BARNABAS ROBOTICS

<BUILD. LEARN. TEACH. INSPIRE>

THE TINKER SERIES

Projects For Young Inventors

Barnabas Movie Maker

REVISION HISTORY

Revision 1.02
Creation Date: 5/30/2018
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Revision History

- 1.00: First revision
- 1.01: Created version two session version for Aveson
- 1.02: Minor updates

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The Barnabas Movie Maker

Overview

Build a robot movie theater!

Topics Covered

Breadboarding, Animation, Gears

Materials Needed

Materials listed required to build one robot.

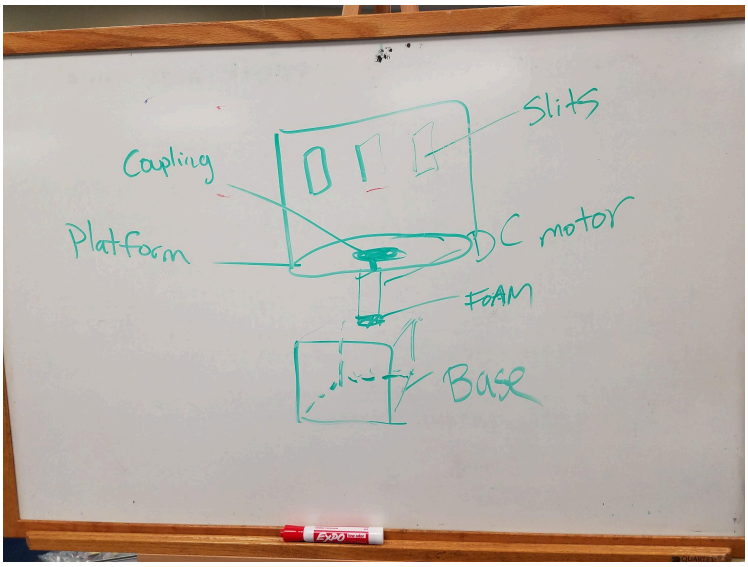
Item	Qty	Notes	How To Purchase
9G DC Geared Motor	1		Barnabas E-Store
Servo Coupling	1	Make sure that it fits onto the 9G DC geared motor!	
Micro-Breadboard	1		Barnabas E-Store
On/Off Switch	1	3-pin	
Male to Male Arduino Wire	4	Best if you use 2 Black and 2 Red, but any color will work	
Paper jewelry box (2x2x2)	1		
AA Battery	1		
AA Battery Holder (Female)	1		
Double-stick Foam (Rectangular)	1	To stick motor to box	
Construction Paper with slits	1	For the spinning drum	
Animation Film (free-draw)	1	Optional. Use if kids want to draw their own movie.	
Animation Film (pre-drawn)	1	3 options on an 8.5”x11” paper	
Soup Cup Top	1	For the base of the spinning drum	
Additional Parts			
Plate	1	Only necessary if you are doing the two-session class	
Turn & Learn Gears	1	Only necessary if you are doing the two-session class	Lakeshore Learning

Additional Craft Materials	1	Scissors, Construction Paper or Origami paper, markers, Scotch Tape	

Introductions and Ice Breaker (5 min)

Introduce today's project. Talk about how we are going to be making a "Zoetrope", which is one of the first movie machines. The first one was invented in 1867 by William Lincoln.

Designing The Base (10 min)



Draw the following in order:

1. The Base (3x3 box)
2. Sticky foam on top of the box
3. DC Motor
    a. Notes about DC motors - they spin forever, and they can go in both directions.
4. DC Motor coupling
5. Soup Lid -- the platform
6. Construction paper with slits
    a. Have the kids think about which part of body will turn. Have them look at the motor
7. AA Battery inside of the the base
8. Breadboard on the side of the base

Building The Base (15 min)

1. Hand out the box and have the kids put it together. Spend some time decorating the box (5 min)

Gears (Bonus Material - 10 min)

The following module can be performed if you have the Turn & Learn Gears.

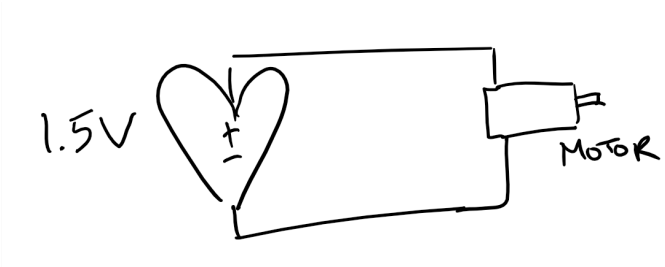
Explain that we will be using a DC motor today, but that it will be different from before because it has gears. Gears a special circle things that do a few special things for us.

1. Transfers energy from one place to another. Demonstrate the transfer of energy from one gear to the other
2. Changes the speed of the motor. Demonstrate that when you move gears with different sizes, it changes the speed.
3. It changes the strength. It is harder to turn the end of a gear train. Demonstrate this with your gear set. See that you can spin just one gear really fast when you flick it, but it's not the case when you have an entire gear train

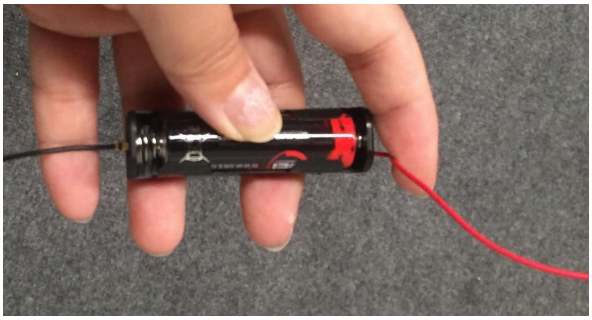
Spend some time and having the kids build a gear train across the entire board.

DC Motors (5 min)

1. Explain what a DC motor is. It is a type of motor that has two special things about it:
    a. It spins forever when you give it power (at least until it runs out of batter)
    b. It spins both ways. When you reverse the plus and minus, it turns the other way.
2. Draw the following circuit:



3. Open-Circuit: An open-circuit is when the loop is broken. In this case, electricity cannot flow. Explain that the robot cannot live if we have an open-circuit - much like how we cannot live if blood is not circulating in our body.
4. Put the AA battery into the battery holder. Have them figure out which way to put the batter in, and which side is positive and negative (red = positive, black = negative). Teach them not to directly connect the black and red wires together (short-circuit!).



5. Short-Circuit: A short-circuit is when you have a loop, but electricity is flowing too fast. Ask the kids what happens in our body when blood flows so fast that our veins can't handle it (it might burst!). In order to fix this, we need to slow it down. This introduces our final concept... resistance!
6. Resistance: Resistance is introduced in a circuit to slow down the flow of electricity so that our wires don't burst. It is important, because without it, our circuits may get really hot and catch on fire! In a circuit, we call this component the resistor. Our resistor will be a motor.
7. Experiment with the robot's heart. See if you can get the motor to turn on!

Mounting The Motor (10 min)

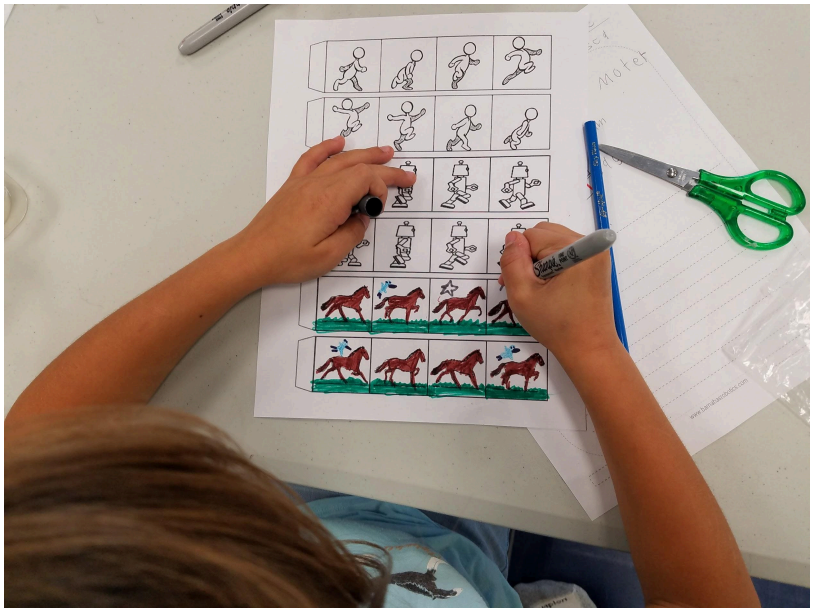
1. Have the kids draw a dot in the middle of the top of the box. Go around and check to make sure that the dot is in the center. Adjust if necessary.
2. Take the foam and stick it on the top of your box. While you are doing it, make sure that the end of the rectangle covers the dot. This will make sure that the motor shaft of your DC motor is going to be in the middle of the box cover.

Mounting The Plate (Bonus Material - 10 min)

This step is not necessary for home builds.

1. Decorate your plate to be something that rotates. Take a plate and draw a dot in the middle of the top.
2. Take your motor coupling and place the center hole of the coupling over the dot.
3. Tape the wings of the coupling to the lid. Make sure not to cover the hole as you will use that to connect the lid to the DC motor.
4. Place the plate onto the DC motor. Press down on the center of the lid to fasten it tightly to the shaft. Remind the students here that the coupling must attach to the motor shaft.

Making Our Movie (15 min)



1. Hand out the movie strips and have the kids select one that they would like to color. Let them know that they can take the whole sheet home.
2. Show them the demo of how you can decorate their character.
3. Go over the concept of animation. Each "frame" of the movie need to go in sequence after the previous "frame".
4. Have the kids decorate
5. Cut out the two film strips and tape them together to form a 8 frame film.

Attaching The Movie Slits (10 min)

1. Place double-stick tape along the bottom of construction paper. Use 3x2 inch long strips.
2. Now stick the slits onto the lid. Add a piece of single sided tape for where the two sides come together.

Attaching The Soup Lid (10 min)

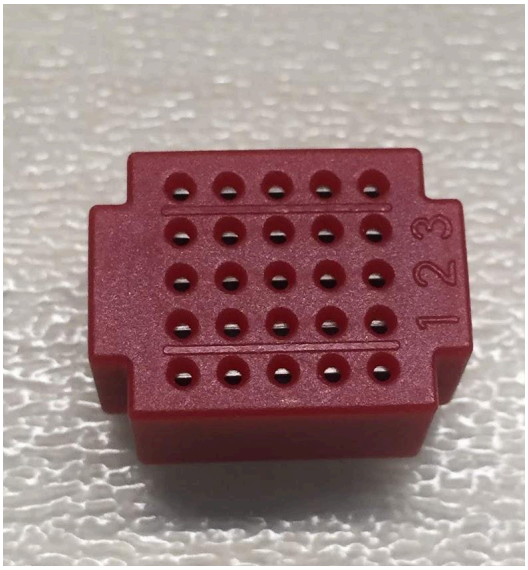
1. Take your soup lid and draw a dot in the middle of the top.
2. Take your motor coupling and place the center hole of the coupling over the dot. Remove the coupling from the plate if you completed the "Mounting The Plate" step.
3. Tape the wings of the coupling to the lid. Make sure not to cover the hole as you will use that to connect the lid to the DC motor.
4. Place the platform (soup lid) onto the DC motor. Press down on the center of the lid to fasten it tightly to the shaft. Remind the students here that the coupling must attach to the motor shaft.

Introducing The Mighty Breadboard (5 min)

The breadboard is a special tool that is used by engineers to wire robot hearts. Note that there is a sticky foam under the breadboard.

VOCABULARY word: *Breadboard* - A tool to connect wires together

1. Draw the breadboard on your worksheet. Make sure to turn it horizontal (or hamburger). This is the opposite of vertical (or hotdog).

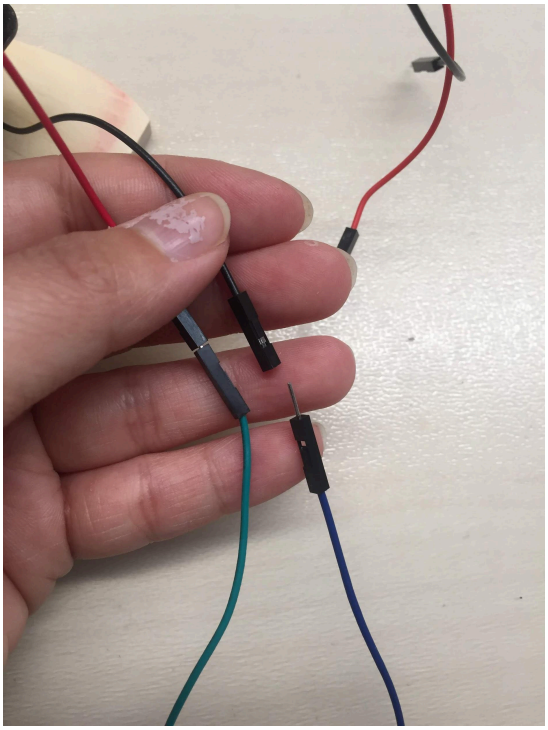


Connected or Not Connected? (5 min)

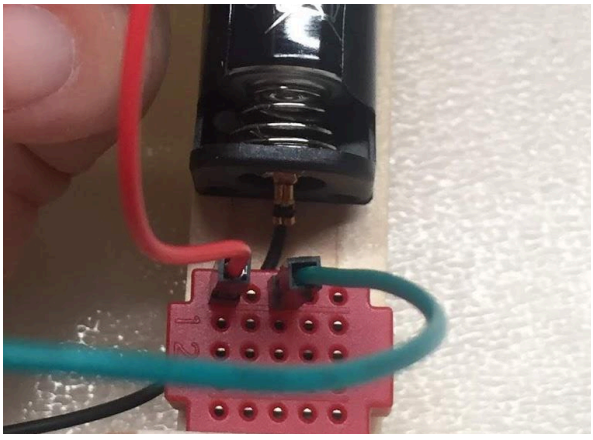
1. If holes are on the same row, they are connected.
2. If holes are on a different rows, they aren't connected.
3. Using 5 different color markers, draw lines across the 5 rows of holes.

Our First Breadboard Connection (10 min)

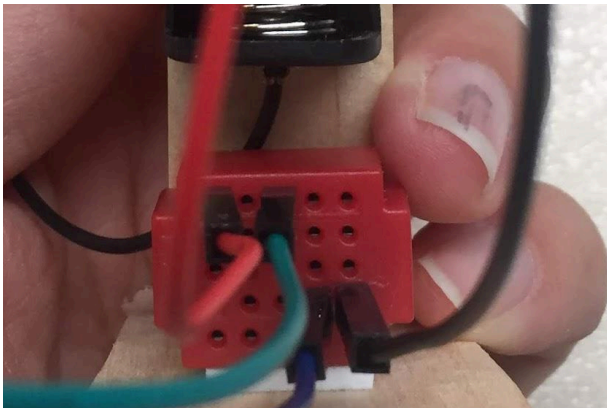
1. Add Two Arduino Wires to the red and black wires of the battery holder



2. Add Two Arduino Wires to the red and black wires of DC motor.
3. Connect the positive wire of the battery to one motor wire.



4. Connect the negative wire of the battery to the other motor wire. You just made the second connection. It should turn on!



Key Learning: Whenever you make a new connection between two wires, it should always go on a different row.

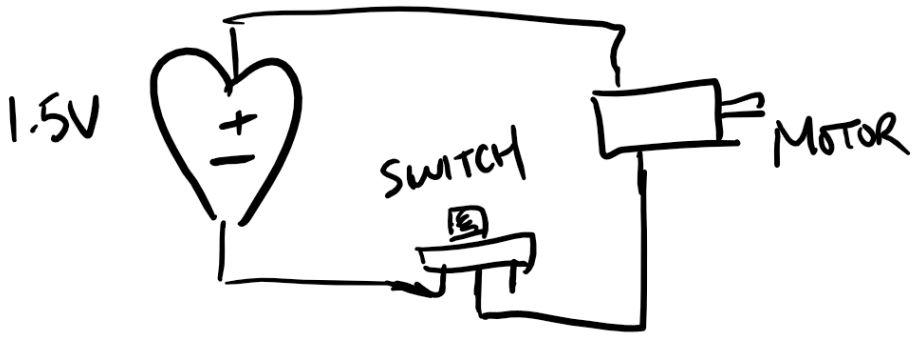
This would be a good time to review open circuit and closed circuit.

1. Have the students make an open-circuit (remove one of the wires so that the electricity cannot flow)
2. Now have the students make a closed-circuit by putting the wire back.

Switch (10 min)

If you have time, you can try adding a switch to your fan.

Draw a new circuit that shows a switch. This is going to be able to make your fan turn on and off.



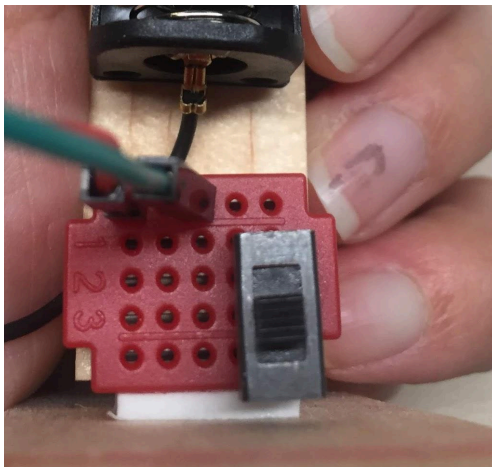
The way a switch works, is that the top part slides back and forth.

1. When the switch slides to the left side, the middle and left pins are connected.

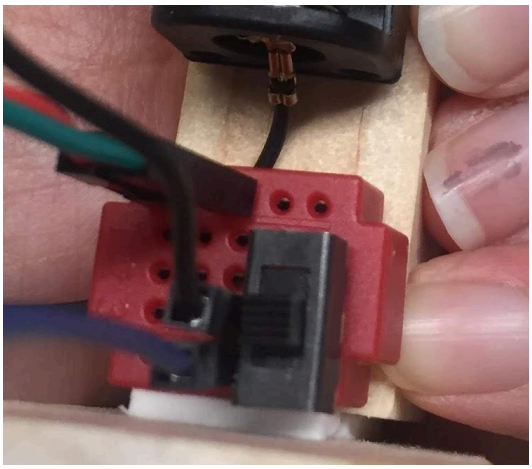
2. When it is slid to the right side, middle and right pins are connected.

Using this switch, let's connect an outside pin to the minus of the battery and the middle pin a motor wire.

First, let's insert the switch. Make sure that all three pins are on different rows. Now connect the positive of the battery to one motor wire. We always want this connection on, so we'll put this connection on a row that isn't used by the switch.



Now connect the other motor wire to the middle pin of the switch and the other motor wire to one of the outside pins of the switch. Try it out!



Experiment! (5 min)

1. Put in your film and watch your movie!