controlling the Gap.

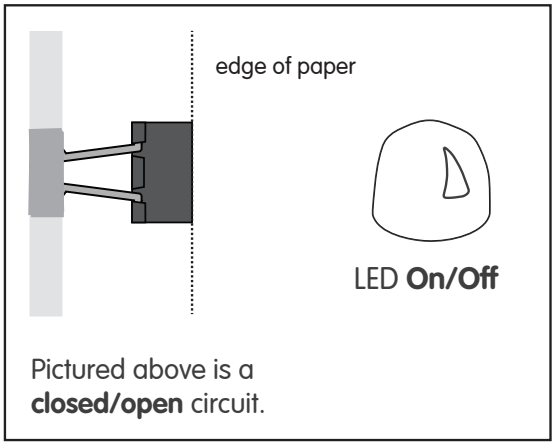
What is the name of the component that allows you to turn off a simple light at home?_____

Device	Describe the Switch

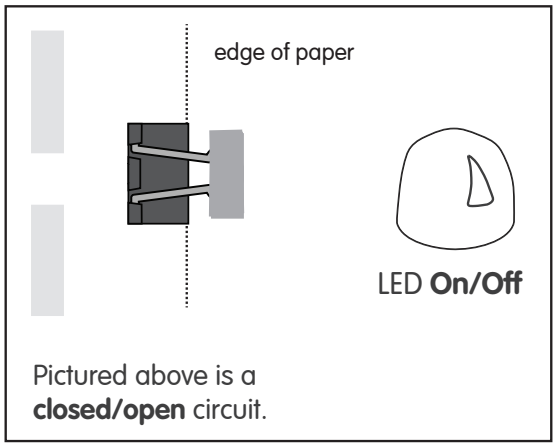
Doing the same thing in different ways

There are many different kinds of switches that work in different ways to open and close circuits or portions of circuits. Below are examples of switches you made. Use the diagrams and your experience building and operating them to help you describe how they work.

The Binder Clip Switch

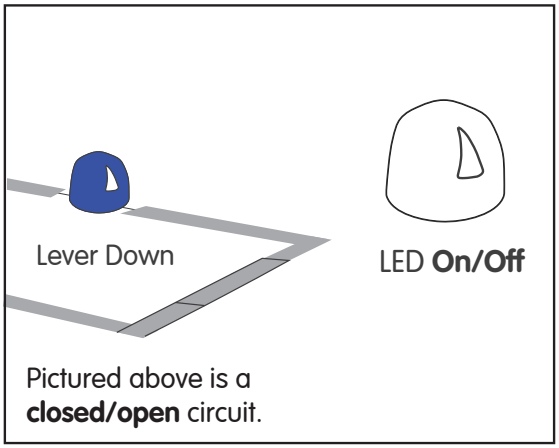


Pictured above is a **closed/open** circuit.

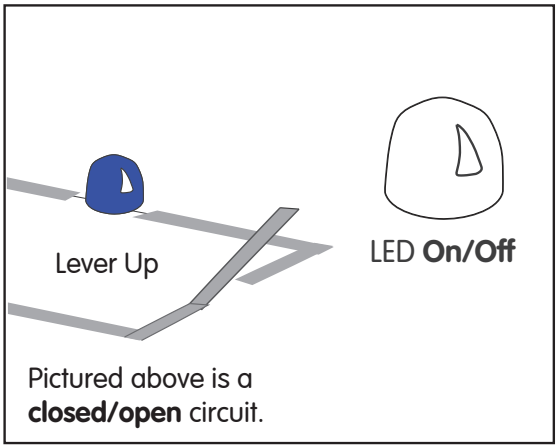


Pictured above is a **closed/open** circuit.

The Lever Switch

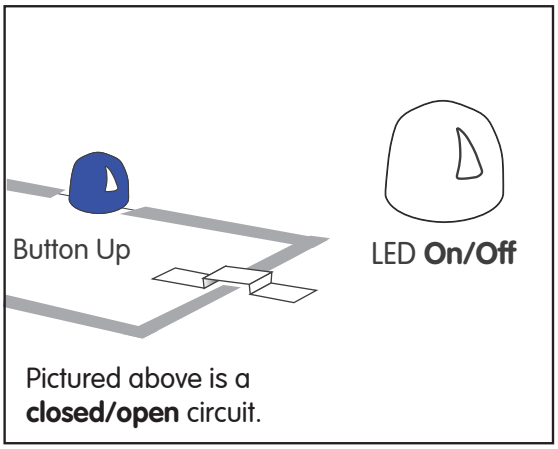


Pictured above is a **closed/open** circuit.

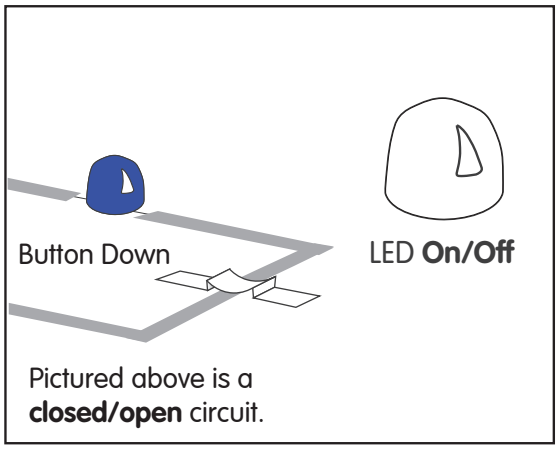


Pictured above is a **closed/open** circuit.

The Push Button

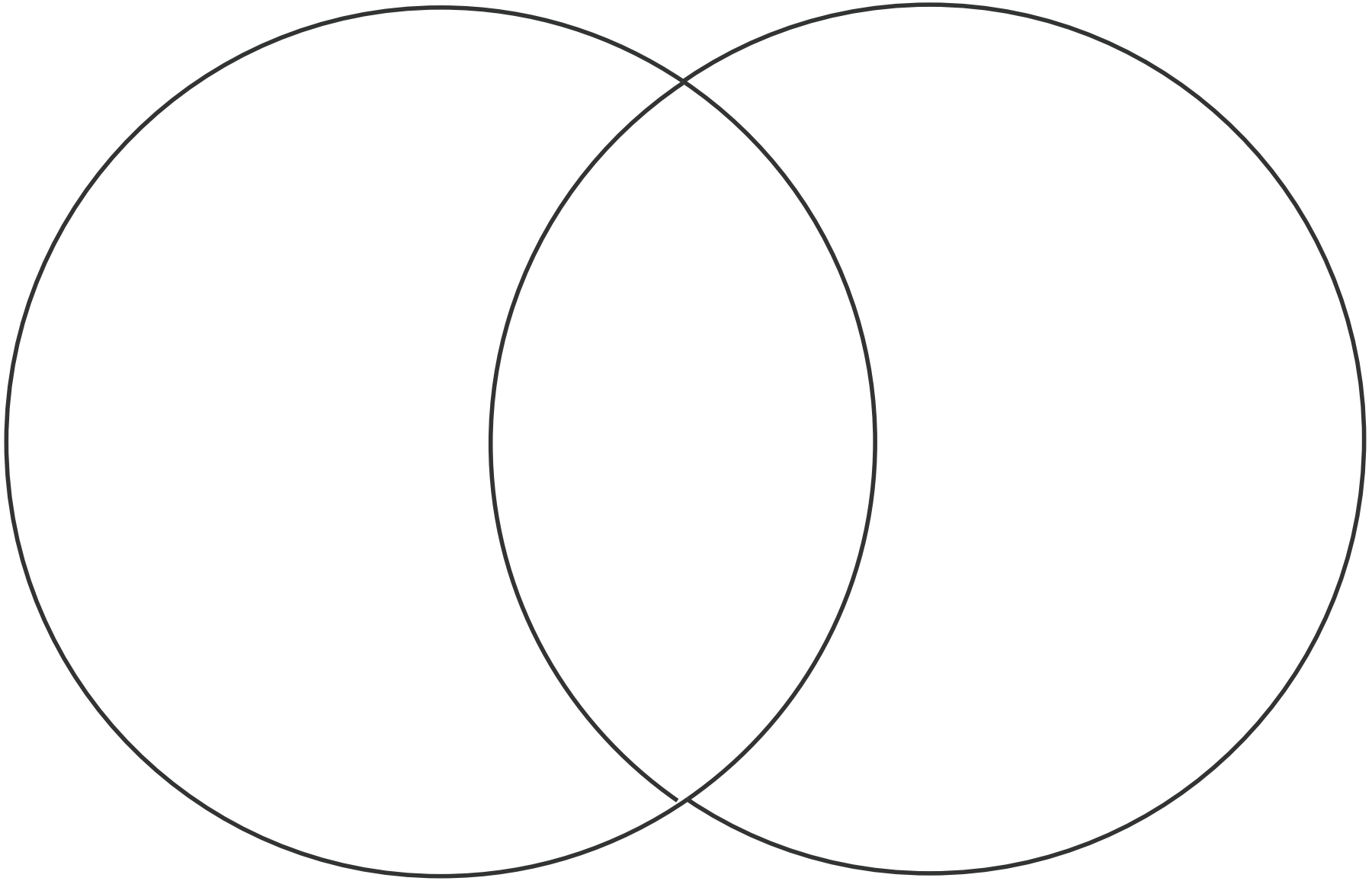


Pictured above is a **closed/open** circuit.



Pictured above is a **closed/open** circuit.

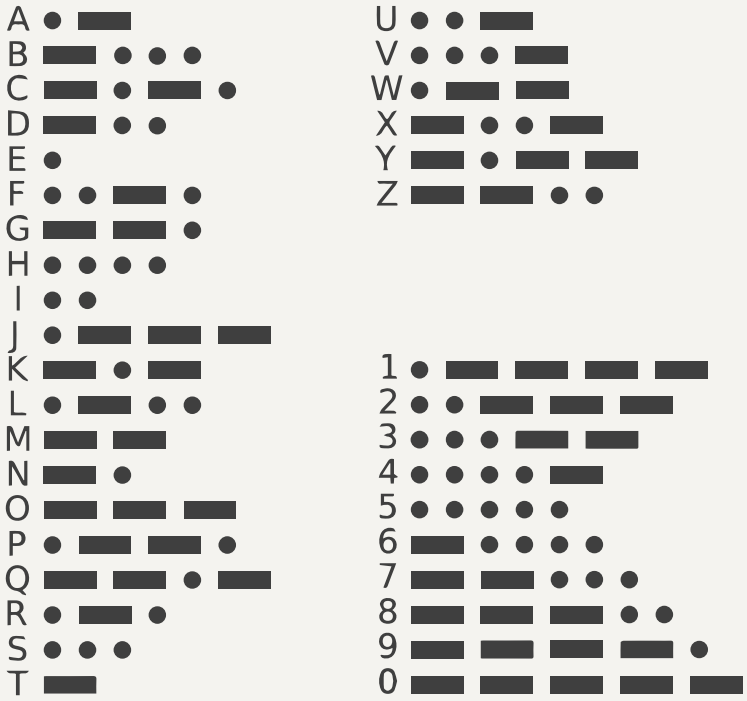
Compare and contrast two of the switches you used today.



_____switch

_____switch

International Morse Code

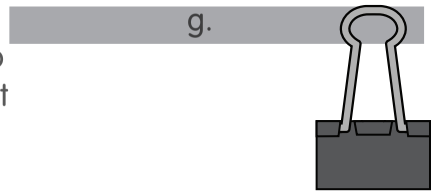


Binder Clip Switch

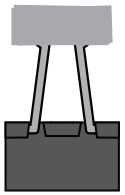
1. Bend legs of LED outward so it can lay flat against paper. Orient long and short legs as shown. Measure, cut, peel and stick Maker Tape pathways "a,b,c,d and e" ("d,e" over LED legs.

2. Make a tape loop out of Maker Tape and stick it atop the battery end of path "a". Then stick battery atop tape loop (+) side UP. Make and stick path "f".

3. Stick a piece of Maker Tape™ to the rounded part of one of the binder clip leg.

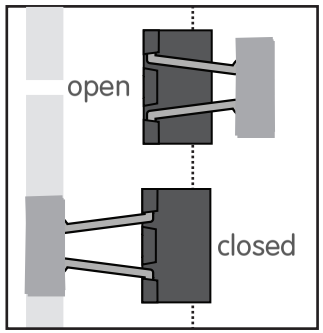


4. Wrap the tape around a few times to build up the conductive surface.



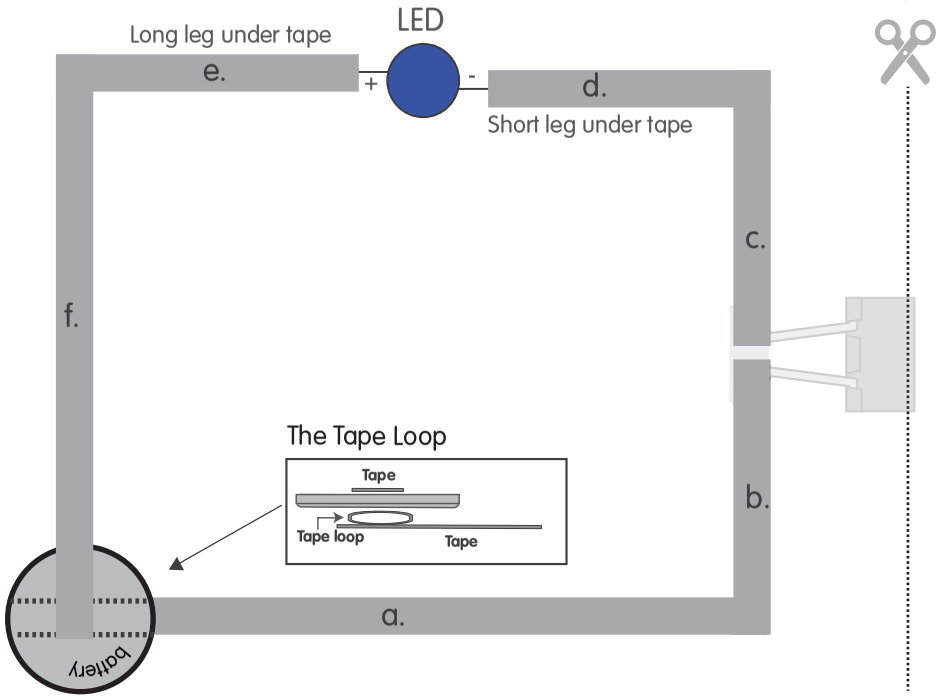
5. Our switch will have two positions, opened and closed.

Flipping the leg over to bridge the gap in the tape will close the circuit.

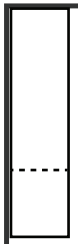


6. Cut the or fold the paper so you can place the binder clip close enough to make contact with the circuit.

7. Flip the leg to complete the circuit and turn on the LED!



Paper Lever Switch



1. Bend legs of LED outward so it can lay flat against paper. Orient long and short legs as shown. Measure, cut, peel and stick Maker Tape pathways "a,b,c,d " ("d,c" over LED legs).

2. Make a tape loop out of Maker Tape and stick it atop the battery end of path "a". Then stick battery atop tape loop (+) side UP. Make and stick path "e".

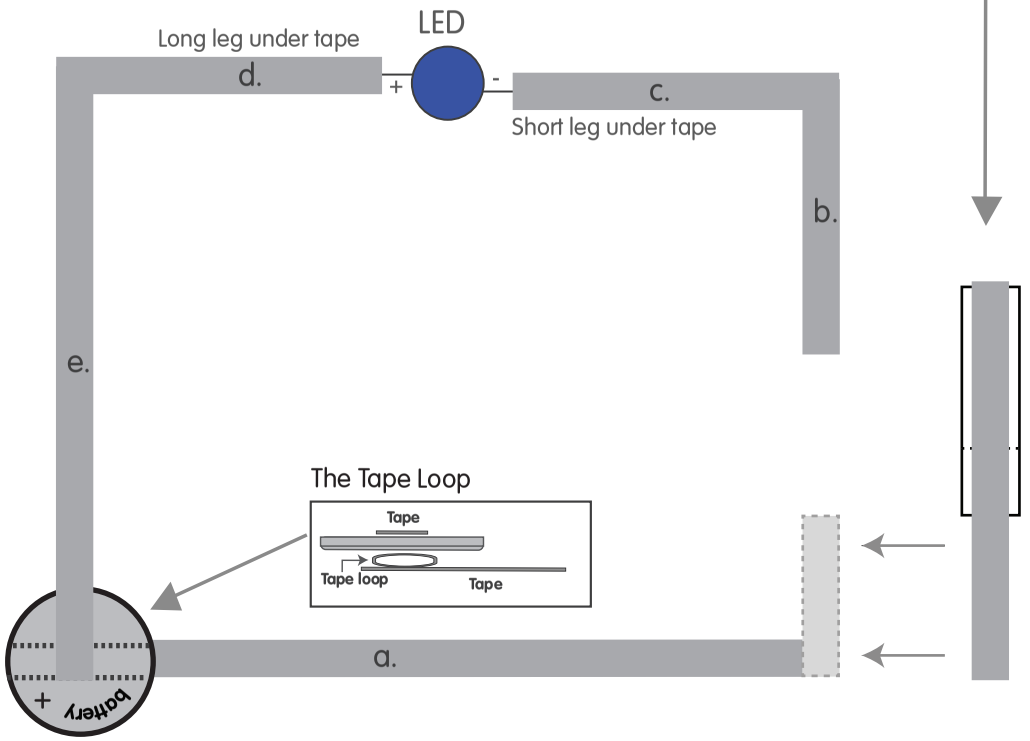
3. Cut out switch using scissors. Fold on dotted line.

4. Place Maker Tape™ path "f" on top of switch. Leave enough extra tape to stick to switch down to paper and to wrap around the bottom of the switch.

5. Fold tape over long end of switch and attach securely.

6. When your switch is ready stick it down to the paper where indicated with dotted lines below.

7. Press the switch down to make contact and turn on the LED!



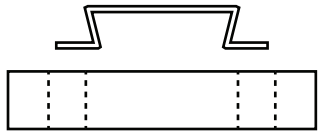
Paper Push Button

1. Bend legs of LED outward so it can lay flat against paper. Orient long and short legs as shown. Measure, cut, peel and stick Maker Tape pathways "a,b,c,d and e" ("d,e" over LED legs.

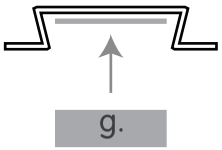
2. Make a tape loop out of Maker Tape and stick it atop the battery end of path "a". Then stick battery atop tape loop (+) side UP. Make and stick path "f".

3. Cut out button using scissors.

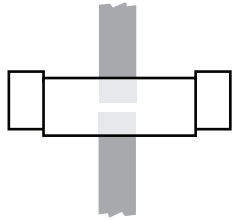
4. Fold paper as show below using dotted lines as a guide.



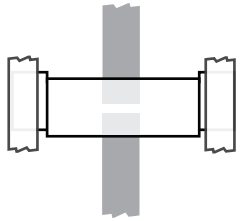
5. Attach Maker Tape™ path "g" to the bottom of the button.



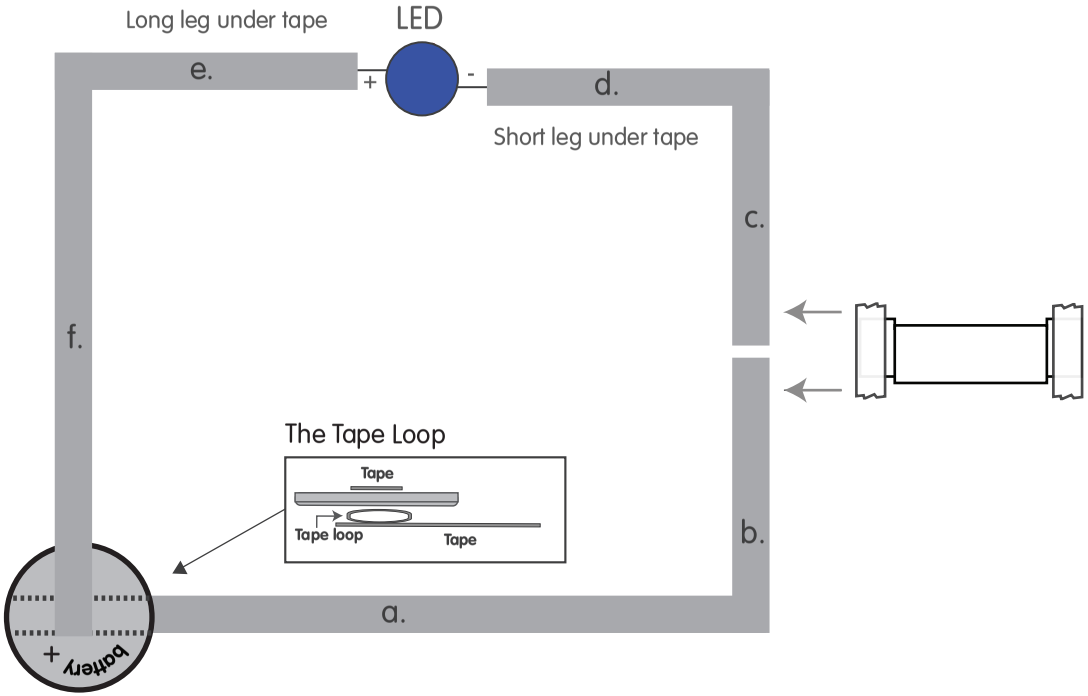
6. Align your button (tape side down) over the gap in the circuit between paths "b,c".



7. Use tape to hold the button in place.



8. Press the button down to make contact and turn on the LED!



Student Sheet Name: _____

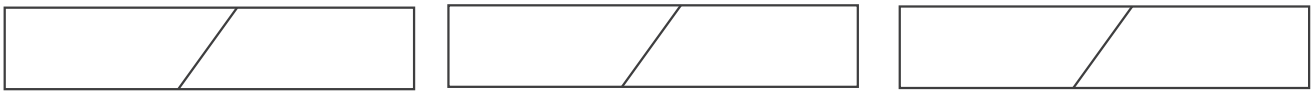
Circuits that create multiple outcomes

Think of three different scenarios that involved using ONE switch while observing more than one outcome. Use the table below to help you organize your thoughts.

Scenario	Device/ Switch Used	Outcomes Observed
	/	
	/	
	/	

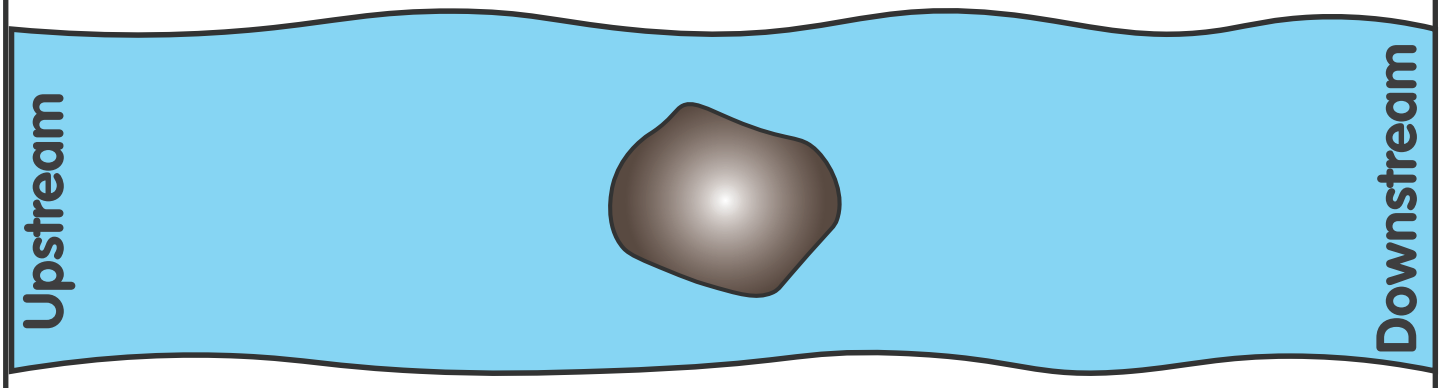
The Chain of Magnets

In the world of magnets, opposites attract. Below are images of three bar magnets. Label each side with a "+" or "-" to show a combination of orientations that would join the three magnets together.



A River Runs Around it

Draw arrows to show the direction(s) the river water would flow **from upstream, to the island, to downstream**.



Parallel vs. Series Circuits

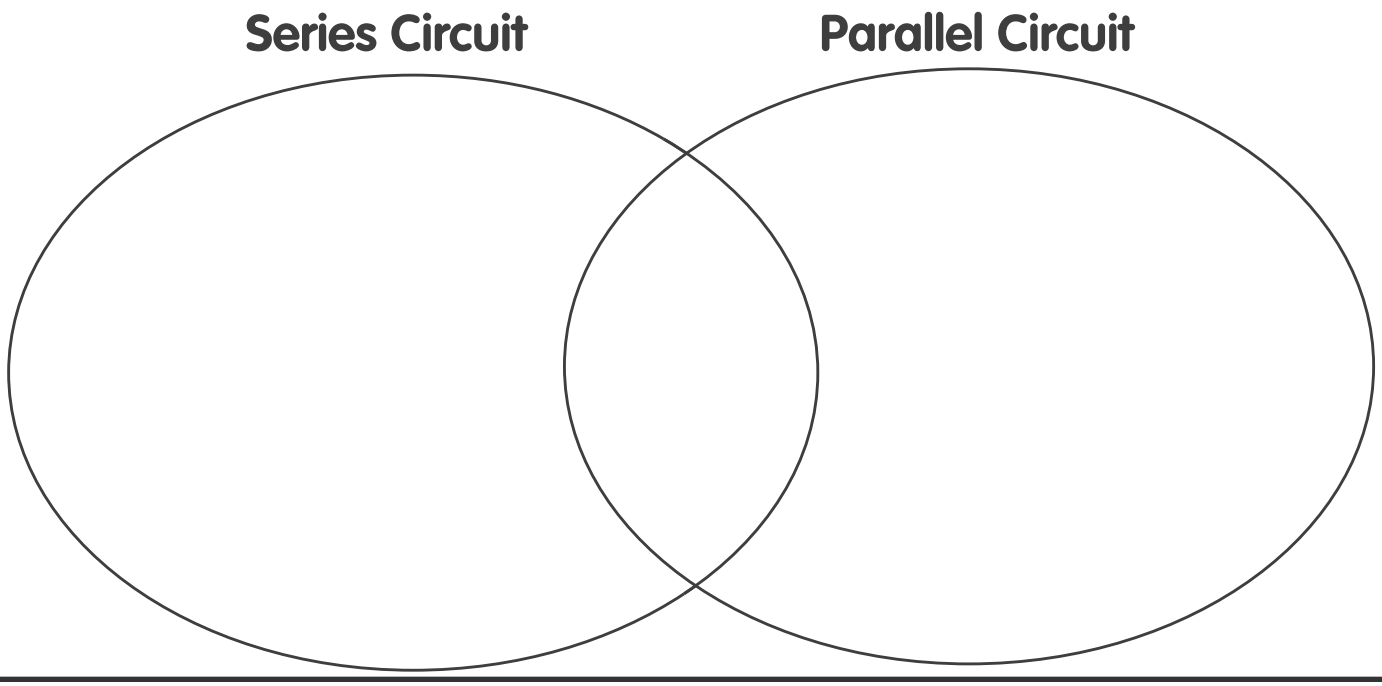
Series Circuit Observations

1. Did the series arrangement succesfully light up both LEDs with one battery? **Yes/No**
2. Did you use the same battery as you had in the earlier circuits or a different kind? **Same/ Different voltage source**
3. In comparison to the single LED circuits you assembled and tested in previous days, describe the BRIGHTNESS of the two LEDs in your series circuit.
Same brightness/ Brighter than one by itself/ Dimmer than one by itself
4) When you removed a single LED from the working, connected series circuit, did the other LED stay on or did it also turn off? **On/Off**

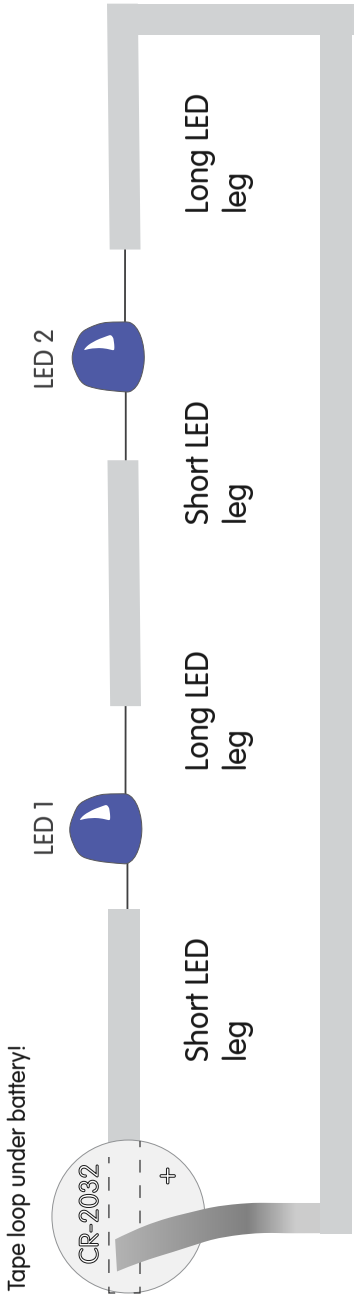
Parallel Circuit Observations

1. Did the parallel arrangements succesfully light up both LEDs with one battery? **Yes/No**
2. Did you use the same battery as you had in the earlier circuits or a different kind? **Same/ Different voltage source**
3. In comparison to the single LED circuits you assembled and tested in previous days, describe the BRIGHTNESS of the two LEDs in your parallel circuits.
Same brightness/ Brighter than one by itself/ Dimmer than one by itself
4) When you removed a single LED from a working, connected parallel circuit, did the other LED stay on or did it also turn off? **On/Off**

• Use the Venn Diagram below to help show what is the same about and unique to parallel and series circuits. Put things that are the same in the overlapping center and things unique to each in the outside sections.



Series Circuit



Now that you have put together a number of circuits with these materials, your pathways are no longer labeled with letters.

Remember

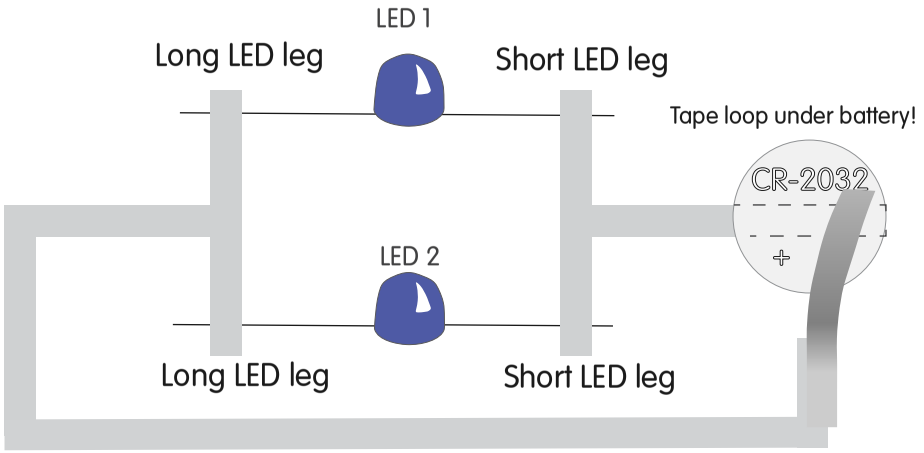
1. The orientation of your LED legs is important.

2. Maker Tape segments go on top of LED legs.

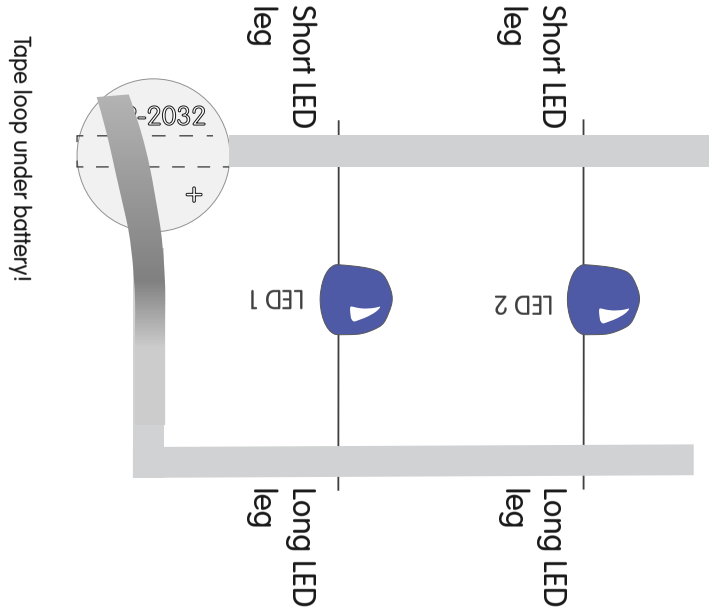
3. There is a Maker Tape loop atop the "battery end" of the segment under the battery.

4. Positive side of battery should face UP.

Parallel Circuit Variation 1



Parallel Circuit Variation 2



Student Sheet Name:_____

Switches for controlling multiple outcomes.

Stop...Go...Slow!

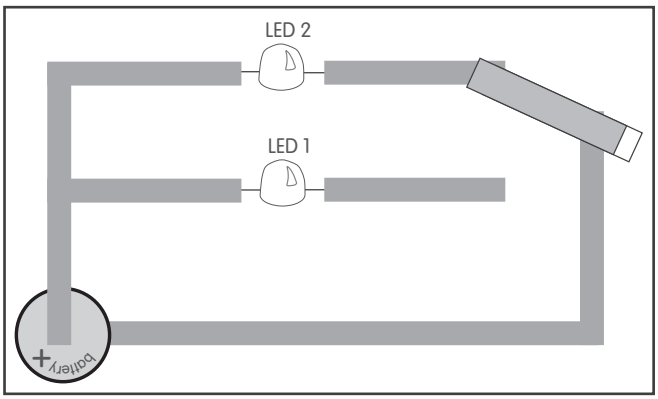
Consider your past experiences at a common traffic light...

1. How many lights (outcomes) are present in the device?_____
2. Have you ever seen them all on at once? **yes/no**

Mapping how electricity flows through the 2 Position Switch Circuit

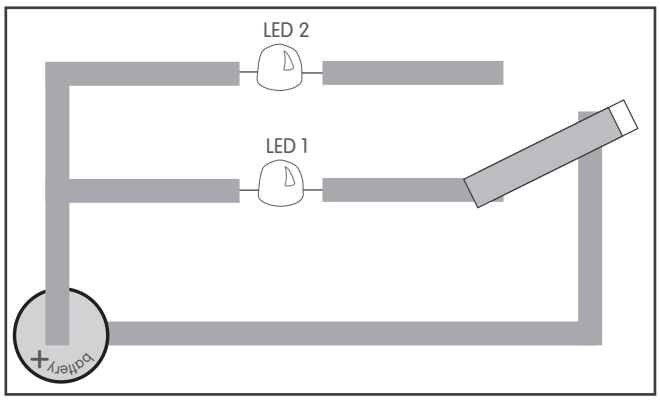
Examine the diagrams below. Each shows the switch in a different position. Color the LED or LEDs that should light up in each scenario. Use arrows to show how electricity flows through the circuit first FROM the battery, through the switch/ components and then back TO the battery.

A.



1. With the switch in this position, which LED(s) light up._____
2. The pathway for LED 1 is: **Open/Closed**.
3. The pathway for LED 2 is: **Open/Closed**.

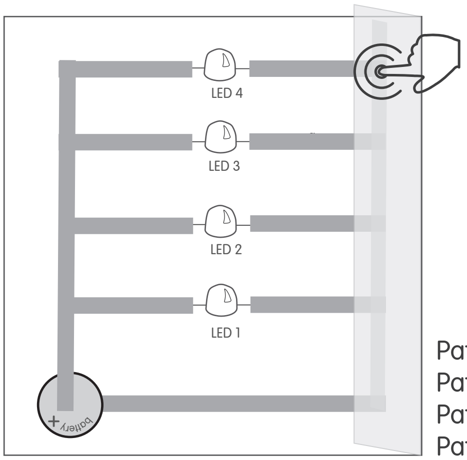
B.



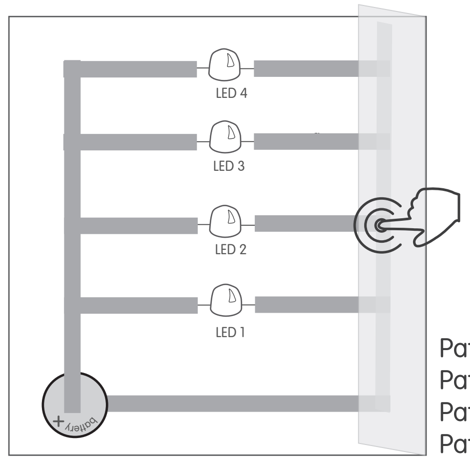
1. With the switch in this position, which LED(s) light up._____
2. The pathway for LED 1 is: **Open/Closed**.
3. The pathway for LED 2 is: **Open/Closed**.

Mapping how electricity flows through the 4 Position Switch Circuit

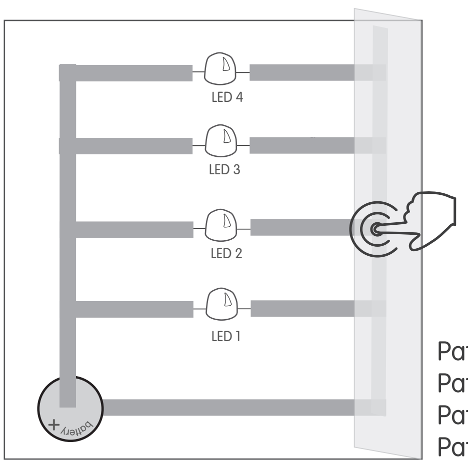
Examine the 5 diagrams below. Each shows a finger in a different position. Color the LED or LEDs that should light up in each scenario. If no LEDs should light up, leave them all uncolored. Afterward, use arrows to show how electricity flows through the circuit first FROM the battery, through the switch/ components and then back TO the battery.



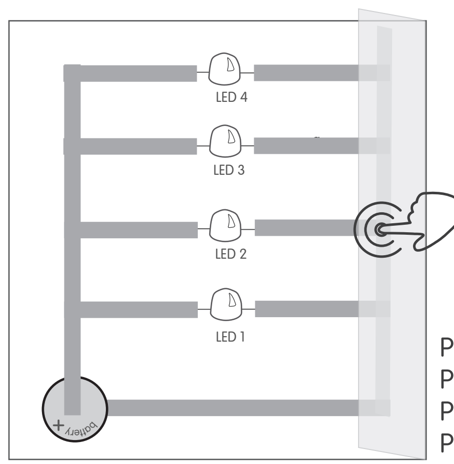
Path 4: **Open/Closed**
Path 3: **Open/Closed**
Path 2: **Open/Closed**
Path 1: **Open/Closed**



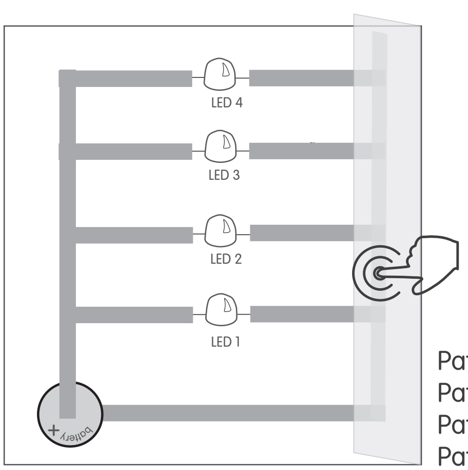
Path 4: **Open/Closed**
Path 3: **Open/Closed**
Path 2: **Open/Closed**
Path 1: **Open/Closed**



Path 4: **Open/Closed**
Path 3: **Open/Closed**
Path 2: **Open/Closed**
Path 1: **Open/Closed**

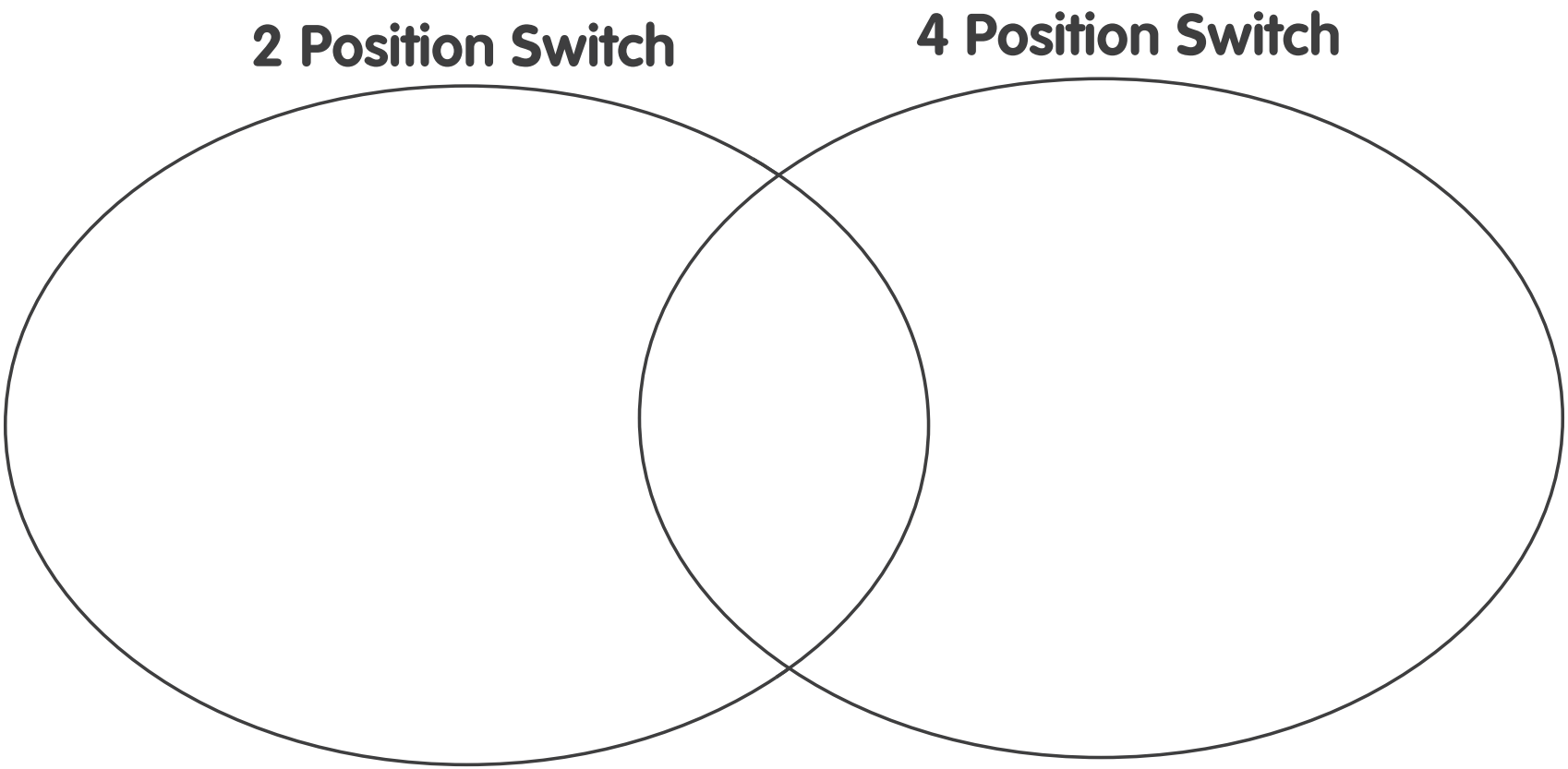


Path 4: **Open/Closed**
Path 3: **Open/Closed**
Path 2: **Open/Closed**
Path 1: **Open/Closed**



Path 4: **Open/Closed**
Path 3: **Open/Closed**
Path 2: **Open/Closed**
Path 1: **Open/Closed**

• Use the Venn Diagram below to help show what is the same about and unique to each of these two switches. Put things that are the same in the overlapping center and things unique to each in the outside sections.



2 Position Switch

1. Prepare LED legs by bending them outward so that they can lay flat against paper. Position them with the correct orientaion of legs where shown.

2. Measure, cut, peel, and stick Maker Tape segments "a-e" with "c-e" placed on top of the LED legs.

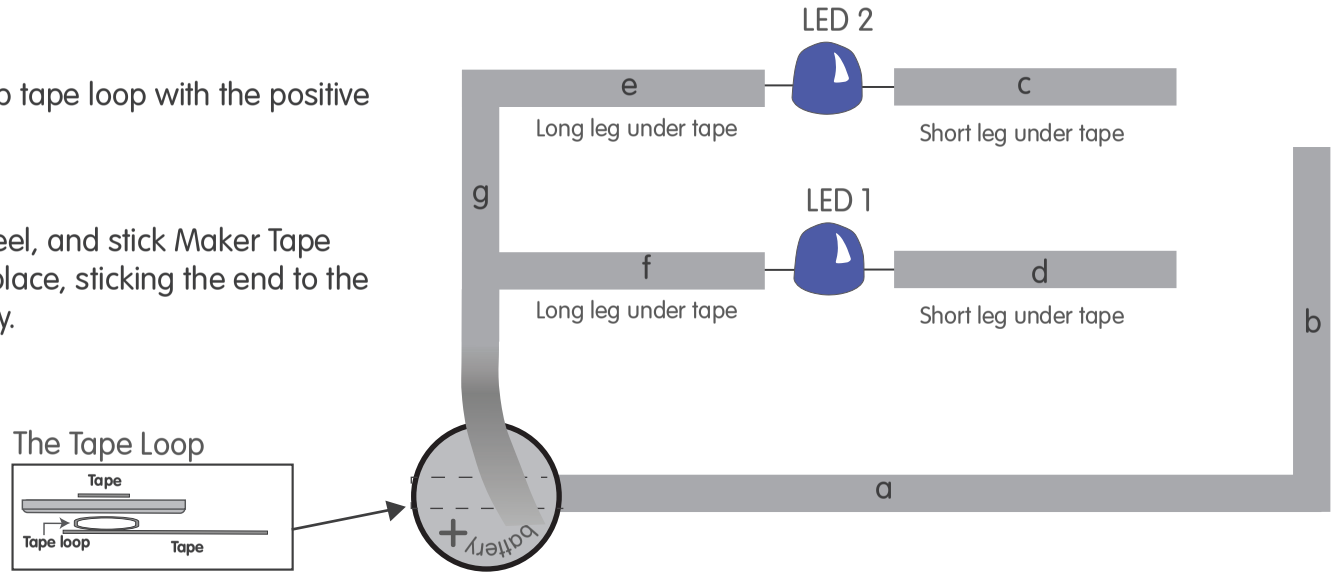
3. Make and stick a Maker Tape loop atop the battery end of segment "a".

4. Stick battery atop tape loop with the positive side facing UP.

5. Measure, cut, peel, and stick Maker Tape segment "g" in place, sticking the end to the top of the battery.

6. Cut tab out and run a piece of Maker Tape along its length around to the other side, covering it neatly with conductive material.

7. To operate, you will need two hands. Press and hold one end of your tab in contact with the end of Maker Tape path "b". Use your other hand to rotate the other end of the tab from path "d" to "c" to selectively complete each branch of what should remind you of your first parallel circuit arrangement.



4 Position Slide Switch

1. Prepare LED legs by bending them outward so that they can lay flat against paper. Position them with the correct orientaion of legs where shown.

2. Measure, cut, peel, and stick Maker Tape segments "a-j" with "c-j" placed on top of the LED legs.

3. Make and stick a Maker Tape loop atop the battery end of segment "a".

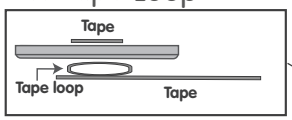
4. Stick battery atop tape loop with the positive side facing UP.

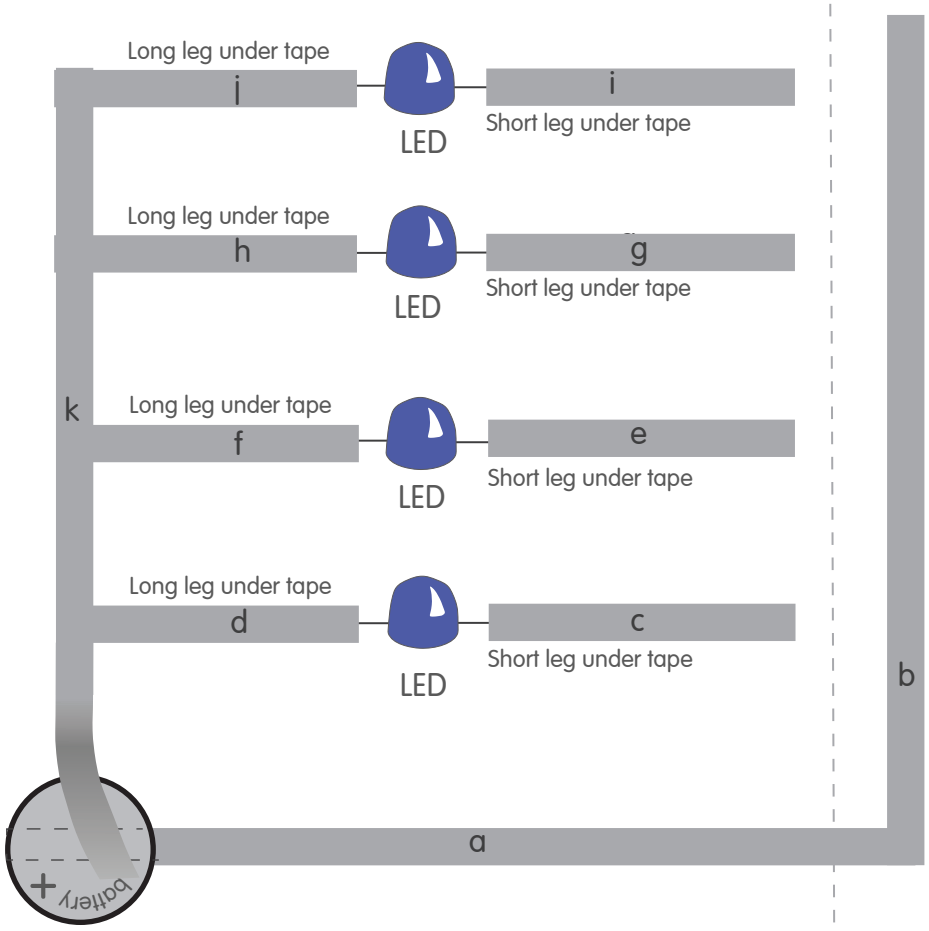
5. Measure, cut, peel, and stick Maker Tape segment "k" in place, sticking the end to the top of the battery.

6. Fold paper along dotted line so that path "b" is hovering over the top of paths "c,e,g,i"

To operate: With circuit assembled and paper edge folded over, apply downward pressure on any point on path "b" with your finger. Maintain pressure and run your finger up and down the length of that path. Each LED will light up as "b" is brought into contact with its corresponding path. Likewise, any LED that WAS lit will turn off as pressure to its corresponding path is removed.

The Tape Loop

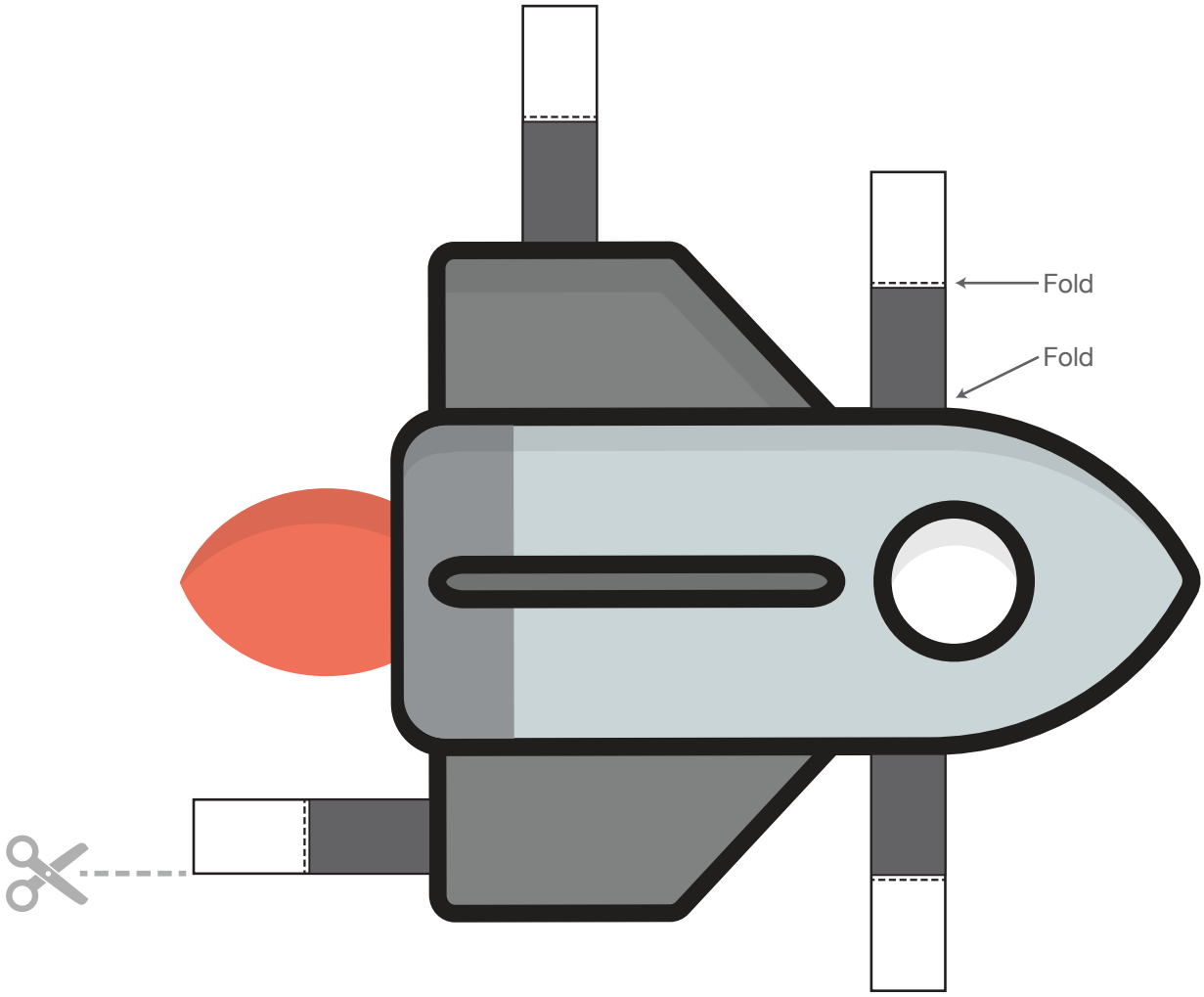




Rocket Badge

1. Cut out the top of the rocket along the outside edge.

2. Fold the tabs away from the front side of the rocket.

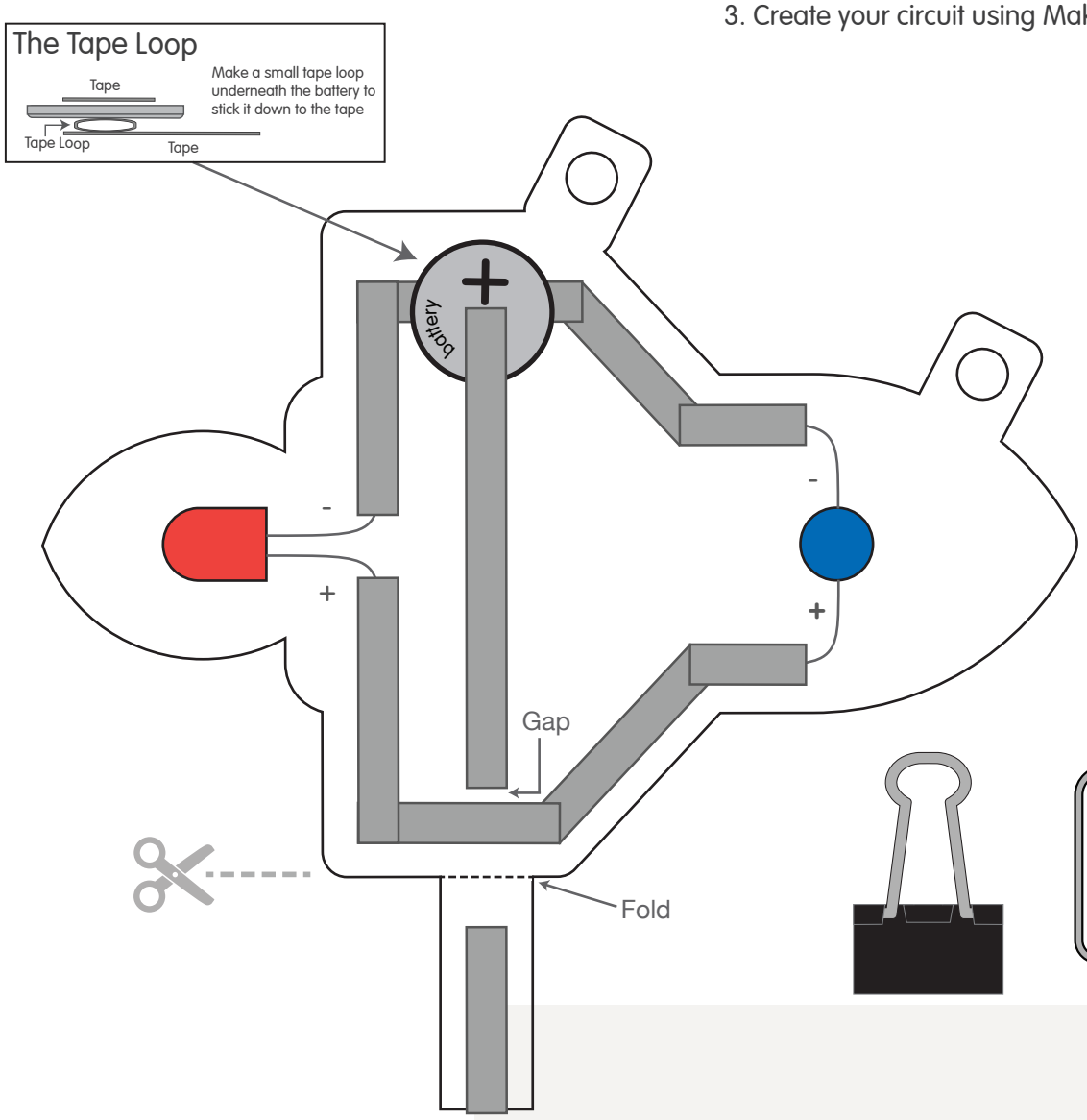


Rocket Badge

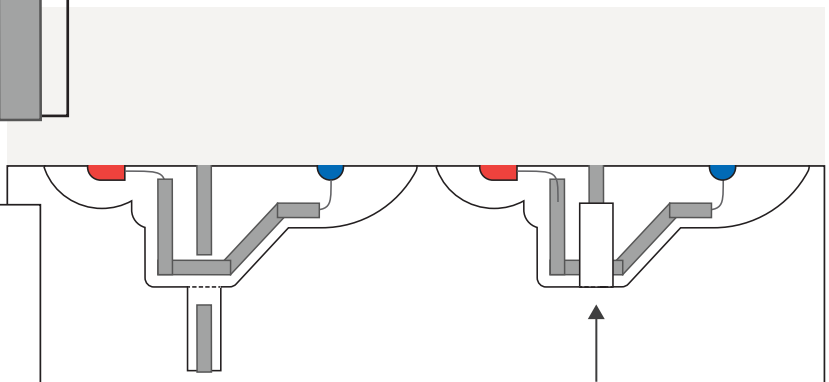
1. Cut out the bottom of the rocket along the outside edge.

2. Use a hole punch to make the holes in the tabs.

3. Create your circuit using Maker Tape.



Side View



Bend red LED legs so the LED lays flat on its side.

Bend blue LED legs so the LED lays flat on its base.

Fold over paper switch to close the gap in the circuit and hold it in place with a paperclip or your binder clip.

Student Sheet Name: _____

Making things move with motors.

Use what you know!

Use the same circuit assembly you used for a single LED circuit and wire up your self-sticking motor Don't peel and stick it down...you'll need it for a different project later this week.

1. What color is the wire that you connected to the Maker Tape path leading from the underside of the battery? **Red/Blue**

2. Did all of your classmates use the same colored wire for that same portion of the circuit? **Yes/No**

3. Did all of your classmates circuits work? **Yes/No**

4. Based on your observations, do you think that motors are polarized components? **Yes/No**

Testing direction of motion.

There are many devices that can cause motion mechanically. Some of them create motion that travels in a straight line (linear motion) while others create motion that travels a circular path (rotational motion).

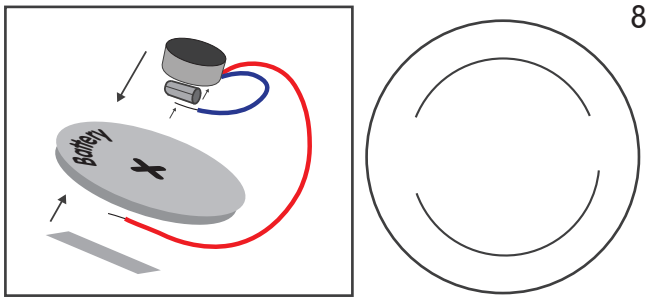
5. When you connected your battery and motor combo to the 3.0" paper disc with arrows on it, did the disc move in a straight line or rotate in a circle? **Straight Line/ Circle**

6. Based on your observations, motors create **rotational motion/ linear motion.**

Testing polarity changes in motor use.

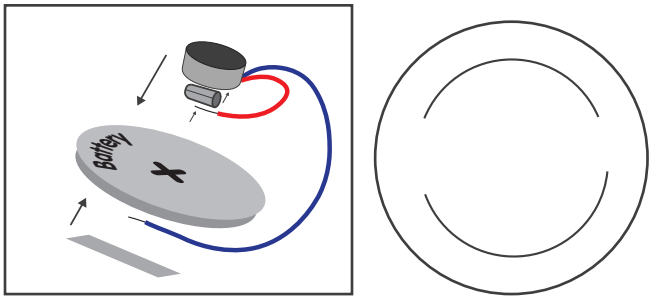
After trying out both motor wire orientations in combination with the visualizer disc and observing the DIRECTION of travel, use the circle diagrams & incomplete arrows to show the direction of motion you observed.

7.



Polarity Variation 1

8.



Polarity Variation 2

Testing the effects of mass and friction on motor outcomes.

9. Which of the five discs do you predict will rotate the fastest? **1"** **1.5"** **2.0"** **2.5"**

10. Why do your think that?_____

_____

_____

_____

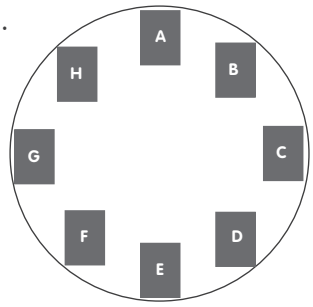
11. After testing the same motor/battery combo atop each different disc, draw each disc and label it for size along the line below to rank them for speed of rotation.

Fastest ⟶ Slowest

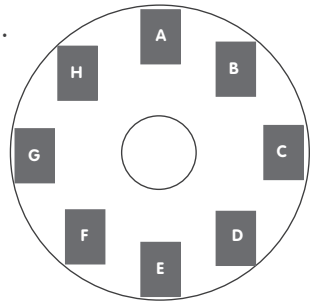
Testing the effects of mass distrubution on motion of disc.

Draw circles where you taped pennies onto the 2.5" disc for each of three trials and then draw a line that describes the resulting path of travel in the space below the diagrams.

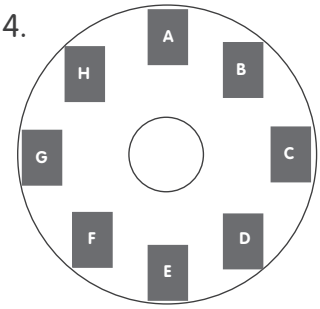
12.



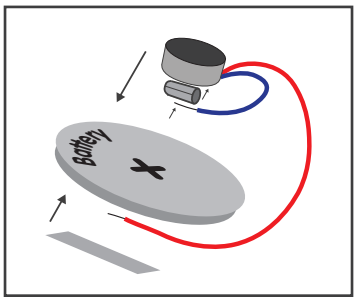
13.



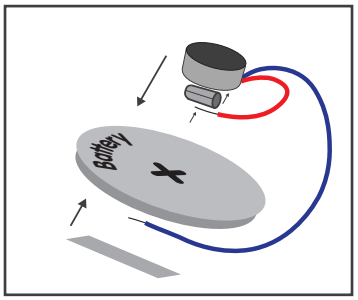
14.



Motor Motion Visualizer Templates



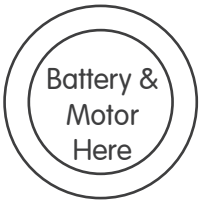
Polarity Variation 1



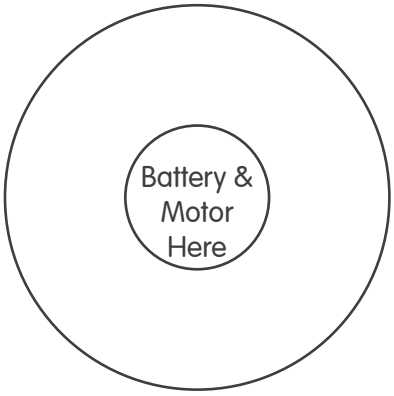
Polarity Variation 2

Wiring the motor/battery combo:

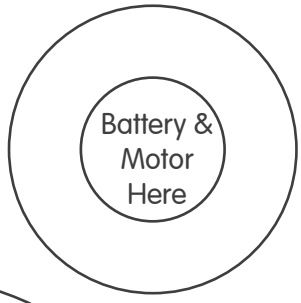
1. **Stick one wire to battery bottom (-) with Maker Tape.**
2. **Stick a Maker Tape loop to motor bottom and the remaining wire to the tape loop.**
3. **Press the Motor/Loop/Wire combo on top of the battery (+).**
4. **Stick an invisible tape loop to a center circle on the visualizer disc.**
5. **Press the vibrating motor/battery combo to tape on disc.**



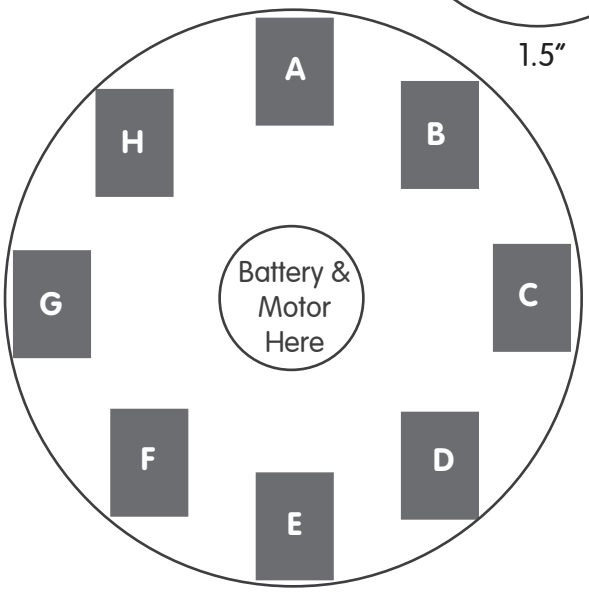
1.0″



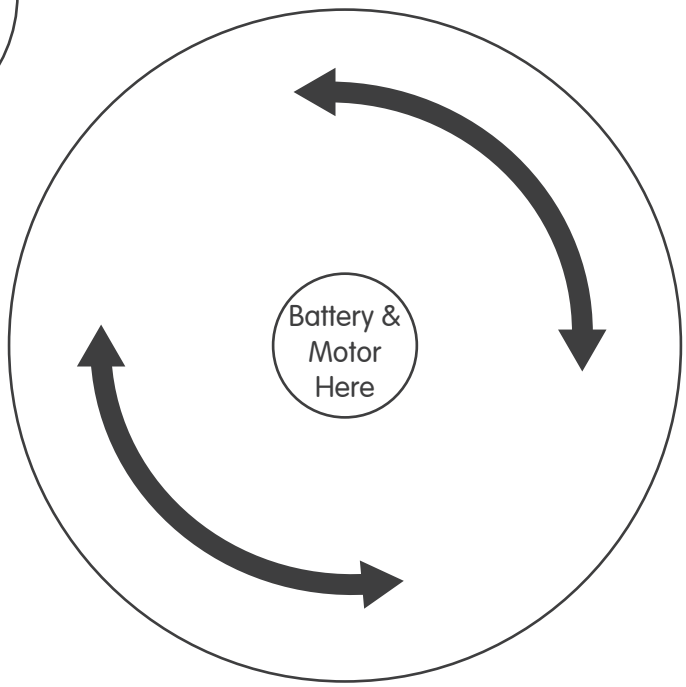
2.0″



1.5″



2.5″



3.0″

Student Sheet Name: _____

Resistance is Useful!

Language Connection

1. The root word of resitor is resist. If you resist something, you:
a) Go at it, full speed.
b) Stop your impulse.

2. Resistors **constrict/expand** the quantity of electrons that can travel out of a voltage sourcet at a given time through a circuit.

Resistor Tester Observations

After having pressed each of the items shown below in contact with the paths that are on either side of the gap in your circuit, rank them in order of brightest (1) to most dim (5).

LED Brightness Rank

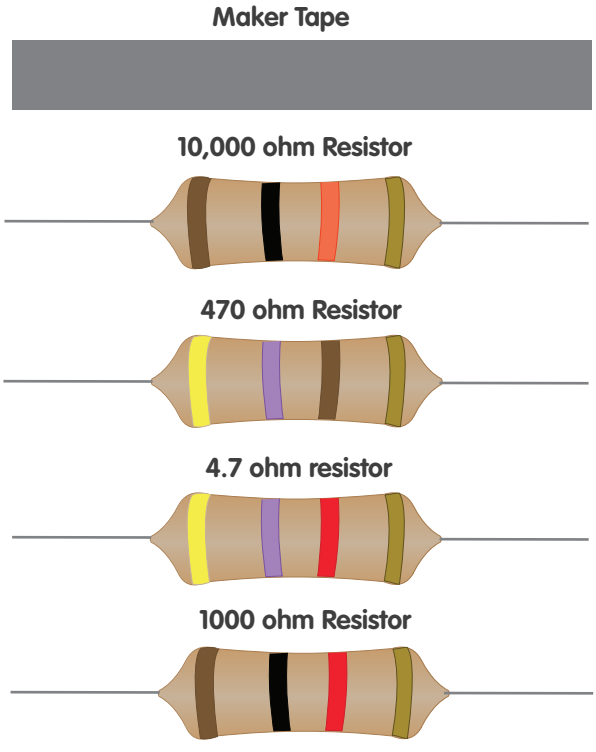
3. _____

4. _____

5. _____

6. _____

7. _____

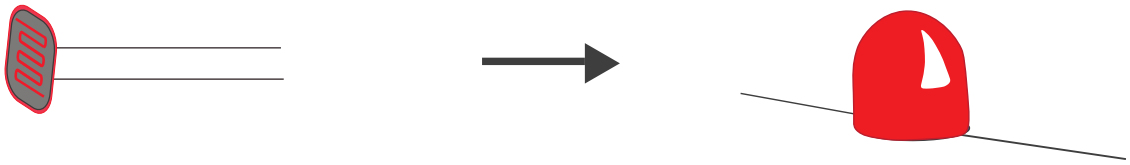


8. When the resistor value was highest, the light was the **brightest/ dimmest.**

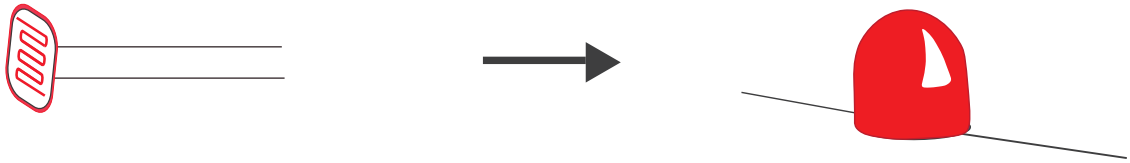
9. When the resistor value was lowest, the light was the **brightest/ dimmest.**

LDR Observations

10. When your LDR was in the DARK... your LED was **bright/dim.**



11. When your LDR was in the light... your LED was **bright/dim.**



Think about the way you ranked the first resistors and apply it to what you are observing with the LDR.

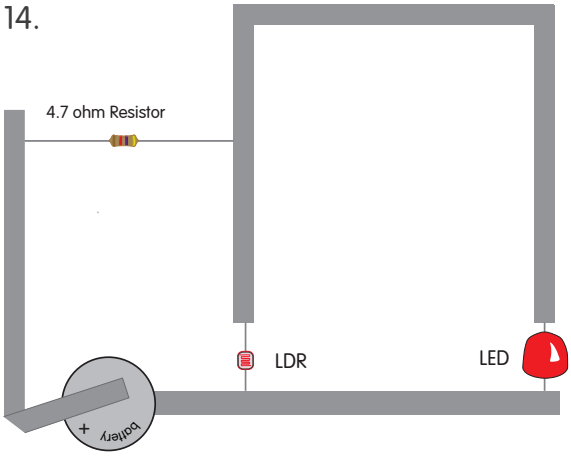
12. When the LDR is in the DARK, its resistance must be **high/low.**

13. When the LDR is in the LIGHT, its resistance must be **high/low.**

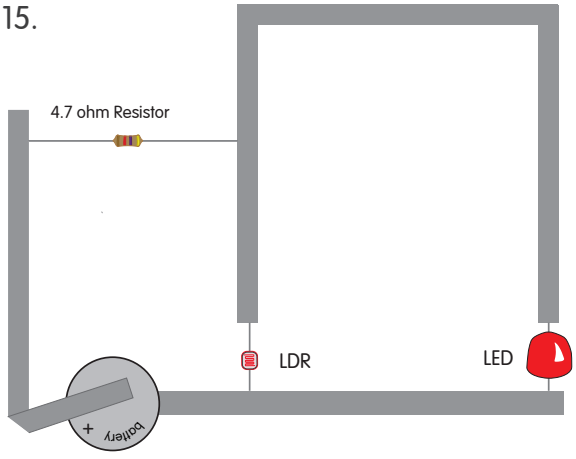
Dark Detecting Circuit Observations

Draw lines and arrows on each of the two diagrams below to show each of the two potential routes that electricity can travel through this circuit.

14.



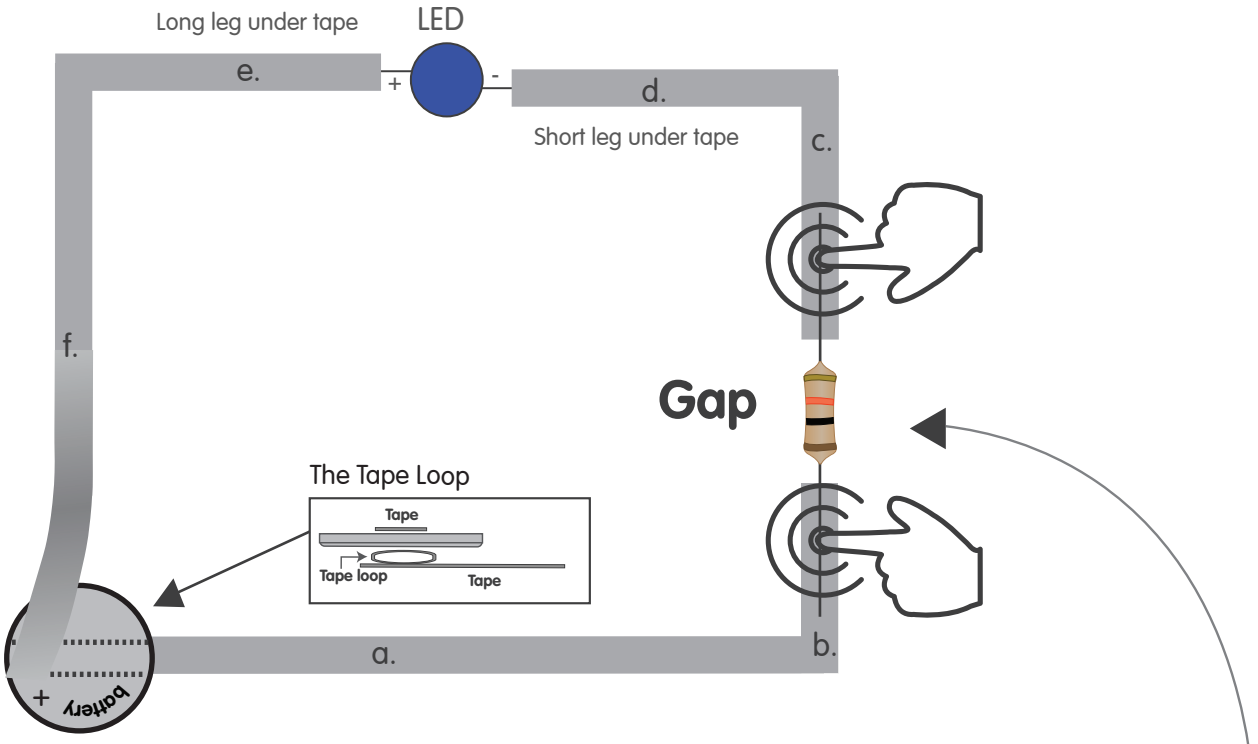
15.



16. When the LDR is in the dark, electricity travels **the LED path/ the resistor path.**

17. When the LDR is in the light, electricity travels **the LED path/ the resistor path.**

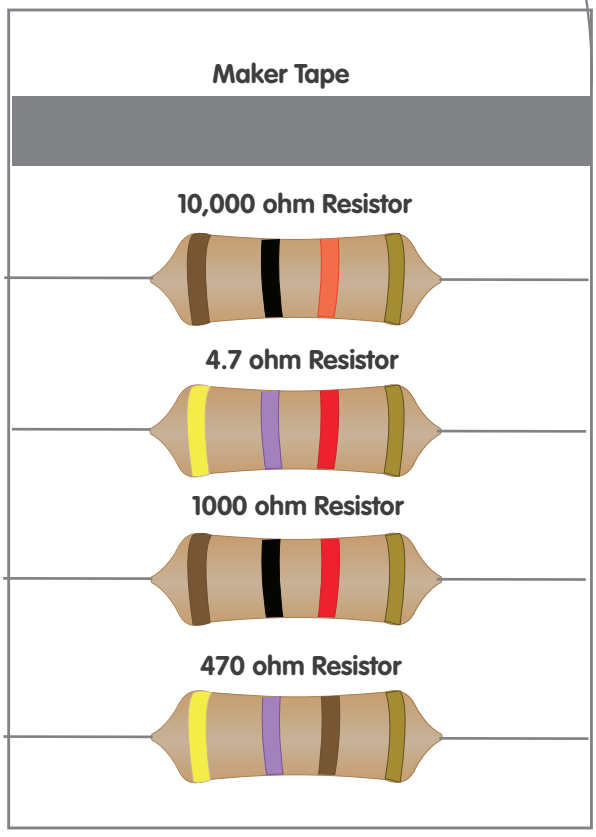
Resistor Tester Circuit



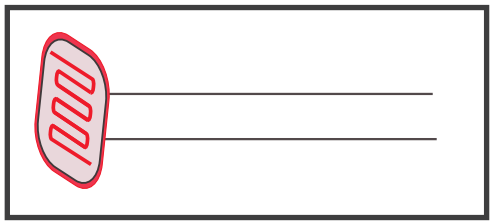
1. Bend legs of LED outward so it can lay flat against paper. Orient long and short legs as shown. Measure, cut, peel, and stick Maker Tape pathways "a,b,c,d,e " ("d,e" over LED legs).

2. Make a tape loop out of Maker Tape and stick it atop the battery end of path "a". Then stick battery atop tape loop (+) side UP. Make and stick path "f".

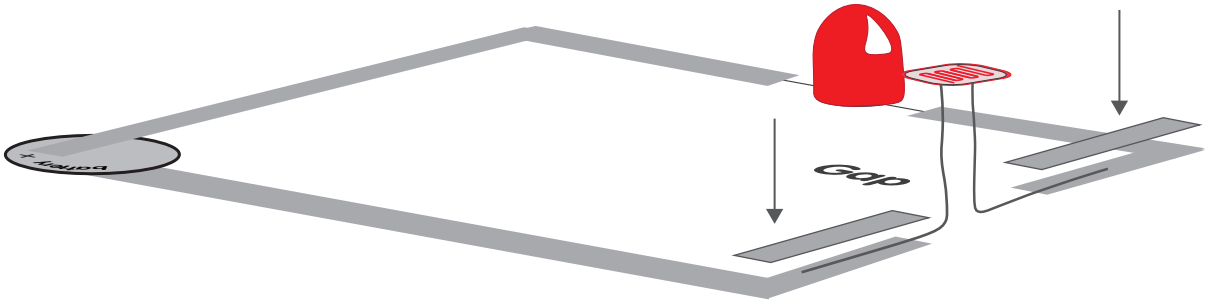
3. Your circuit will be an "open", non-working circuit without something conductive to bridge the gap indicated. One-by-one, press each of the items in the box at right in contact atop paths "b,c" and observe the resulting light at the LED. **Don't Maker Tape them in place so you can swap them in and out quickly and compare more easily.**



4 After logging your observations about the five trials you conducted (Maker Tape strip for a base comparison and the 4 fixed resistance resistors), find the LDR in your kits. Bend the legs as shown below and use two pieces of Maker Tape to stick each leg atop the paths on either side of the gap.



Your LDR (Light Dependant Resistor) is also sometimes called a Photoresistor



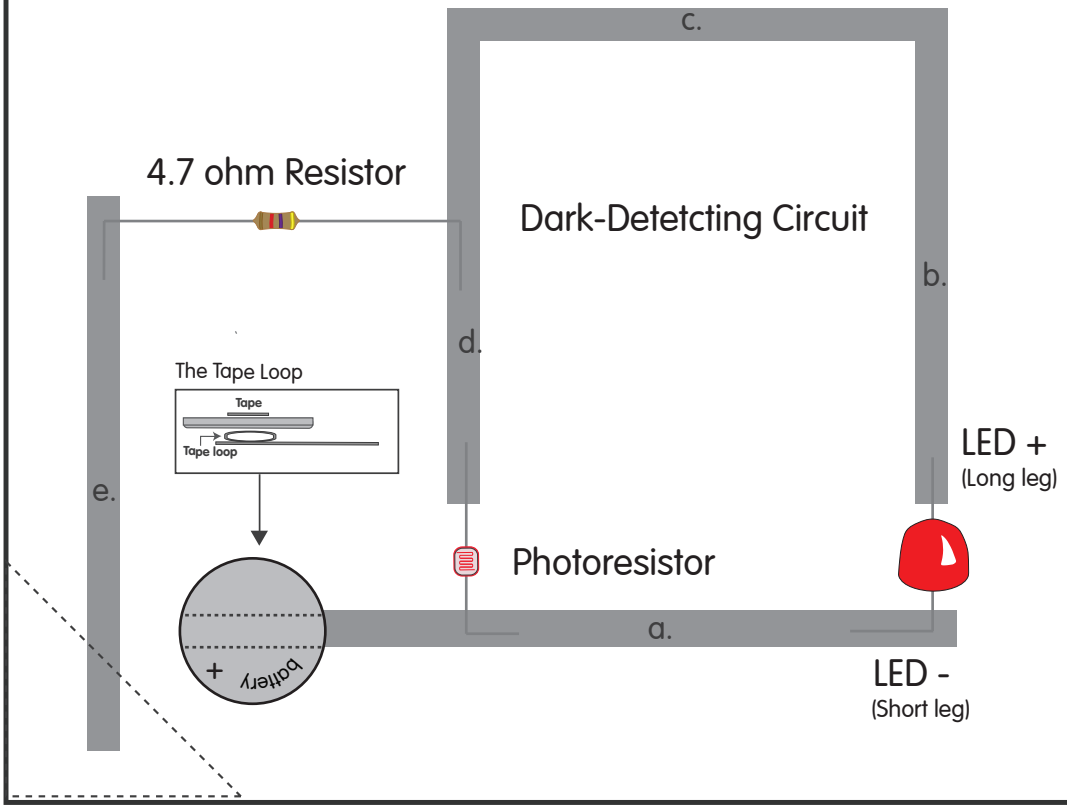
5 Use your student worksheet to guide your observations of the LED light while the LDR is covered by your hand (dark/low light) in comparison to it while uncovered and exposed to light.

Dark Detecting Circuit v1

1. Bend legs of all components as shown so they can lay flat against paper and join the paths. Orient long and short LED legs as shown. Measure, cut, peel, and stick Maker Tape pathways "a,b,c,d,e ".
Note: Maker Tape paths go OVER the 3 components. They are only shown below to describe bends.

2. Make a tape loop out of Maker Tape and stick it atop the battery end of path "a". Then stick battery atop tape loop (+) side UP.

3. **To operate:** Fold corner over and use your binder clip to hold path "e" in contact with the top (positive) side of the battery. Test to see what happens at the LED when the LDR is in a bright environment and when it's in a dark environment.

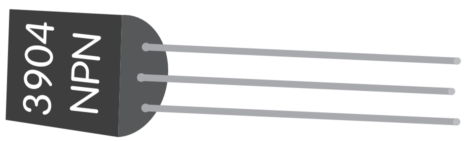


Student Sheet Name: ______________________________

Transistors as switches

Your NPN Transistor

Your transistor has three wires. One is the Base. One is the Collector. One is the Emitter. Use the the blank spaces to the right of the image below to show which is which.



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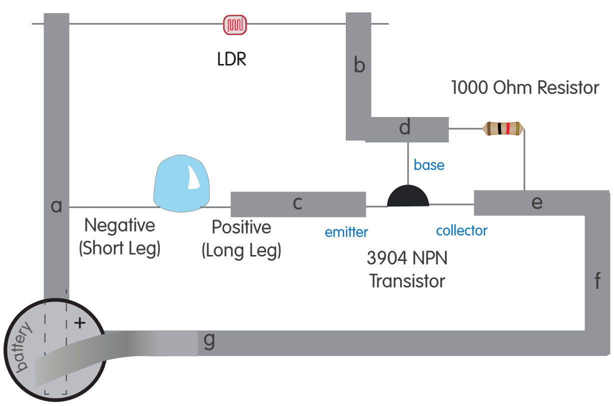
Touch-Activated Switch

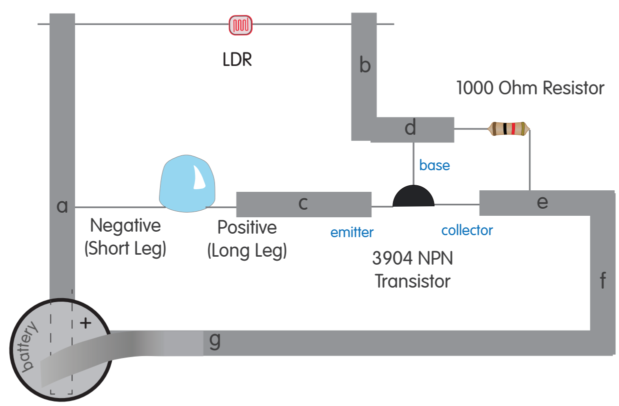
1. Which of the three wires on this transistor needs to have voltage applied to it in order for the condition of the remaining parts to change? **Emitter/ Base/ Collector**

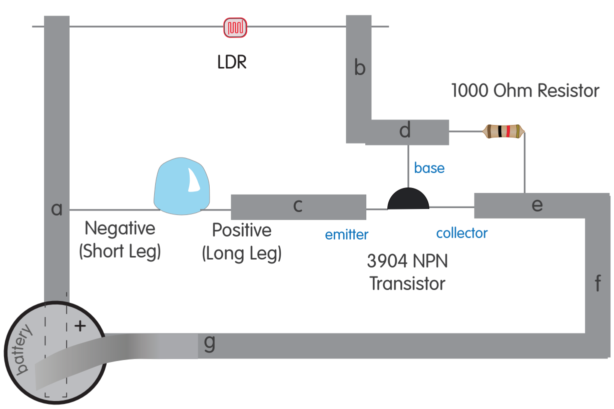
2. What happens to the rest of the transistor when voltage is applied to that wire? ______________
____

Mapping the Dark Detecting v2 Circuit

Below are three identical images of your Dark Detecting v2 Circuit. There are three potential paths electricity can take through it. Draw a single path on each diagram.







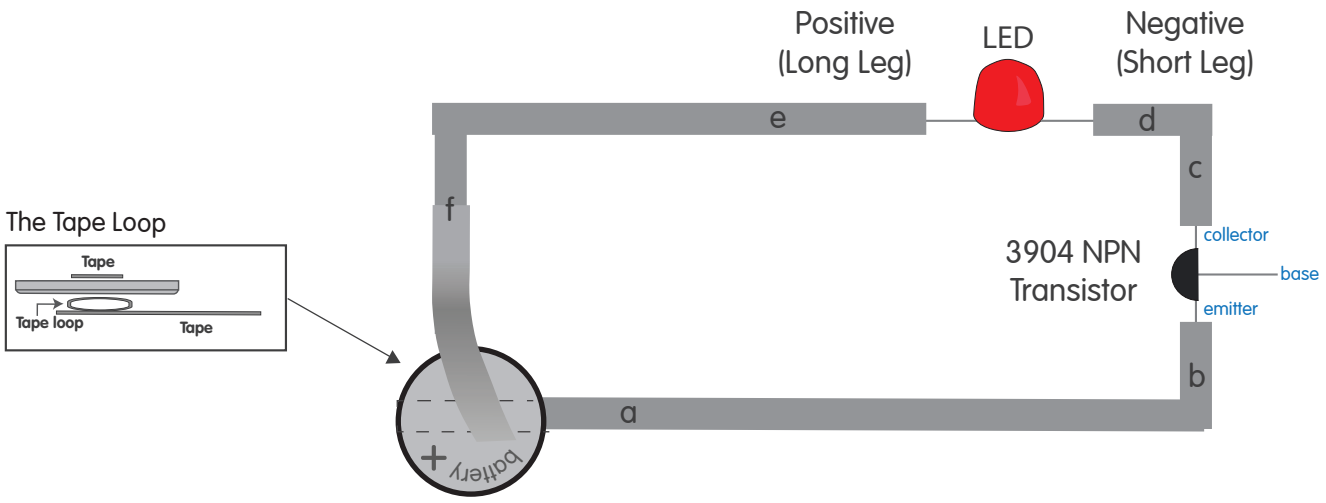
6. In order for the transistor to allow electricity to pass through the path that includes the LED, the **Emitter/ Base/ Collector** needs to have voltage applied to it.

7. In order for the above to happen, the LDR and Resistor path needs to have **higher/ lower** resistance than the Transistor Base path.

8. The light condition that needs to be present for the LED to turn on is: **Bright/ Dark**

Touch-Activated Transistor Switch

1. Pre-bend the 3904 NPN Transistor as shown in the diagram. Afterward, position all components atop the diagram as shown.
2. Measure, cut, peel, and stick Maker Tape paths "a-e" atop the wire leads from all components.
3. Make and stick a Maker Tape loop atop the battery end of segment "a".
4. Stick battery atop tape loop with the positive side facing UP.
5. Measure, cut, peel and stick Maker Tape segment "f" in place, sticking the end to the top of the battery.
6. Test by touching and releasing the base of the transistor.

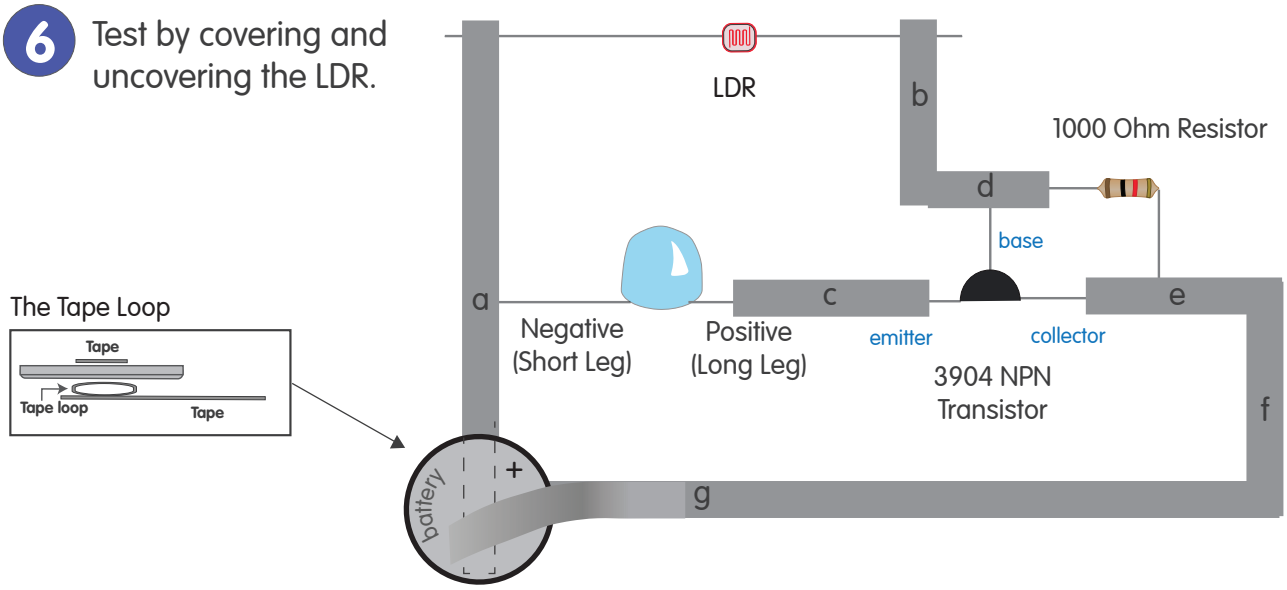


This circuit can only be turned on by contacting the base of the transistor and anywhere on the path that leads back to the top of the battery. A small amount of measureable current is running through our body at all times and, by contacting the base of the transistor, the path through the transistor becomes active, allowing current from the battery to complete the loop from and back to the battery through the LED.

Dark Detecting Circuit v2

Materials: 1x Blue LED, 1x CR2032 Battery, 1x 3904 NPN Transistor, 1x 1000 Ohm Resistor, 1x Light Dependent Resistor (LDR), Maker Tape, Circuit Card,

1. Pre-bend the 1000 ohm resistor and the 3904 NPN Transistor as shown in the diagram. Afterward, position all components atop the diagram as shown.
2. Measure, cut, peel, and stick Maker Tape paths "a-f" atop the wire leads from all components.
3. Make and stick a Maker Tape loop atop the battery end of segment "a".
4. Stick battery atop tape loop with the positive side facing UP.
5. Measure, cut, peel, and stick Maker Tape segment "g" in place, sticking the end to the top of the battery.
6. Test by covering and uncovering the LDR.



- The general idea behind this circuit begins with understanding how LDRs AND Transistors work. You already know how the LDR changes resistance in different light conditions. The transistor in this circuit acts as a switch between two of the three paths present in this circuit.

- Adjusting the resistance at one pathway forces the electricity to travel different paths under different conditions.

- An NPN transistor turns on when the current flows through the base of the transistor. The path though the transistor and LED is inactive unless current hits the base. When the LDR is in a bright environment, its path is lower in resitance than the base and the current travels through IT and the resistor, bypassing the base. When it is dark, the resistance of that LDR path is too great and the current DOES hit the base; opening the path from collector to emitter and then to the LED.

Student Sheet Name: _____

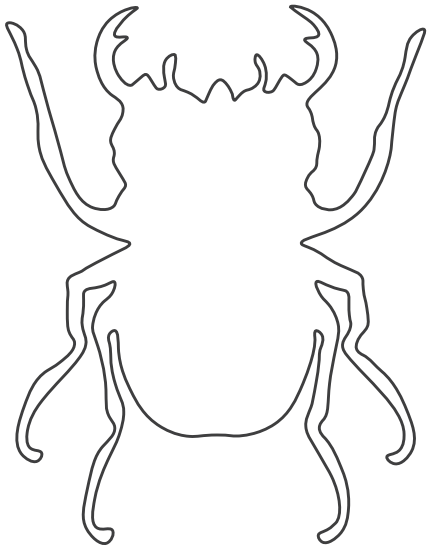
Solar Powered Circuits

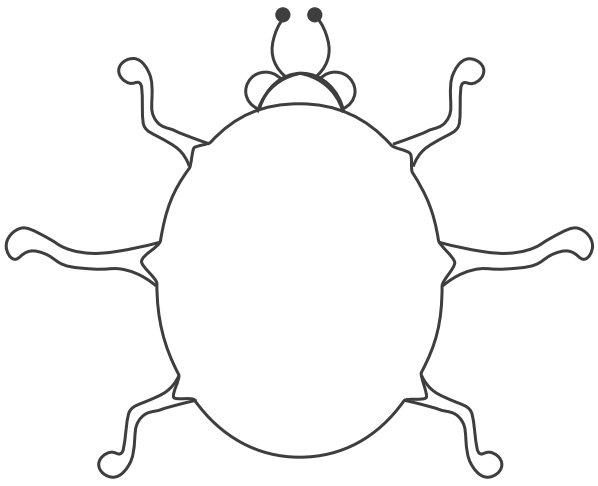
Single LED Solar Circuit

1. The solar cell circuit **worked/ didn't work** when exposed to direct sunlight.
2. The solar cell circuit **worked/ didn't work** when exposed to other sources of light.
3. All light from all sources must be **the same/ different**.

Solar Bug Performance

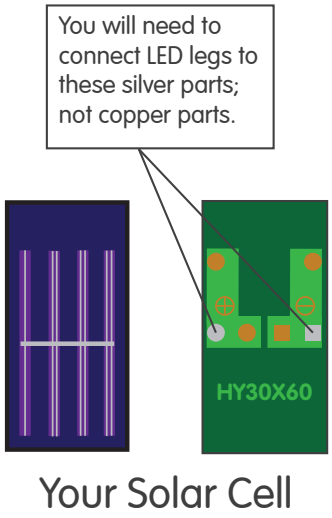
Use the image of the bug body you chose for your project. Draw circles to depict the number of googly eye/rumble feet you chose to use as well as the approximate position of them. Then, use the space above the bug to draw an arrow shape that describes the resulting motion of your bug. Now compare YOUR bug's path with your classmates'.



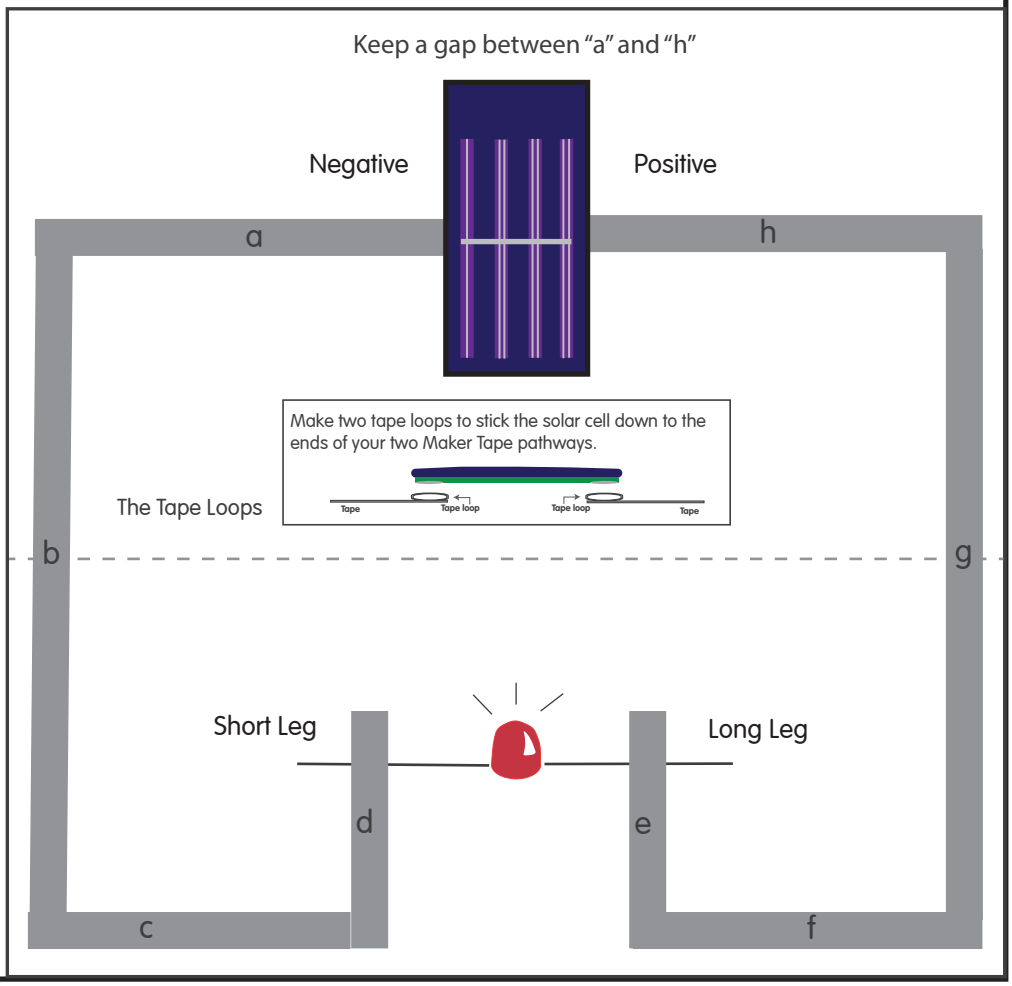


Solar Cell & LED Circuit

1. Measure, cut, peel, and stick Maker Tape paths "a-h" placing your red blinking LED between and under paths "d,e". Leave a gap where shown between paths "a,h".
2. Cut two small pieces of Maker Tape and make two separate tape loops.
3. Stick one loop atop the solar cell side of path a and the other atop the solar cell side of path h.
4. Stick the solar cell atop those two loops at the silver contact points shown below left. Cut the project out/fold at the dotted line so LED and Solar Panel are on opposite sides.
5. To test: Hold panel side above head facing the sun while observing the LED from below in the shade.
6. Try different angles of the Solar Panel in relation to the sun! Is there an angle that makes the blinking light stop blinking?

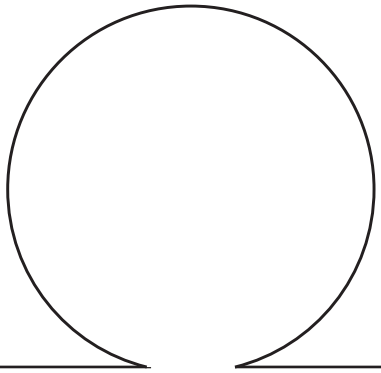


Your Solar Cell



Motor and LED Tube

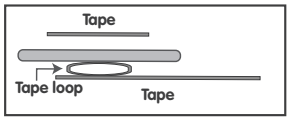
Print file back-to-back!

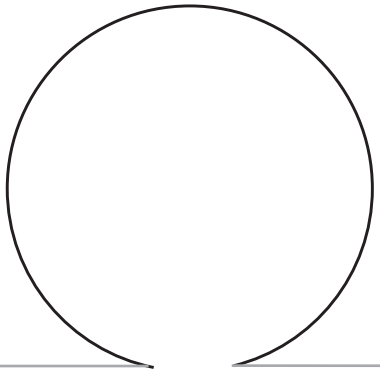


- Design around where the LED will be!
- Use scissor to cut out your shape taking care to leave the circular cap attached to the lower rectangle.
- Follow diagram on back of project to assemble circuit.
- Curl into a tube shape and secure back edge with a piece of transparent tape.

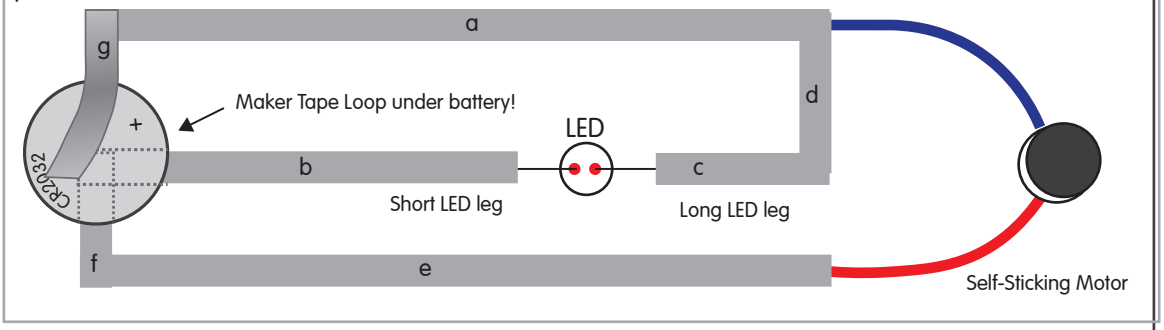
Idea: Draw and cut out things to tape to the outside of the tube with its circular motion in mind! Eyes, ears, antlers, branches, tentacles... go wild!

The Tape Loop





*Stick tape to battery to turn on;
peel back to turn off.

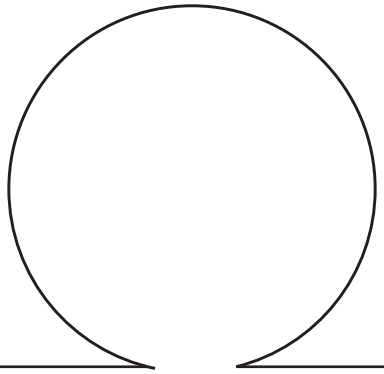


Circuit Assembly Instructions

- Poke 2 small holes from this side for the LED where shown.
- Insert LED from the front (short leg in right hole; long leg in left hole when viewed from the front) and bend them in opposite directions to lay flay against paper.
- Peel and stick the motor where shown.
- Cut and lay down Maker Tape paths "a-f" in order where shown (tape goes OVER LED legs).
- Make a tape loop out of Maker Tape and stick it where "b and f" meet.
- Stick battery on top of tape loop (+) positive side up.
- Cut and lay tape path "g" to complete.

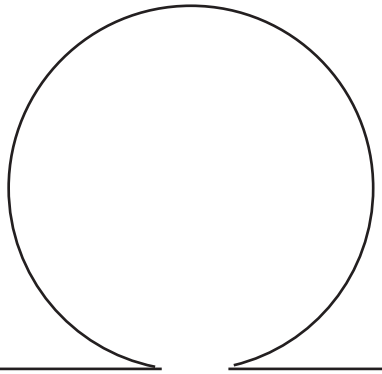
Parallel Tube

Print this file back-to-back!

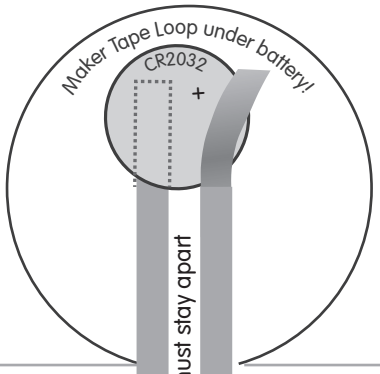


- Use a scissors to cut out your shape taking care to leave the circular cap attached to the lower rectangle.
- Design around where the LEDs will go.
- Follow diagram on back of circle to assemble light ciruit.
- Curl into a tube shape and bend LED legs to match the curve you make.
- Secure back edge with a piece of transparent tape

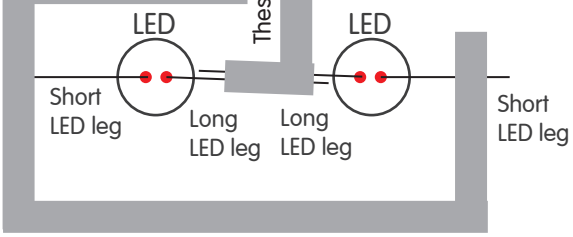
Backlit Tube



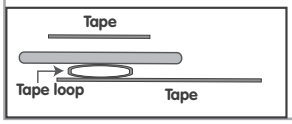
- Use a scissors to cut out your shape taking care to leave the circular cap attached to the lower rectangle.
- Lightly sketch what you want to cut out.
- Cut out those parts so light can shine through.
- Curl into a tube shape and secure back edge with a piece of transparent tape.
- Follow diagram on back of circle to assemble light circuit.



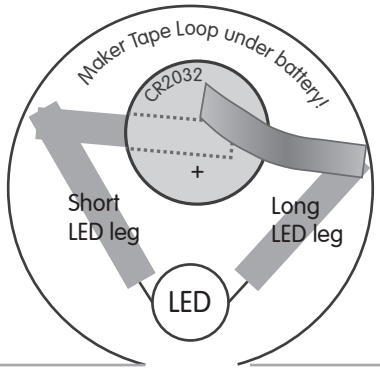
*Stick tape to battery to turn on; peel back to turn off.



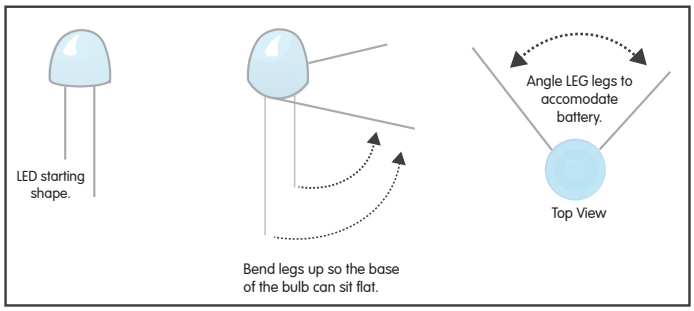
The Tape Loop



Poke holes in the 4 dots so you can thread the LED legs through from the outside TO the inside.

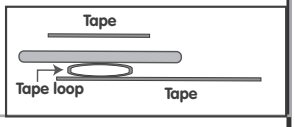


Preparing the LED legs



*Stick tape to battery to turn on; peel back to turn off.

The Tape Loop



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