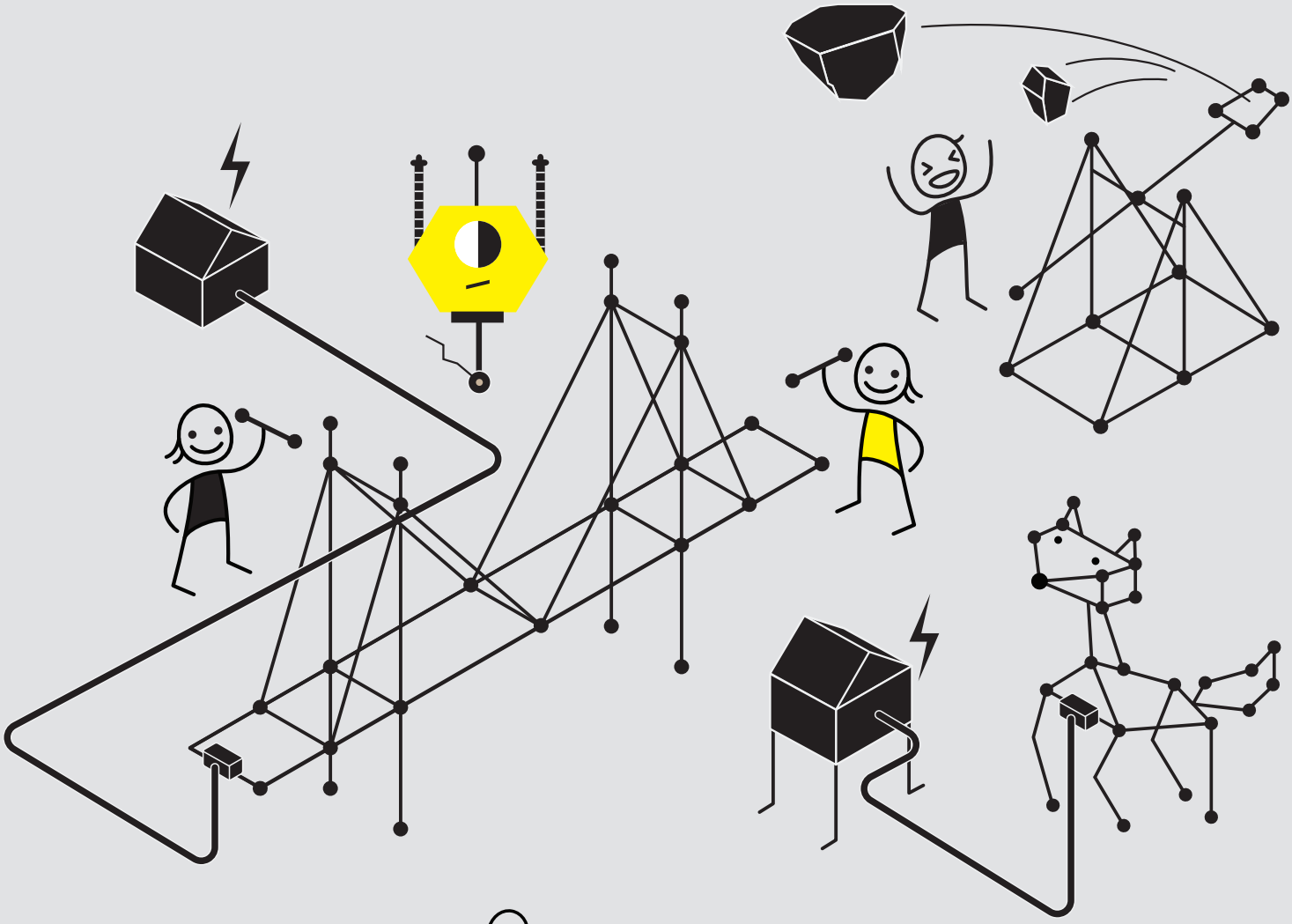
TEACHER GUIDE



Strawbees®
EDUCATION

TEACHER APPRECIATION LETTER

Dear educator,
We would like to take this opportunity to share how much we appreciate you.

Thank you for
choosing to be an educator, a role model, an inspirer, and an empowerer.

Thank you for
sharing your uniqueness and strengths both in and outside of the classroom.

Thank you for
your hours of dedication and hardwork.

Thank you for
always trying to see the best in your students.

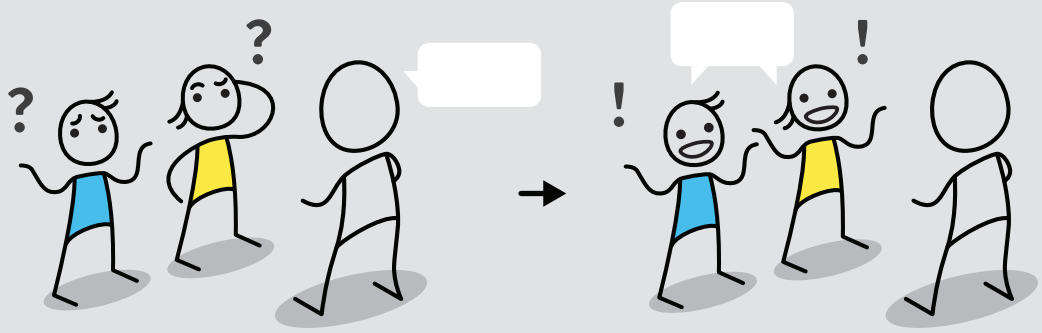
Thank you for
working with us to help inspire more students throughout the world.

Most importantly, thank you for being you.

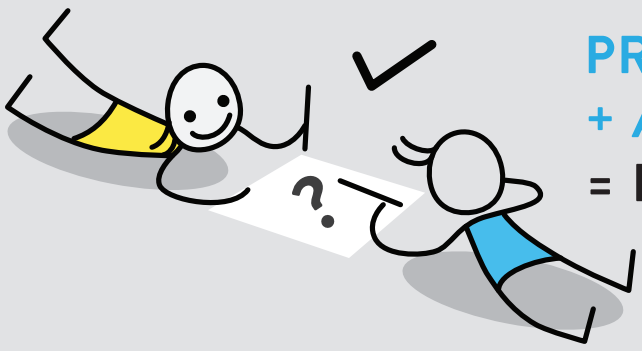
- STRAWBEES TEAM

STRAWBEES
TEACHING PHILOSOPHY

LEARNING
THROUGH
PLAY



ASKING RIGHTLY + LISTENING CAREFULLY
= A CURIOUS MIND



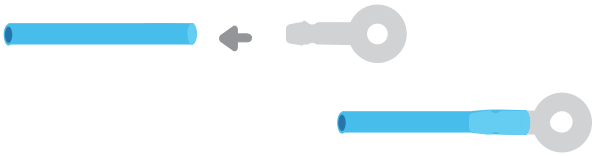
PROBLEM SOLVING
+ A POSITIVE ATTITUDE
= FOSTERING CREATIVITY

USING AND TEACHING WITH STRAWBEES

Strawbees curriculum is broken down into 5 levels; Easy, medium, hard, expert, and legendary. Although we recommend completing these challenges in order, feel free to start from any level you believe is best for your students. Before you jump into these lessons, we recommend beginning with the basics! You may choose to show these steps or play our introductory video!

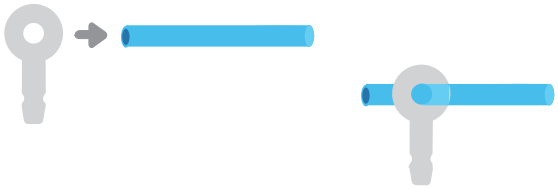
INTRODUCING STRAWBEES

1. Establish a common language and Identify then name each of the four different types of Strawbees. Example: (Single, Double, Triple, and Five) or (Key, Watch, Triangle, Star) You will use these names for the rest of your lesson!



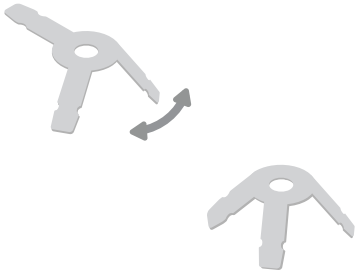
2. Insert the “head” of the Strawbees into an end of the straw.

3. Insert straw through the “Hole” of a Strawbees.



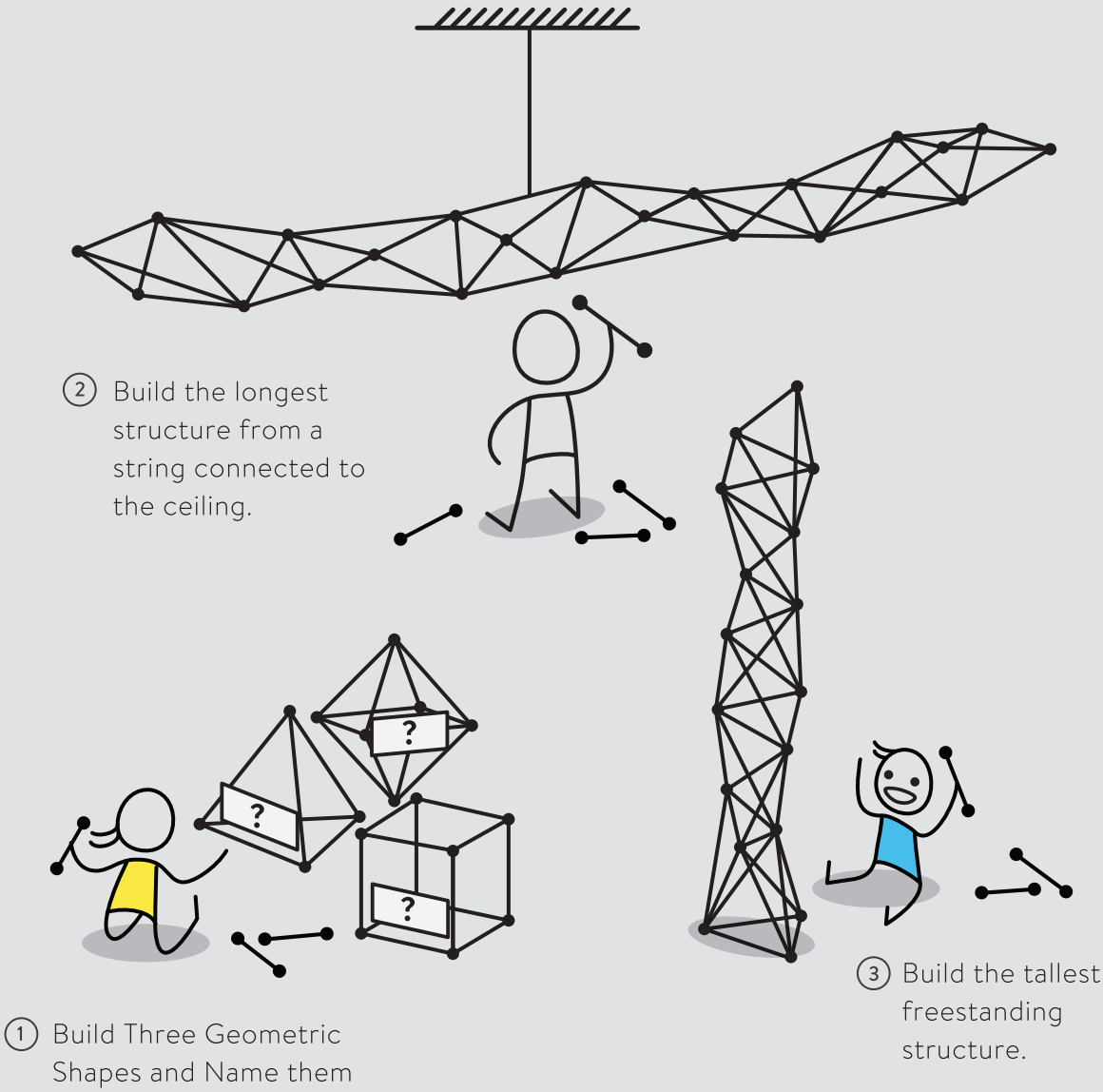
4. Insert the “head” of the Strawbees into the “hole” of another Strawbees.

5. Bend Strawbees leg and bend them back. (Don’t worry, they are meant to be bent!) There will be times when bending a Strawbees before using them will be beneficial.



STRAWBEES WARMUP

After the introduction, you may either choose for your students to freebuild for 15 minutes or provide them with an easy challenge.



SIMPLE CHALLENGE

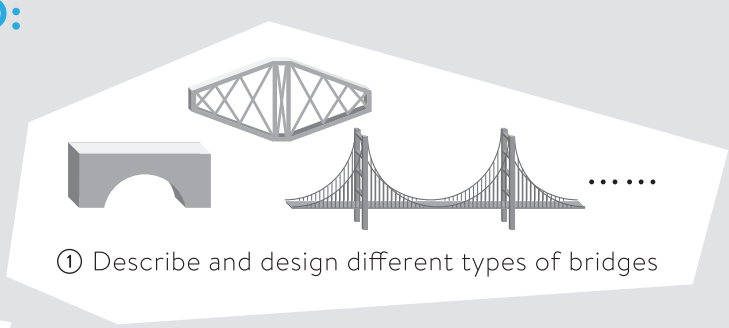
Tell your students to spell out their name or create a shape in 2D by laying out straws. Next, have them use Strawbees to connect the straws together. Which Strawbees could you use?

BRIDGE CHALLENGE 1

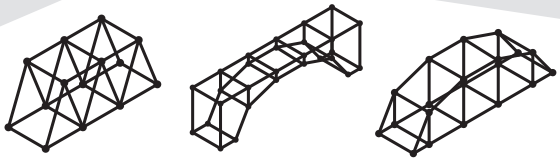
BRIDGE LESSON LEARNING OBJECTIVE

Students will work individually and in teams to design and build a bridge using Strawbees, straws, and other materials depending on the lesson. Each bridge model will be tested for strength by adding weight to them until they collapse, as well as functionality and any other criterias you and your students propose.

AFTER THESE LESSONS, STUDENTS WILL BE ABLE TO:

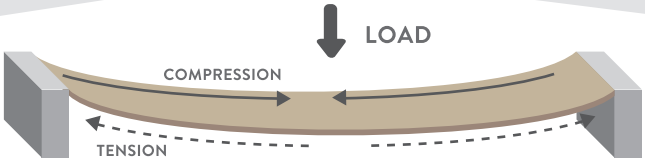


① Describe and design different types of bridges

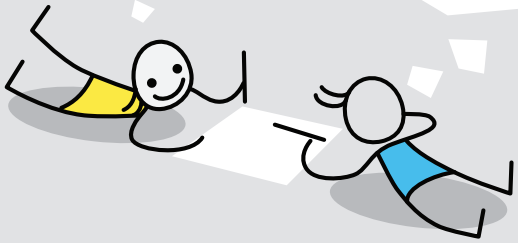


$a^2 + b^2 = c^2$

② Identify effective geometric shapes as well as formulas used in bridge designs



③ Identify factors that civil engineers consider when designing bridges



MORE SUGGESTED LEARNING OUTCOMES

1. Make predictions, supported by reason relevant to the content.

2. Identify variables (number of straws, shapes to use) that can alter an experiment as well as apply solutions to a technical problem. (How could you improve your designs and creations?)

3. Create models that help to explain scientific concepts and hypotheses. (Design a blueprint, make predictions, test the predictions, reflect on how we learn from mistakes/failures.)

BRIDGES INTRODUCTION

Why do we need bridges? What are they for? When was the first bridge built? What are some concerns an engineer may have when designing a bridge (e.g. environment, cost, labor, weather, etc.)? You could write down their ideas on the board.

HISTORY LINK

Spark curiosity by leading students with questions. What did the first bridge built by humans look like? What will bridges of the future looks like? Use the opportunity to provide knowledge gaps that will be answered and discussed together after completing the challenge!

BRIDGE LINK

Ask them about local bridges around the area so that you are connecting with a familiar world. What bridge connects _____ and _____ ? Which bridge will I go over to get to _____ ? Which bridge is parallel to _____ ? (Linking to their community and math PLO's)

BRIDGE CHALLENGE

Create a context or story before introducing the challenge. The more detailed and exciting the story, the more likely students will engage with the lesson.

SAMPLE DIALOGUE We have provided blank spaces for you to customize the lesson for your class!

"Today, you have been recruited into a team of architects, designers, and engineers that need to sketch and build a bridge model. We have been asked by _____ to build a bridge to cross _____ . An _____ is being built on the other side and visitors need a way to reach it! The _____ is spawning with many different species of _____ . Therefore, your bridge may not touch the _____ to ensure we do not disturb them. Since this bridge will be used by _____ , we must make it safe and exciting to cross!"

Encourage students to take risks and make mistakes. This is especially important when they are reflecting on their "failures". Engineers do it all the time when building models and testing. We are not trying to find a winner in this activity. We are trying to step into the shoes of the engineers/architects and ask the right questions.

Tip: To make this a more creative exercise, try filling these out with your class mad lib style!

MATERIALS USED

Decide on what materials to provide and how much of each. We will provide suggested materials to use for each challenge. However we challenge you to be creative with how you deliver this information. For example, you could split the class into groups and provide each group with a certain amount of "money". Place objects on a table (Strawbees, Straws, cardboard, bottles, rocks, strings...) with a price tag and have each group decide what materials they would like to purchase for their bridge!

EXPLORE NEW CREATIVE PROBLEMS TO SOLVE.

After each lesson, we suggest exploring new possibilities by creating new problems.

SAMPLE DIALOGUE

Besides the ability to hold X number of people, what else do you think a bridge should do? Why? Can we all agree on one or two things? Guide the discussion by asking more questions to spark a creative discussion (not a debate). If students are hesitant, start by providing an example for them. "I never have time to wash my car. I would love someone to invent a carwashing bridge."

EVALUATION

How your students are evaluated will determine what they build. You will notice that each bridge reflection (at the end of the lesson) allows students to record what materials they used and how much weight it was able to withstand before collapsing. However, we also recommend engaging your students by asking how they would like to be evaluated. Every student is unique and has different strengths. Imagine being evaluated on a diverse range of criteria instead of just one. For example, students need x number of points to pass this challenge. Points are provided for each criteria they accomplished.

Hold x weight = 1 point
Hold x weight = 2 point
Hold x weight = 3 point
Using fewer than x straws = 1 point
Using fewer than x Strawbees = 1 point
Bridge spans over x length = 1 point
Bridge design has more than x triangles = 1 point

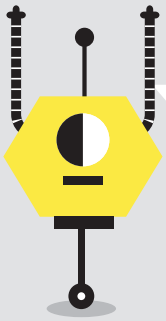
REFLECTION

Establish an environment where children will feel safe to share their insights and reflections. Start an open discussion with your students.

EASY
BRIDGE CHALLENGE

BACKGROUND

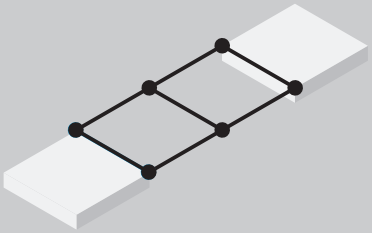
The first bridges made by humans were spans of cut wooden logs or planks. These logs were eventually combined to stretch across longer creeks and evolved to become beam bridges. Use the blank space below to design your beam bridge. Use Strawbees and straws to bring it to life and test your creation!



CHALLENGE

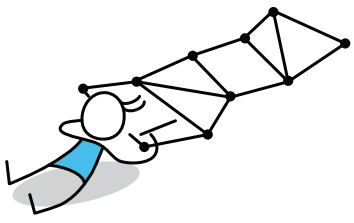
Can you build a 2D beam bridge that spans at least 36cms (one and a half Strawbees straw length) with a width of at least 12cms (Half of a straw). Explore different shapes like squares and triangles as you build!

Materials: Strawbees, straws, 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.



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?

LEARNING OBJECTIVE

1. Identify and explain shapes used in bridges.
2. Identify variables (number of straws,) that can alter your results.
3. Identify and measure angles.
4. Explain and describe tension and compression.

CLASSROOM PREPARATION

Prepare two objects, such as tables, that are at least 36cms apart.

SUGGESTED MATERIALS

15+ straws, 20-50 Strawbees, scissors, Weight (to measure bridge strength)

DURATION

45-90 Minutes.

DURATION	ACTIVITY	TIPS
5-10 min	Introduction	
5-10 min	Initial design planning	Students research or use their knowledge from the projectile lesson to come up with an optimal design for their bridge.
20-30 min	Build and test	Students work individually or in groups to build their bridge design and do some initial testing.
5-10 min	Student discussion	Students come back in groups and discuss their findings from the experiment, focusing on their assumptions.
10-15 min	Redesigning and final test	
5-10 min	Evaluation and reflection	

FORMULAS AND THEORIES YOU CAN INCORPORATE

Pythagorean theorem to calculate cross beam.

EVALUATION

Get creative and use a checklist to record how many points each team gets. Receive various points for completing certain challenges. For example 2 points for a certain length, 3 points for holding x weight, and 1 point for using less than x Strawbees.

REFLECTION

Review learning objectives and have a few students describe what they learned throughout the challenge. Ex: How was your sketch compared to your final creation?

HOMEWORK

Research and identify 3 of the most common forces in Mother Nature that bridges must withstand.

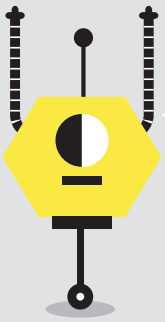
NOTE

Most of the Strawbees bridges will not break, they will simply bend until the edges fall off of the table. Students will discover this as they build and test their creations.

MEDIUM
BRIDGE CHALLENGE

BACKGROUND

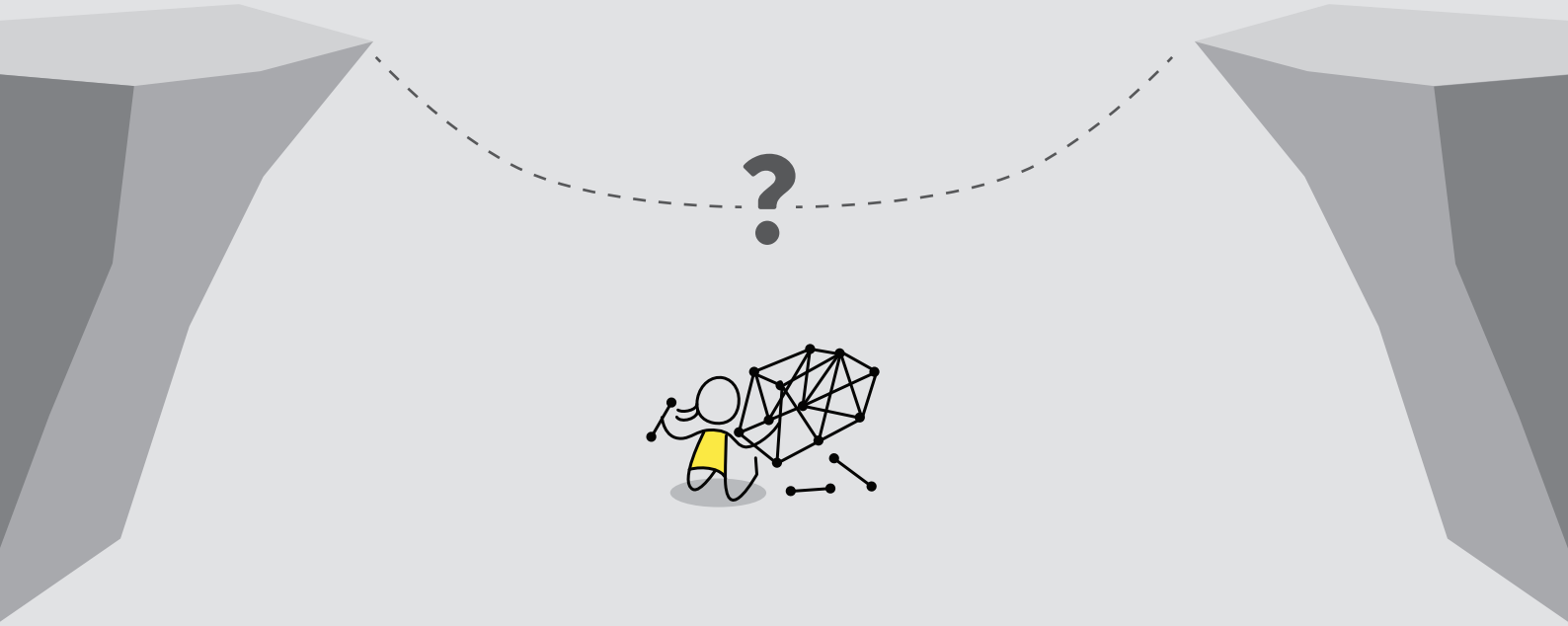
Ancient Romans and Chinese bridge builders improved the beam bridge by adding structural support. This allowed them to span great distances and build sturdier and more durable bridges. Your team will use their concepts to design and build a bridge across a portion of the Grand Canyon.



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, 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.

LEARNING OBJECTIVE

CLASSROOM PREPARATION

SUGGESTED MATERIALS

DURATION

DURATION	ACTIVITY	TIPS

FORMULAS AND THEORIES YOU CAN INCORPORATE

EVALUATION

REFLECTION

HOMEWORK

HARD
BRIDGE CHALLENGE

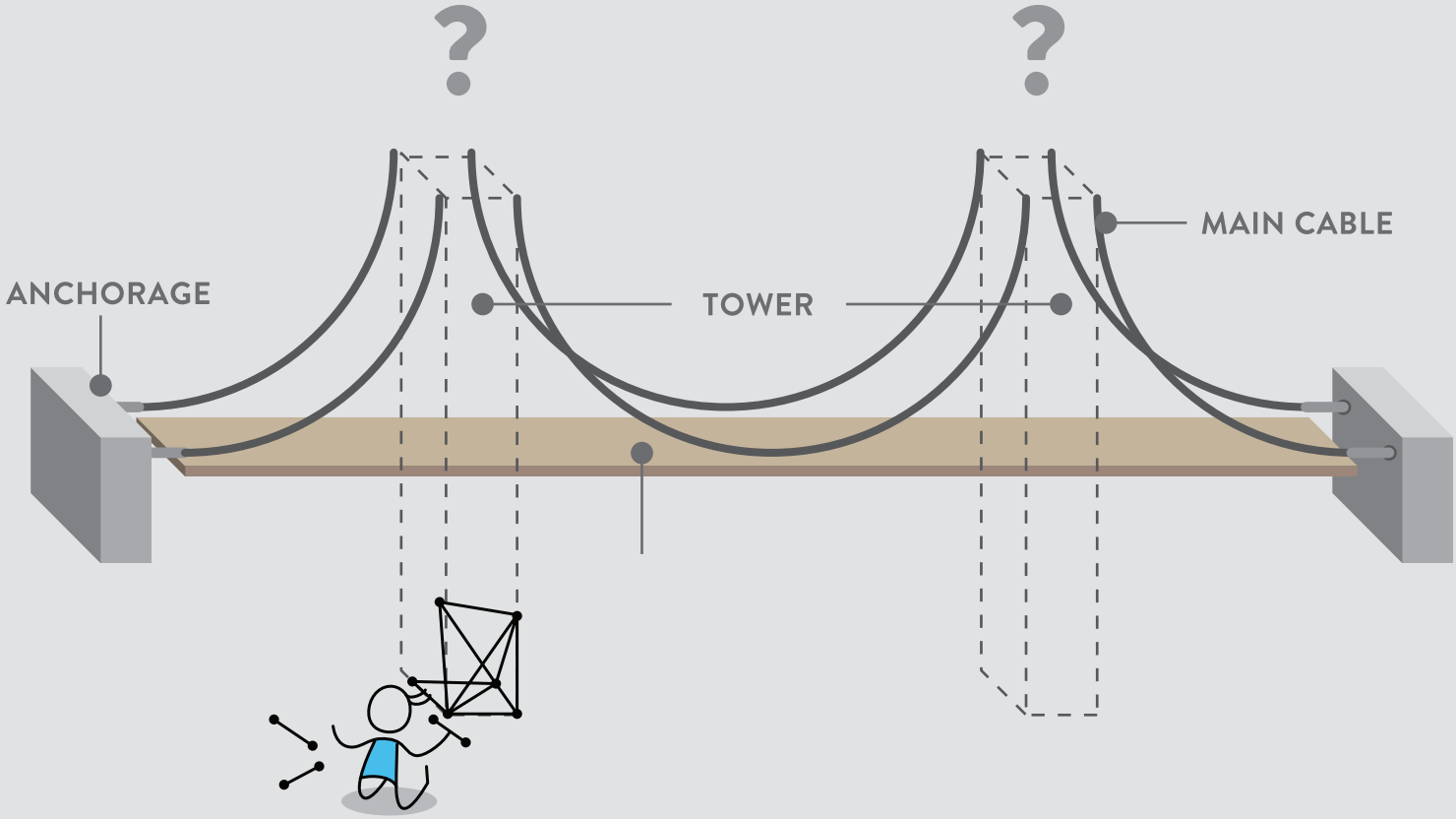
BACKGROUND

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?

LEARNING OBJECTIVE

CLASSROOM PREPARATION

SUGGESTED MATERIALS

DURATION

DURATION	ACTIVITY	TIPS

FORMULAS AND THEORIES YOU CAN INCORPORATE

EVALUATION

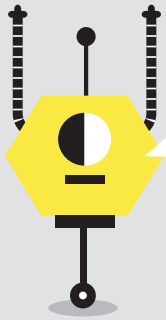
REFLECTION

HOMEWORK

EXPERT
BRIDGE CHALLENGE

BACKGROUND

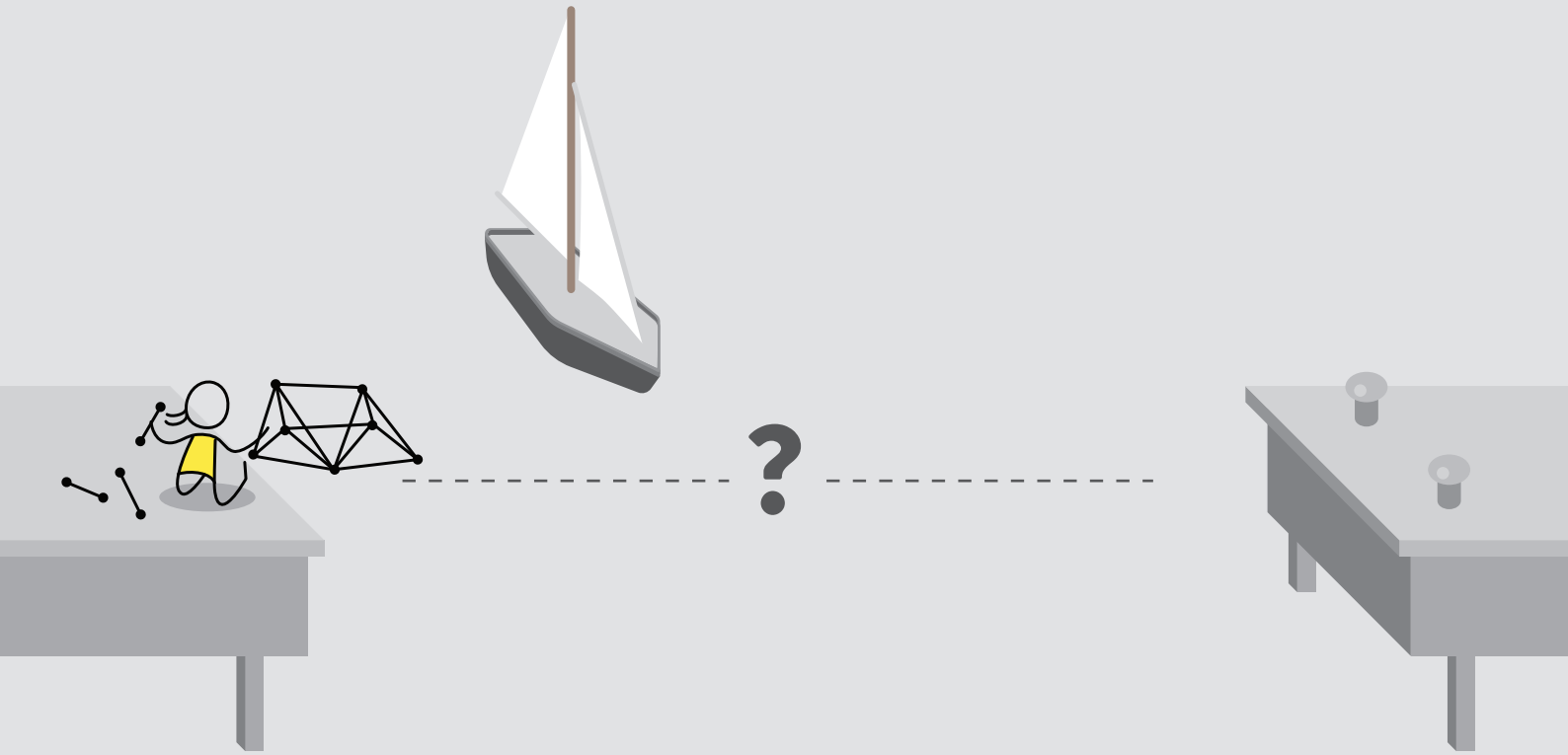
One of the first popular movable bridges was used at the entrance of a castle surrounded by a moat. Today, moving bridges have evolved to include many different designs including drawbridges, curling bridges, and bascule bridges. You are an aspiring architect with a dream to reinvent the moveable bridge.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

LEARNING OBJECTIVE

CLASSROOM PREPARATION

SUGGESTED MATERIALS

DURATION

DURATION	ACTIVITY	TIPS

FORMULAS AND THEORIES YOU CAN INCORPORATE

EVALUATION

REFLECTION

HOMEWORK

LEGENDARY
BRIDGE CHALLENGE

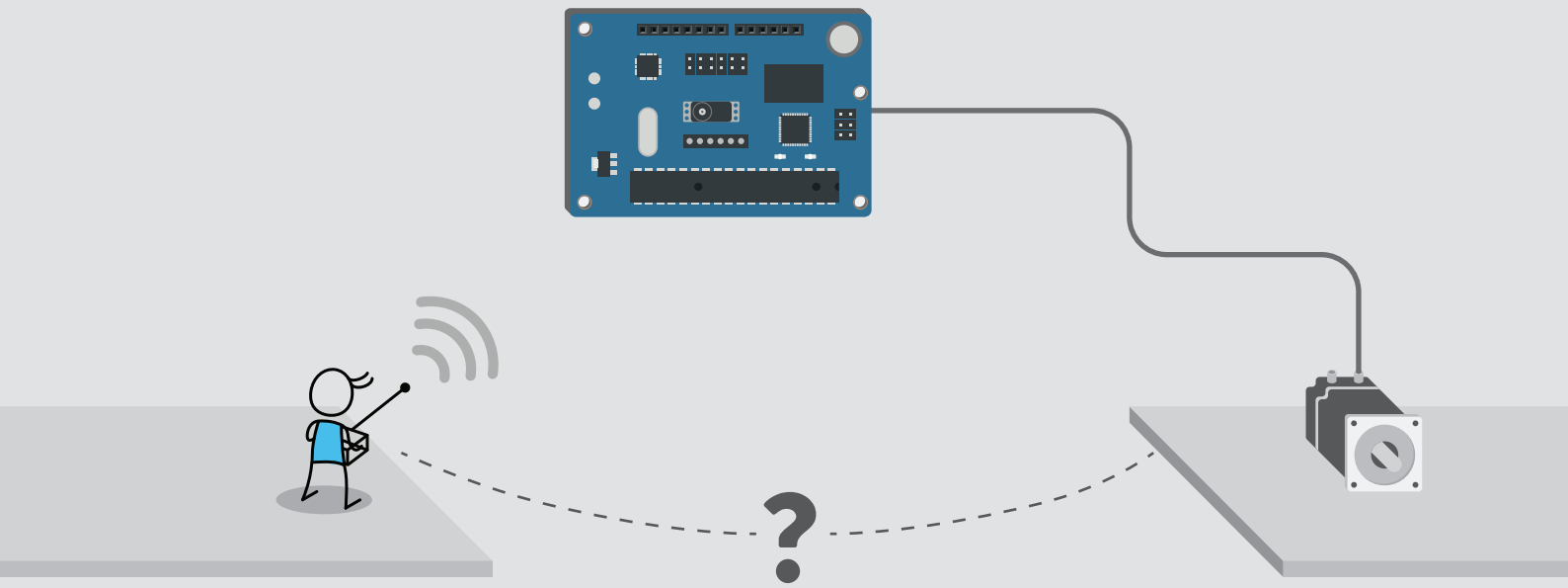
BACKGROUND

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! ;)

LEARNING OBJECTIVE

CLASSROOM PREPARATION

SUGGESTED MATERIALS

DURATION

DURATION	ACTIVITY	TIPS

FORMULAS AND THEORIES YOU CAN INCORPORATE

EVALUATION

REFLECTION

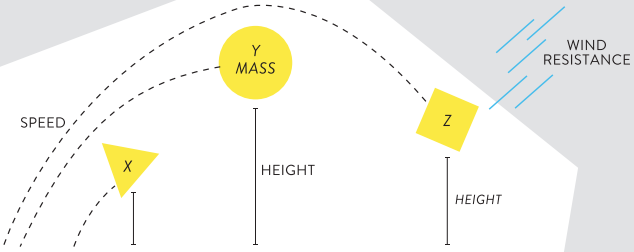
HOMEWORK

PROJECTILE CHALLENGE 2

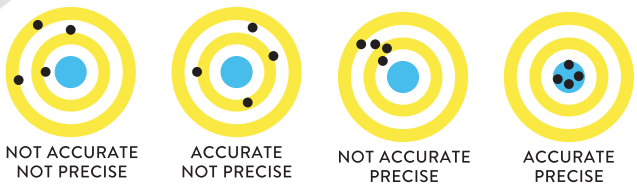
PROJECTILE LESSON LEARNING OBJECTIVE

Students will work individually and in teams to design and build a projectile machine using Strawbees, straws, and other materials depending on the lesson. Each projectile model will be tested for distance, accuracy, as well as functionality and any other criterias you and your students propose.

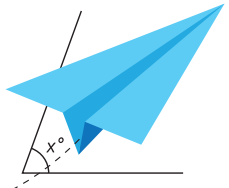
AFTER THESE LESSONS, STUDENTS WILL BE ABLE TO:



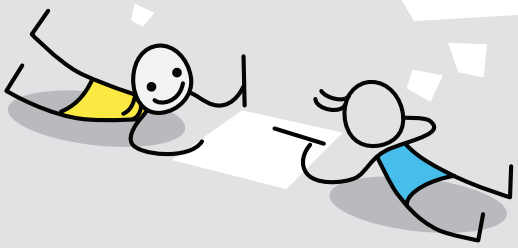
① Describe what conditions affect a projectile in motion.



② Predict the landing point of a projectile and explain the difference between accuracy and precision.



③ Explain how trajectory angle affects the distance traveled and discover what the optimal trajectory angle is for the greatest distance.



PROJECTILE INTRODUCTION

Begin each lesson by discussing motion and energy. How do objects move? How do we calculate motion? What is acceleration? What is speed? What are some of the forces that act upon objects in motion?

HISTORY LINK

Spark curiosity by leading students with questions. What was the first type of projectile? Why was it needed? What is the most commonly seen projectile machine today? How will they be used 20 years from now? Share and discuss.

PROJECTILE LINK

Discover and explore projectile motion around your local area. What similarities or differences are there between a water fountain and nerf gun? Research and explore different projectiles and how they travel. Use this opportunity to provide knowledge gaps that will be answered and discussed together after completing the challenge.

PROJECTILE CHALLENGE

Create a context or story before introducing the challenge. The more detailed and exciting the story, the more likely students will engage with the lesson.

SAMPLE DIALOGUE We have provided blank spaces for you to customize the lesson for your class!

Encourage students to take risks and make mistakes. This is especially important when they are reflecting on their "failures". Engineers do it all the time when building models and testing. We are not trying to find a winner in this activity. We are trying to step into the shoes of the engineers/architects and ask the right questions.

Tip: To make this a more creative exercise, try filling these out with your class mad lib style!

MATERIALS USED

Decide on what materials to provide and how much of each. We will provide suggested materials to use for each challenge. However we challenge you to be creative with how you deliver this information. For example, you could split the class into groups and provide each group with a certain amount of “money”. Place objects on a table (Strawbees, Straws, cardboard, bottles, rocks, strings...) with a price tag and have each group decide what materials they would like to purchase for their projectile!

EXPLORE NEW CREATIVE PROBLEMS TO SOLVE.

After each lesson, we suggest exploring new possibilities by creating new problems. Suggestions:

1. What projectile will work best in Space? Why?
2. Can you create a projectile that will shoot water? Your design will be used on new firetrucks to fight forest fires.

EVALUATION

how your students are evaluated will determine what the build. We recommend engaging your students by asking how they would like to be evaluated. Every student is unique and has different strengths. Imagine being evaluated on a diverse range of criteria instead of just one. For example, students need X number of points to pass this challenge. Points are provided for each criteria they accomplish

Over X distance = 1 point
Over X distance = 2 point
Hitting the target = 2 point
Using Fewer than X Straws = 1 point

REFLECTION

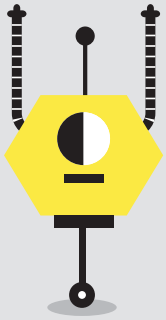
Establish an environment where children will feel safe to share their insights and reflections. Start an open discussion with your students.

Discuss and reflect as a group.
1. What was your group attempting to achieve with its projectile design?
2. How did the projectile launch the object in motion?
3. Which challenge did you meet best, accuracy or distance?
4. What could you have done to make your creation better?
5. What helped it work as well as it did?
6. What did this activity teach you about motion and forces?

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?

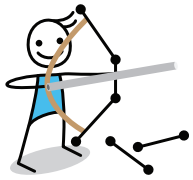


CHALLENGE

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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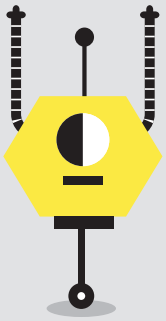
MEDIUM
PROJECTILE CHALLENGE

BACKGROUND

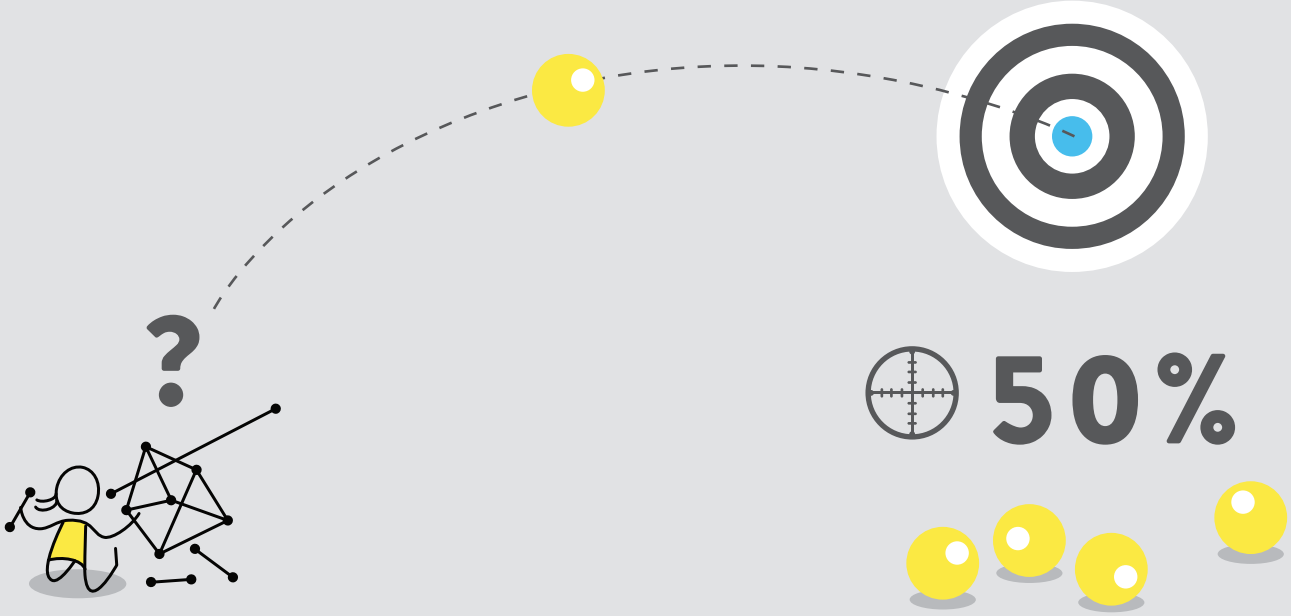
The first known catapults were built by the Greek and Romans. They initially started by building giant crossbows which evolved to launch heavy projectiles instead of arrows. You are Greek's most innovative architect. What would your masterpiece catapult look like?



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!

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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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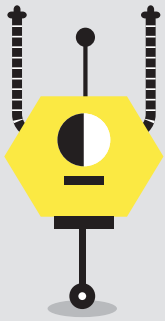
HARD
PROJECTILE CHALLENGE

BACKGROUND

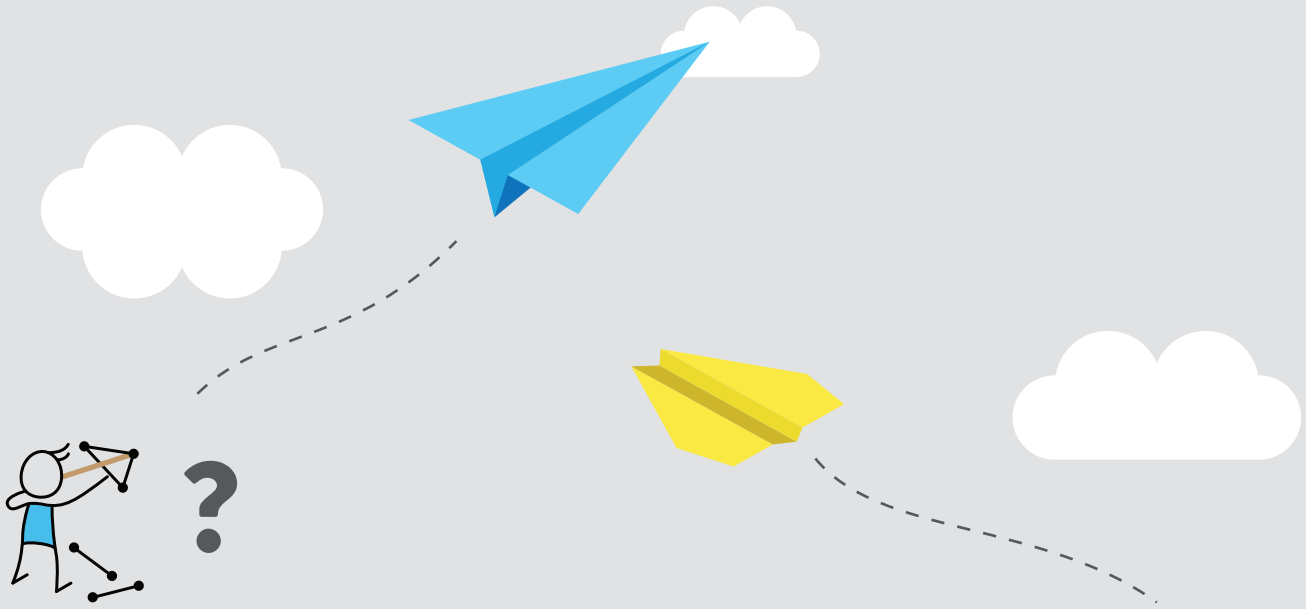
An aircraft catapult is a device used to launch aircrafts from ships, which are most commonly used on aircraft carriers as a form of “assisted take off”. It’s time to re-design a new aircraft launcher. You have been entrusted with this mission. Can you do it?



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?

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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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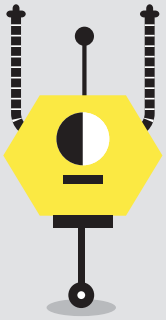
EXPERT
PROJECTILE CHALLENGE

BACKGROUND

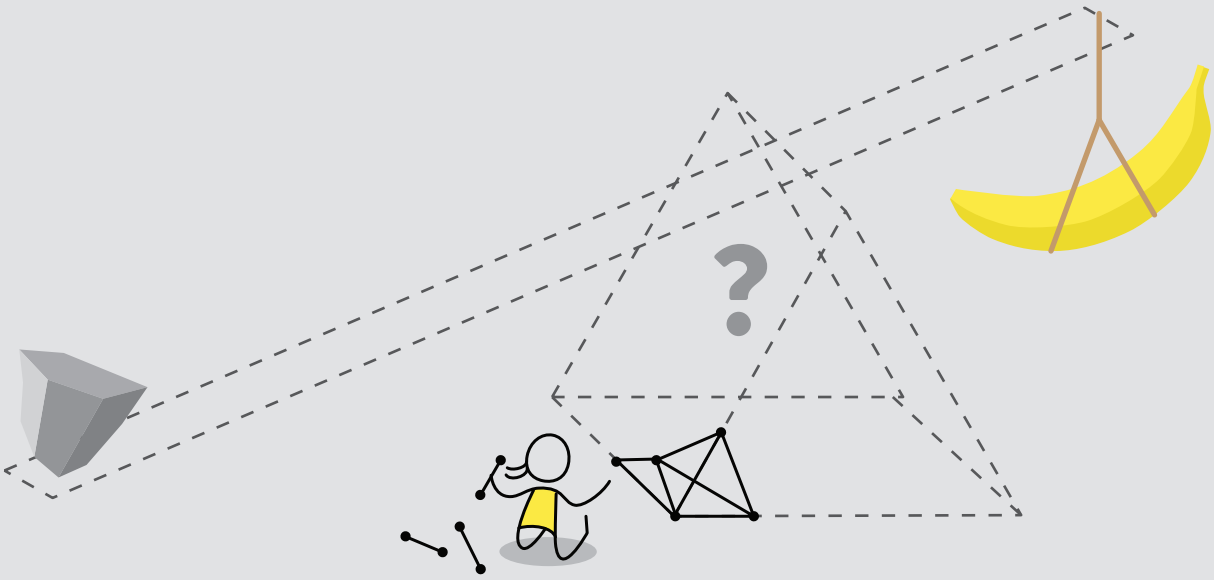
A trebuchet is a type of siege engine most frequently used in Middles Ages, which uses a counterweight or stored potential energy to launch objects. You are an aspiring architect with a dream to reinvent the trebuchet. What would your masterpiece look like?



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!

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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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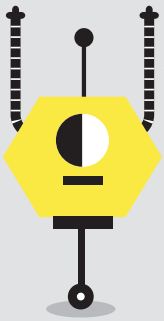
LEGENDARY
PROJECTILE CHALLENGE

BACKGROUND

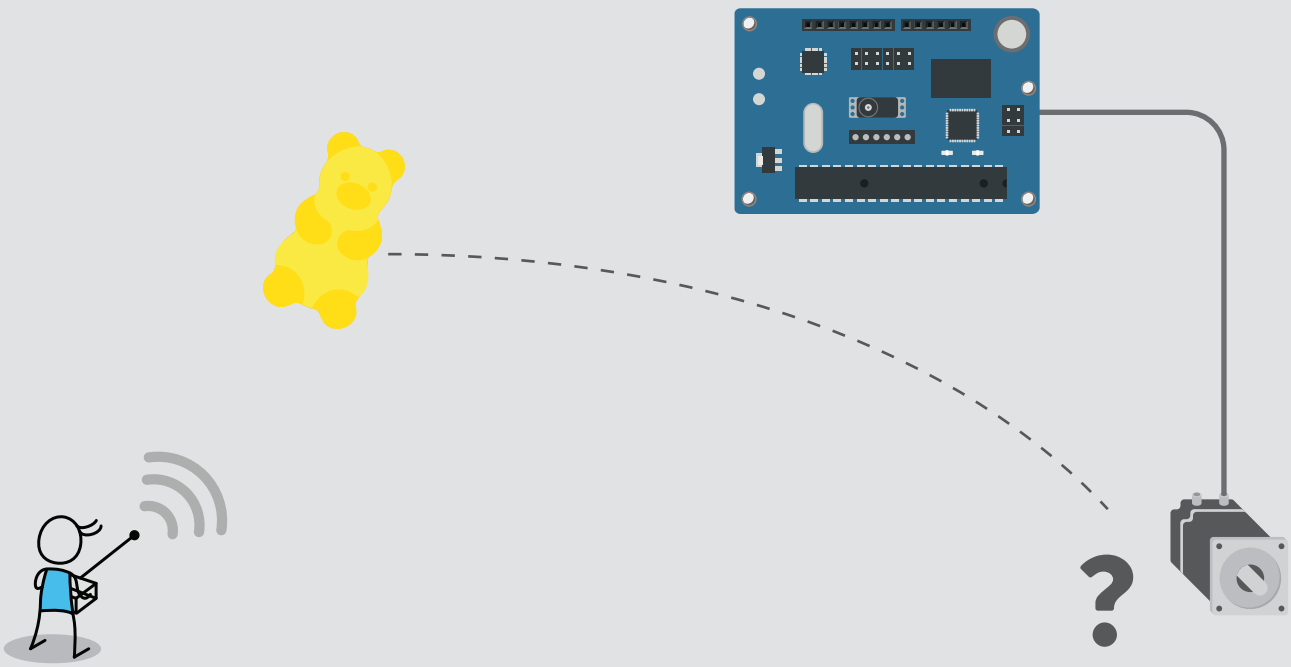
Technology enables us to accomplish more with less effort. How can technology help you create a self-automated catapult?



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?

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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		
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3		

SUMMARY

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