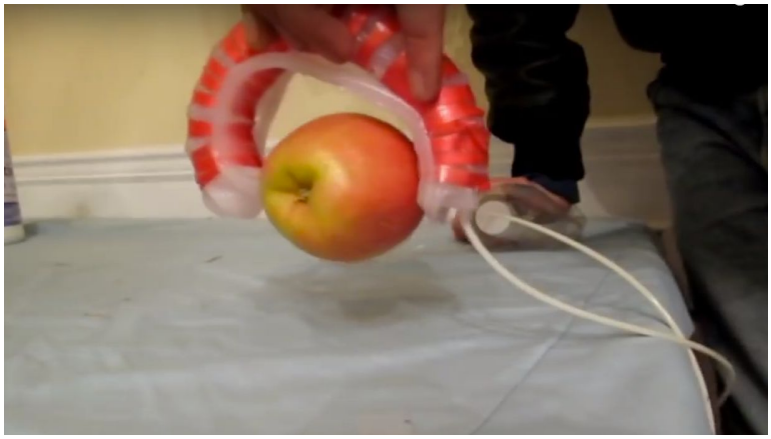
Student Name: _____ Date: _____

Activity Sheet

Activity 1: Building a Soft Robot

Classroom Procedure:
Fiber Reinforced Soft Robotic Gripper Construction

The students should view the powerpoint and the videos as well as read the assigned readings before they write the final report.



Classroom Procedure:
Fiber Reinforced Soft Robotic Gripper Construction

Video Instructions for DIY Soft Robotic Gripper:

https://www.youtube.com/watch?v=uPx8x...

Written Instructions for DIY Soft Robotic Gripper:

Building the Mold For the Robotic Body

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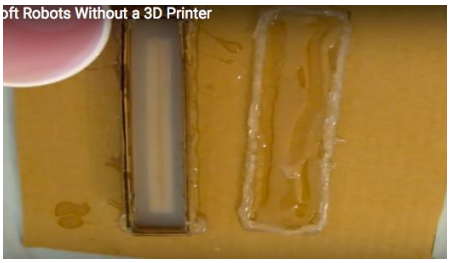
To make the mold for the main robotic body, cut six retangles of of cardboard must be cut as shown. Glue the two 0. 5” pieces together to make a block, cover in tape and fold down the edges of the tape to completely cover the block you have created. Cover the block with hot glue. Repeat the process with the two 5” and the two 6 “ pieces. Glue all the pieces together to form a mold for the robot. Cover everything with hot glue to seal up the small cardboard mold. You will need to cover the mold two or three times with hot glue to make sure it is sealed. Glue this box to a sturdy piece of cardboard with the hot glue gun. Be sure and seal the edges of the mold several times with the hot glue gun. After the glue on the mold is cool, you may fill the mold with Eco Flex. Leave the robotic body in the mold and allow it to air cure at least four hours. After the part has cured for at least four hours, you may carefully pry it out of the mold.

Building the Mold for the Bottom of the Robot

Draw a 7” x 1.5” rectangle on a piece of cardboard. Cut a piece of printer paper to size just so that it can fit inside of this shape. Trace the edge of the retangular shape several times in order to build up the edges of a shallow mold. The mold should be ¼ ” deep or a little more. Apply a layer of Eco Flex to the inside of the mold. Insert the printer paper and continue to fill the shallow mold with Eco Flex to an approximate depth of ⅛ “. Allow the part that will be the bottom of the robotic robot to cure at least 4 hours.



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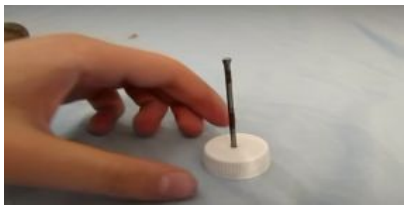
After curing, carefully pull the piece out. Be careful not to tear the paper core.

Putting the Robot together

In order to finish the hollow robotic body, you may choose to smooth some more Eco Flex over the inside of the body and along the bottom to smooth away any imperfections.

You will again need to let it air cure for at least 4 hours. The final step in building the body of the robot is to smooth hot glue on the robot back and put the two pieces together.

Creating the Squeeze Bottle Power Source



Use a clean and empty plastic bottle, preferrably 1 or 2 liters. If the student wants to test a change on his attempt at improving the first robot, he may change the bottle size and test the results. Take off the bottle cap and poke a hole in the lid with a nail. Put the lid back on. Insert a 20 foot length of tubing into the hole made in the bottle cap. Seal the edges where the tubing connects carefully with hot glue. Poke a hole into the end of the body of the robot (once you have carefully pulled the robot body and bottom out of the molds). Insert the other end of the tubing into the robot body. Glue a piece of duct tape or another molded, thin piece of rubber to the bottom of the gripper to increase its traction and thus its grip.

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Constraining the Soft Robot with Fiber

Once you have attached the robot to the squeeze bottle, squeeze the bottle and inflate the robot body. You will find that the shape of the inflated robot is not exactly what is needed for a gripper. You will now constrain the robot with fiber in just the right way so that it inflates into the needed shope. Wind a 20" ribbon around the robot body and tie it. You will have two ends of about equal length. You will wrap each end in a different direction. One end you will wrap clockwise and the other counter-clockwise. Continue to wind it around the body as pictured. Wind each end of the ribbon in a different direction. You will want to test the effects of you squeeze the "power source" plastic bottle the pressurized air should move from the squeeze bottle to the robot body and inflate it. Practice squeezing and inflating the body and using it as a gripper. As the robot body deflates, the gripper will grasp the object. Because of the "give" of the soft robot body, the robot should grab the object as it it deflating. After the ribbon is wrapped correctly, you will glue another piece of thin rubber that you have molded for this purpose or a piece of tape to the back of the robot for more gripping traction. One of the most important properties of soft robots is in how they deform while being used. In the case of the soft robot that we build, the robot is powered and moves by the inflation and deflation of the robot body which is its actuator. There are different parts in the robot actuator of varying stiffness. The modulus of elasticity will vary in each piece. The process of building the robot has actually purposely included these materials which each have a different amount of stretch. The ribbon is particularly stiff and is used intermittentantly along the body to constrain the shape. The back of the robot has had a piece of paper inserted into the material as it was molded, but the body of the robot is simply rubber. The tape or additional piece of rubber that is hot glued to the back of the robot will also have its own elastic modulus.