

INNOVATION WYRKSHOP

LASER CUT CART PUSHING ROBOT

ESTIMATED TIME: 45 MINUTES

LEARNING OBJECTIVES

- Learn how to make 2D designs into a 3D robot
- Discover how a stepper motor works
- Create a working push-cart robot

LEVEL: 1

STANDARDS

- NGSS
 - Defining Engineering Problems ETS1.A
 - 3-5 ETS1-1
 - Developing Possible Solutions ETS1.B
- PBL
 - Sustained Inquiry
 - Authenticity
 - Student Voice and Choice
- STEM
 - Abstraction used to reduce complex problems
- ISTE
 - Empowered Learning 1.1d
 - Innovative Designer 1.4c
 - Creative Communicator 1.6a, 1.6b

MATERIALS NEEDED:



AA Battery Pack with Batteries



1 Piece 8x10 Balsa Wood 1/8" Thick



Glowforge/ Laser Cutter



Rubber Bands



TT V6 Stepper Motor



Candle (optional)

ACTIVITY OUTLINE:

INTRODUCTION:

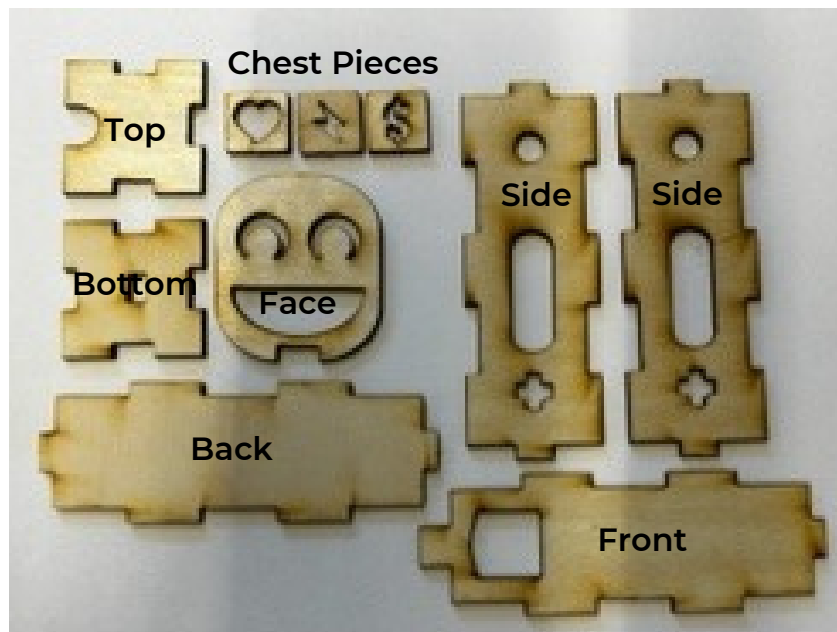
For video instructions follow this link:

<https://www.youtube.com/watch?v=TDdahxxYM7Q&t=6s>

For template click here: <https://www.instructables.com/Laser-Cut-Cart-Pushing-Robot/>

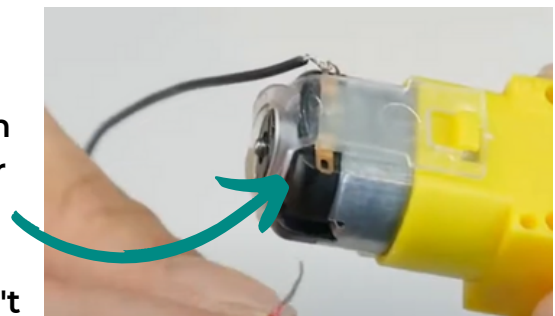
Cut out all parts on the laser cutter. The laser cutter uses a process called subtractive manufacturing, this means that instead of adding material to the build plate like a 3D printer does, this takes away material and cuts it away. This laser cutter uses a high powered laser to cut out or engrave your material.

ROBOT BODY ASSEMBLY



STEP 1:

Take your battery pack and make sure it is in the off position. Now take the stepper motor and locate the small loops on the end see photo here. Thread one lead through each loop. Twist them to keep them in place. Don't worry, they don't need to go in any specific one!



STEP 2:

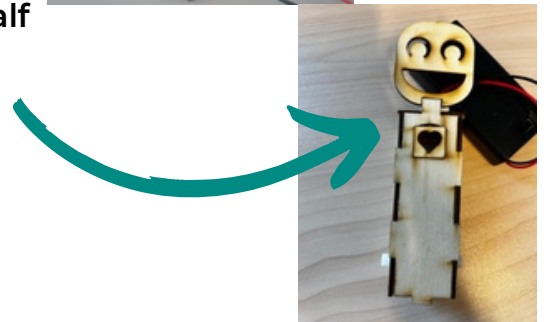
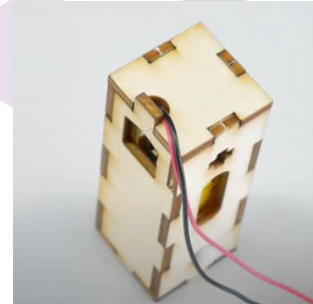
Now, take the motor and insert the plastic peg through the circular hole in one of the side pieces. Switch on the battery pack and notice what direction the plastic peg is rotating. If it is turning clockwise relative to the side piece, the front of your robot will be to your right, if it is turning counter clockwise, the front side will be to your left.

STEP 3:

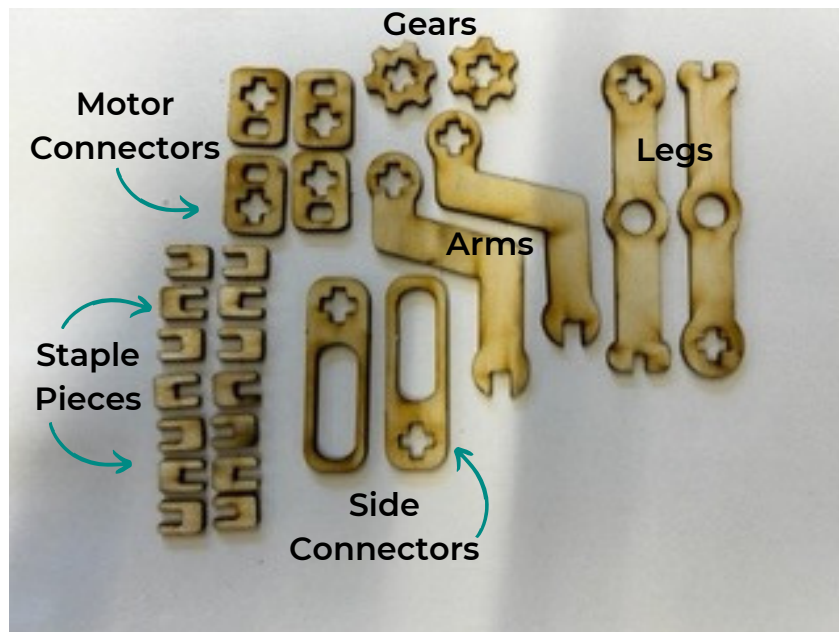
Next, take the front piece and put it on the front of your robot (if you are confused on which side is the front, take a look at step 2). Then attach the other side and back pieces.

Grab the bottom and top pieces. The top piece has a half moon shape cut out of it. This is the "neck" hole. Take your wires and feed them through the neck hole, half moon piece against the front of the robot. Attach the bottom piece.

Lastly, put your face on the front piece, and choose a chest piece!

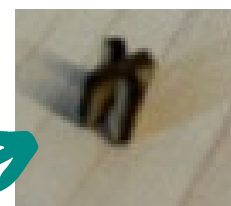


LEGS AND ARMS ASSEMBLY



STEP 1:

Take all of the staple pieces and assemble them to make small "X" shapes using two staple pieces for each X shape. You should have seven "X" shapes.

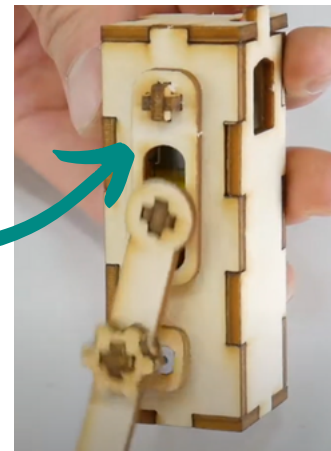
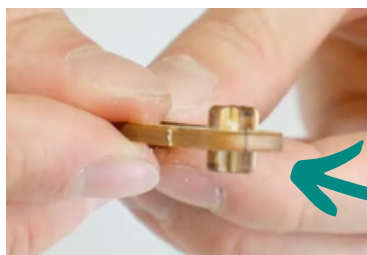


STEP 2:

Grab the motor connector pieces and slide one of them onto the oval part over the motor shaft. Next, insert one of the X's into the cross shaped hole so it is flush with the side of the robot. Do this for the other motor connector piece. Note, the motor connectors should be going opposite ways. The easiest way of doing this is to turn the robot so the front is facing you, and see if one of the motor connector X shapes is closest to the front and the other to the back.

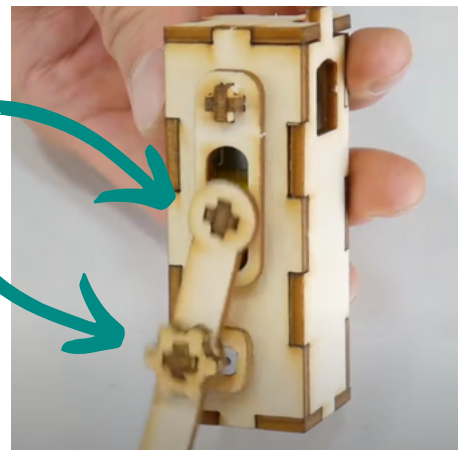
STEP 3:

Now take one of the side connectors and insert an X into the cross shaped holes so that it is poking out half way through. Then, slide this into the cross shaped hole above the shaft as seen here. Do this for both sides. Careful not to apply too much pressure and crack the wood!



STEP 4:

Take the leg pieces and put an X piece into the top cross shaped hole, inserting it until it is flush. Now, insert that leg piece into the side connector piece (this will fit in that oval shaped groove). Then connect the hole in the middle of the leg to the X piece on the motor connector. To secure this in place, take a gear and place it over this piece. Repeat for the other side.

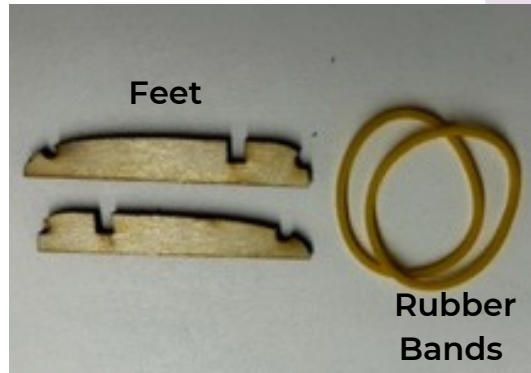


STEP 5:

Lastly, let's connect the arms! These will connect to the X shaped piece on the side connector. When connecting the arms, make sure they are facing the front of the robot. Also, be sure not to push the X shape into the robot, grasp the whole body and wiggle the piece on with both thumbs.



FEET ASSEMBLY

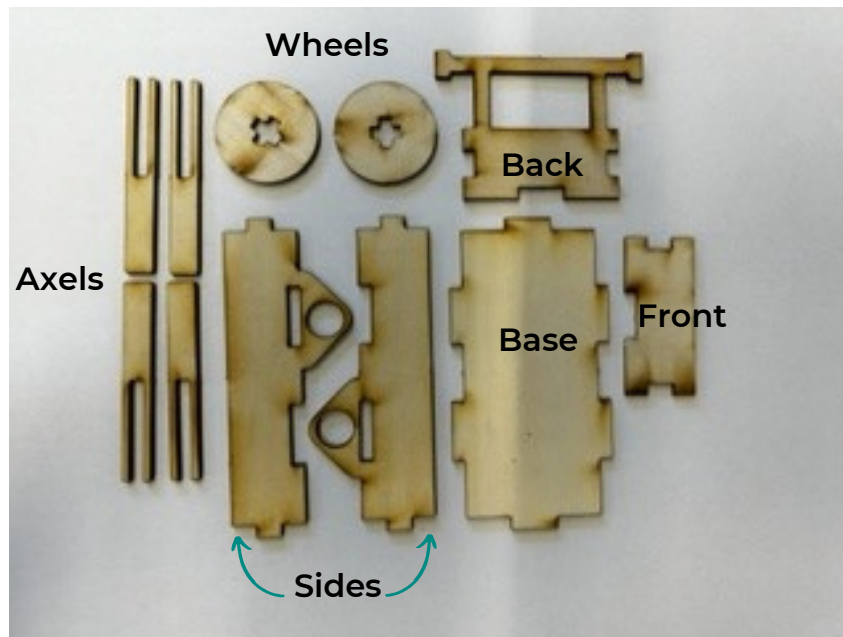


STEP 1:

Take the two foot shapes and attach them so that the long parts are facing inwards. Attach a rubber band connecting the grooves on the outside of the foot to the grooves on the inside of the foot. This will give your robot some traction when its walking! Repeat for the other foot.



CART ASSEMBLY



STEP 1:

Start with the side piece, slide it onto one of the long sides of the base piece. Repeat on the other side, making sure that the holes in the side pieces line up.

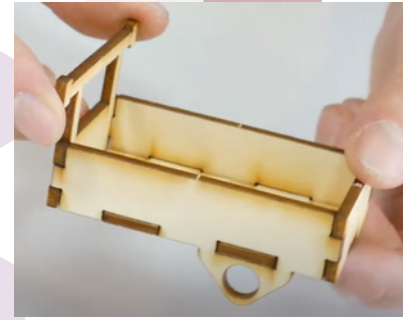
STEP 2:

Take the back piece and attach it to the short side of the base piece, closest to the holes of the side piece. Then take the front piece and attach it to the remaining side.



STEP 3:

Then, take two axel pieces and create long X shapes. Insert the X into the hole on the side pieces. Then attach the wheels to each end of the X piece.



STEP 4:

Take your cart and insert it into the hands of the robot. Then take the battery pack and put it into the cart, switch face up.

TROUBLESHOOTING

Sluggish robot?

This means that the piece connected to the robot is too tight. Loosen this up by hand or use a tool to wiggle it out a bit.

Leg falling off?

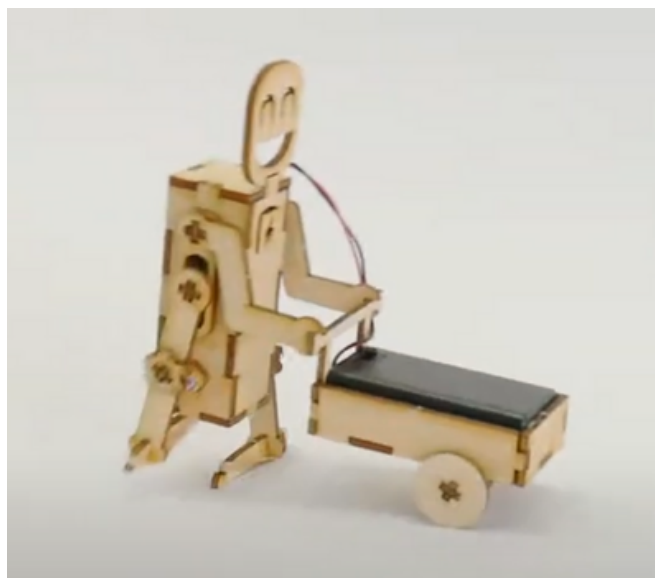
This typically means that the motor connection (the piece with the gear) is too loose. Tighten as much as possible by hand. If it still persists, use some glue!

The wheels on the cart go round... oh wait they don't.

Are your cart wheels too tight? This is usually caused by the work surface being too smooth. To combat this, take some candle wax and rub it in the holes where the axle is. Also, rub some wax onto the axel.

Pieces too loose or too tight?

Grab a candle and use some of the wax to loosen up the joints if they are too tight. If the pieces are too loose, try either cutting them on a thicker piece of wood or using a bit of wood glue.



Enjoy your robot!

