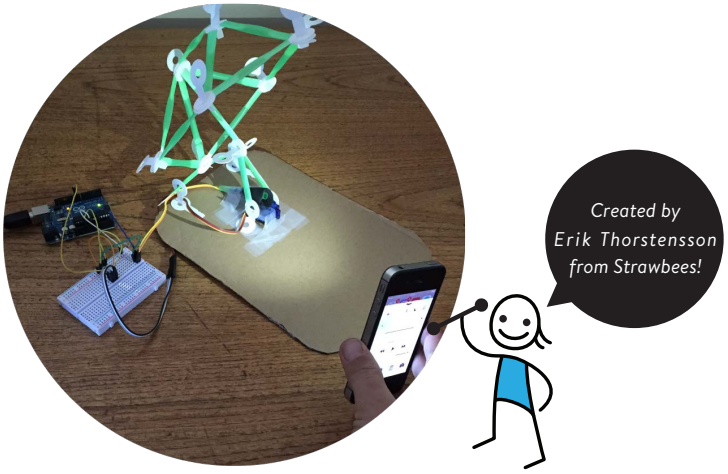


NAME

Light Sensing Leaf

DESCRIPTION OF ACTIVITY

In this excercise we learn how to build a leaf that reacts to light, much like certain plants in the real world.
To achieve this we use an Arduino, a photoresistor, a servomotor and some Strawbees.

Students can work in group sizes according to how much material is available, the more unique leaves the merrier.

To find an example of the lightsensing leaf, click HERE

LEARNING GOALS

Explore how:
- sensors in mechanical systems work
- power of the sun
- 3D contructions
- copy and shape
- sketching & executing
- circuit connecting
- programming

PRE-REQUISITE KNOWLEDGE/SKILL

Connecting an Arduino and uploading the program (modifying the code is optional)

MATERIALS NEEDED

1 Arduino, 1 breadboard, 1 microservo, 1 10kΩ resistor, 1 photoresistor, 10 male/male cables, 2 male/female cables , cardboard, black paper, 6 straws and 51 strawbees (4 doubles, 47 singles).

CLASS DURATION

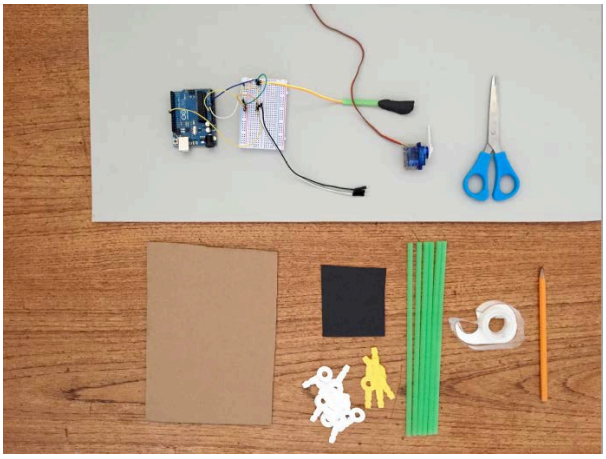
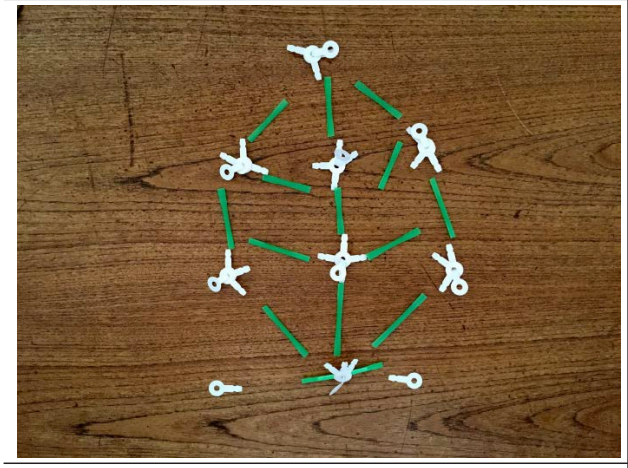
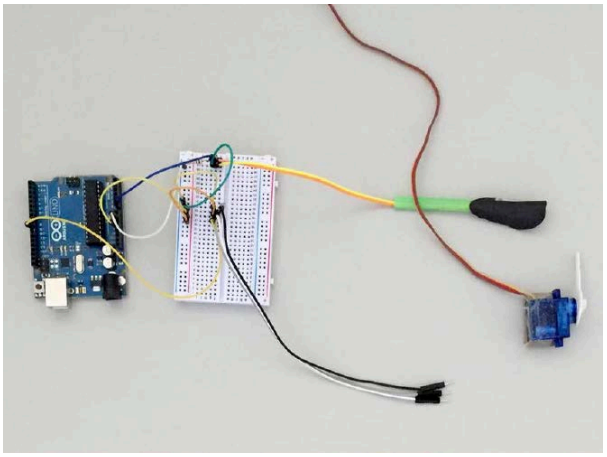
DURATION	*ACTIVITY*	*TIPS*
15 min	Introduction	Time may vary depending on previous knowledge and group size.
30 min	Build the leaf	
20 min	Programming	
20 min	Build the platform	
20 min	Cover the photoresistor	
20 min	Exploration	

ADDITIONAL CHALLENGE

- Can you come up with some other structure and build a mechanical system that reacts to change in light?

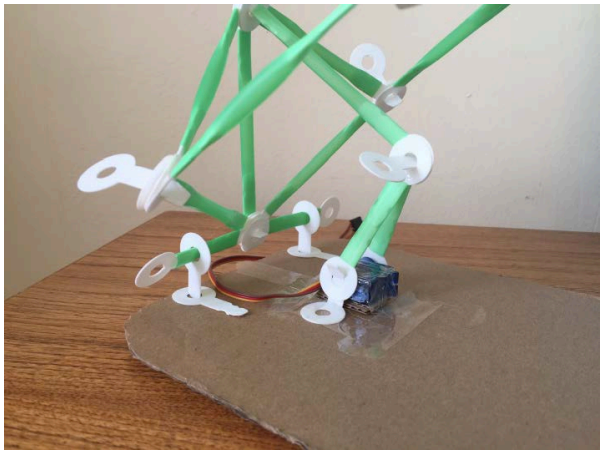
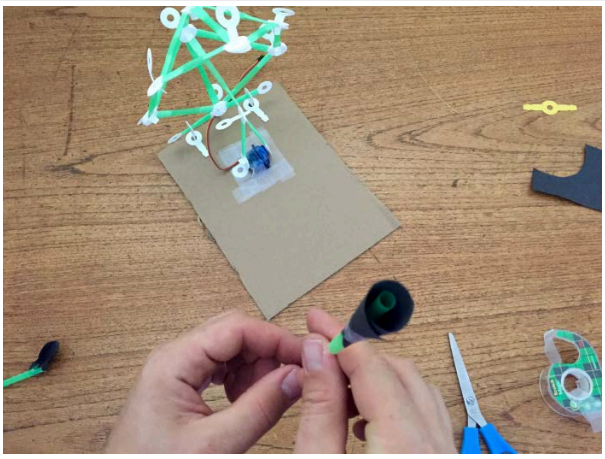
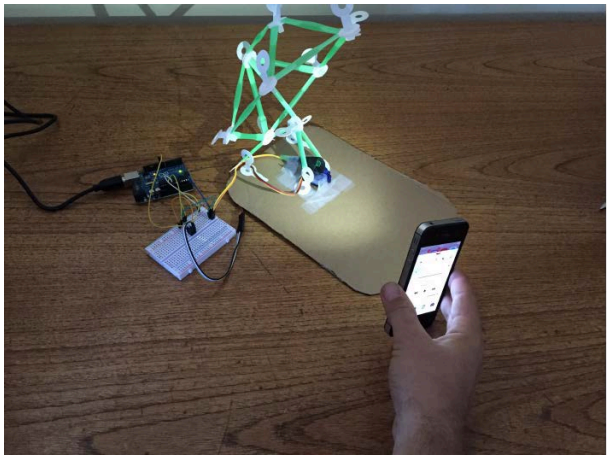
- Can you add a servo and make the leaf heliotrope?

STEP - BY - STEP INSTRUCTIONS

IMAGES	*NOTES*
	1. INTRODUCTION (15 min) Introduce the students to leaves and their function in nature. Talk about photosynthesis and the suns role in how a leaf collects energy and grows. Some leaves seasonally face towards the sun to get the most amount of sunlight, called phototropism or heliotropism. We make a simple version where the leaf opens up and collects light and closes when it's dark. Introduce Strawbees to the students, play intro video if needed. Supply the groups with the Strawbees they need and let them get acquainted to connecting strawbees and straws with some free building. No cutting at this stage. Watch Strawbees introduction video HERE
	2. BUILD THE LEAF (30 min) Let the students find a picture of a leaf or a real leaf that they want to copy, or supply the students with a good collection of simple leaves. Let the students sketch the leaf in the scale they are going to build. The scale can be defined with the cardboard supplied, we suggest 15x24cm but this is an arbitrary measurement so feel free to vary it. Make sure to include: central stem, branches and an outline. It is important that the base of the leaf has a horisontal swivel straw like the one in the picture. More pictures can be found under additional resources. Watch inspiration for the swiwel base of the leaf HERE
	3. PROGRAMMING (20 min) Option 1: Upload our example code and modify it Option 2: Let the students write their own code. Use the Arduino IDE to program the movement of the leaf between two values. How far back/forth will it be able to move, and what are the light levels your can measure? Set your parameters according to the light levels you see in the serial monitor. Find circuit diagram and example code for the Arduino under additional resources.

Note:
Feel free to include links to videos too!

STEP - BY - STEP INSTRUCTIONS

IMAGES	*NOTES*
	4. BUILD THE PLATFORM (20 min) Cut out your cardboard base, approximately 15x24cm. Make a cardboard base to lift the servo from the surface so the servo arm can move freely. See additional resources for a solution. Explore where the servo can be placed to make the movement of your leaf nice. Play with the position and try moving the servo manually. When you are pleased lock it into place with tape. Make sure the tape does not get in the way of the servo movement. More pictures can be found under additional resources. Example of servo testing and installation can be found HERE
	5. COVER THE PHOTORESISTOR (20 min) Cover the photoresistor with a piece of black paper so the light only comes in from the front of the sensor. Make sure that it will fit on top of the servo and not be in the way of the movement. Without the cover the photosensor sees light in all directions. The cover makes the lightsensing leaf see light in the direction of the opening. Now the leaf can be used to react to light from the front and slightly upwards. More pictures can be found under additional resources.
	6. EXPLORATION (20 min) Try out your your leaf with a lightsource. Now explore and test your creations carefully. Change values in the program to make it suit your environment, light conditions. Put it in the sunlight in a window, how much does the lightsensor input vary when cloud passes by. Can you make the leaf react to clouds? Find the brightest spot in the room by aiming the leaf towards the light and watching the leaf move up and down. Reflect on your different leaves and how they work. What was the hardest part in making this leaf? Maybe your class can make an installation for the other students that reacts on daylight. Can you make a truly Phototrope or Heliotrope leaf?

Note:
Feel free to include links to videos too!