

NAME

Excavator Boom

DESCRIPTION OF ACTIVITY

This activity let's students explore the mechanics of an excavator by building the boom, stick and bucket of an excavator and controlling it with servos and programming. The activity can be expanded by making a base, further linkages, making it 3D or using the mechanical construction to make something else, maybe an animal.

To find an example of the Excavator, click [HERE](#)

LEARNING GOALS

The major learning goals are learning about linkages and specifically links, actuators and electronics in mechanical systems. Control systems, mathematics and mechanics can be learned on a level adapted to the classroom, works just as well in higher education as in lower grade education.

PRE-REQUISITE KNOWLEDGE/SKILL

Connecting hardware and uploading programs to the physical computing platform of choice (modifying the code is optional)

MATERIALS NEEDED

Cardboard, Strawbees, straws, pencil, scissors, 2 micro servos and your choice of physical computing hardware.

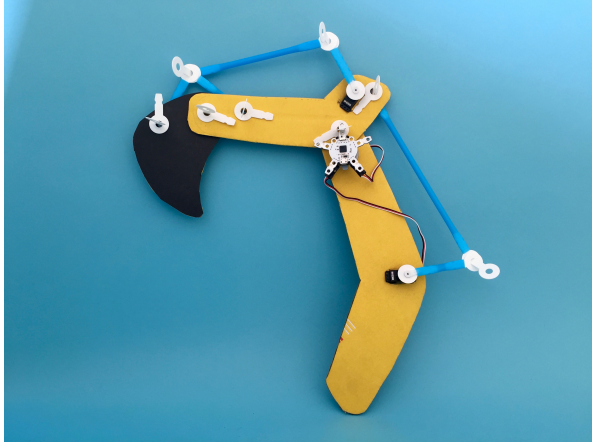

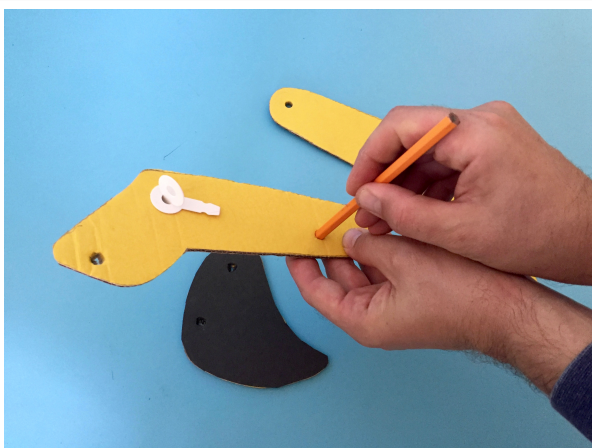
CLASS DURATION

<i>DURATION</i>	<i>ACTIVITY</i>	<i>TIPS</i>
15 min	Introduction	Times may vary from group to group.
45 min	Making the Links of the Excavator	
35 min	Add actuators (struts + servo)	
45 min	Programming	

ADDITIONAL CHALLENGE

- Make the base structure and the swivel link, add one or two actuators for full control.
- Make it 3D and make it pick up popcorn and other light weight stuff.
- Modify the mechanical construction and imagine what else it could be, maybe a dinosaur foot, a leg of some awesome robot or something completely different. Make room for the unexpected!
- Make a joystick or another type control interface for the excavator.

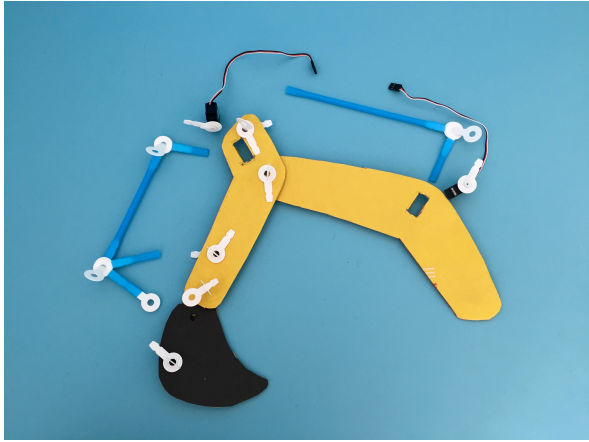
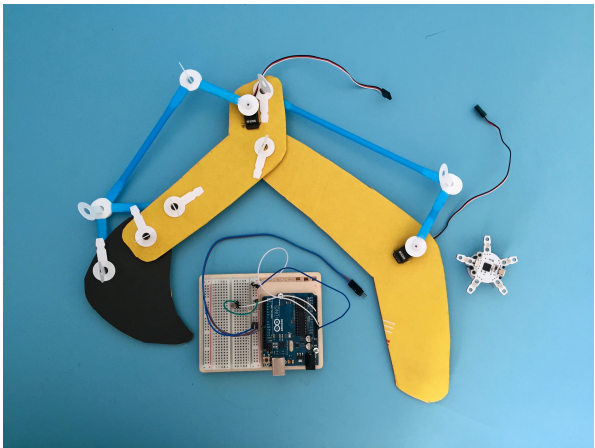
STEP - BY - STEP INSTRUCTIONS

IMAGES	NOTES
	<p>1. INTRODUCTION (15 min) Start with an introduction about excavators, their functions and basic vocabulary. What are the linkages used in the excavator?</p> <p>Introduce Strawbees to the students (play our intro video if needed). Supply Strawbees to the students and if it's the first time they see them, let them get acquainted to them with some free play first.</p> <p>Strawbees intro video can be found HERE</p>
	<p>2. MAKING THE LINKS OF THE EXCAVATOR (45 min) Option 1: Let the students find an excavator design to copy. Draw a sketch, and cut the model out of cardboard. Make sure there is room for the servos. Connect with Strawbees in the main link points.</p> <p>Option 2: Download our PDF and trace onto cardboard, modify it if you want. Cut it out and assemble with Strawbees.</p> <p>Make sure there is room to add your Servos to the Excavator Boom and Stick.</p> <p>More pictures can be found under additional resources. Find PDF of cardboard cut out under Additional resources.</p>
	<p>HINT! It's really easy to make a hole for your connections with a regular pencil. The size of the holes are perfect for low friction swivel connections with your Strawbees.</p> <p>To make swivel connections in cardboard use one Strawbee pushed all the way into another Strawbee as a washer from the front, then lock into place with another Strawbee from the back.</p> <p>If it wobbles to much, gently slide the washer Strawbee slightly inward. Make sure it doesn't add too much friction. When it swivels nicely you are done! Click HERE to see a video of how to do the above.</p>



Note:
Feel free to include links to videos too!

STEP - BY - STEP INSTRUCTIONS

IMAGES	NOTES
	<p>4. ADD ACTUATORS (STRUTS + SERVO) (35 min) It's time to add the actuators, which in this case is a series of struts and servos. Make sure it looks something like in the picture. When you move the actuators, does it move the way it is supposed to? Are the servo arms in the right place? Try out the movements and make sure it is real excavator like.</p> <p>It is important that experimentation with the movement is allowed to take some time. Occasional failures and weird connections in this stage can yield interesting results.</p> <p>More pictures can be found under additional resources.</p>
	<p>5. PROGRAMMING & PLAY (45 min) Upload our example code and adjust the endpoints of your servos movement to fit the construction. Can you modify the code to make a real nice digging motion?</p> <p>If you have enough sensors, like lights or knobs or potentiometers, it can be really fun to add a control system. Can you add controllers, buttons or levers?</p> <p>Or just make it move in fun ways.</p> <p>Example code can be found under additional resources.</p>



Note:
Feel free to include links to videos too!