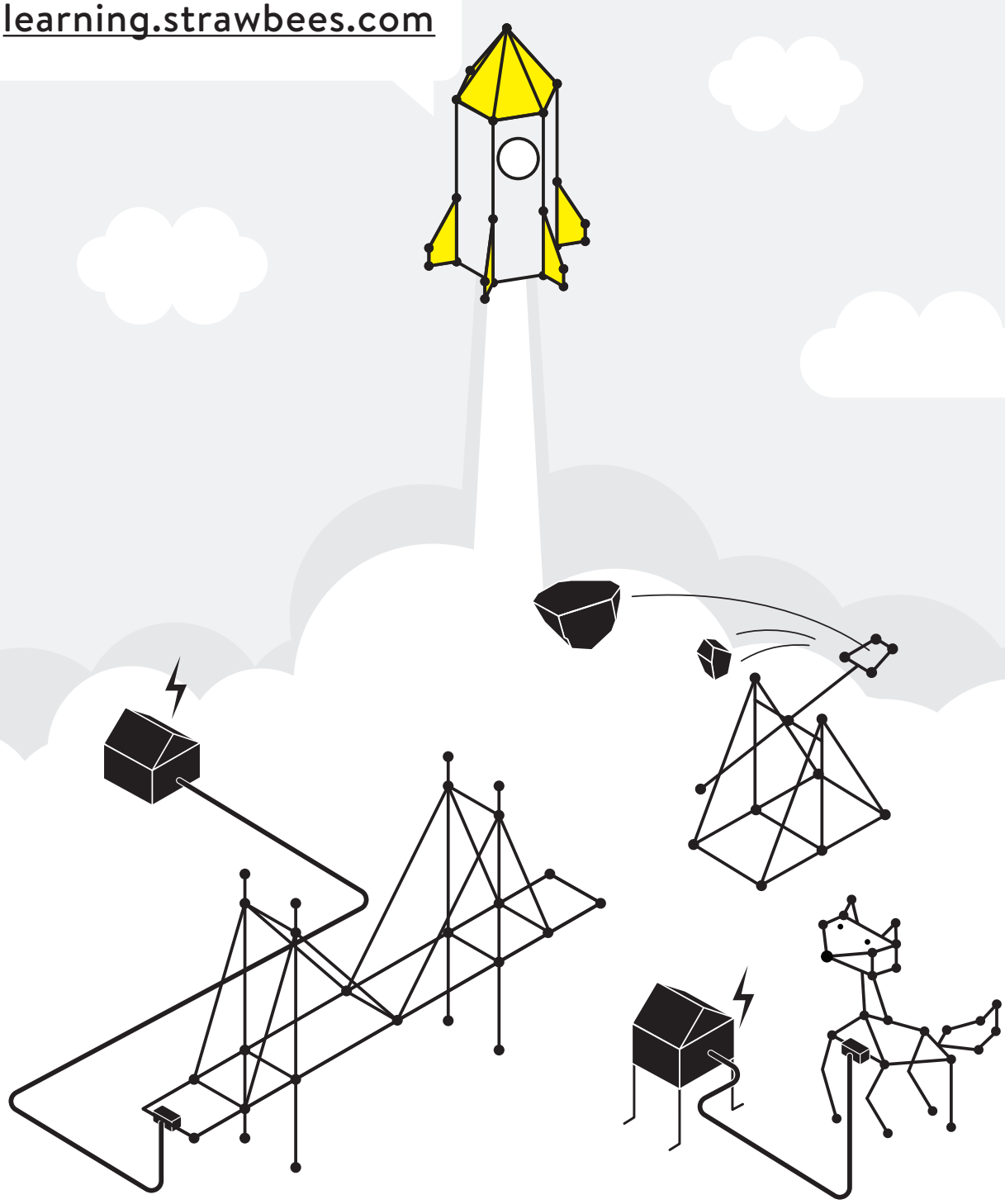
Strawbees.

Full lesson plans on
learning.strawbees.com



THE FUTURE OF EDUCATION

Challenges suitable from age 5 to university

TEACHING FOR THE FUTURE

EDUCATION TEAM

We are committed to empowering teachers to help **students believe in their own ideas and DREAM BIG in order to create our future.**

COMMUNITY, CONTENT, COURSE & LESSON PLANS

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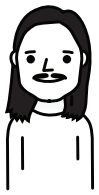
Content and Community Manager



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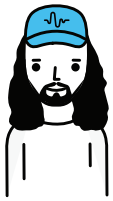

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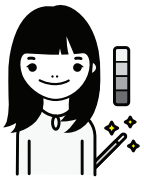

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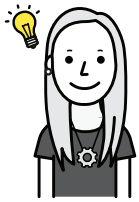
LEARNING FOR THE FUTURE



Nina Lindström
Vice President Education

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ONLINE LEARNING PLATFORM AVAILABLE AT learning.strawbees.com

DEAR TEACHER

Education is changing

Groundbreaking technology creates **new opportunities** for and expectations on us humans. When **today's students** grow up they **will live in a world we know little about**, many will work in professions that no one has yet heard or thought of. In order to make a living in the future, **humans will need to be more creative than robots**. This has a big impact on teaching. **Mastering innovation** requires **problem solving skills** and **creative confidence** to dare to try out their ideas, all of which will become even **more important in the future** than it is today. **Using our hands** and tinkering is crucial to develop all of the neural connections that we need but can not develop through abstract thinking alone.

We grasp a lot at great speed when learning is fun

Effective learning also requires us to **create safe spaces** where questions and experiments are encouraged and all students feel supported. When students are **encouraged to dream** and **set their own goals** their **potential for learning is virtually unlimited**.

Explore together with your students

Your students will likely come up with ideas for projects that we could have never imagined. Our materials provide ample opportunities to learn more about **mechanisms, construction, design and interaction**. And most importantly for **the unexpected** to happen. We learn much more from **when things do *not* work out** the way we thought they would. **Encourage students to dare to try the uncertain and celebrate whatever result**. You will not need to know much about our materials before you start exploring yourself.

Teachers are invaluable in supporting students

You help students set up their hypothesis and designs, find the tools to put them to the test, and reflect upon the result. With our open ended learning system you can also **encourage learning through play** – by **testing** and making, **observing** what became and **modify** the result in an iterative process.

Full lesson plans & inspirational activities for students ages 5-17+ online

You can introduce basic tricks to your students, or you can simply ask them to investigate the different ways to use Strawbees are before starting your first challenge. Should you want more inspiration we provide **full course and lesson plans categorized by age ranges 5-7, 8-9, 10-13, 14-16, as well as 17+ at learning.strawbees.com.** Most of our lesson plans can be broken down into two 45-minute sessions, totaling about 2 hours.

Welcome to our global teacher community supporting the creators of our future – happy making!

The Strawbees Education team

LEARNING BY DREAMING AND CREATING

The Strawbees Educational team puts a lot of effort into investigating and exploring **the full potential of learning** together with researchers in **neuroscience, behavioral psychology** and teaching - all in close cooperation with teachers and students all over the world.

The most amazing thing is that **we, teachers and students alike, can learn almost anything**. The key to being able to overcome almost any learning challenge is to **really want to conquer something new**. This incentive is best created by someone's own clear vision of what we wish to achieve (change, make, explore). This is why **one of our most important tasks is to help all students believe in their own ideas and DREAM BIG**. We encourage questions and suggestions, and support everyone to try out their ideas.

Strawbees connectors provide an easy, quick and inexpensive way for **instant prototyping** which enables students to **try out new ideas again and again. We facilitate building while dreaming**. A pyramid can become a completely different shape by simply cutting one of its straws. We get ideas, discover how one thing leads to another and learn - all while creating, **individually or together**.

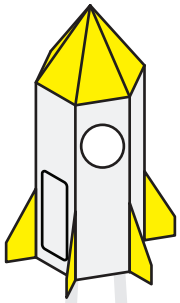
Using our hands is key to developing our nervous system and problem solving skills. What we learn from tinkering, putting things together, taking them apart - investigating real life 3D structures - is helpful to us in almost all aspects of life.

CULTIVATING INVENTION LITERACY

"Invention literacy is the ability to read and write human made stuff, from toasters to apps."

How could we "read and write human made stuff"? Jay Silver who first introduced this concept shares our view of us being able to **cultivate our ability to look at objects or computer programs, grasp what they are about** - and **train ourselves** to gradually be able to **come up with new ideas with more ease** as we gain experience.

Inventors don't perform magic. Once we are familiar with the **basic building blocks of invention**, such as understanding **mechanisms**, movement, **design, programming** and whatever else is relevant to the object we need to write - then we can put these blocks together in new, innovative ways. Much like understanding grammar enables us to make sense of what we read and help organise our texts to make sense when we write.



BUILDING CREATIVE CONFIDENCE

ANYONE CAN BECOME AN INVENTOR

How many times have you heard someone say that they are not creative, good at maths or technology?

The interesting thing about **our brain and nervous system is that it gets really good at whatever we repeat time after time**. We can think of the things that we do **seldom** as hard to find paths in the woods or jungle. They are barely visible and may be hard to find and follow. The things that we do **every day**, or even several times a day - like brushing our teeth or chew - turn into super broad and **fast highways that we find and follow easily and without hesitation**.

There is actually no such thing as a 'uncreative' person or someone who can not learn maths. Modern science has proven again and again that **we become proficient at what we do**. Start **observing** and **examining** stuff in **your surroundings.** Ask yourself how they work and get building and exploring - and **this will be the abilities that you cultivate**. With time it will feel easier and more natural to come up with crazy new ideas.

CHALLENGE YOUR FEARS

What we do not recognise, are not used to or do not feel confident doing sometimes **feels scary**. This is normal. What can we do to dare to step into new directions anyway? Even the smallest thing that we recognise may help. Almost all teachers and students are familiar with straws and cardboard. Perhaps you have not yet used them to realise your dreams. **Using familiar tools and materials often lowers the threshold and get people into the new game**. We **learn more when we are not certain about what is going to happen**. What is more exciting to your students than experiments when not even you, the teacher know what to expect?

CELEBRATE ANY RESULT

One of the most effective ways of inspiring students is for the teacher to reveal his or her own mishaps, or silly outcomes. There are not really any failures, only learning opportunities. Ask what happened, or what didn't happen? Have a laugh. Some of the most treasured inventions in human history are the results of "mistakes."

WELCOME TO OUR ONLINE PLATFORM

We hope that you will find this inspirational guide useful. Welcome to our online Teaching Center and community which also provides detailed course and lesson plans for students of all ages.

USING OUR APPROACH TO ANY SUBJECT

As you learn about and try out, or **come up with your own new ways of using Strawbees connectors new opportunities unfolds**. How many different ways are there? What materials can you incorporate into your creations? How can materials be combined?
On our learning platform you can also find ideas for how to incorporate our materials into maths, physics, chemistry and lots of other subjects.

TIPS AND TRICKS

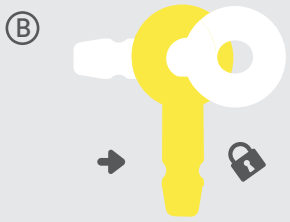
This is a collection of tips and tricks you can use to help students understand how to use Quirkbot. Listed in this section is support for Strawbees construction techniques and learning how to use the hardware interface of Quirkbot. Strawbees and Quirkbot together can enhance student learning to bring their projects to life.

STRAWBEES

CONNECT & LOCK

Strawbees are small pieces with a head and has legs used for connecting straws and to other Strawbees.

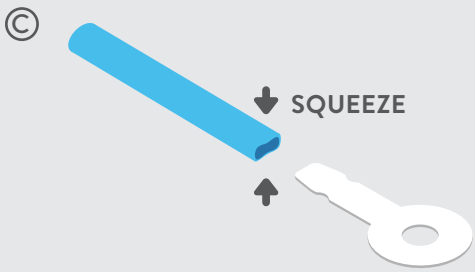
You can connect and lock Strawbees to each other in two ways:

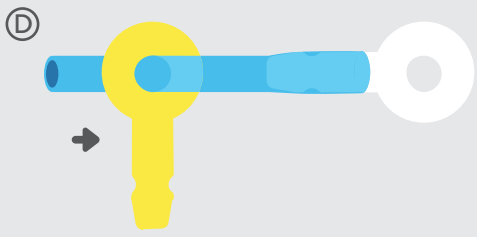


Ⓐ Slip the groove of the leg into the head of another Strawbee and listen for the click! This will secure the Strawbee and still allow it to rotate.

Ⓑ Push the leg all the way through the head to lock the Strawbee in place. The Strawbee will be limited in rotating when placed in this position.

CONNECTING TO STRAWS





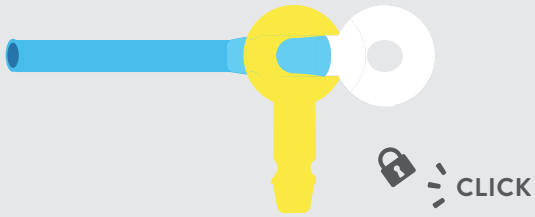
Ⓒ Squeeze the opening of the straw for easy insertion of the Strawbee.

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

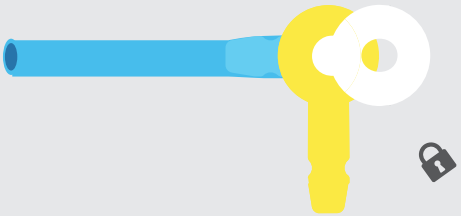
USING LOCKS

On top of combining Strawbees together, you can lock them into position using the straws to make tension and extrusion locks. These locks are very useful for structures such as bridges for your next design challenge!

Ⓔ TENSION LOCK



Ⓕ EXTRUSION LOCK

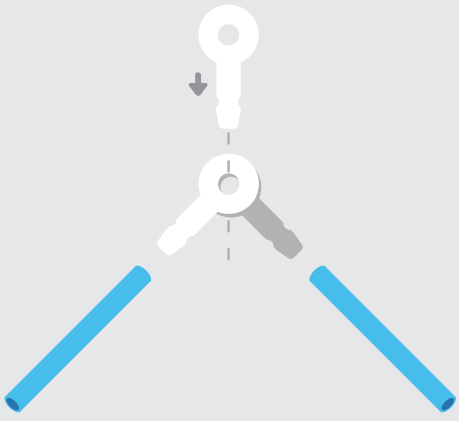


Ⓔ A tension lock can be used to secure the straw and Strawbee. With a Strawbee leg inside a straw, slide a seperate Strawbee head along the straw and snap onto the groove of the leg until you hear the click!

Ⓕ If you push the Strawbee further on the straw it will be completed locked in position creating an extrusion lock.

JOINTS

Joints are useful for creating a point that can shift and move or become secure and stable in your creation.



Connect 3 Strawbees together by lining up 2 heads and slide the leg of a third Strawbee through. 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.

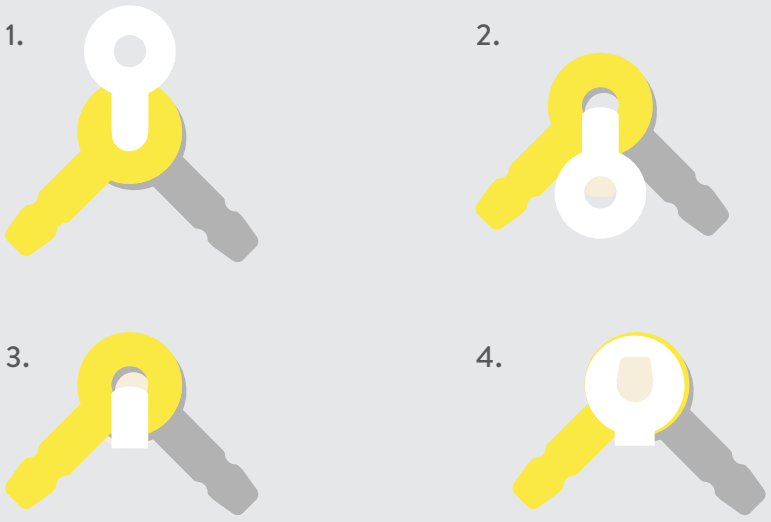
Ⓖ MOVING JOINT

Ⓖ If you snap the heads into the groove on the leg of the third Strawbee you will make a moving joint. Push halfway until you hear a click.

Ⓗ LOCKED JOINT

Ⓗ If you push all the way through, the Strawbees will lock into their positions for a locked joint.

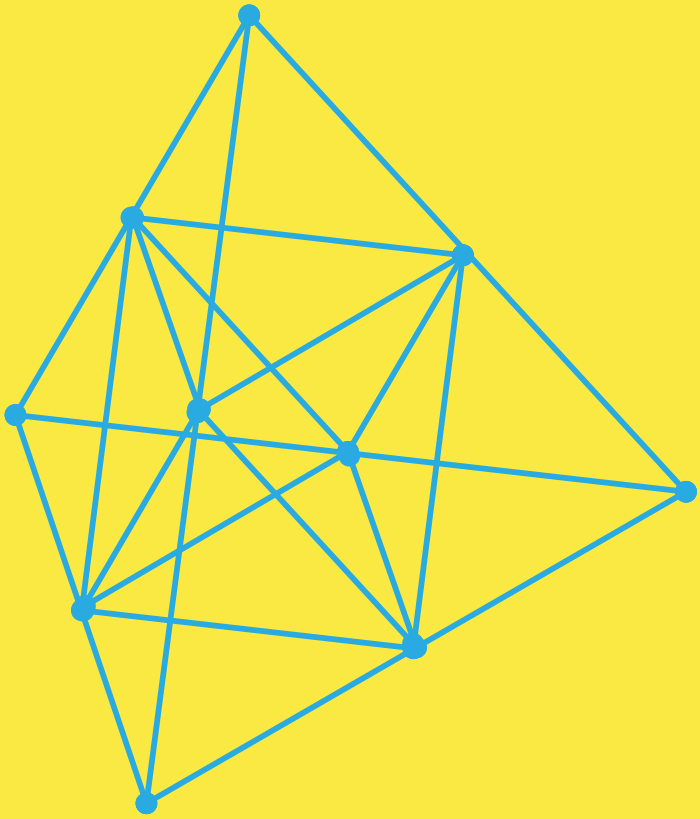
Ⓘ FRICTION LOCK



With the moving joint, you can also fold the Strawbee head over to the otherside and snap it to the tip of the leg to create a friction lock. This will allow the exposed legs of the Strawbees to shift and hold into different positions.

INTRODUCTION TO STRAWBEES

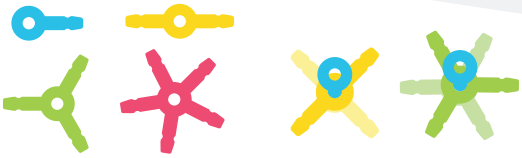
1



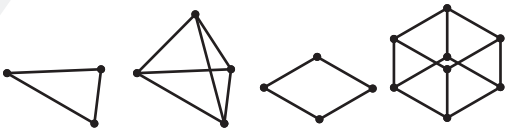
LEARNING OBJECTIVE

Students will explore how to sculpt their ideas into physical shapes using Strawbees. In this introductory lesson warm-up with a free-building challenge. Engage in an overall class challenge to build a prototype to solve a problem and to present to everyone their ideas.

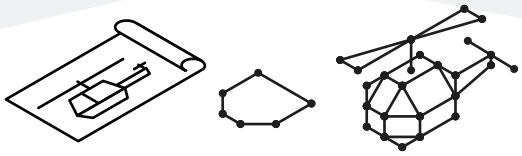
AFTER THESE LESSONS, STUDENTS WILL BE ABLE TO:



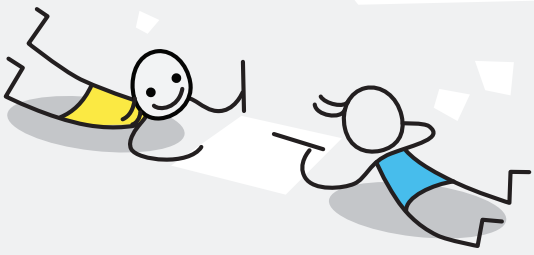
① Familiarity with the building capabilities of using Strawbees and understanding the techniques of construction using different Strawbees pieces.



② Comprehend spatial reasoning about 2D to 3D shapes and how to manipulate objects in space.



③ Work on problem-solving skills by rapidly prototyping their ideas and focus on fine-tuning their top idea to present.



INTRODUCTION

With the building challenges presented to the students this gives them an opportunity to engage in a guided, open-ended exercise to learn how to use different types of building materials and acquire an understanding about the many Strawbees combinations possible.

INVENTIONS IN HISTORY

Begin by asking your students what are examples of inventions used. Share invention examples such as nails and a hammer, the car, scissors, shoes, paper, and more. Ask the class if they have sketched or wrote an idea down and then made their idea physical.

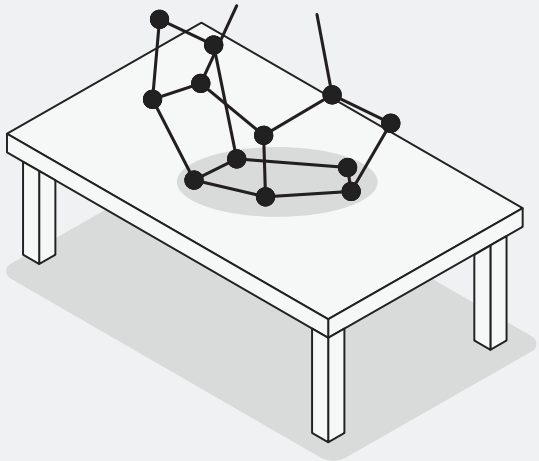
PROTOTYPING INVENTIONS

Explain to students this is a process that inventors often use to make their ideas come to life by brainstorming ideas and building prototypes until they make something that works. A prototype is a draft of an idea. Prototyping does not always mean they will make just one and will often make many versions!

PROTOTYPING CHALLENGE

Challenge your students to invent something for an astronaut to travel with through space.

Encourage students to discuss with their group examples of tools used for space exploration. Think about the daily challenges and obstacles endure and how the prototype students will create can improve their lives.

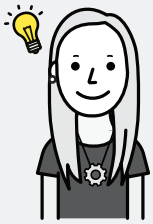


INTRO TO STRAWBEES

ALL AGES

OVERVIEW

Explore different Strawbees connectors and explore how to build mechanic shapes to make moving models. This exercise is for students to discover how to collaboratively create a 2D design and build a 3D model together.



CHALLENGE

As a group of 2-3 students build the tallest structure possible without falling down! You can build prototypes of existing inventions and improve them to help for space exploration.

MATERIALS

Straws
400

Scissors
30

1-Legged Strawbees
500

2-Legged Strawbees
400

3-Legged Strawbees
300

5-Legged Strawbees
300

ACCESS THE FULL LESSON AT learning.strawbees.com/strawbees-intro

LEARNING OBJECTIVES

1. Building the spatial capacity to visualize objects in two and three dimensions and draw conclusions about those objects from limited information.
2. Understand the basic principles of the geometric shapes used in engineering and architecture.

CLASSROOM PREPARATION

- Using Strawbees and straws pre-build a set of 2D shapes: squares and triangles and a set of 3D shapes: a cube, pyramids, and additional shapes you can create.
- You can precut a set of 1/2 and 1/3-sized straws ahead of time for students to begin building ahead of time.
- Gather pictures of inventions made over the last century to inspire the class to build.

DURATION

Two, 45-minute sessions.

DURATION	ACTIVITY	TIPS
10 min	Introduction	
5 min	Introduction to Strawbees	
10 min	Warm-Up	
25 min	Building Bases	
30 min	Building Challenge	
15 min	Reflection	

REFLECTION

Review learning objectives and have a few students describe what they learned throughout the challenge. Ask your students the following questions:

- When planning their prototype with the group what were the challenges of making an idea become real?
- What solutions did you come up with as a group when building a 3D model together?

BUILDING BRIDGES

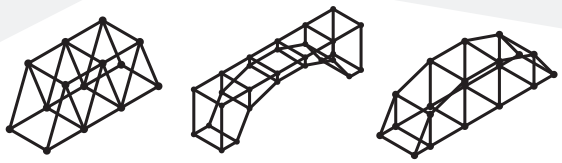
2

LEARNING OBJECTIVE

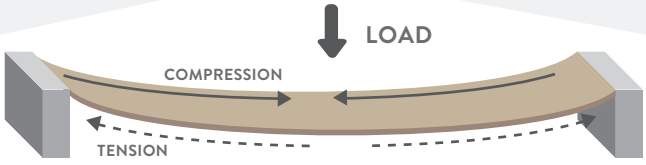
Learn about how bridges are made! Learn about the different types of bridge designs and replicate a model one using Strawbees and straws. Draft a blueprint of the structure exploring shape geometry used in everyday architecture and put it to the test to carry load and various weights.

AFTER THESE LESSONS, STUDENTS WILL BE ABLE TO:

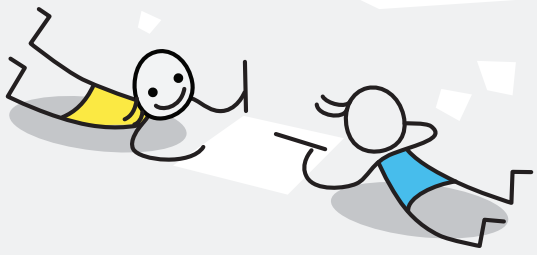
① Learn about a method of physical model making engineers undertake to explain scientific concepts and begin to visualize the factors taken in building a bridge.



② Understand the basic principles of the geometric shapes used in the construction of bridges and architecture.



③ Be introduced to Civil Engineering, a discipline focused on the development and maintenance of manmade and naturally built environments and constructions.



INTRODUCTION

Why do we need bridges and 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.

BRIDGES AROUND THE WORLD

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!

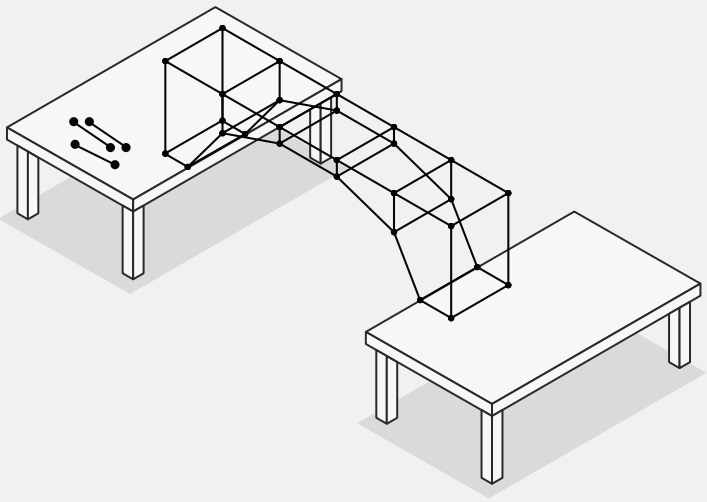
BRIDGE LINK

Introduce some aspects of what makes bridges safe, and how complicated foundations, balance, and weight can be when designing and building a bridge. This is to introduce the structural elements of beams and columns and understand how these elements joined together will resist tension and compression and will accept the load as long as the weight is distributed.

BRIDGE CHALLENGE

Draft a 2D bridge drawing on paper and build a bridge that spans across two surfaces that can hold a weight in the center of the design.

Encourage students to research different bridges for engineering inspiration. They can begin to draft their designs on paper. This is a helpful tool for students to identify the elements that alter the strength where the joints are in the design and make a hypothesis as to potential risks and strengthening factors for their models.

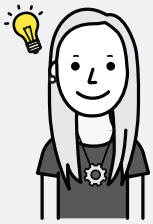


BUILDING BRIDGES

ALL AGES

OVERVIEW

Explore how to build models of bridges seen around the world! This exercise is for students to discover the capabilities of building bridges from a Civil Engineer's perspective. Students work in teams to draft the shape geometry used in bridge design.



CHALLENGE

Break students into groups of 3-4 and draft bridge designs on paper. Build the strongest bridge possible exploring different shapes to withstand varying weights.

MATERIALS

Straws
300

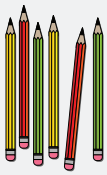
Scissors
30

1-Legged Strawbees
300

2-Legged Strawbees
300

3-Legged Strawbees
300

Cardstock Paper
40



Pencils
15

ACCESS THE FULL LESSON AT learning.strawbees.com/bridges

LEARNING OBJECTIVES

1. Identify and explain shapes used in bridges.
2. Identify variables that can alter the results for each test.
3. Identify and measure angles.
4. Explain and describe tension and compression.

CLASSROOM PREPARATION

- Build a Strawbees bridge for demonstration.
- Prepare a .5 kg / 1 lb weight by filling small bags with sand for the testing phase.
- Cut large sheets of paper for students to draft the actual size of their bridge designs onto.
- To inspire and prepare your students search and print images of the following bridges to use as examples found around the world for this lesson:
    1. Beam Bridge: Tianjin Grand, China
    2. Truss Bridge: Little Belt, Denmark
    3. Suspension Bridge: Golden Gate, US

DURATION

Two, 45-minute sessions.

DURATION	ACTIVITY	TIPS
5 min	Introduction	
5 min	Intro to Bridge Design	
10 min	Drafting Designs	
45 min	Building	
15 min	Testing	
10 min	Reflection	

REFLECTION

Upon completion of the test have students share their thoughts on what was successful for their bridges and what they would do that was different in their designs. Review the learning objectives and ask your students to describe what they learned. Ask your students the following questions:

- What happened when we placed the weight on the center of the bridge?
- Did you find that your bridge twist or shift when the weight was placed?
- What would happen if you modified the size of the materials used to build?
- If you refer back to your drawing, do you see any parts you would change that would affect your bridge design?

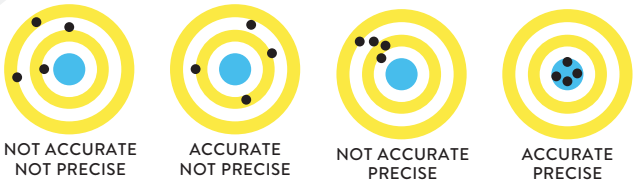
CATAPULTS AND TREBUCHETS

3

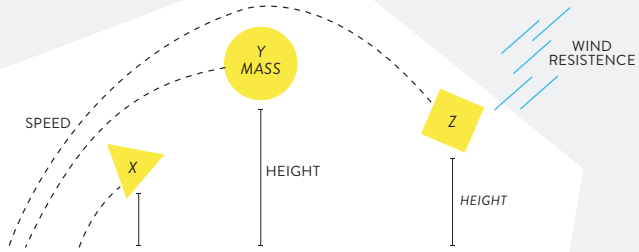
LEARNING OBJECTIVE

Students will design and build a catapult or trebuchet using. They will observe how different models made by each group will range in distance and accuracy as an opportunity for students to identify how they can make modifications to improve their own designs.

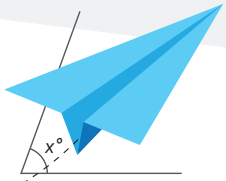
AFTER THESE LESSONS, STUDENTS WILL BE ABLE TO:



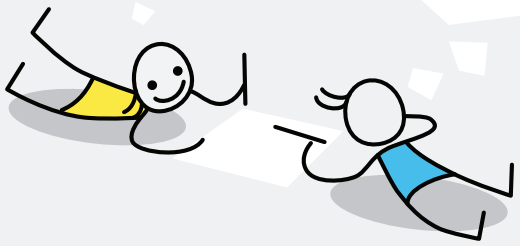
② Predict the landing point of a projectile and explain the difference between accuracy and precision.



① Describe what conditions affect a projectile in motion.



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



INTRODUCTION

Students will work together as a team and begin to draw designs on paper for staging the first iteration of their idea. Students begin to understand the different parts of the catapult and trebuchet and how they are able to launch into the air.

HISTORY

Introduce different ways to launch projectiles and how they travel through the air. Ask your students that are catapults and trebuchets? How have them been used in history and what are the differences between the two?

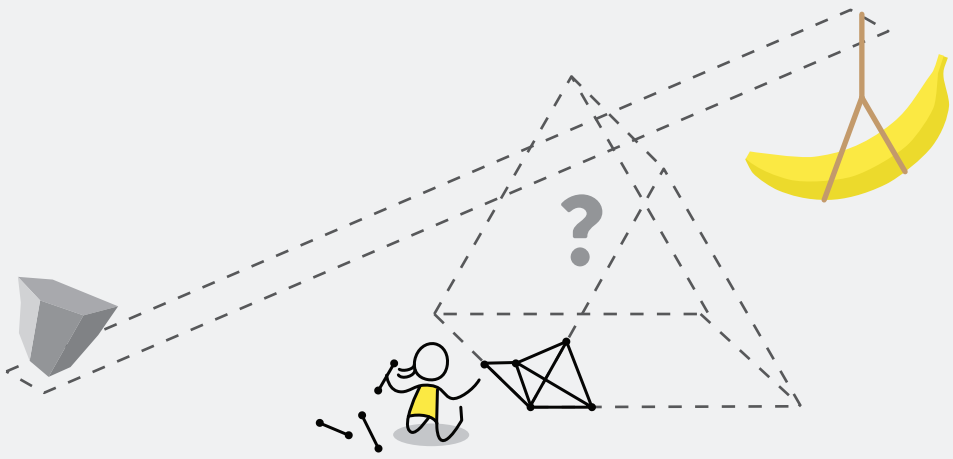
CATAPULTS AND TREBUCHETS

Introduce to your students that they will be building catapults together a team and launch on a range to achieve a certain distance. Spark curiosity by asking students what are examples of projectiles are and how they can be launched.

CHALLENGE

Design a type of catapult to launch a marshmallow projectile as far as possible and then accurately strike a target.

Encourage students to test their projects multiple times during the building process to identify early in their design process parts that will succeed and will face challenges.

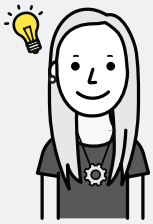


CATAPULTS AND TREBUCHETS

ALL AGES

OVERVIEW

Create catapults and trebuchets to launch projectiles the furthest you can. Use a pyramid base and combine an arm to fling a marshmallow across marked points on the ground.



CHALLENGE

Break students into groups of 2-3 and create catapults and trebuchets to launch projectiles the furthest possible. Build a base and combine an arm to fling a marshmallow as far across the marked points on the ground.

MATERIALS

Straws
300

1/2 Sized Straws
150

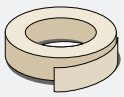
2-Legged Strawbees
50

3-Legged Strawbees
100

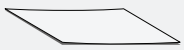
5-Legged Strawbees
100

Rubber bands
50

Marshmallows
35



Masking tape
1 roll



Large paper
20 sheets

Markers

Scissors
20

ACCESS THE FULL LESSON AT Learning.strawbees.com/projectiles

LEARNING OBJECTIVES

1. Iterative process: being able to identify and reflect on designs that need improvement.
2. Real-world applicability: stepping into the shoes of engineers in the real world.
3. Creating a multi-purpose project to accomplish different tasks during the testing phase: accuracy and distance.

CLASSROOM PREPARATION

- Build a simple catapult and trebuchet model ahead of time to show students a working design and demonstration.
- Lay down a line of masking tape on the floor for the students to test their catapults from.
- Create a small round target for students to launch for practicing accuracy.

DURATION

Two, 45-minute sessions.

DURATION	ACTIVITY	TIPS
5 min	Introduction	
10 min	Planning	
30 min	Building	
25 min	Feedback and Improvement	
10 min	Testing	
10 min	Reflection	

REFLECTION

Review learning objectives and have a few students describe what they learned throughout the challenge. After testing the projects, have students discuss and reflect as a group together and ask the following questions:

* How did the projectile launch the object in motion?
* Which challenge did you meet best, accuracy or distance?
* What could you have done to make your creation better?
* What are the strengths to your design that make it successfully launch?

UNDERSTANDING HOW COMPUTERS WORK

WHAT IS PROGRAMMING

Programming is **to frame and express a problem in such a way that a computer can help us solve it**.

In order for a computer to actually assist us in solving a problem we need to phrase the **input** in such a way that a particular programming language can interpret our data (or sensor signals), then design and write the algorithms to **analyze** it and determine what **output** should be provided.

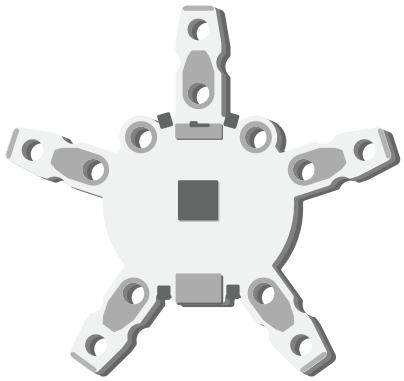
CODE THAT IMPACTS THE REAL WORLD

Strawbees uses both software (our intuitive online development environment) and hardware (our unique Quirkbot circuit board) to explain how computers and robots work and let you control och impact the real world outside of your computer.

OUR UNIQUE SOLUTION

We provide an **intuitive first introduction to programming**, as well as **infinite opportunities for gradually building more advanced projects** using an electronics platform fulfilling a standard loved and tested by millions of people who use electronics for real-world applicable projects across the globe. In our online tutorials, course and lesson plans we show you how!

The Strawbees Learning Platform **provides several different approaches and programming languages**, as well as compatibility with a full scale professional development environment for advanced users to create any project and employ it anywhere.



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Full lesson plans available at
learning.strawbees.com
Challenges suitable from age
5 to university

UNLEASHING CREATIVITY AND MAKING PROGRAMMING EASY