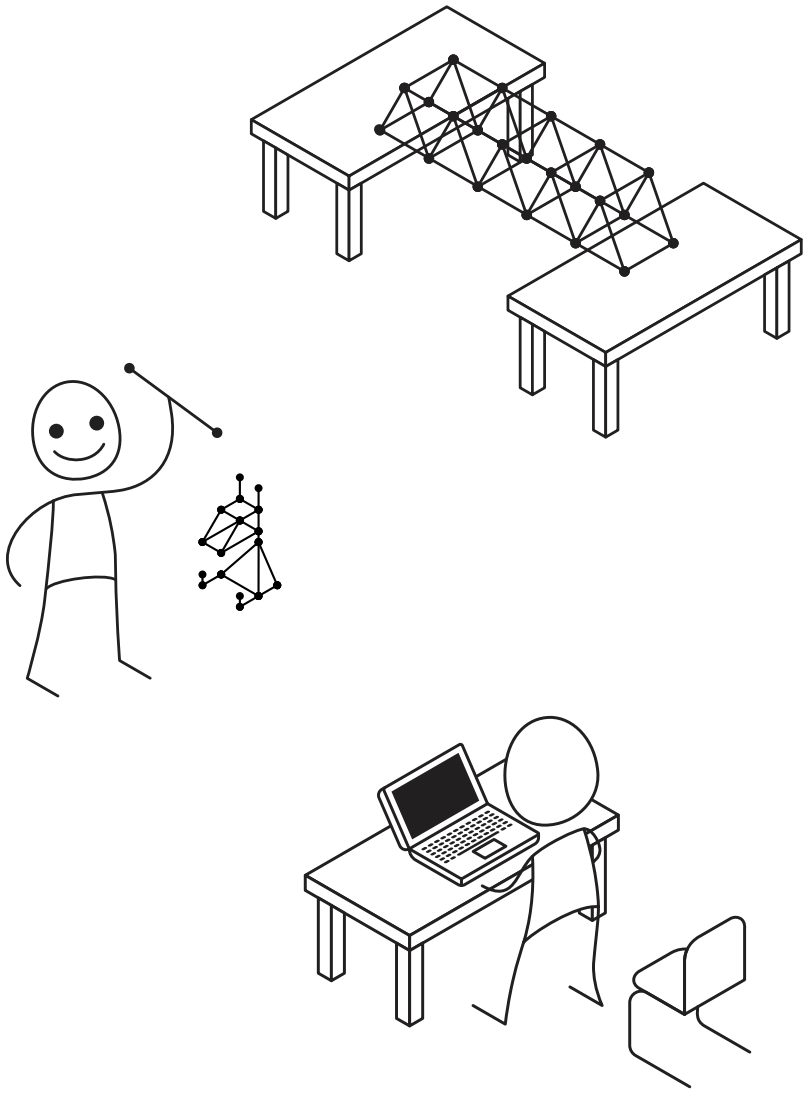
Quirkbot

Strawbees.

# EDUCATOR'S GUIDE v1.0
# STEAM LESSON PLANS



## *LEARNING PHILOSOPHY*

Quirkbot is an educational resource for STEAM subjects (Science, Tech, Engineering, Arts, Maths) for children 8-12. Teach kids to code hands-on with Quirkbot CODE, a free online tool that every Quirkbot owner has access to in order to program their Quirkbots. Our friend, Quirkbot, goes beyond robotics, and propels yourself and your students into the realm of Artificial Intelligence by allowing you to impart personality traits into your physical inventions. By connecting Strawbees, motors, LED's and sensors with simple straws, Quirkbot opens up a world that has no limits to the amount and type of inventions you and your students can come up with.

**Explore & Code a new world, with Quirkbot!**

Quirkbot is designed by creative developers, artists and inventors with a vision to see invention as the daily norm.

**Comprehensive & Curriculum Aligned Lesson Plans Available**
**Suitable for Ages 8-12**
**Recommended: Grades 2-6**

**Common Core Standard Aligned**
**Math, Science, Social Studies/History, ELA**

# TIPS & TRICKS 1/2

## INTRODUCTION
Start by getting familiar with the material. Demonstrate a visual glossary of the anatomy of the Quirkbot to your class and explain how each part works and then clearly state the correct term for it. E.g. Straws vs. Strawbees, Servo-Motor vs. Servo-Horn. Walk through the intro booklet with your students or use the online tutorials availible.

All the components of Quirkbot are listed in the booklet that comes in each kit. Some useful micro activities are also available online.

Finally, whether or not it's your first Quirkbot class or one of many, it is always good to break the ice with an absurd question or idea that relates to the class you're about to give. Don't be afraid to ask big questions that have no obvious answere. Like "What's the difference between humans and animals?", "Why do we invent?" or "What is gravity and where does it really come from?"

## TROUBLE SHOOTING:
In general, if a student gets stuck it's good to implement the "3 before me rule", that is, tell your students to ask 3 of their peers for help before asking you. This will make things much easier for you as a teacher and also encourages the collaborative spirit of your students to help each other.

If your class involves any programming and your students are experiencing difficulties please check out the Quirkbot CODE trouble shooting guide on code.quirkbot.com

## TECHNICAL
Charge Quirkbots ahead of time, and before class, by attaching them via the usb cable provided in the Quirkbot kit either to a laptop or to a mobile charging device.

Advise your students to bend the connectors slightly to emphasize the stability of the structure they are building. E.g. for a Cubic structure bend the strawbees at right angles quite severely.

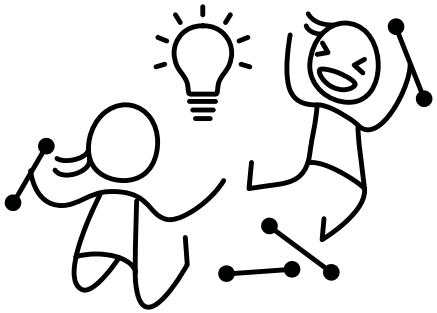
Always have colourful masking tape and blu-tak on-hand for unsteady structures or some structures that need a quick fix. Rubber bands are also a great additional material to use.

Use Quirkbot's wealth of online resources to improve and animate your classes.

## ORGANIZATION
You can pre-attach the Quirkbots to their back-packs to save valuable class time.
This also can apply to pre-assembling the Strawbees that attach around the Servo-motors. This will save about 5-10 minutes off of class time, or time that would have had your students figuring this step out. You can find out how to this here: http://www.quirkbot.com/guide-quirkbot-basics

Before starting a Quirkbot Lesson, check the length of time required per project. If using Quirkbot resources for longer than 2 weeks, have each child/a designated child in a team bring in a large shoebox or cardboard box that they can label and keep their Quirkbot inventions in.

**TIPS & TRICKS 2/2**



If you are doing several intro classes with lots of different students and the students need to dismantle their projects after each lesson a tip is to complement with additional see-through boxes. One where you can put all the motors, one for all the strawbees, one for all the quirkbots, one for all the USB cables, one for all the screw drivers and one big one for all the straws. You can use one of the smaller boxes that comes inside each kit for storing smaller components such as LED's, light sensors, servo horns and screws.

**INCENTIVES**

Get creative juices flowing by giving open-ended challenges in class. Remember, every class can be executed at any difficulty level so if your class is about building a bridge it can be from building the largest bridge to building an earthquake simulator to building an exact copy of a famous bridge.

Prizes for the largest structure, or awards for the most multi-coloured structure can encourage students to show their personality in their inventions. It's also good to follow up with open-ended questions to invoke the kids curiosity and connect what they made to examples and phenomena in the real world..

**SHARING**

Kids like to share what they have created online with other kids. You can help them do this safely by setting up a teachers account on the creativity platform creatubbles.com Just go to ctbl.es/quirkbot and follow the instructions. Creatubbles is a great platform for your students to document and share their inventions .

**RESPONSIBLE USAGE**

Quirkbot is an open electronics platform and we intentionally did not enclose the circuit board that makes up its anatomy because we believe it's important to always be able to see what's inside. However, this also makes Quirkbot quite vulnerable. Tell your students to be especially careful with the on/off switch and keep your Quirkbots away from water.

Strawbees is a modular construction toy for connecting straws. Often straws are not considered modular or reusable because they are cut in irregular sizes. This can generate a lot of waste and a feeling that Strawbees are not so nice to build with. If you cut straws in proportional sizes (half, third, two thirds, quarter, three quarters and so on) you will have modular reusable straw sizes which generates nicer, more stable structures than irregular straw sizes. Of course some builds will need specific odd straw sizes but these proposed proportions still get you a long way.

# *STRIDERBOT*

**LESSON PLAN 1**

**AGE-RANGE:** 8-12

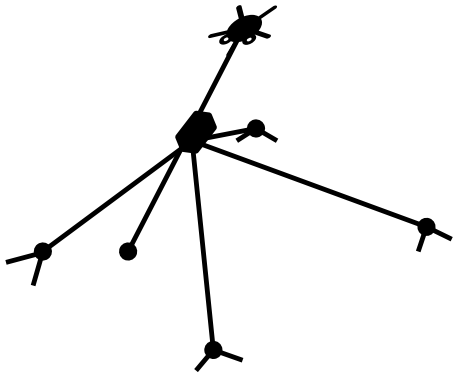
**LEVEL OF DIFFICULTY:** Beginner

**TIME REQUIRED:** 1 x 45 - 60 Minutes
*This can be extended to 2 lessons of 45 minutes if the students want to complete the challenges included in their print out Assembly Instructions.*

**GROUP ACTIVITY:** Small groups of 2-3 students per Quirkbot Kit

**GOAL**
Get your students comfortable with the idea of motion, easily creating moving inventions and introduce how character affects product design. Probe the depths of speed, balance and the different characteristics in inventions as your students create their very own Strider Bot. In this exercise students will create a 4-legged robot which moves via the servo-motor. It is an introduction to Quirkbot and allows the students to start feeling comfortable with experimentation in tech.

**TIPS**
Strider Bots built by teams can be included in a Strider Bot Race, where each team have their own colours, characteristics and they compete along a track that you create in the classroom.
Make it clear that the students can cut the straws to create different and complementing structures. The feet of the Strawbees need to be facing outwards.



**REQUIRED MATERIALS (per group)**
You should take 10 minutes to build an example structure prior to class, as inspiration and reference for your students. Lay out materials and paper print-outs before the class.

*Scissors*
*8 Straws*
*4 1-legged Strawbees*
*3 2-legged Strawbees*
*4 3-legged Strawbees*
*1 Quirkbot & Backpack*
*1 Servo-motor*
*Small screwdriver*
*Blu-tack / Masking Tape*

**ADDITIONAL MATERIAL (not required for class)**
*Coloured Paper*
*Coloured Masking Tape*
*Pipe Cleaners*
*Mini-flags to represent teams*

# *STRIDERBOT – CLASS PLAN*

**5 MIN**

Introduce the power of different characteristics in inventions throughout history. Show them a picture or a completed version of the Strider Bot and give them the challenge to complete it within the timeframe, and perhaps motivate them to work in their teams towards a Strider Bot Race between teams.

**10 MIN**

Explore: Allow the students to watch the introductory videos in their groups and talk about how they will assemble their Strider Bots.
Introductory video 1: How to attach Quirkbot to it's backpack: https://youtu.be/XO3nd1q9Yx4
Introductory video 2: How to attach Servo-motor to a Quirkbot: https://youtu.be/wWDKuAK6-ok
Direct your students to the materials on their tables and their step-by step instructions of how to assemble their Strider Bot.

**20 MIN**

Help the students by going table to table and referring them back to the directions on their assembly sheets.

**10 MIN**

Now they have completed their structure, each group can take some time to inspect each other's Strider Bots, observe what is different about each and every one of them, and test them out to see if they can race against one another!

**CHALLENGE YOURSELF & YOUR TEAM:**

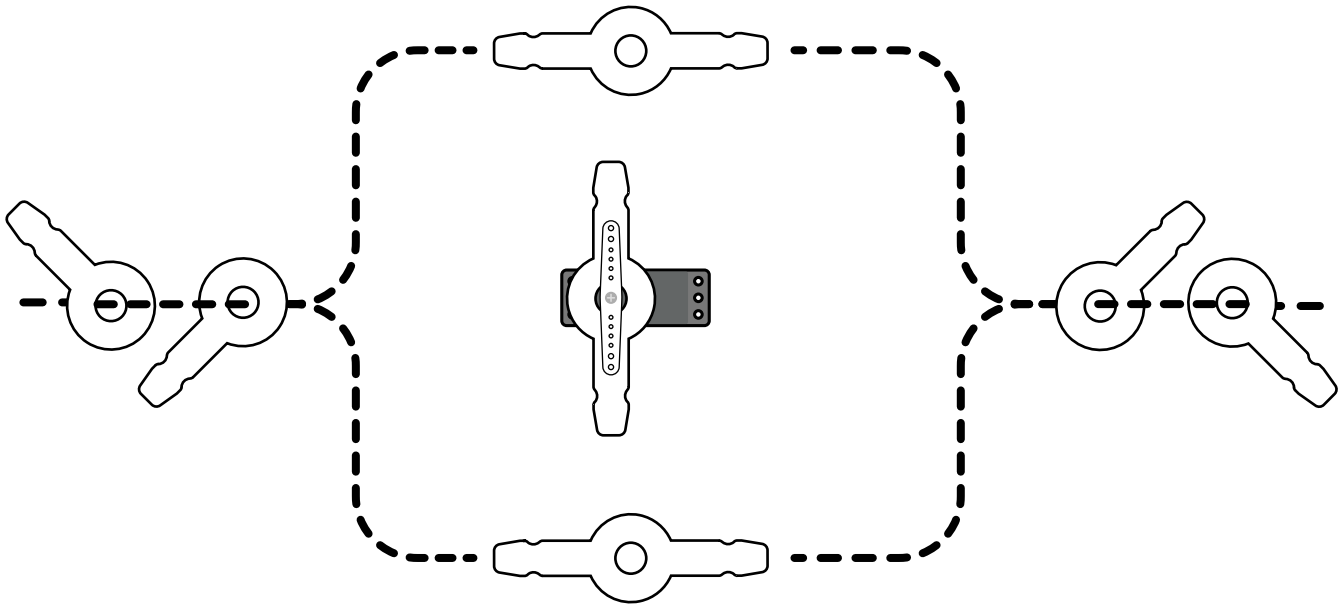
- Turn your Striderbot into a drawing machine
- Turn your Striderbot into a dancing robot
- Give your Striderbot emotions and personality change it's behaviour and/or apperance)
- Make your Striderbot interact with its surroundings

# STRIDERBOT – ASSEMBLY

STUDENT MATERIAL

## 1.

Start by getting the servo mount together. Then you attach the legs as well as the head which will swing back and forth.

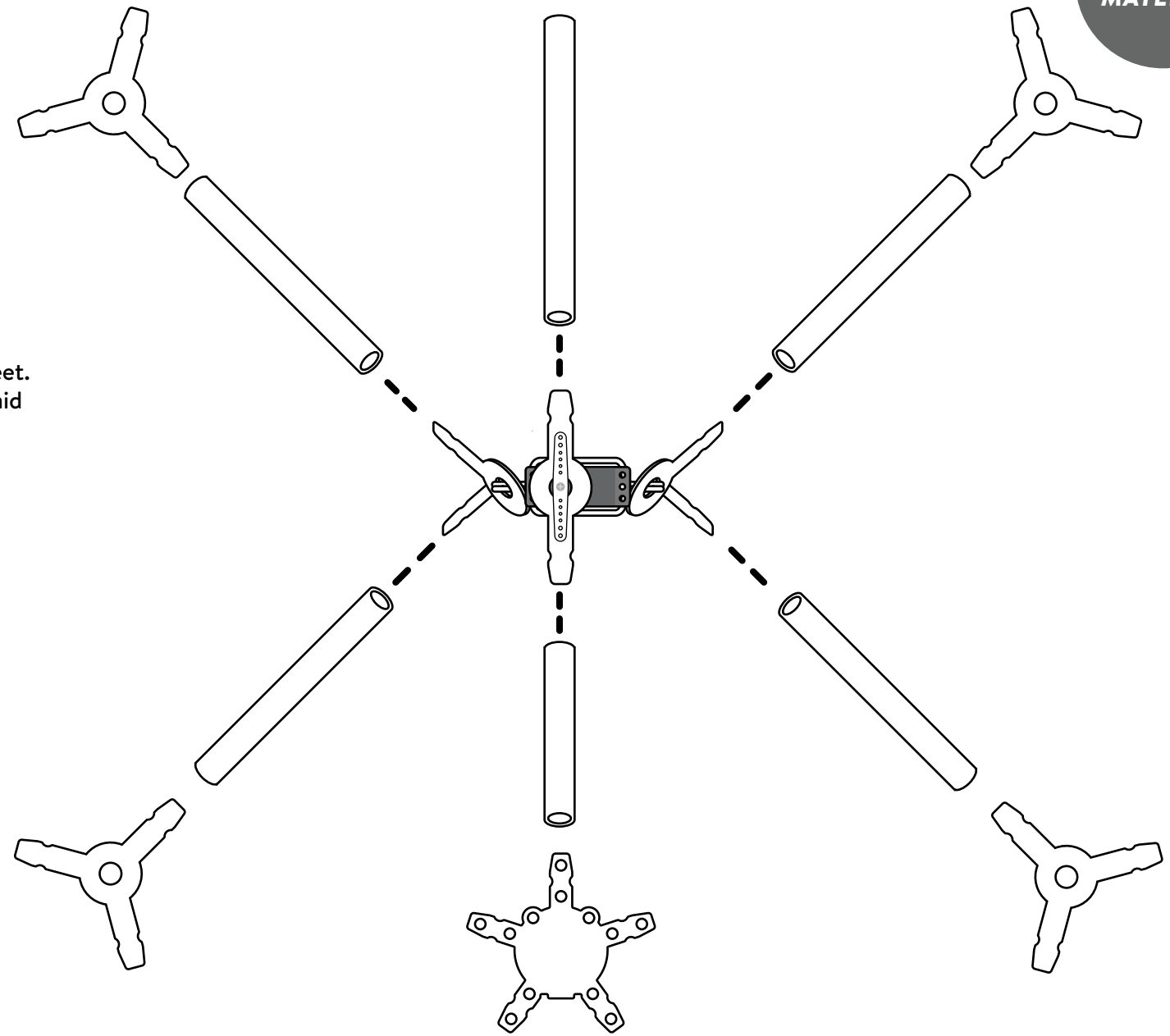


# *STRIDERBOT – ASSEMBLY*

STUDENT MATERIAL

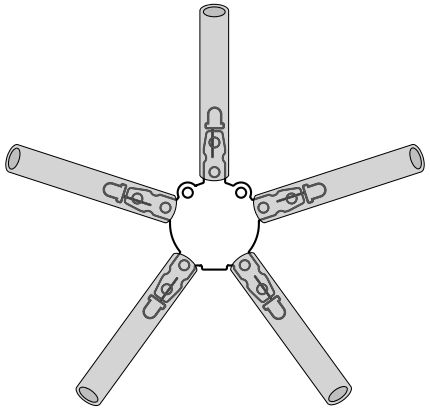
## *2.*

You can always extend your Striderbot by for example adding more straws to the feet. Be creative and don't be afraid to try different things out!



# *BLINKING STAR*

**LESSON PLAN 2**



**AGE-RANGE:** 8 - 12

**LEVEL OF DIFFICULTY:** Intermediate

**TIME REQUIRED:** 1 x 45 - 60 Minutes.
*This can be extended in to 2 lessons of 45 minutes if the students want to complete the challenges included in their print out Assembly Instructions.*

**GROUP ACTIVITY:** Small groups of 2-3 students per Quirkbot Kit

**GOAL**
Learn the basics of programming and make an amazing blinking creature. Enable participants to use the Quirkbot CODE programming web interface and squeeze-on electronics (LEDs), connect programming and personality, creativity and fun. This lesson is the perfect introduction to programming the Quirkbots and working with external LED's, which is a pre-requisite for starting to use the light sensor.

**TIPS**
Read the Getting Started tutorial yourself and try out the lesson on yourself beforehand. Practice putting your Quirkbot in recovery mode as this will be needed in case your students program makes the Quirkbot crash so it's no longer recognized by the computer. Decide if participants are going to work in groups or individually. Make sure all Quirkbots have the default program erased and that they have an empty program inside of them. Install the Quirkbot Google Chrome app and drivers (only for Windows) or do it as a part of the activity.

**REQUIRED MATERIALS (per group)**
You should take 10 minutes to build an example structure prior to class, as inspiration and reference for your students. Lay out materials and paper print-outs before the class.

*1 Scissor*
*5 Straws*
*1 Quirkbot*
*5 Dual Color LED's*

**ADDITIONAL MATERIAL (not required for class)**
*Coloured Paper*
*Coloured Masking Tape*
*Pipe Cleaners*

# *BLINKING STAR – CLASS PLAN*



**5 MIN** Tell the participants they are going to make a blinking robotic creature today and decide how it will blink, program it!
Show inspirational and engaging material.
Demonstrate your pre-made blinkstar. Provide participants with the names of quirkbot's parts of body (Horn, Arms, Legs, Eyes, Mouthes).

**5-10 MIN** Make your blinkstar. Demonstrate how attach the LEDs, provide help if needed.

**10-15 MIN** Connect the blinkstars to the computers using USB cables. At this point you have to install the Google Chrome app, drivers (only for Windows) and create an account on the website. Using overhead projector, whiteboard or laptop present the programming web interface. Make sure to clarify the concept of the workspace, node's panel on the right, nodes and their parameters and the 'upload code' button.

*Example: **presenting the LED node.** Drag and drop an LED node onto the workspace. Demonstrate that it is possible to move and arrange nodes freely. Nodes have type (LED), name (led1 – yellow box, can be changed) and parameters. LED node has 2 parameters – 'light' and 'place'.*

*Light can have values from 0 to 1; 1 being the brightest and 0 meaning the absence of light. Most of the parameters have 1 as their maximum. We can click and drag or type in the value. Let's set it to 1. We choose place from the dropdown menu (when clicked on). Choose 'left eye' and press the 'upload code' button, continue with the green upload button, wait until the code is uploaded and press 'done'. Now Quirkbot's left eye is lighted.*

# *BLINKING STAR – CLASS PLAN*



**10 - 15 MIN** **PRACTICE**

Controlled practice. Ask participants to light both eyes and mouthes of their blinkstar using LED nodes. Challenge them to make them blink. Present the ‘wave’ node and demonstrate how to use it. Encourage participants to use ‘Dual Color LED’ nodes to light up the limbs.

**5-10 MIN** **EXPLORATION**

Let participants reflect on their creations. Encourage them to connect what they just did with their world and associate it with what they already know. Let them explore, use different wave types and parameters, play with their blinkstars for a bit, provide help if needed. Use the questions from the activity pdf.

**10-15 MIN** **CHALLENGE**

Create or let participants create a challenge for themselves or other pairs/participants. Use the ideas from activity pdf or your own.
Depending on the level of participants, some activities from previous stages can be done in this part.

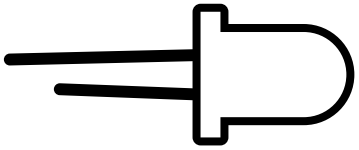
**10 -15 MIN** **OUTRO**

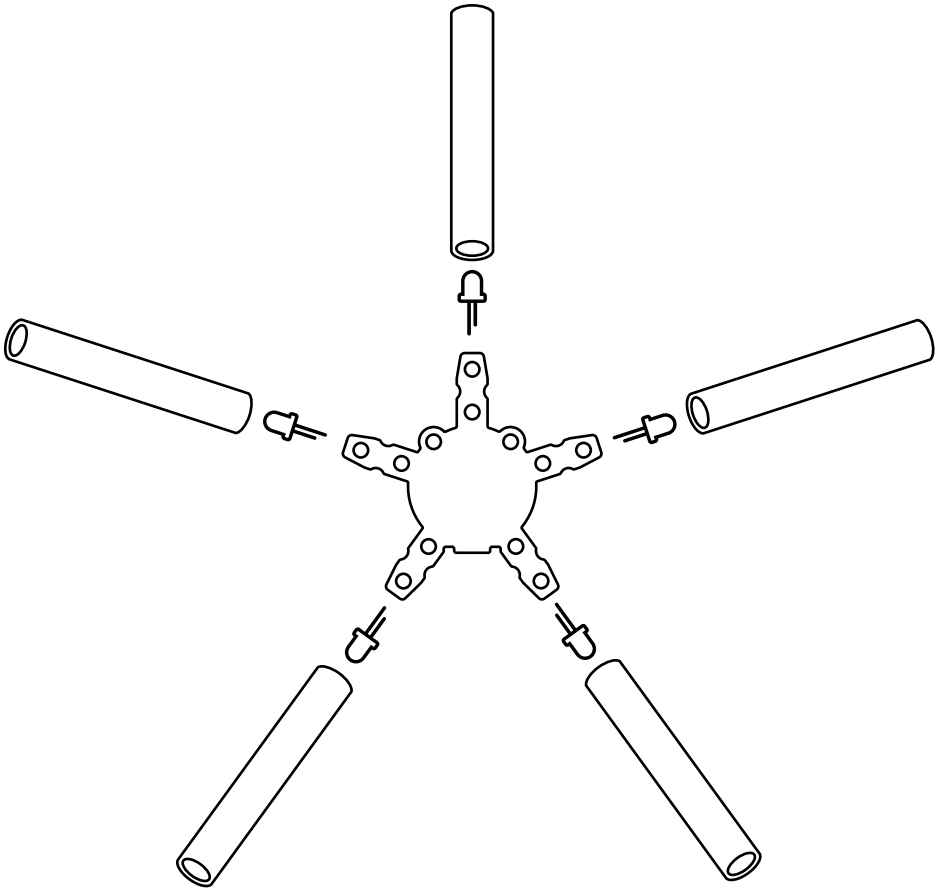
Let participants take photos of their creations, upload them to Instagram with #quirkbot.
Disassemble the creatures and put everything back into the boxes.

# *BLINKING STAR – ASSEMBLY*

STUDENT MATERIAL

The basic build for the Blinking Star is as simple as it gets. Put Dual Color LED's over the legs of the Quirkbot, and hold it in place with a straw.





**BUILDING TIPS**

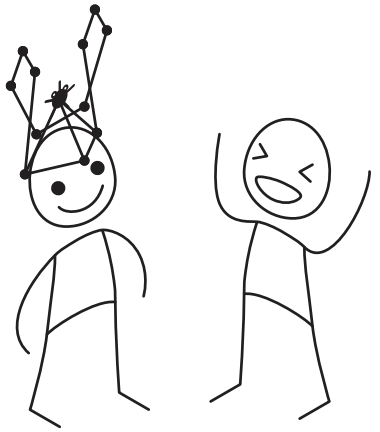
**1.** Squeeze the leads gently together to make them grab the Quirkbot arm better.

**2.** The **long lead** of the LED goes **on the front**. Push it all the way down!

**3.** Put a straw over the LED and the Quirkbot arm. This will help keep the component in place.

# *THINKING HAT*

**LESSON PLAN 3**



**AGE-RANGE:** 8+

**LEVEL OF DIFFICULTY:** Beginner

**TIME REQUIRED:** 45 - 60 Minutes.
*This can be extended in to 2 lessons of 45 minutes if the students want to complete the challenges included in their print out Assembly Instructions.*

**GROUP ACTIVITY:** Small groups of 2-3 students per Quirkbot Kit

**GOAL**
Get your students thinking creatively by making their own Thinking Hats! In this exercise kids will learn how to assemble a simple three dimensional structure in the shape of a tetrahedron / pyramid, with the full use of the motor, their Quirkbot and their Strawbees. A motor with the Quirkbot will be attached to the top of the structure and "wave", perhaps in connection with all the ingenious ideas they are coming up with as they wear the structures they have built.

This can be in the form of a challenge where the team that builds their thinking cap in the most creative way possible gets a reward or a prize.

**REQUIRED MATERIALS (per group)**
You should take 10 minutes to build an example structure prior to class, as inspiration and reference for your students. Lay out materials and paper print-outs before the class.

*Scissors*
*6 Straws*
*3 3-legged Strawbees*
*1 Quirkbot & Backback*
*1 Servo-motor*
*3 1-legged Strawbees*
*2 2-legged Strawbees*
*Plastic blade attached to servo-motor*
*Small screwdriver*

**ADDITIONAL MATERIAL (not required for class)**
*Coloured Paper*
*Pipe Cleaners*
*Glitter*
*Feathers*
*Props of some kind*

# *THINKING HAT – CLASS PLAN*

**5 MIN**

Introduce the power of Inventions through history and inspire students with some examples of recent inventions, especially some examples related to motors and wearable technology. Something fun, like Simone Gertz's teeth brushing helmet. Show them a picture or a completed version of the Waving Thinking Hat Structure and give them the challenge to complete it within the timeframe.

**10 MIN**

Explore: Allow the students to watch the introductory videos in their groups and talk about how they will assemble their Thinking Hats.

Direct your students to the materials on their tables and their step-by step instructions of how to assemble their Thinking Hat.

**20 MIN**

Help the students by going table to table and referring them back to the directions on their assembly sheets.

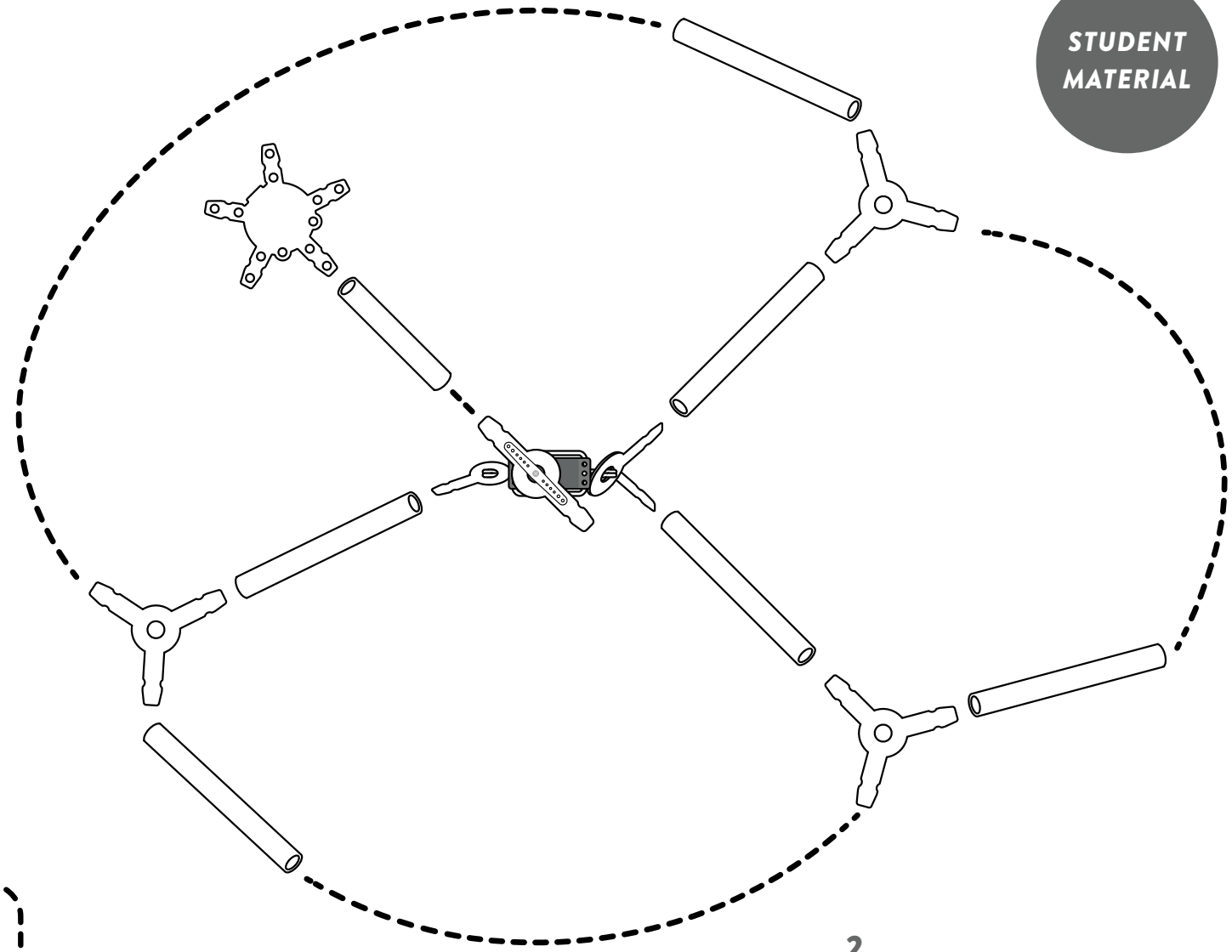
**10 MIN**

Now they have completed their structure, each group can take some time to inspect each other's thinking caps and test them out to see if they wave to each other.

# *THINKING HAT – ASSEMBLY*

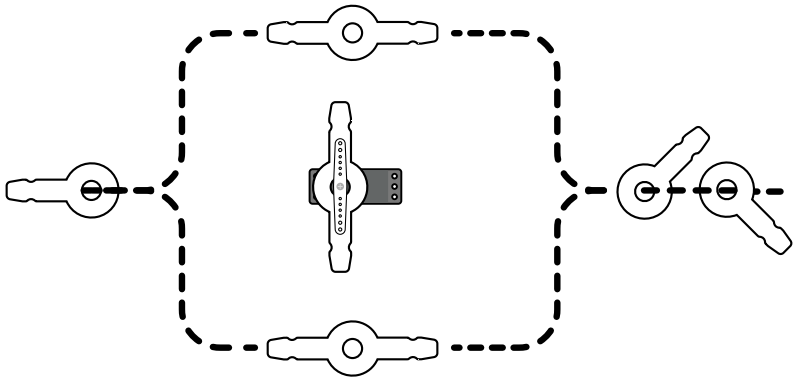
**STUDENT MATERIAL**

The easiest way to make your thinking hat is by putting a waving Servo Motor on top of a pyramid.



## *1.*

First, make the servo mount so you will have a base to start from.

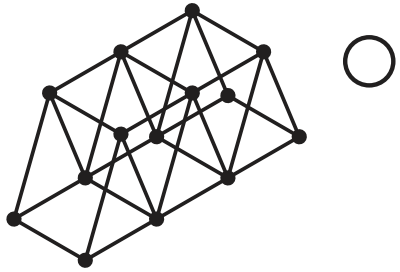


## *2.*

Continue by making the pyramid shape, but use the servo mount in one of the corners. On the servo arm, you can attach a straw and the Quirkbot on top and start decorating!

# *SHAKING BRIDGE*

**LESSON PLAN 4**



**AGE-RANGE:** 8+

**LEVEL OF DIFFICULTY:** Beginner

**TIME REQUIRED:** 45 - 60 Minutes.
*This can be extended in to 2 lessons of 45 minutes if the students want to complete the challenges included in their print out Assembly Instructions.*

**GROUP ACTIVITY:** Larger groups of 3-4 students per Quirkbot Kit

**GOAL**
Heavy Load ahead! In this project your students will learn about the fundamentals of what is necessary to create a safe bridge structure. They will create a bridge out of Strawbees and connectors and add a "natural disaster" twist with the use of their servo-motors as well as test their structure with 3 differently weighted balls. The aim is for them to brainstorm, think of solutions to potential problems that could come up and act on them by reinforcing their bridge with the different materials you give them! Introduce some aspects of what makes bridges safe, and how complicated foundations, balance, and weight can be when designing and building a bridge.

*This can be used as the first part of a 2-part lesson where in the second part they can build their own bridges from scratch with their teams. Or complete some of the challenges listed below in their Assembly Instructions Print Out.*

**REQUIRED MATERIALS (per group)**
You should take 10 minutes to build an example structure prior to class, as inspiration and reference for your students. Lay out materials and paper print-outs before the class.

*Scissors*
*17 Straws*
*20-30 1-legged Strawbees*
*10 2-legged Strawbees*
*1 Quirkbot & Backback*
*1 Servo-motor*
*Servo horn attached to servo-motor*
*Small screwdriver*
*Cardboard or Thick coloured Paper*
*Coloured Masking Tape*
*Blu-tack*
*1 Tennis Ball / 1 Golf Ball / 1 Ping Pong Ball*

# *SHAKING BRIDGE – CLASS PLAN*

**5 MIN**

Introduce the power of Inventions through history and inspire students with some examples of recent inventions, especially some examples related to motors. Show them a picture or a completed version of the Thinking Hat structure and give them the challenge to complete it within the timeframe.

**10 MIN**

Explore: Allow the students to watch the introductory videos in their groups and talk about how they will assemble their waving thinking caps.

Direct your students to the materials on their tables and their step-by step instructions of how to assemble their Waving Thinking Hat.

**20 MIN**

Help the students by going table to table and referring them back to the directions on their assembly sheets.

**10 MIN**

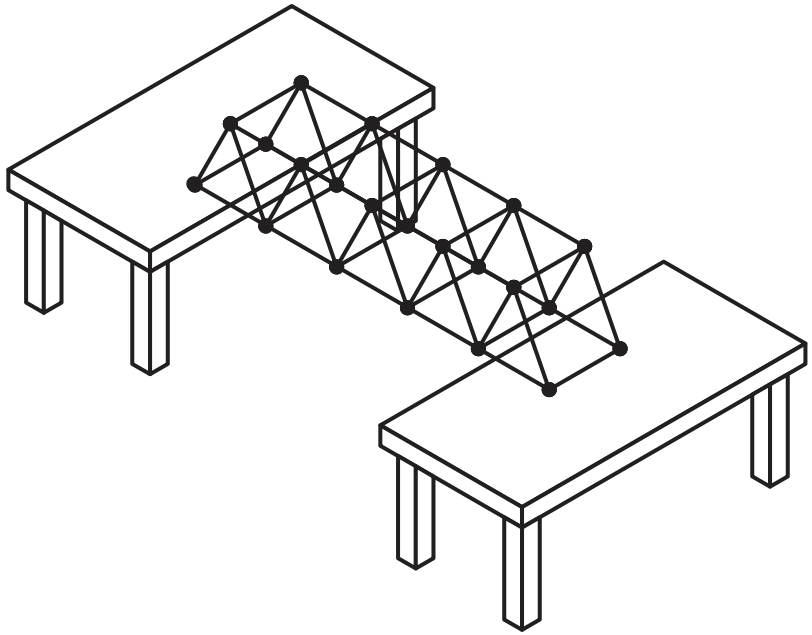
Now they have completed their structure, each group can take some time to inspect each other's thinking caps and test them out to see if they wave to each other.

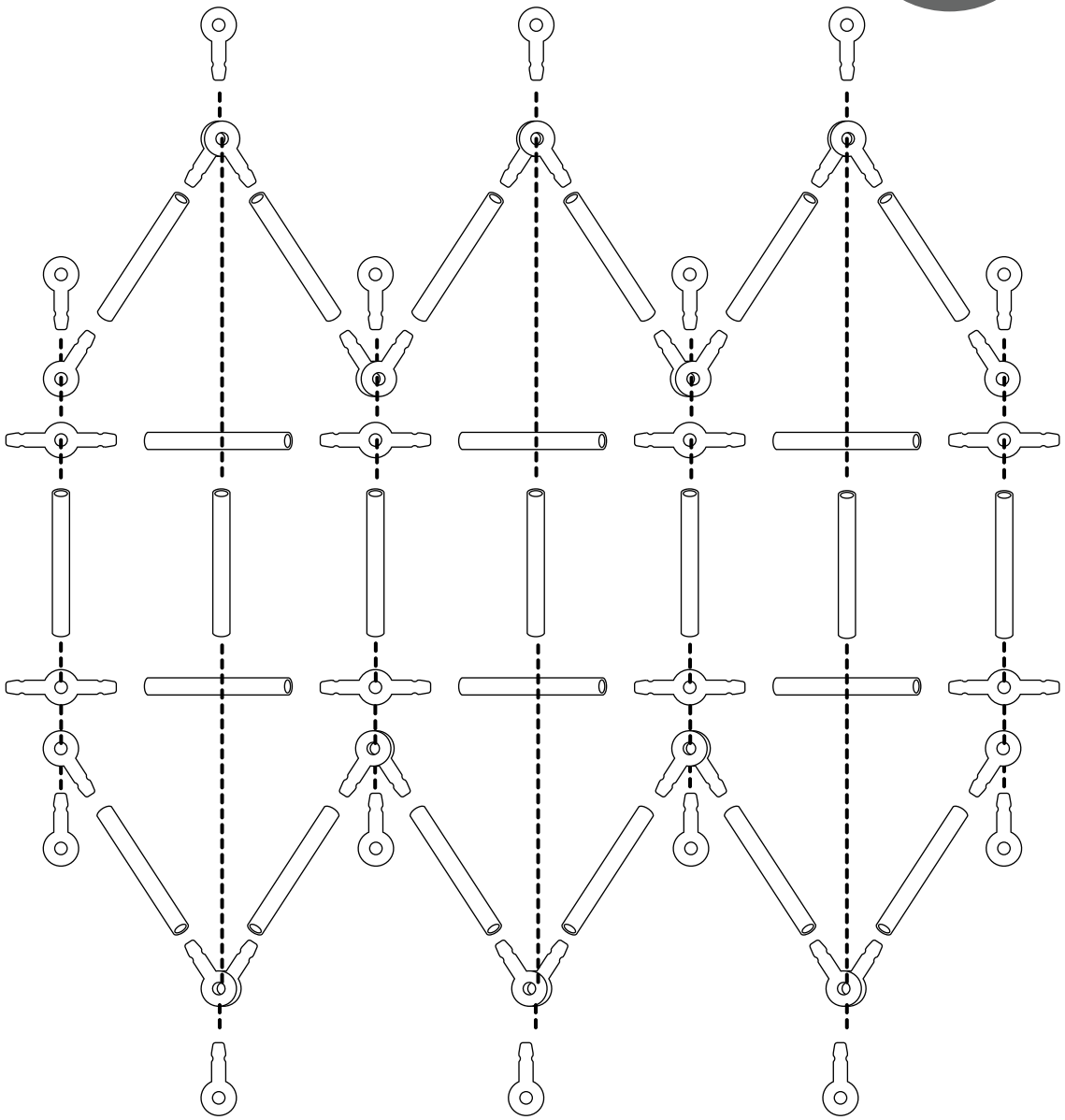
# *SHAKING BRIDGE - ASSEMBLY*

**STUDENT MATERIAL**

This is a Truss Bridge with triangular shapes. The shape can be repeated and strengthened in different ways. Add paper or cardboard on the base of the bridge.

Do you want to make your bridge shake? Attach the servo-motor to different parts of the bridge to see if it would withstand an earthquake! Or a natural disaster? Try rolling different balls across





# *BALANCING GAME*

**LESSON PLAN 5**

**AGE-RANGE:** 8+

**LEVEL OF DIFFICULTY:** Beginner

**TIME REQUIRED:** 2-3 x 45 Minutes

**GROUP ACTIVITY:** Small groups of 2-3 students per Quirkbot Kit

**GOAL**
Get your students starting to think practically about balance and 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. 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. 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 ping pong ball). The motor is programmable through Quirkbot's CODE portal so students can adjust the angle and speed at which the motor operates.

*This is a good series of lessons to teach in conjunction with lessons related to speed, angles of rotation, velocity and as an introduction to coding. This has several challenges that can provide a competitive element between the teams and used as self-learning benchmarks for the individual teams.*

**REQUIRED MATERIALS (per group)**
You should take 10 minutes to build an example structure prior to class, as inspiration and reference for your students. Lay out materials and paper print-outs before the class.

*Colourful masking tape*
*Blu-tack*
*10 Straws*
*Small Screwdriver*
*3 3-legged Strawbees*
*3 1-legged Strawbees*
*9 2-legged Strawbees*
*1 Servo-motor*
*Plastic blade attached to servo-motor*
*1 Ping Pong ball*

**TIPS**
Advise students to keep track of their progress by marking with a pencil which step they are on in their instruction sheets so they can easily come back to the task at the next class.

Suggested order of classes: 1. Team Building, Bridge Construction (& Servo-motor Mount) 2. Servo-motor Mount and Building of Balancing Structure (& Challenges) 3. Challenges & Recap

# *BALANCING GAME – CLASS PLAN 1*

| | |
|---|---|
| **5 MIN** | Introduce the power of Balance in relation to Inventions through history and inspire students with some examples of recent inventions, especially some examples related to balance. Show them a picture or a completed version of the Balance Game and give them the challenge to complete it with 2-3 classes. |
| **10 MIN** | Explore: Allow the students to get familiar with the items in their pack. And they can begin assembling the Bridge Structure. |
| **20 MIN** | The students should by now be assembling their servo-motor mount. Go from table to table assisting when you can and always directing them back to the diagrams. |
| **10 MIN** | Now they have completed their 2 tasks, let each group can take some time to inspect each other's bridges and servo-motors and put away their creations tidily. |

# *BALANCING GAME – CLASS PLAN 2*

**5 MIN** Open your class up to questions related to the structures they have been building before they split up into their groups. Ask them about challenges or difficulties the have run into and offer help to the class.

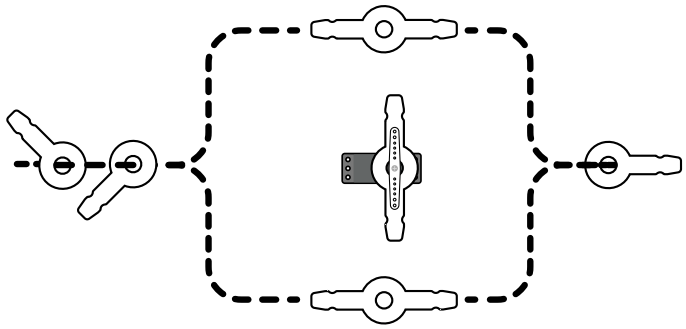
**20 MIN** Explore: All students are to build their Balancing Structure now. Help the students by going table to table and referring them back to the directions on their assembly sheets.

**20 MIN** Now they have completed their structures, each group can take some time to complete some of the challenges included on their assembly instructions, including programming some unique characteristics with Quirkbot Code:

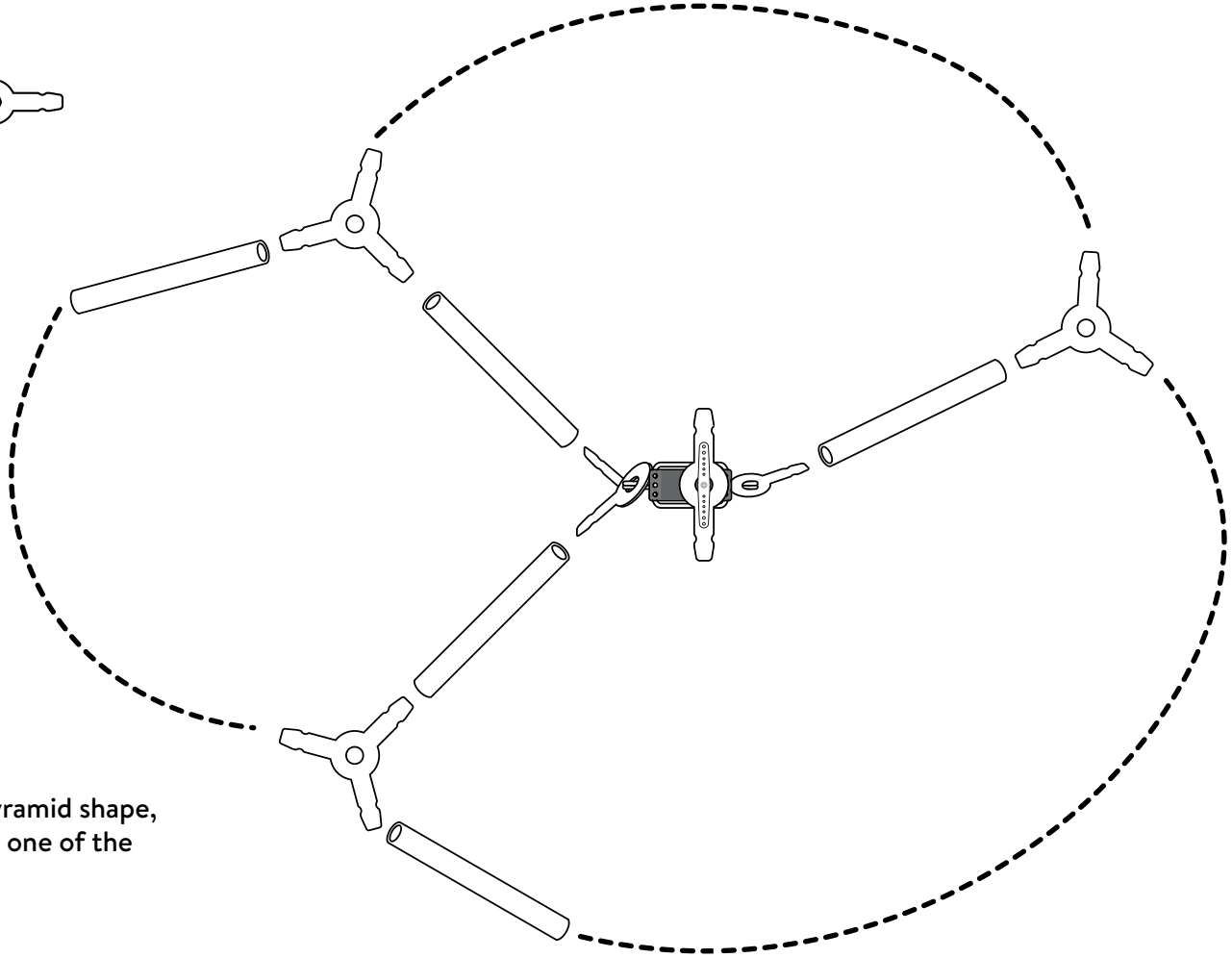
# *BALANCING GAME - ASSEMBLY*

**STUDENT MATERIAL**

The basic shape of the balacing game is a waving Servo Motor on top of a pyramid.



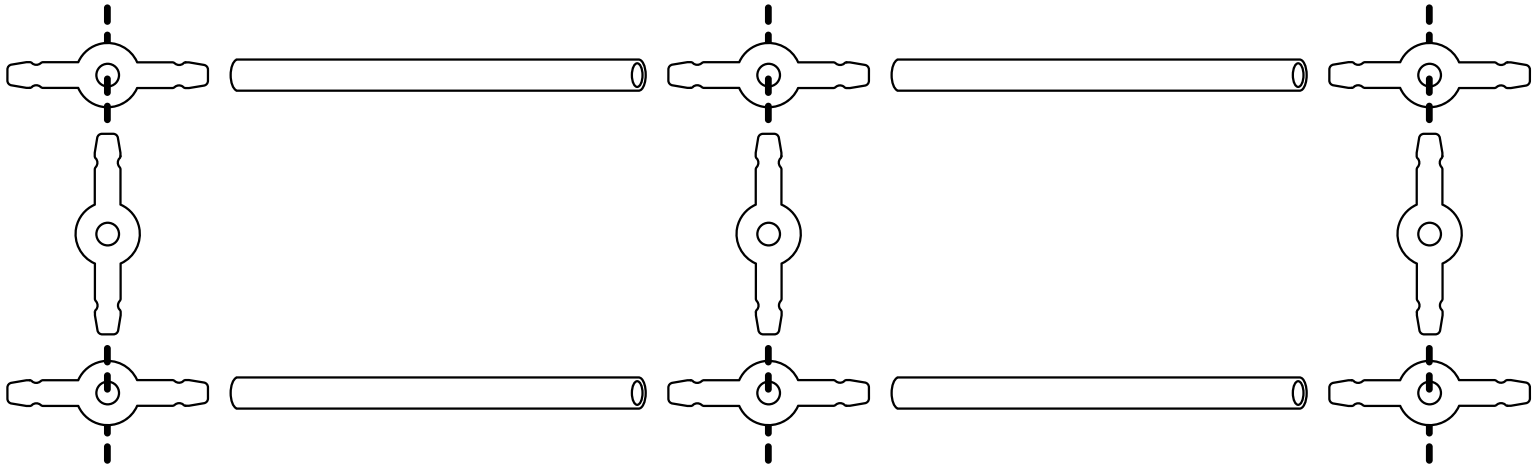
**1.**
First, make the servo mount so you will have a base to start from.



**2.**
Continue by making the pyramid shape, but use the servo mount in one of the corners.

# *BALANCING GAME - ASSEMBLY*

STUDENT MATERIAL



**3.**
Now let's make the bridge that will be attached to the horn of the Servo Motor. Note that you should use the 2-legged Strawbee attached on the servo as one of the middle in Strawbees in this drawing.

**CHALLENGE YOURSELF & YOUR TEAM:**
- Can you use another sensor to control the servo-motor?
- What is your highest score with your eyes closed, being able to grab what it is that you're balancing on the quirkbot?
- Can you pass the ball from one Balance Game Structure to another?
- Can you program the Quirkbot to keep the ball on top without having to touch it?