BrainStorm
STEM EDUCATION

STEM KIT

BUILD & LEARN
GUIDE

CATAPULT

SUSTAINABLE MATERIAL

NO GLUE OR MESS

SAFE AND EASY USE

6+ AGES

PROJECT OVERVIEW

Today's project will be the students building and testing the wooden BrainStorm catapult. The catapult uses the mechanics of a mangonel catapult to store tension in the rubber band in the form of elastic potential energy and transfer that to kinetic energy to allow the projectile to fly. All of the materials that are needed to build the catapults can be found inside the BrainStorm STEM Education Wooden Catapult Kit.

SAFTEY WARNINGS:

Please read all saftey warnings before use:

Choking Hazard: Small parts not for children under 6 years or any individual who have a tendency to place inedible objects in their mouths.

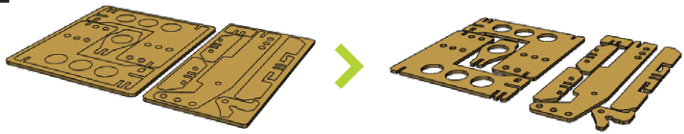
Eye protection should be worn at all times.

Adult supervision required.

MATERIALS

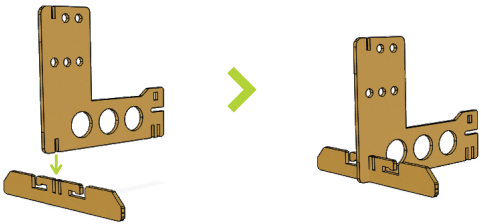
Durable wooden construction pieces
Rubber Bands
Adjustment Dowels
O-Rings
Screws
Screwdriver
Foam Balls

1



NOTE: If you can not break out the pieces by hand, use a blunt tool or a small knife to cut or punch them out. If you have no experience with tools or use a knife, get help from an adult. If there are any burrs, points or rough spots do to breaking or cutting, smooth them with a piece of sand paper.

2



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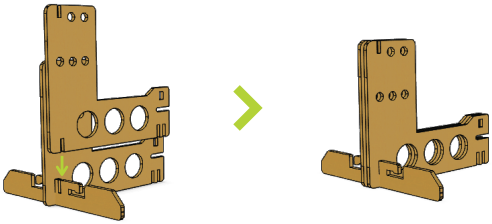

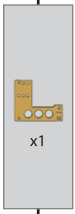

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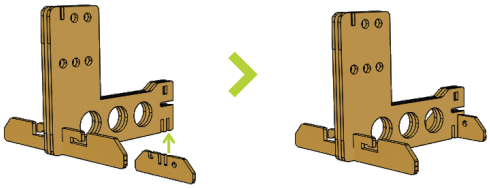

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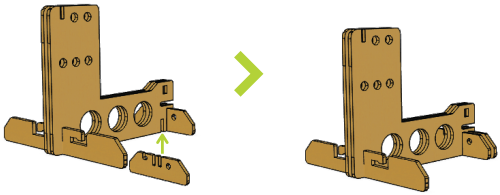

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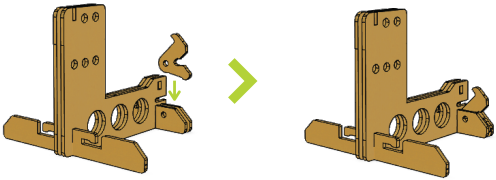

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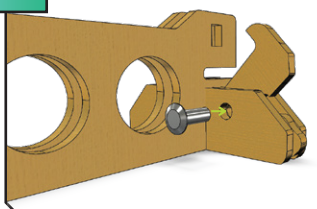

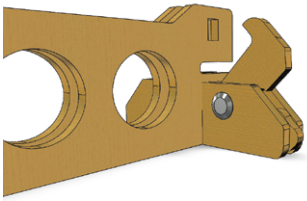

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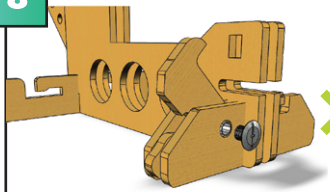
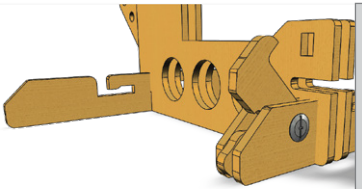




x1

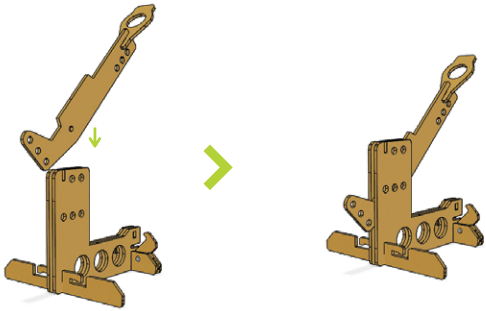
Screwdriver recommended

9

x1

x1

10



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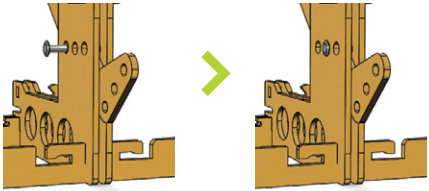

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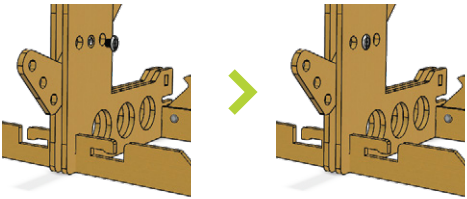

Screwdriver recommended

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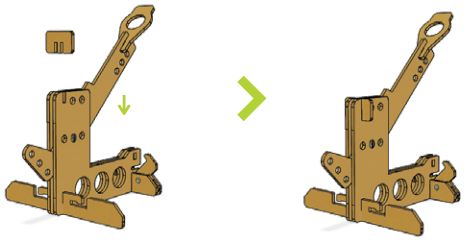

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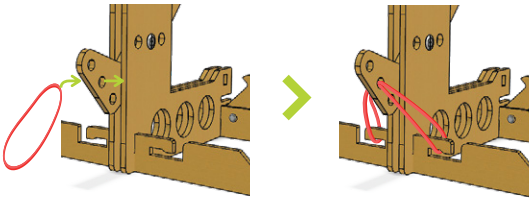


Use large rubber band

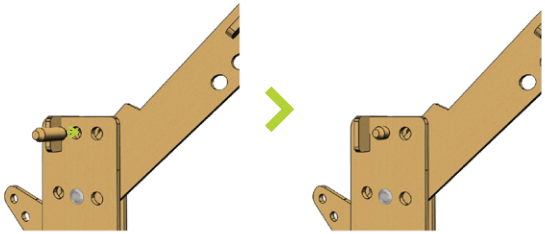
x1

15

Use small rubber band

x1

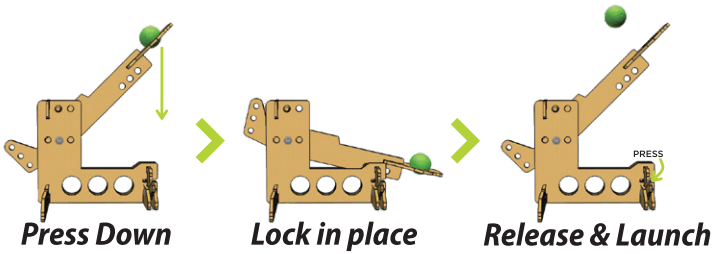
16



x1

HOW TO USE

DO NOT SHOOT AT PEOPLE OR ANIMALS.



HAVE FUN & BE SAFE

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CATAPULT ENGINEERING

Catapults were engineered to be effective weapons in siege warfare. There are 3 main types of catapults that were designed for different objectives to magnify their strengths. The three main types of catapult designs are the Ballista, Trebuchet and the Mangonel.

BALLISTA

This catapult is very similar to a crossbow on a much larger scale. The projectile resembled a long arrow that was fired horizontally at a target. This design was very accurate but not very powerful making it not as effective in siege warfare.

TREBUCHET

Trebuchets are built with a large frame and a long firing arm attached at a fulcrum point on a cross beam. One end of the arm has a large counterweight that uses gravity to launch the projectile. Due to the design of this catapult the projectiles can be launched up to 300 feet with immense power, knocking down castle walls with a single launch.

MANGONEL

This is the most common image of a catapult as well as the design for the brainstorm catapult. This catapult design primarily consists of a long arm with a place to hold a projectile at the end. The other end was attached to the base at a fulcrum. Mangonels could throw their projectiles over 1,000 feet, making it very effective in siege warfare.

Images Credit: https://historyplex.com/types-of-catapults

SIMPLE MACHINES

A Catapult is an example of a simple machine called a lever. When we think of levers, we picture a board that is resting on a support called a fulcrum. If you push down on one side of the lever, it will push the other side of the lever up with an increased force. In the example of a catapult, the force is the tension being applied to the short end of the lever. As the tension pulls the short end of the lever down, it pulls the long end of the lever up with a greater force, launching the projectile at the end of the lever.

Simple machines are devices that help increase the magnitude or direction of a force. There are 6 types of simple machines:

Each simple machine is used to assist the user by amplifying the force that they apply to the machine to allow for a better output. Catapults are a great example of using simple machines, particularly using the lever and an axle to magnify the force of the projectile.

Other Definitions
Tension - Stretching or pulling force

Potential Energy - Stored Energy depending on its position

Kinetic Energy - Energy of objects in motion

Simple Machine - A device with few moving parts in order to change motion and/or force.

CATAPULT SCIENCE

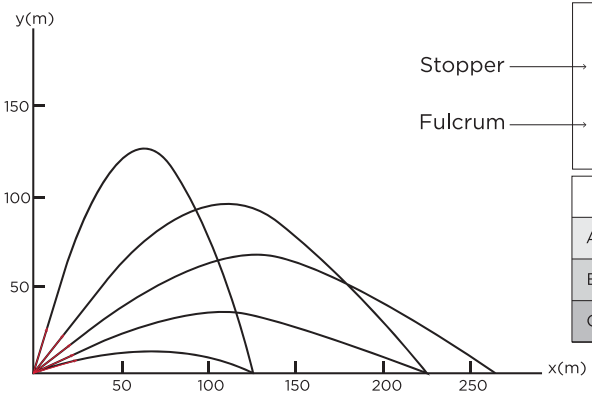
Projectile Motion

Projectile motion is how an object flies through the air when released at an angle. The motion of a projectile is influence by 2 forces at the same time, gravity and forward motion. As the object is moving forward from its launching point, gravity is also trying to pull it down to earth. This results in a flight path that looks like a parabola.

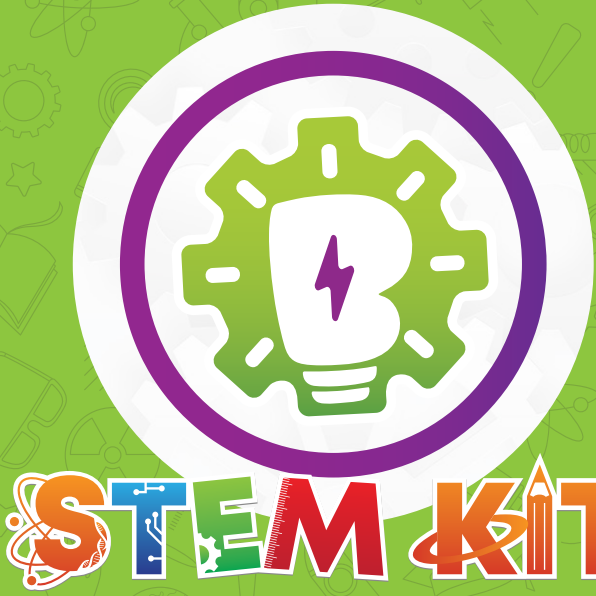
Controlling Projectile Motion

To make the projectile cover the most horizontal distance, it should be launched from a 45º angle. If the angle is greater than 45º, it will go higher but not as far.

Using the Brainstorm Catapult, there are a few points you can alter to effect the angle of launch. The Stopping point and the Fulcrum. The stopping point are the 3 spots at the top of your catapult. The Fulcrum is the point on the lever on which the arm rotates. Using the image below to see the different stopping and fulcrum points, you can set the catapult to match the graph settings to achieve different launch angles.



	1	2	3
A	55°	75°	90°
B	35°	55°	75°
C	25°	35°	45°



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