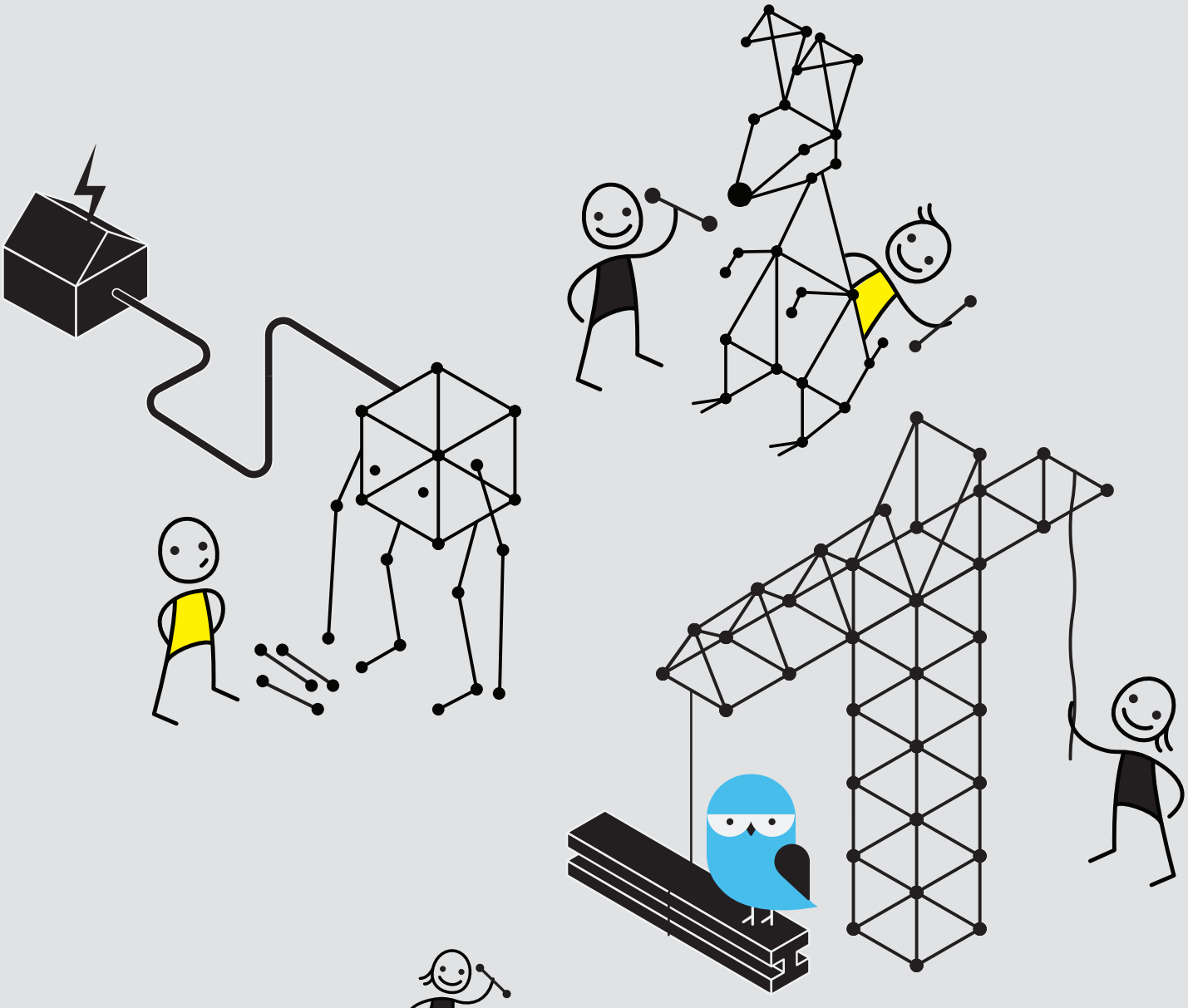
STUDENT GUIDE



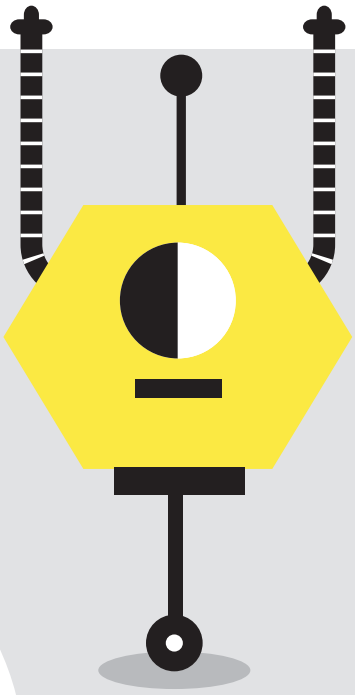
Strawbees®
EDUCATION

WISE OWL

Height: 57 cm, Weight 22 kg
Food preferences: Loves celery and peanut butter. (Only known vegetarian owl in the world)
Hobbies: Oil painting, gardening, reading novels
“What if and why questions are the best way to explore our world. My wisdom of historical events will help you gain more insight into your challenges.”

NERDY ROBOT

Height: 310 cm, Weight 741 kg
Energy Preferences: Salt water and Solar Power.
Hobbies: Scary Movies, long strolls on the beach, and solving Einstein's unfinished theory.
“How questions are my favorite to solve. I will provide formulas, which will aid in solving any mechanical problems. ”



MIO

Height 121 cm , Weight 33 kg
Favorite Food: Watermelons and Bacon
Hobbies: Writing, Debating, and Kickboxing
“There must be an explanation for that.”

LEY

Height 118 , Weight 34 kg
Favorite Food: Tofu and Baked Potato
Hobbies: Volleyball, Salsa Dancing, and Cooking
“It’s Strawbees time!”

GREETINGS

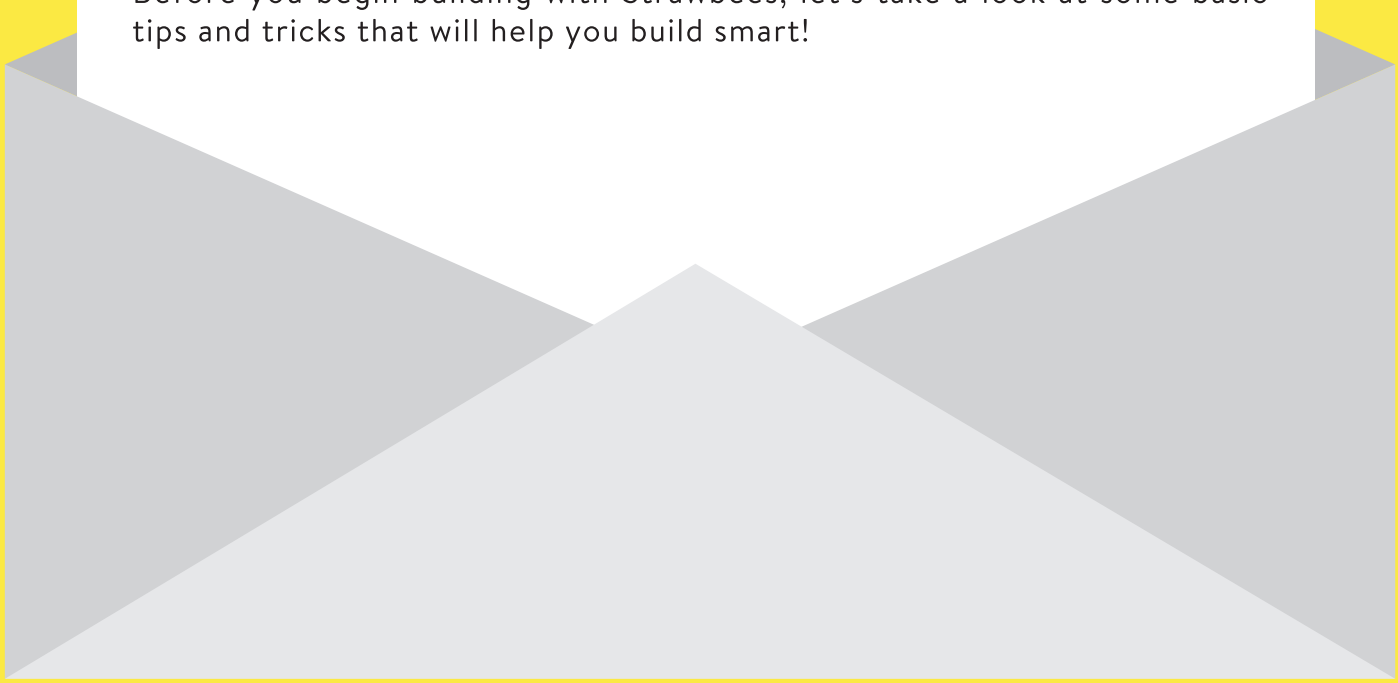
Welcome to Strawbees education! Here we encourage you to explore the five major questions; How things work, why they work, who made them work, when they work, and where they work in the world. You will be challenged to solve problems and be adventurous. The more questions you ask, the more answers you will receive. Take advantage of all the resources and information available to you through your teacher, books, and the internet.

Building with Strawbees is unique. Be patient, courageous, and adventurous as you explore and build. Let your imagination go wild, fall in love with tackling challenges, and most importantly have fun! Things won't always go the way you plan, but it's important to remember that there's no right or wrong. You have just simply discovered something new! Even if you're done, you can always find ways to remake your creation by making it bigger, smaller, taller, wider, stronger, cuter and so on! Also remember that when building with strawbees, nothing is destroyed or broken; it is only modified.

EXPECTATIONS

Throughout the lessons, you will work individually and in teams. Once you have completed a challenge be sure to evaluate it and present your findings to the class. Additional challenges are provided after each lesson for more fun and exploration!

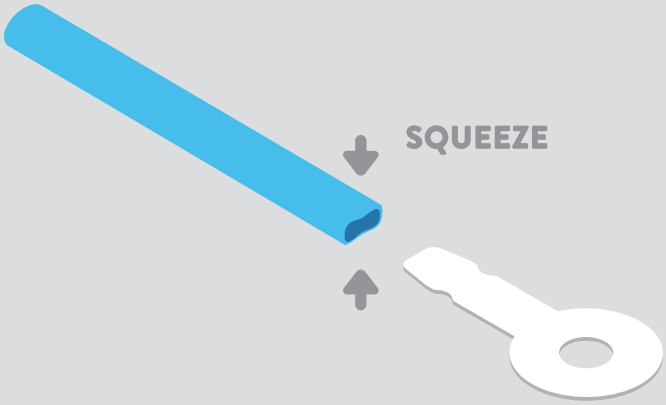
Before you begin building with Strawbees, let's take a look at some basic tips and tricks that will help you build smart!

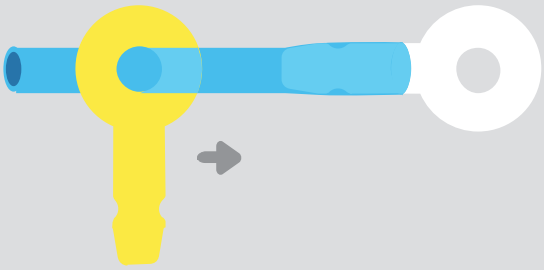


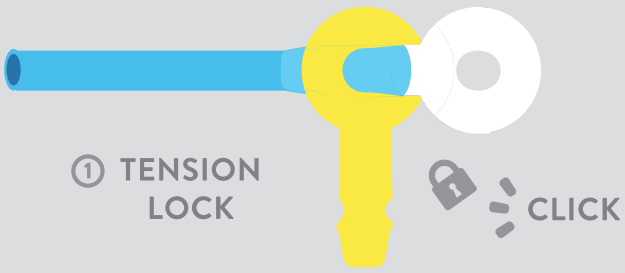
CONNECT & LOCK

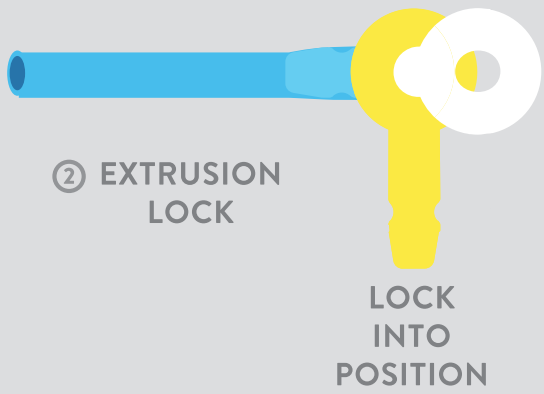
Strawbees are little pieces that connect to each other and to straws. To connect the Strawbees to each other, simply snap one into the other.

It connects to other Strawbees in two ways:
1) Snapped into the groove, or
2) Pushed all the way through.









CONNECTING TO STRAWS

Squeeze the opening of the straw for easy insertion of the Strawbee.

If your straws slide off the Strawbees, you can lock them with another Strawbee.

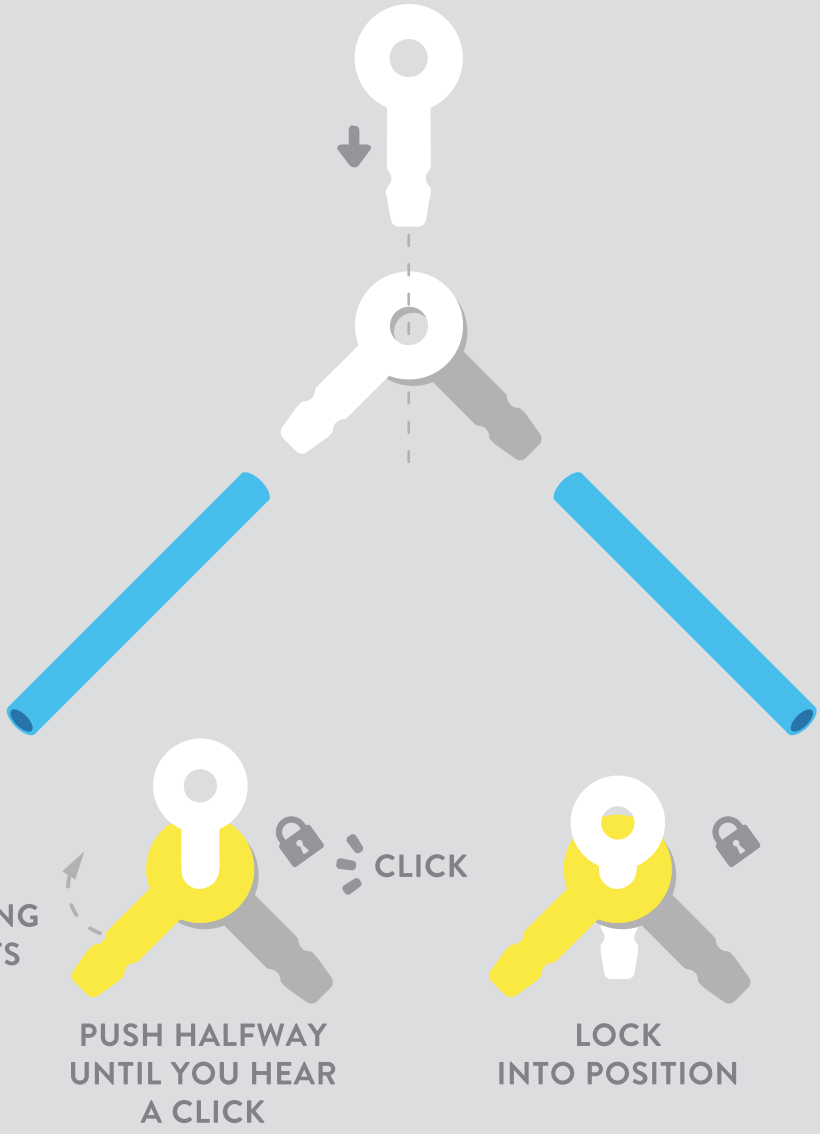
We call this the tension lock. Push a Strawbee on over the Strawbee that is already attached to the straw.

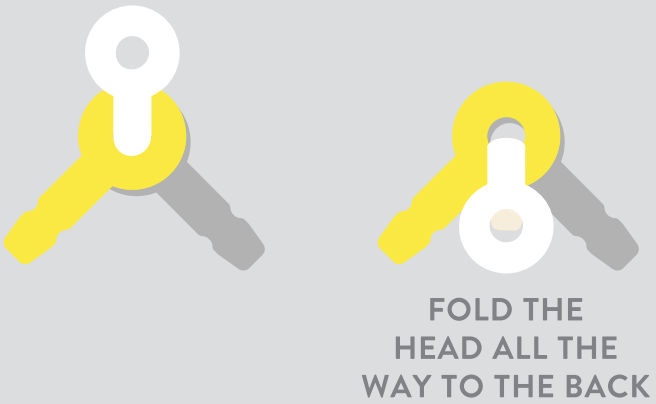
Another way of attaching a straw to a Strawbee is a joint pushed all the way in and adding Extrusion lock - Perfect for extruding and sculpting.

JOINT

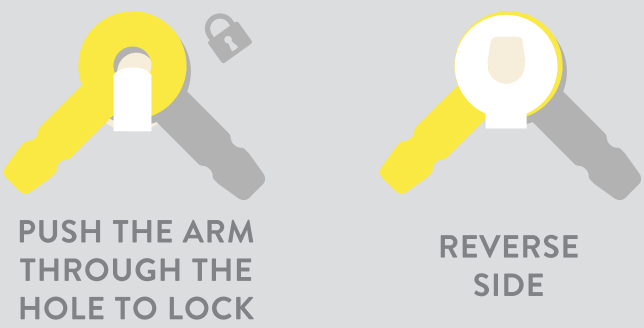
To make two or more Strawbees stick together in a hinge you can push a third one into them.
1) If you snap it into the groove, they will be a moving hinge,
2) If you push all the way through, they will lock into their positions.

Pro tip: Push one Strawbee at a time and if it's hard to fit them into each other, it helps to fold, squeeze, etc. Strawbees are quite resistant.



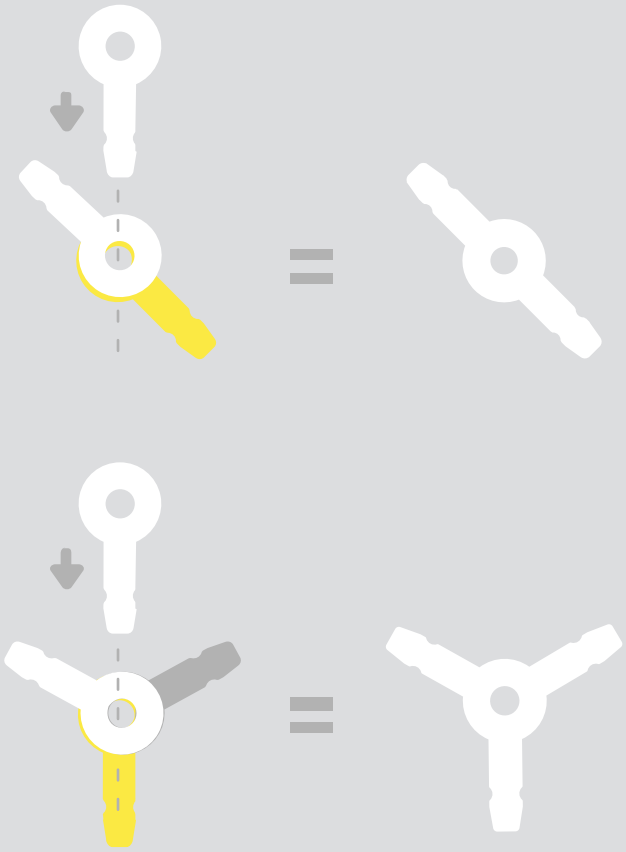


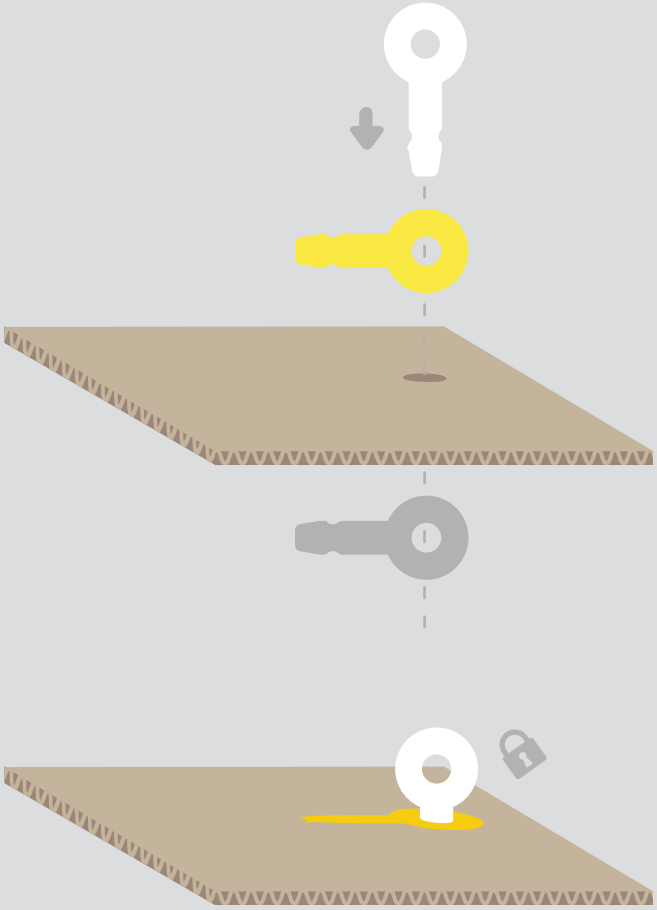
You can also fold the Strawbee over itself to create a friction lock.



HOW TO REPLACE A PIECE

If you start to run out of certain types of Strawbees, you can replace them with a combination of other Strawbees (you can even cut them yourself!). You can put upto 20 Strawbees on a single Strawbee.





CARDBOARD BASICS

Strawbees and cardboard are friends too. You can join two or more pieces of cardboard together by passing a Strawbee through them. Make the cardboards move by cutting out circular holes for joints, or lock the boards into position by simply fitting your Strawbees in a fixed place. Always remember to lock the Strawbees so they don't fall apart.

BRIDGE CHALLENGE 1

EVOLUTION OF THE BRIDGE

How can we account for what is perhaps one of the most spectacular engineering evolutions, the modern day bridge? How can a fallen down tree across a creek capable of only supporting a handful of people turn into the stunning Golden Gate Bridge capable of supporting pedestrians, cars, motorcycles, and even trucks? What major events or “Ah ha!” moments led up to the creation of the Golden Gate Bridge?

5000 BC

Basic bridge designs were developed long ago from natural resources. For example, a tree trunk that has fallen across a stream, vines hanging over a river, or stones that make a stepping-stone path across a shallow stream. These natural bridges were the foundation to beam bridges built upon by ancient bridge builders.

50 AD

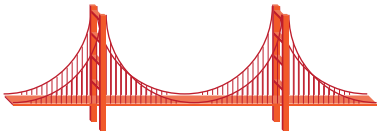
The ancient Romans refined Bridge building with two important contributions. Nearly all of their bridges used the arch design- a structure that can support more weight than a flat surface. Also, the Roman’s discovery of natural cement allowed them to build strong, long-standing bridges. Many of these ancient Roman bridges are still standing today.

400 AD

During the same time period, excellent bridge builders in Asia also emerged. The cantilever was first discovered around China. This design enabled simple, long-span bridges that stretched across fairly wide rivers.

1500s

Leonardo da Vinci and Galileo helped architects understand mathematical theories, which allowed bridges to be much stronger and lighter.



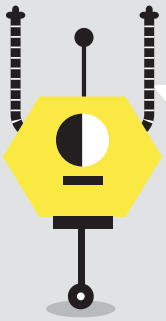
1800s

The industrial revolution led to improved building materials such as “prestressed” concrete and steel. Engineers combined these materials with improved designs from modern architects to build bridges that span across great distances.

EASY
BRIDGE CHALLENGE

BACKGROUND

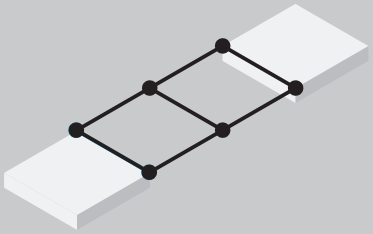
The first bridges made by humans were spans of cut wooden logs or planks. These logs were eventually combined to stretch across longer creeks and evolved to become beam bridges. Use the blank space below to design your beam bridge. Use Strawbees and straws to bring it to life and test your creation!



CHALLENGE

Can you build a 2D beam bridge that spans at least 36cm (one and a half Strawbees straw length) with a width of at least 12cm (half of a straw). Explore different shapes like squares and triangles as you build!

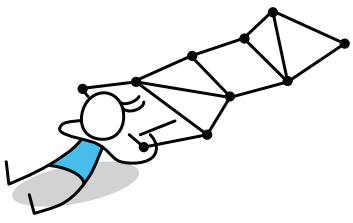
Materials: Strawbees, straws and paper



BEAM BRIDGE

Beam bridges are the simplest structural forms for bridges. They need to be stiff and resist twisting and bending under load. In its most basic form, a beam bridge consists of a horizontal beam that is supported at each end.

Tips: Draw your bridge first, before you start building



ADDITIONAL CHALLENGE

I wonder if I can modify this bridge to become portable, easily folding and unfolding without bending any straws! Can you help me make it happen?

EASY
BRIDGE REFLECTION

MAKE YOUR PREDICTION

Predict how much weight (marbles, coins, bananas) will make your bridge collapse? Can you make it stronger? What shapes will make it stronger?

_____

_____

_____

_____

MATERIALS USED FOR BUILDING

_____ Strawbees # _____ Straws

Once completed, name it and share it on social media using #StrawbeesEdu

TEST

Trial 1: How many _____ did your bridge hold? # _____

After testing your bridge, inspect your bridges weakest and strongest points. Why are they strong/weak? How can we improve your bridge?

_____

_____

Trial 2: How many _____ did your bridge hold? # _____

SUMMARY

Was your prediction correct? What did you learn from this lesson? Share your findings with your classmates and discuss.

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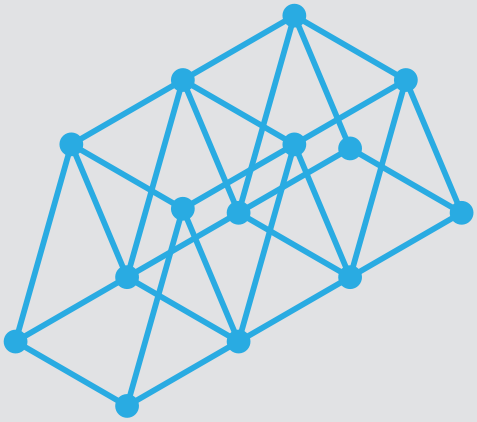
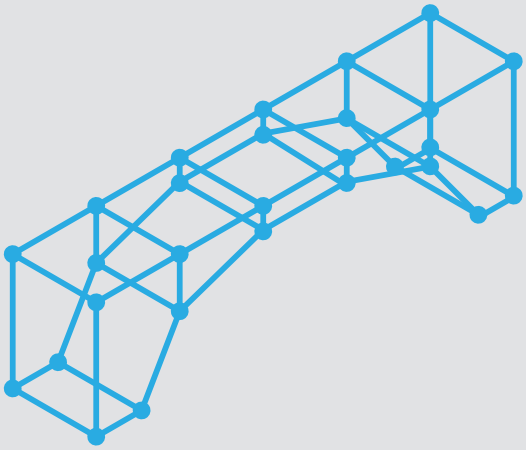
MEDIUM
BRIDGE LESSON

Before you begin your next challenge, take a look below. What else can you learn about these bridges? Research and share with your classmates!



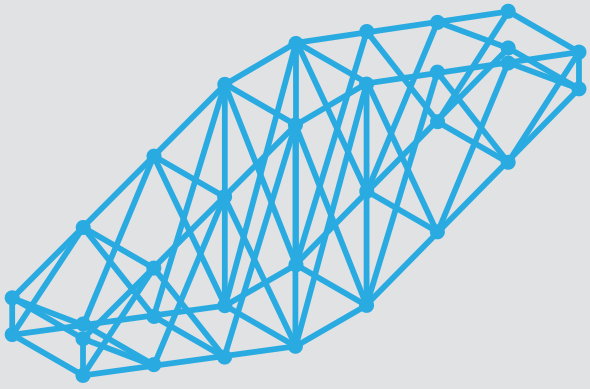
TRUSS BRIDGE

A truss bridge is a type of bridge whose main structure forms triangular units. Truss is used because it is a very rigid structure and it transfers the load from a single point to a much wider area.



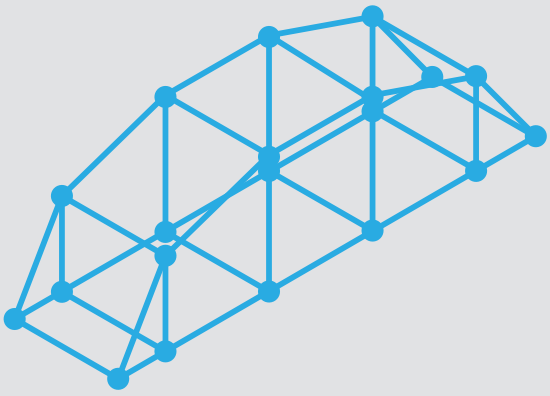
ARCH BRIDGE

An arch bridge has a curved arch that carries the stress load outward along the curve to the supports at each end. The weight is transferred to the supports at either end. These supports, called abutments, carry the load and keep the ends of the bridge from spreading out. The earliest known arch bridges were built by the Greeks, and include the Arkadiko Bridge.



CANTILEVER BRIDGE

Cantilever bridges are built using horizontal beams supported on only one end, usually in the middle. Most cantilever bridges use a pair of continuous spans that extend from opposite sides of the supporting piers to meet at the center. The difference comes in the action of the forces through the bridge.



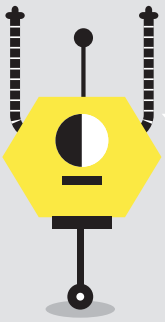
TIED ARCH BRIDGE

Tied arch bridges have an arch-shaped superstructure, but differ from conventional arch bridges. Instead of transferring the weight of the bridge and traffic loads into thrust forces into the abutments, the ends of the arches are restrained by tension in the bottom chord of the structure.

MEDIUM
BRIDGE CHALLENGE

BACKGROUND

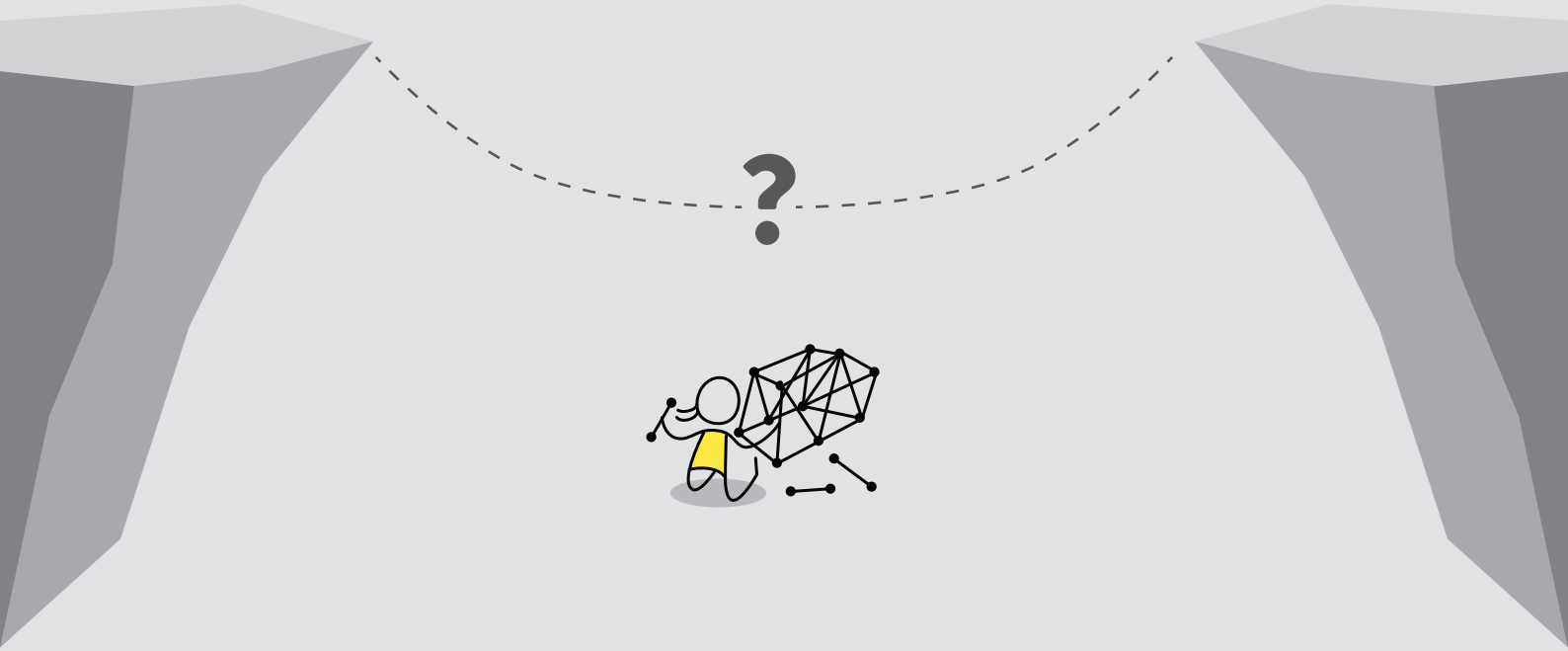
Ancient Romans and Chinese bridge builders improved the beam bridge by adding structural support. This allowed them to span great distances and build sturdier and more durable bridges. Your team will use their concepts to design and build a bridge across a portion of the Grand Canyon.



CHALLENGE

Split into teams to sketch and build a 3D bridge that spans over 48cms long (two straws length), 12 cm high and 12 cm wide. Explore using short vs long straws while building.

Materials: Strawbees, straws, paper, and markers



ADDITIONAL CHALLENGE

This bridge is missing personality! How can we decorate our bridge to become an inspiring art work? both truss and arch bridges. Test and compare results.

MEDIUM
BRIDGE REFLECTION

MAKE YOUR PREDICTION

Which bridge design will be the best option for this challenge? Why? Predict how much weight will make your bridge collapse?

_____

_____

_____

MATERIALS USED FOR BUILDING

#_____ Strawbees #_____ Straws #_____ ( )

WHAT ARE THE MEASUREMENTS OF YOUR BRIDGE?

Length _____ Width _____ Height _____

Once completed, name it and share it on social media using #StrawbeesEdu

TEST

Trial 1: How many _____ did your bridge hold? # _____

After testing your bridge, inspect your bridges weakest and strongest points. Why are they strong/weak? How can we improve your bridge?

_____

_____

Trial 2: How many _____ did your bridge hold? # _____

SUMMARY

Was your prediction correct? What did you learn from this lesson? Share your findings with your classmates and discuss.

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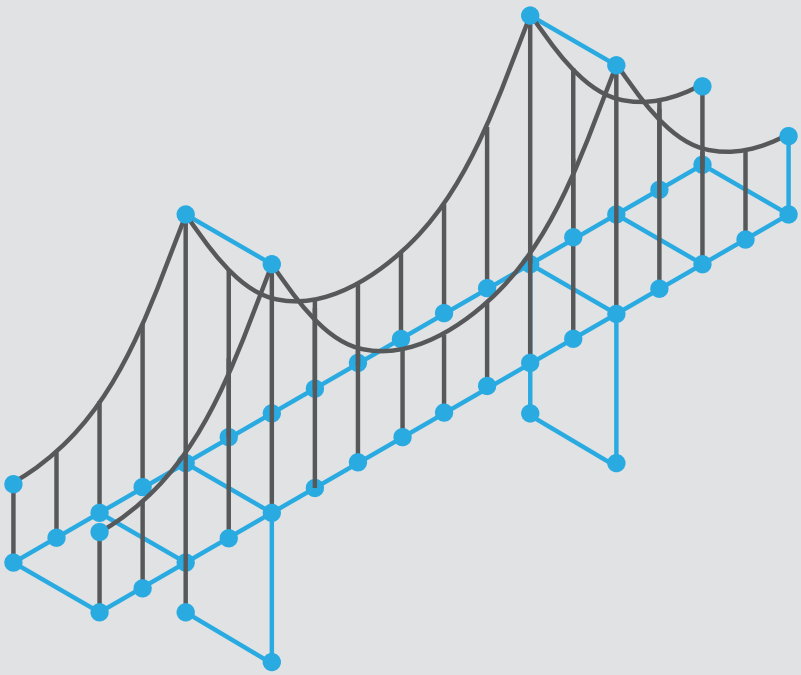
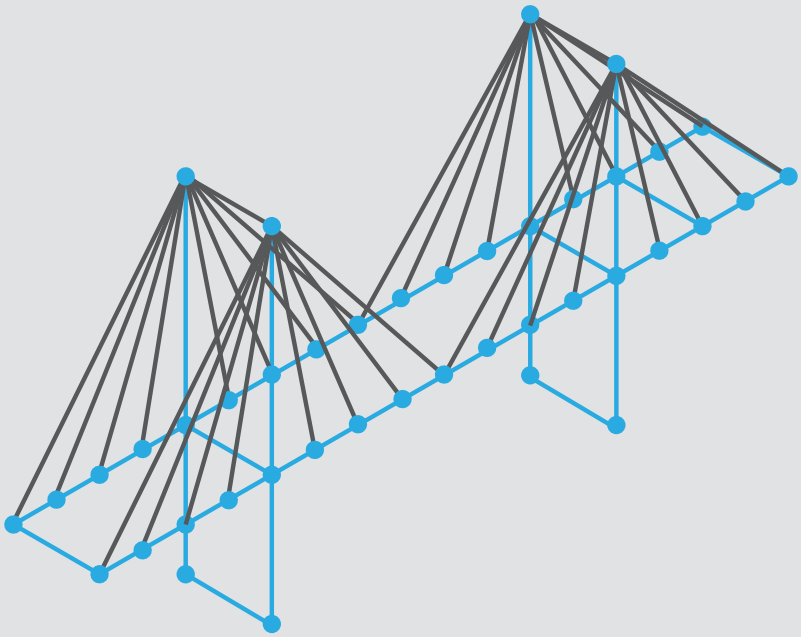
HARD
BRIDGE LESSON

What else can you learn about these bridges? Research and share with your classmates!



SUSPENSION BRIDGE

Suspension bridges are suspended from cables. The earliest suspension bridges were made of ropes or vines covered with pieces of bamboo. In modern bridges, the cables hang from towers that are attached to caissons or cofferdams. The caissons or cofferdams are implanted deep into the floor of a lake or river.



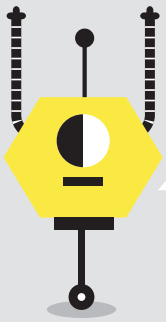
CABLE-STAYED BRIDGE

Cable-stayed bridges, like suspension bridges, are held up by cables. However, in a cable-stayed bridge, less cable is required and the towers holding the cables are proportionately higher.

HARD
BRIDGE CHALLENG

BACKGROUND

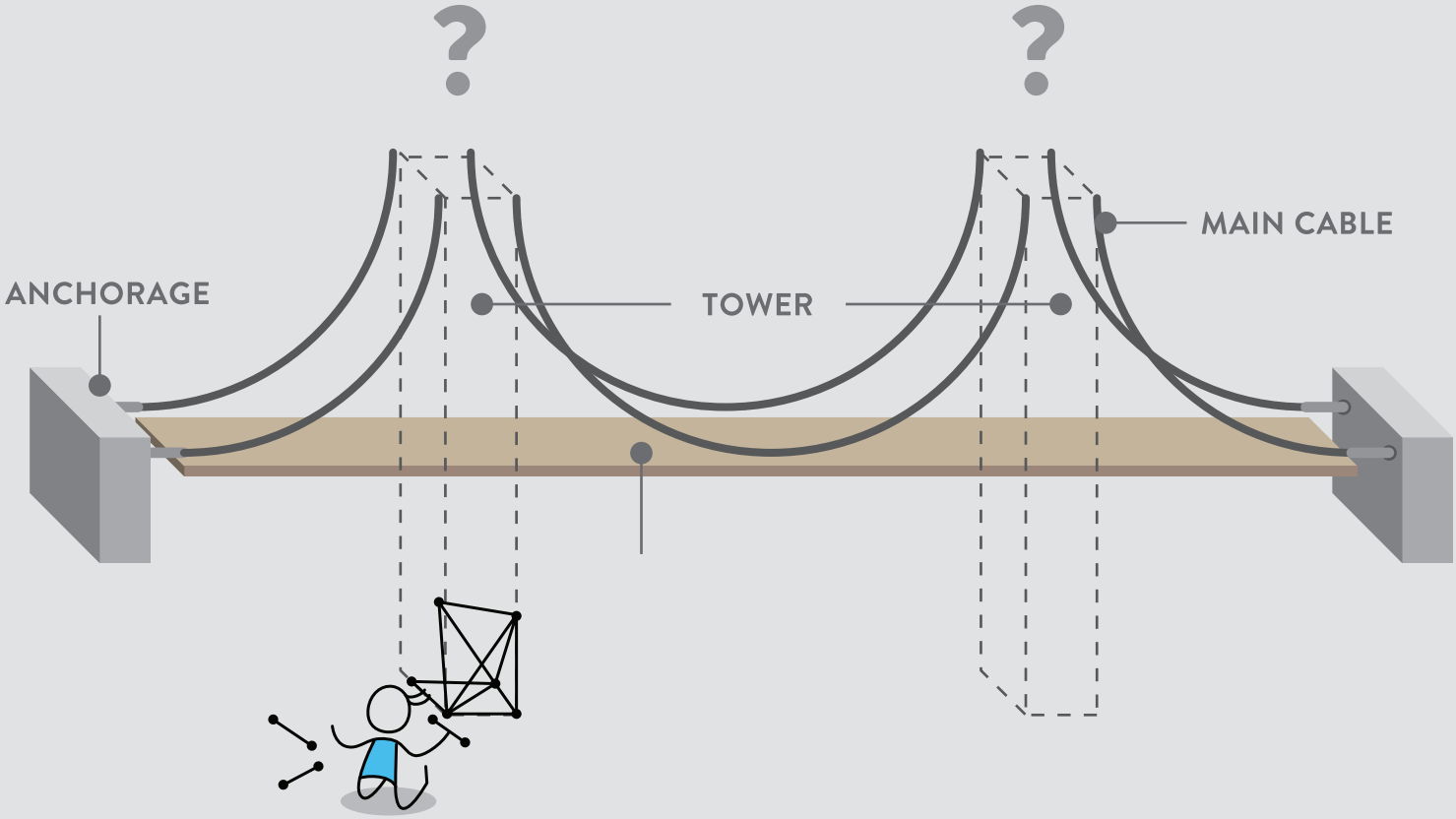
With the industrial revolution, suspension bridges became much sturdier and stretched across greater distances. The longest suspension bridge today in the world is the Akashi Kaikyō Bridge in Japan which spans 1,990 meters.



CHALLENGE

What factors must engineers consider to build a suspension bridge? Discuss this with your team then sketch and build a suspension bridge that spans 96cm long (four straws length) with a height of 24 cm, and width of 12cm. Use only two main focal tower points.

Materials: Strawbees, straws, cardboard, fishing string



ADDITIONAL CHALLENGE

Write and draw a news article featuring your bridge! What would it look like? What would it say?

HARD
BRIDGE REFLECTION

MAKE YOUR PREDICTION

What are the benefits of using suspension or cable-stayed bridges compared to other bridges? Why? Predict how much weight will make your bridge collapse?

_____

_____

_____

MATERIALS USED FOR BUILDING

#_____ Strawbees #_____ Straws

#_____ Long wire #_____ ( )

WHAT ARE YOUR BRIDGES MEASUREMENT?

Length _____ Width _____ Height _____

Once you have finished building, name it and share it using #StrawbeesEdu

TEST

Trial 1: How many _____ did your bridge hold? # _____

After testing your bridge, inspect your bridges weakest and strongest points. Why are they strong/weak? How can we improve your bridge?

_____

_____

Trial 2: How many _____ did your bridge hold? # _____

SUMMARY

Was your prediction correct? What did you learn from this lesson? Share your findings with your classmates and discuss.

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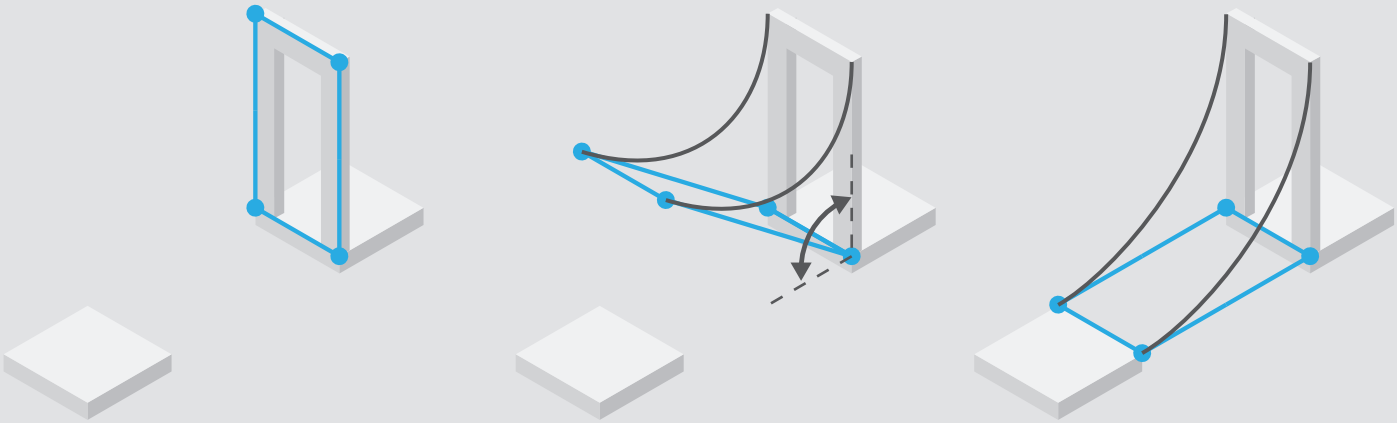
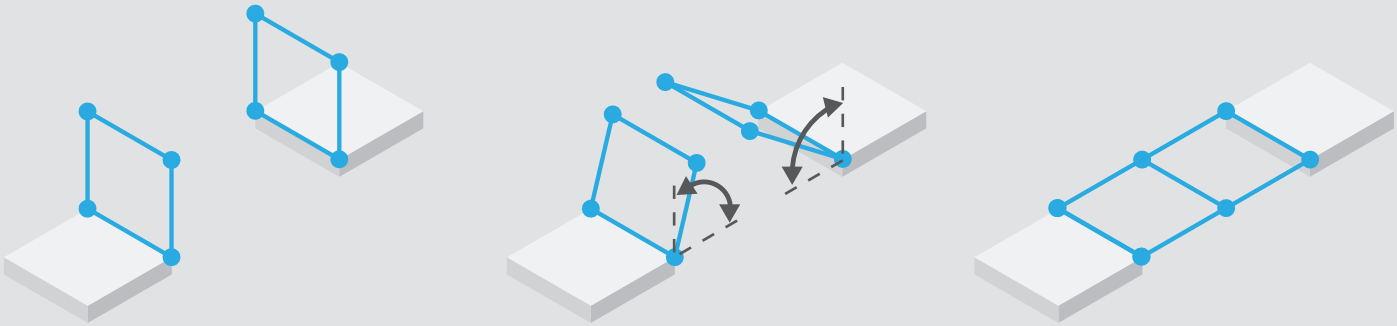
EXPERT
BRIDGE LESSON

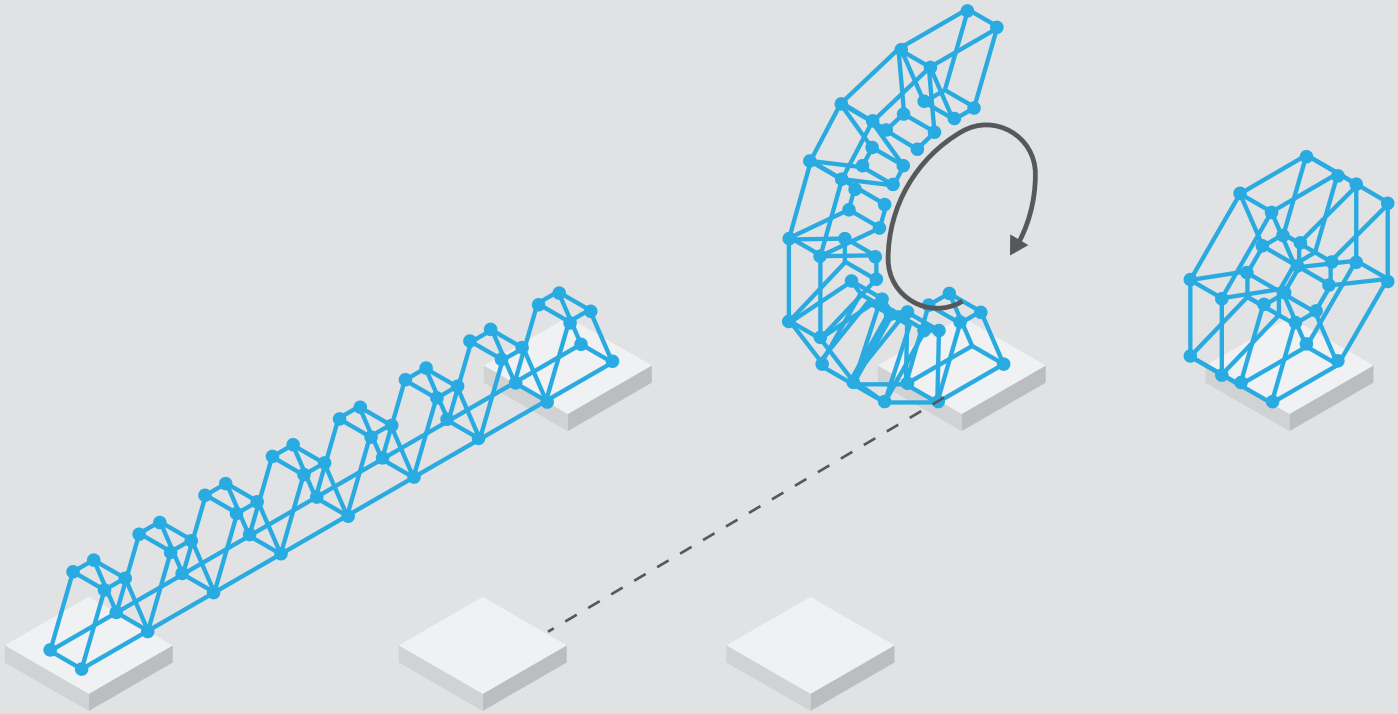
Here are 3 examples of moving bridges. How do they work? Where are they found? Why do we need them? Research and share your findings.



DRAWBRIDGE



BASCULE BRIDGE

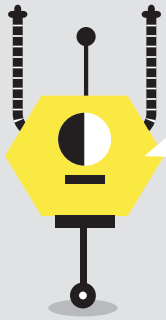


CURLING BRIDGE

EXPERT
BRIDGE CHALLENGE

BACKGROUND

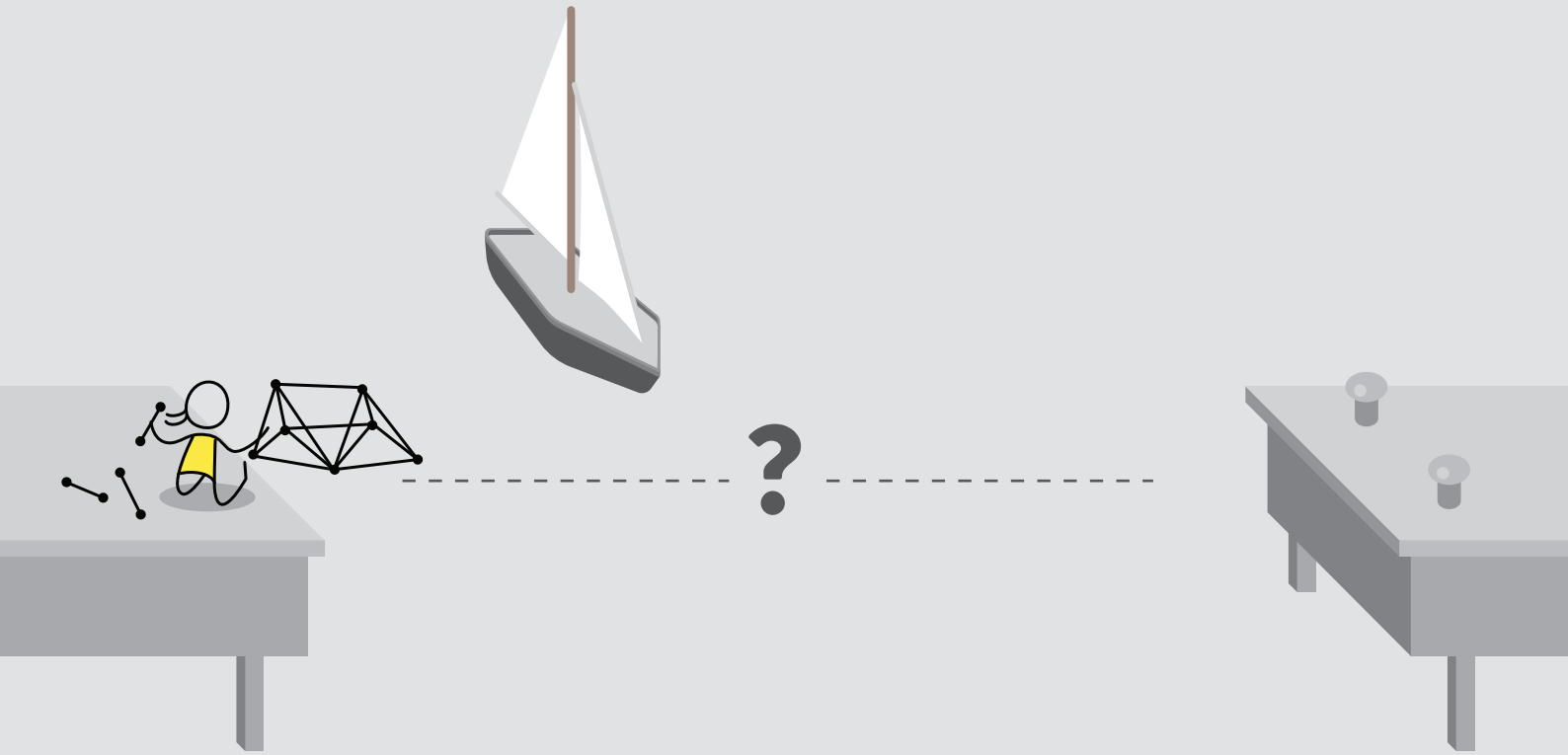
One of the first popular movable bridges was used at the entrance of a castle surrounded by a moat. Today, moving bridges have evolved to include many different designs including drawbridges, curling bridges, and bascule bridges. You are an aspiring architect with a dream to reinvent the moveable bridge. What would your masterpiece look like?



CHALLENGE

Design and build a moving bridge that spans 48cms long (three straws length) 24cm high, and 24cm wide. Your movable bridge must allow a 36cm high sailboat to pass.

Materials: Strawbees, straws, cardboard, strings, rubber band



ADDITIONAL CHALLENGE

Imagine different scenarios where you could use your moveable bridge to solve daily problems. Illustrate or describe these scenarios and explain how your moveable bridge will assist.

EXPERT
BRIDGE REFLECTION

MAKE YOUR PREDICTION

Which bridge design will be the best option for this challenge? Why? Predict how much weight will make your bridge collapse?

_____

_____

_____

MATERIALS USED FOR BUILDING

#_____ Strawbees #_____ Straws #_____ ( )

WHAT ARE YOUR BRIDGES MEASUREMENT?

Length _____ Width _____ Height _____

Once you have finished building, name it and share it using #StrawbeesEdu

TEST

Trial 1: How many _____ did your bridge hold? # _____

After testing your bridge, inspect your bridges weakest and strongest points. Why are they strong/weak? How can we improve your bridge?

_____

_____

Trial 2: How many _____ did your bridge hold? # _____

SUMMARY

Was your prediction correct? What did you learn from this lesson? Share your findings with your classmates and discuss.

_____

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_____

LEGENDARY
BRIDGE CHALLENGE

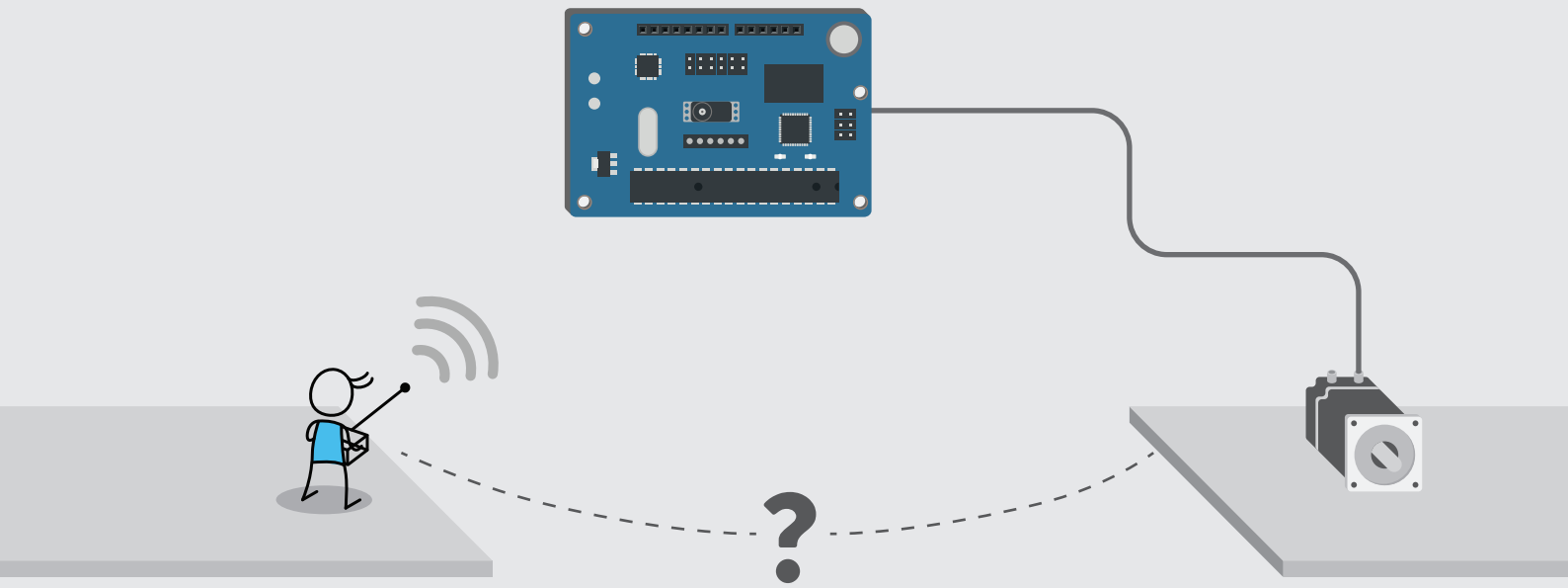
BACKGROUND

Technology enables us to accomplish more with less effort. How can technology help bring your moveable bridge to life?

CHALLENGE

Design and build the most technologically advanced drawbridge, which spans across 48cms. and 24cms wide, and 24 cms High! Sturdy enough to hold 5 cars on either side.

Materials: Strawbees, straws, strings, cardboard, electronics (Arduino, Raspberry Pi, Little Bits, Quirkbots, etc)



ADDITIONAL CHALLENGE

Your bridge is known as the happy dancing bridge. Could you help me program and tweak your bridge to dance and shake its suspensions off! ;)

LEGENDARY
BRIDGE REFLECTION

MAKE YOUR PREDICTION

What do you think will be the most challenging aspect of this challenge? Predict how much weight will make your bridge collapse?

_____

_____

_____

MATERIALS USED FOR BUILDING

#_____ Strawbees #_____ Straws

#_____ ( ) #_____ ( )

WHAT ARE YOUR BRIDGES MEASUREMENT?

Length _____ Width _____ Height _____

Once you have finished building, name it and share it using #StrawbeesEdu

TEST

Trial 1: How many _____ did your bridge hold? # _____

After testing your bridge, inspect your bridges weakest and strongest points. Why are they strong/weak? How can we improve your bridge?

_____

_____

Trial 2: How many _____ did your bridge hold? # _____

SUMMARY

Was your prediction correct? What did you learn from this lesson? Share your findings with your classmates and discuss.

_____

_____

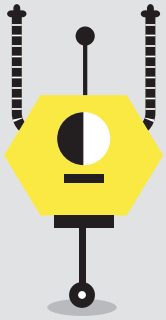
_____

PROJECTILE CHALLENGE 2

EASY
PROJECTILE CHALLENGE

BACKGROUND

The first Bow and Arrow was made with a curved piece of wood with both ends connected by bow string.You are in charge of designing the Bow and Arrow of the future. How would you use Strawbees and straws to prototype your design?

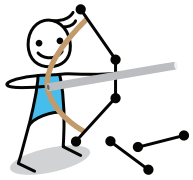


CHALLENGE

Design and create a Bow and Arrow! Strengthen your bow so It won't snap easily. How far can you shoot a straw?

Materials: Straws, Strawbees, rubber band, string

Tips: Draw your bow and arrow first, before you start building



ADDITIONAL CHALLENGE

Your bow and arrow has a special hidden talent of producing the most beautiful noise. How can you bring forth this power/ability?

EASY
PROJECTILE CHALLENGE

MAKE YOUR PREDICTION

How far will your arrow fly? What flexible or elastic material can strengthen your bow?

_____

_____

_____

_____

MATERIALS USED FOR BUILDING

_____ Strawbees # _____ Straws

Once completed, name it and share it on social media using #StrawbeesEdu

TEST

How far did your arrow fly? What improvements can you make your arrow travel farther or more accurately?

Trial#	Distance (cm or inches)	Accuracy (hit or miss)
1		
2		
3		

SUMMARY

What did you learn from this lesson? Share your findings with your classmates and discuss.

_____

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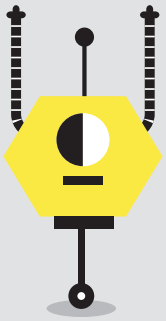
MEDIUM
PROJECTILE CHALLENGE

BACKGROUND

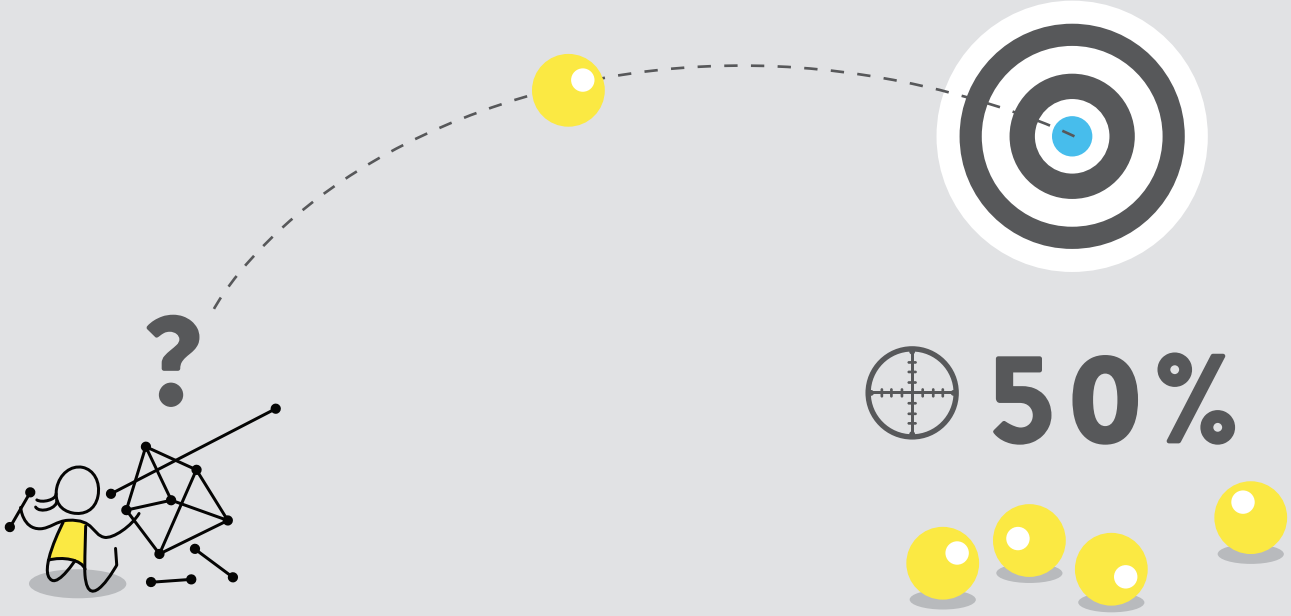
The first known catapults were built by the Greek and Romans. They initially started by building giant crossbows which evolved to launch heavy projectiles instead of arrows. You are Greek's most innovative architect. What would your masterpiece catapult look like?



CHALLENGE

Design and build a catapult which can launch ping pong balls over 48cms and hit a target 50% of the time!

Materials: Straws, Strawbees, cardboard, markers, rubber bands, spoons, paper cups



ADDITIONAL CHALLENGE

How could you modify your catapult to launch arrows and ping pong balls?

MEDIUM
PROJECTILE REFLECTION

MAKE YOUR PREDICTION

Which catapult design will be the best option for this Challenge? Why? Predict how far your catapult can launch!

_____

_____

_____

MATERIALS USED FOR BUILDING

#_____ Strawbees #_____ Straws #_____ ( )

Once completed, name it and share it on social media using #StrawbeesEdu

TEST

How far did your catapult shoot? What improvements can you make to your catapult?

Trial#	Distance (cm or inches)	Accuracy (hit or miss)
1		
2		
3		

SUMMARY

What did you learn from this lesson? Share your findings with your classmates and discuss!

_____

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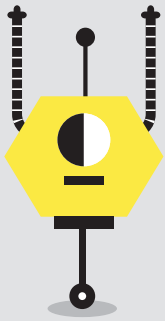
HARD
PROJECTILE CHALLENGE

BACKGROUND

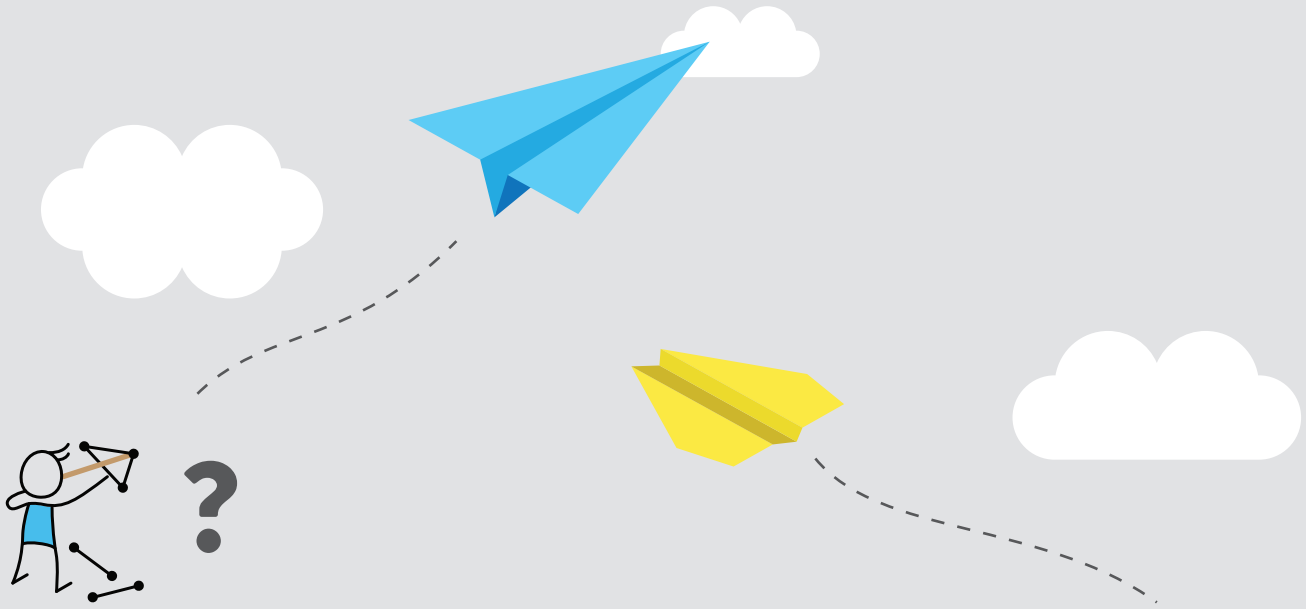
An aircraft catapult is a device used to launch aircrafts from ships, which are most commonly used on aircraft carriers as a form of “assisted take off”. It’s time to re-design a new aircraft launcher. You have been entrusted with this mission. Can you do it?



CHALLENGE

Design and build a Catapult which can launch paper airplanes.
(See further instructions for folding paper airplanes)

Materials: Strawbees, straws, paper, rubber band, cardboard



ADDITIONAL CHALLENGE

Build your aircraft carrier that will support your new launcher! Launch paper plane over 3 meters.

HARD
PROJECTILE REFLECTION

MAKE YOUR PREDICTION

What are the benefits of using aircraft launchers on ships? Predict how far your plane will fly? What are the similarities in launching and stopping a plane on a large ship?

_____

_____

_____

MATERIALS USED FOR BUILDING

#_____ Strawbees #_____ Straws

#_____ ( ) #_____ ( )

Once you have finished building, name it and share it using #StrawbeesEdu

TEST

How far did your plane fly? What improvements can you make to your aircraft launcher?

Trial#	Distance (cm or inches)	Accuracy (hit or miss)
1		
2		
3		

SUMMARY

What did you learn from this lesson? Share your findings with your classmates and discuss!

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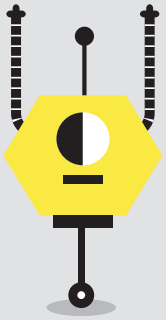
EXPERT
PROJECTILE CHALLENGE

BACKGROUND

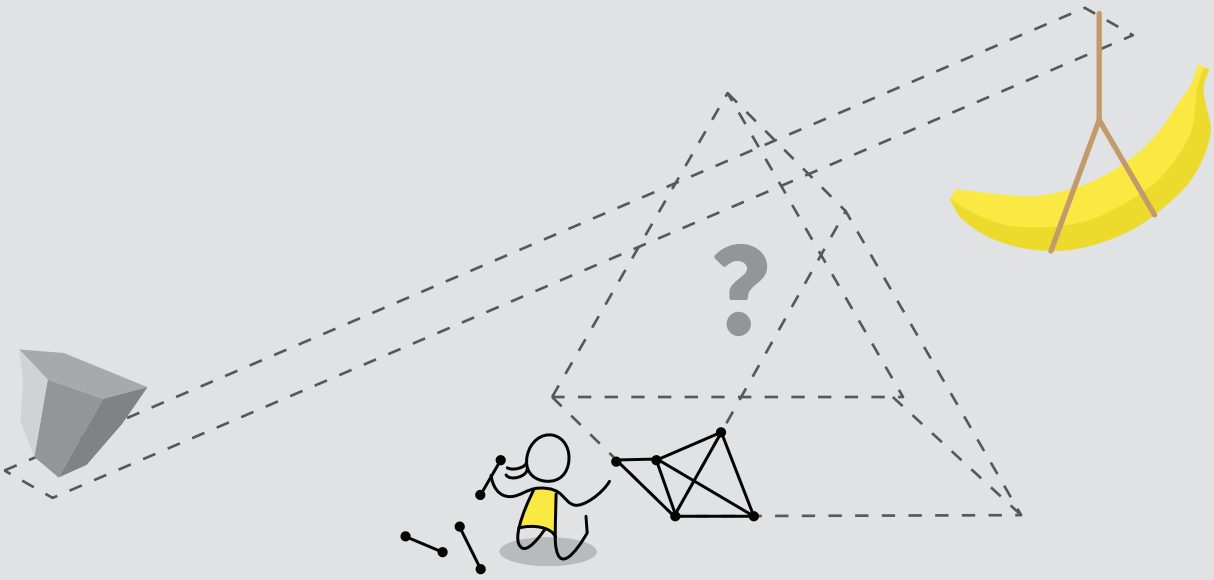
A trebuchet is a type of siege engine most frequently used in Middles Ages, which uses a counterweight or stored potential energy to launch objects. You are an aspiring architect with a dream to reinvent the trebuchet. What would your masterpiece look like?



CHALLENGE

Design and build a trebuchet.
-Use a banana as counter weight.
-Throwing arm is 4 to 6 times the length of counterweight portion.

Materials: Straws, Strawbess, cardboard, strings, PVC pipes, recycled bottles, rubber band, banana



ADDITIONAL CHALLENGE

Imagine different scenarios where you could use your trebuchet to solve daily problems. Illustrate or describe these scenarios and explain how your trebuchet will assist.

EXPERT
PROJECTILE REFLECTION

MAKE YOUR PREDICTION

What is the relationship between the counter weight and the center of the throwing arm? Predict how far your trebuchet will launch!

_____

_____

_____

MATERIALS USED FOR BUILDING

#_____ Strawbees #_____ Straws #_____ ( )

Once you have finished building, name it and share it using #StrawbeesEdu

TEST

How far did your trebuchet launch? What improvements can you make to your Trebuchet?

Trial#	Distance (cm or inches)	Accuracy (hit or miss)
1		
2		
3		

SUMMARY

What did you learn from this lesson? Share your findings with your classmates and discuss!

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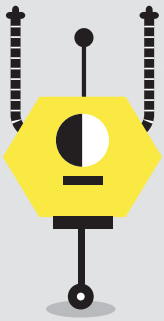
LEGENDARY
PROJECTILE CHALLENGE

BACKGROUND

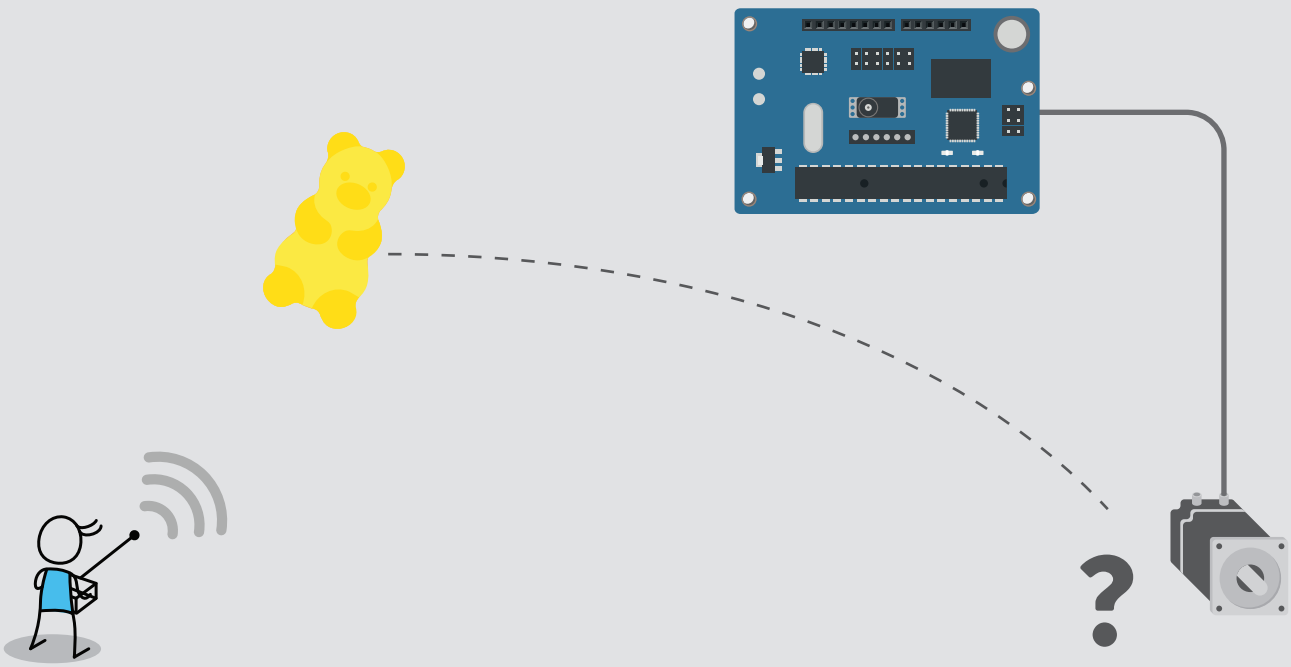
Technology enables us to accomplish more with less effort. How can technology help you create a self-automated catapult?



CHALLENGE

Design and build the most technologically advanced catapult.
-Launches objects with a simple command.
-Sturdy enough to launch a AAA Battery

Materials:
Straws, Strawbees, strings, cardboard, electronics, Gummy Bears candy (Arduino, Raspberry Pi, Little Bits, Quirkbots, etc)



ADDITIONAL CHALLENGE

Can your catapult reload ping pong balls automatically?

LEGENDARY
PROJECTILE REFLECTION

MAKE YOUR PREDICTION

How will you use technology to improve your catapult? Will it automatically reload? Will it shoot on command?

_____

_____

_____

MATERIALS USED FOR BUILDING

#_____ Strawbees #_____ Straws

#_____ ( ) #_____ ( )

Once you have finished building, name it and share it using #StrawbeesEdu

TEST

How far did your catapult launch? What improvements can you make to your Trebuchet?

Trial#	Distance (cm or inches)	Accuracy (hit or miss)
1		
2		
3		

SUMMARY

What did you learn from this lesson? Share your findings with your classmates and discuss!

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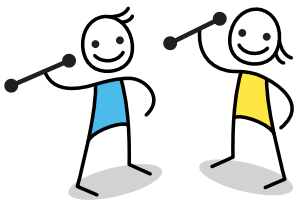
NOTES



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