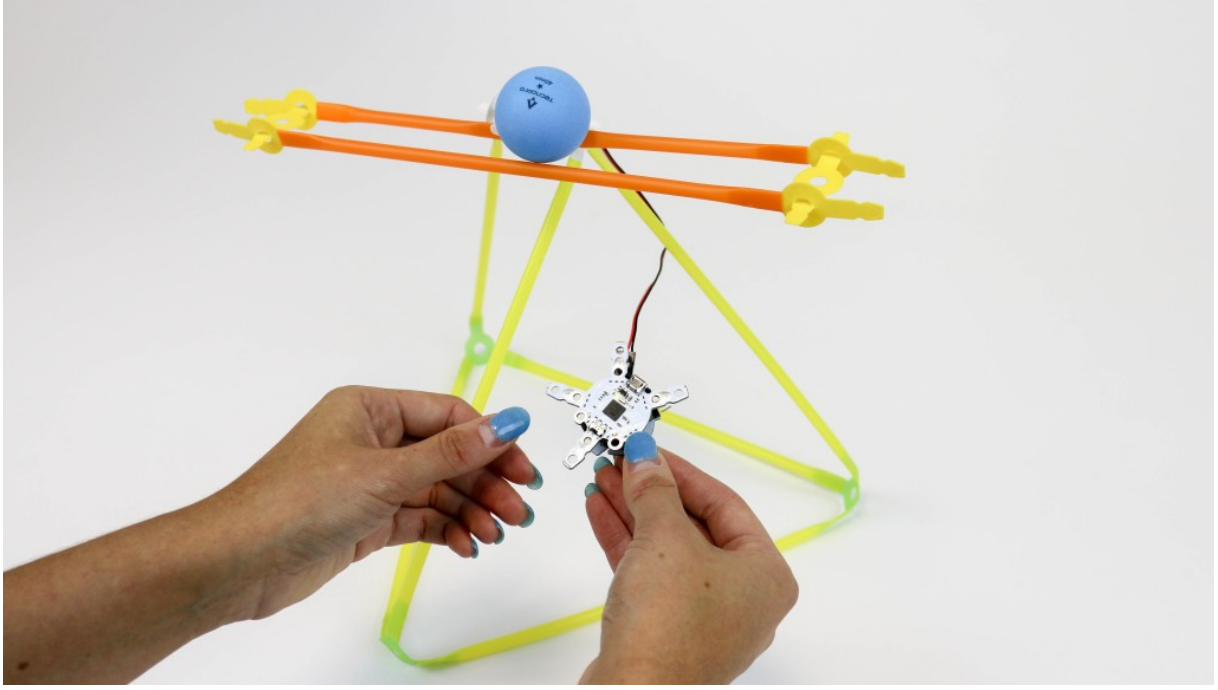
3 - Balance Challenge

Author *Kristofer @ Strawbees*



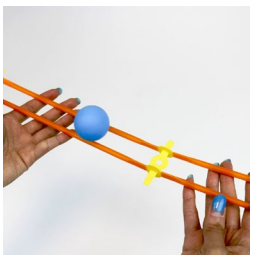
Keep a rolling ball on a Strawbees track and maintain balance using Quirkbot coding.

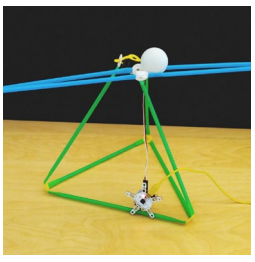
ENGINEERING TECHNOLOGY PROGRAMMING

Duration Class 120 minutes

Size Group Size 30 Students

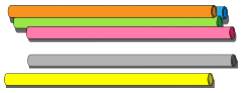
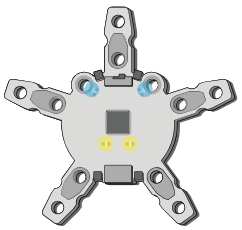
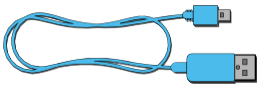
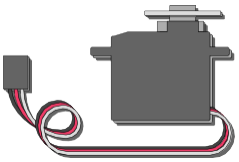
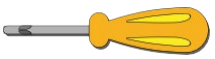
Overview 2-3 Students





Explore fun ways to program with Quirkbot and the hardware capabilities. Use it as a controller connected to the servo motor balancing a teetering, Strawbees seesaw track and balance a table tennis ball. At the end of the lesson challenge the class to try to transport a table tennis ball across as many tracks as possible before hitting the ground.

Materials

			
Straws *200*	1-Legged Strawbees *100*	2-Legged Strawbees *200*	Scissors *20*
			
Quirkbot *10*	Quirkbot Servo Backpacks *10*	USB Cables *10*	Alligator Clips *60*
			
Servo Motors *10*	Computers *10*	Table Tennis Balls *12*	Mini Screwdriver *1*

Modifications

◯ *Lesson Split Time*

Depending on needs, this lesson can be split and taught in two 45-minute periods with an additional 15 minutes dedicated to setup and clean-up for each.

◯ *Team Dynamics*

For groups working with Quirkbot students should understand the following roles: the Driver, the only person allowed to control the mouse for Quirkbot programming, and the Navigators, the ones that give directions on what to nodes to use and connect together. When working with Strawbees and Quirkbot at the same time, the Navigators become the the Builders (the group members that are responsible for constructing with Strawbees and test their creations for challenges). Be prepared to have students switch roles every 5 - 10 minutes.

◯ *Servo Mounts*

Before beginning the lesson and save time build the Strawbees servo mounts and place on them for future use.

Learning Objectives

- Express a solution in such a way that a computer—human and machine can effectively carry out for a problem.
- Dive into an introduction of the Computational Thinking process by engaging in three steps: problem formulation (How does this work?), solution expression (build a model), and solution execution and evaluation (the results and feedback of solution).
- Collaborate as a team to learn programming and build models to meet a solution to accomplish a challenge.
- Engage in a difficult problem to solve using programming as a problem-solving tool where the outcome may not be desirable for a lengthy period of time.

Teaching Assessment

In this lesson you will begin to engage in programming concepts where students will study the cause and effect of modifying code and the impact it makes on the Strawbees project. You will see students learn firsthand the struggles of coding and help them learn how to problem solve with unfamiliar concepts and projects that may not work for lengthy periods of time. Students will build upon previous knowledge of using Strawbees to create a base, track, and decided on how to incorporate Quirkbot as an intentional part of the project. Students can explore designing different base shapes, adjusting the track, and alter the sensitivity of the Quirkbot to make the balancing track easier or hard to use.

Preparation

1. Before teaching with Quirkbot programming be sure to make sure your classroom internet is setup and you are able to access https://code.strawbees.com/index.html It is recommended to use Google Chrome to ensure Quirkbot CODE will work.
2. If a Quirkbot has stopped responding during class you can enable Recovery Mode. While on Recovery Mode the Quirkbot should be detectable again, allowing you to upload new code to it. Before starting lessons with Quirkbot you can familiarize yourself with the Quirkbot Recovery Mode instructions (https://code.quirkbot.com/recovery-mode/).
3. Students can register ahead of time with Quirkbot CODE (https://code.strawbees.com/index.html) and create an account to save and publish projects. Otherwise, students can log in as an Anonymous User and begin programming immediately.
4. Before screwing down the plastic horn onto the servo motor, snap a 2-Legged Strawbee onto the back of the longest horn and secure it down with mounting screw.

Lesson Steps

1. Introduction

Duration: 5 minutes

Get your students starting to think practically about how elemental balance is for all inventions. In these exercises students will learn how to assemble a simple electronically powered balance that pivots a complimenting structure on a small motor.

Ask the class, "If you stood on the tip of a mountain, what is the motion you would make?" Have your students explain or even act it out! Mention, "You would fall! But you might be able to prolong your fall by balancing yourself using your arms and legs."

2. Building

Duration: 20 minutes

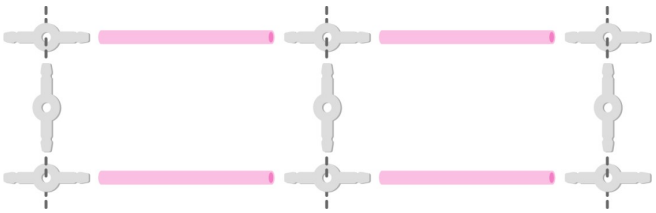
Let your students know they will create a three dimensional structure in the shape of a pyramid, with the full use of the motor, their Quirkbot and their Strawbees. If you have an example made, display how it works. The motor will be attached to the top of the structure and pivot their “bridge” that will balance any items they choose to place on it (in this case, a table tennis ball). The motor is programmable through Quirkbot’s CODE portal so students can adjust the angle and speed at which the motor operates.

Have some students work on building the Strawbees tetrahedron structure to mount the servo motor on for the track. You can have students build multiple tetrahedrons that slightly decrease in size in order for a longer track for the ball to roll down on.

3. Building a Track

Duration: 20 minutes

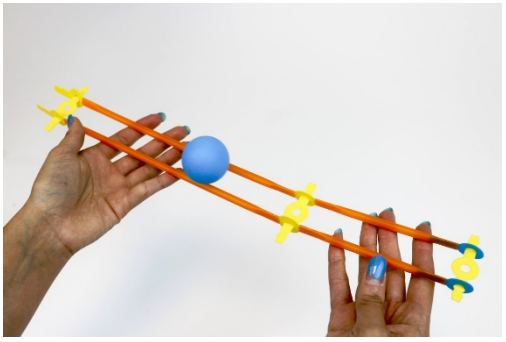
Let your students know building the track is a process and many times the ball will fall off. Make sure to show students how to assemble together the 2-Legged Strawbees and start by making a lot of them first before adding straws. It's important to note that the 2-Legged



Strawbee's legs are slid further into each head of the other 2-Legged Strawbees. The center should not be rotating or moving around, but should be stationary. Walk around the room to check student's progress making on these.

4. Track Testing

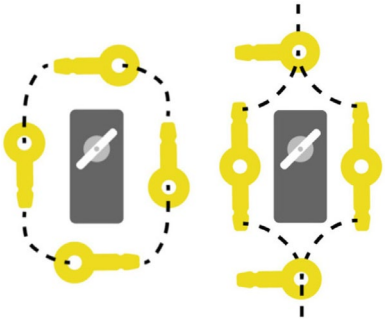
Duration: 5 minutes



Test the track to see if the ball can roll down from one end to the other. If the ball cannot, then fix the 2-Legged Strawbees and make sure the straws are not warping or are twisted between them. This might cause the ball to roll off the track before reaching the bottom. If your students are making extra tracks for the additional tetrahedra and the ball rolls down it fine, use a 1-Legged Strawbee to make a friction lock from the middle of the track

5. Servo Strawbees Mounts

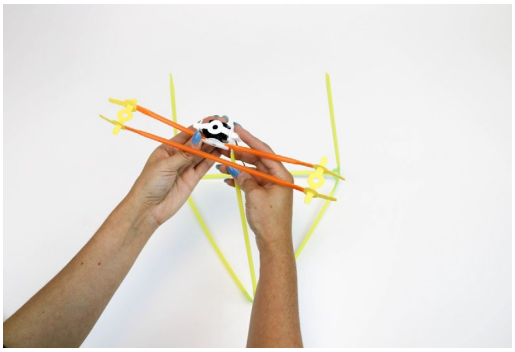
Duration: 10 minutes



To fasten the Servo Mount in your student's Strawbees constructions, here are two examples of how to wrap and connect Strawbees and creating a Servo Mount. You can add more Strawbees connected to each other to increase the friction and pull their legs through the holes to tighten the Servo Mounts. This helps your students attach the servo easier.

When putting a straw on the Strawbee on the servo motor horn, make sure to slide it over both the Strawbees and the motor arm itself. Encourage your students to pinch the end of the Straw first before sliding it so it covers both the servo horn and Strawbee.

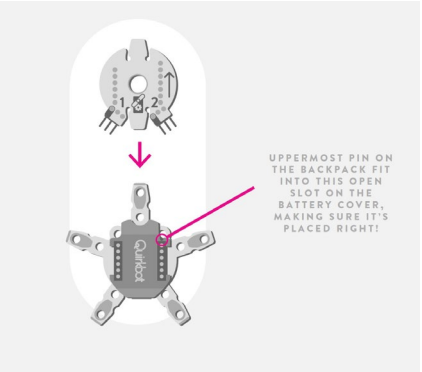
6. *Assembling the Track and Base*



Duration: 15 minutes

For this lesson, add two, 1-Legged Strawbees on each end of the servo motor mount. Students will attach the Quirkbot to the servo motor once the track is carefully assembled. Advise students to carefully slip the straws onto the servo horn and 2-Legged Strawbee to the track. One side of the track must be cut in half and trimmed to attach to the middle of the track. See the image as a reference.

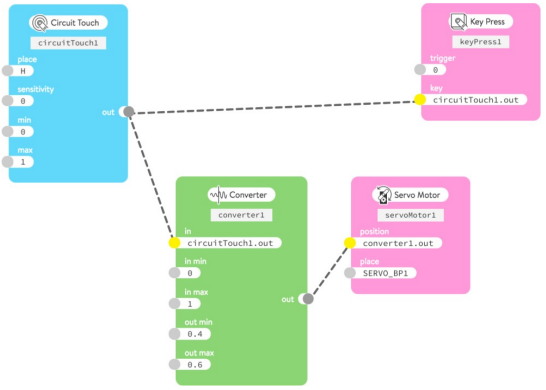
7. *Connecting Quirkbot*



Duration: *10 minutes*

Attach the servo backpack to the Quirkbot in order to program the servo motor and connect the headers on the wire to the number 1 pins on the back. You can carefully hang the Quirkbot from the servo motor since it will be freely hanging as a touch controller.

8. *Programming Quirkbot*



Duration: 20 minutes

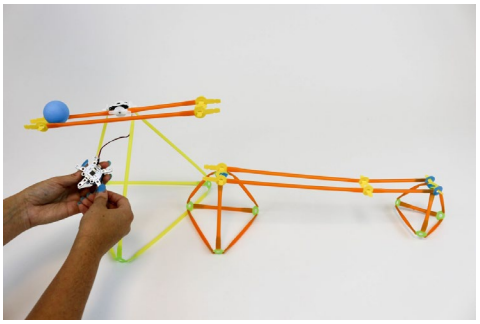
Open Quirkbot CODE with the settings on Advanced so your students can see all nodes for this program. Have your students drag the following the nodes: 2 LEDs, 1 Converter, 1 Circuit Touch, 1 Servo Motor, and 1 Key Press.

You can find an example here:

https://code.strawbees.com/flow/?p=57b55be2d98853497a2ca82b

9. *Showcase*

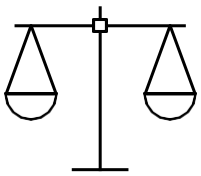
Duration: 15 minutes



Challenge your class with these: "Can you pass the ball from one Balancing structure to another?" "Can you make a long, steady track going down? See what happens if the ball rolls down too fast!" "Can you program the Quirkbot to keep the ball on top without having to touch it?

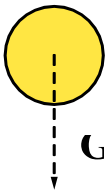
Let your students take turns and attempt to carefully balance the ball onto the tracks until it reaches the end. The Ball cannot fall off otherwise they have to switch!

Vocabulary



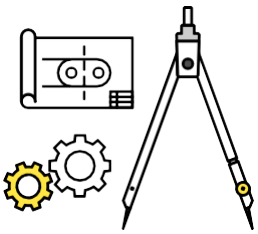
Balance

To become steady and upright by distribution of weight.



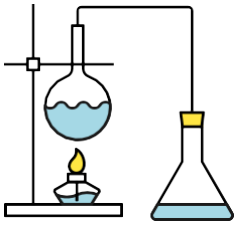
Gravity

The force from a physical body attracting another physical body with mass to its center.



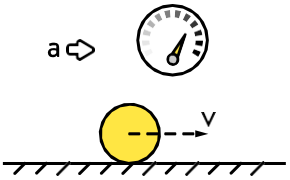
Engineering

The intersection of technology and science through a design process of transforming an idea and bringing it to life.



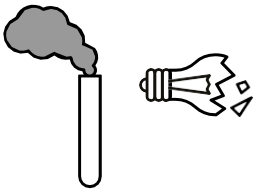
Experiment

The process to making a discovery through testing a hypothesis to prove a fact.



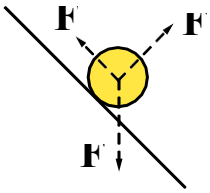
Acceleration

The act of building up speed to move faster.



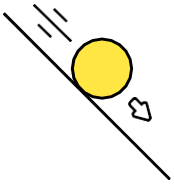
Failure

The conditions when the outcome is undesirable and the opposite of success.



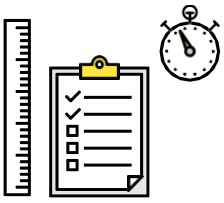
Force

The change in the motion of an object through physical action or movement.



Slide

To steadily move something along a surface.



Test

A method of measuring the skill capability of a group or characteristic of something to pass through a set of conditions.