BrainStorm
STEM EDUCATION

STEM KIT

BUILD & LEARN
GUIDE

ROCKETRY

SUSTAINABLE MATERIAL

NO GLUE OR MESS

SAFE AND EASY USE

6+ AGES

PROJECT OVERVIEW

Engineer a rocket made from the body of a straw and construct a stomp launcher all in the same project. Test the multiple ways to angle and launch the rockets to see which method gets the best results! Shoot for distance or accuracy in this activity.

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.

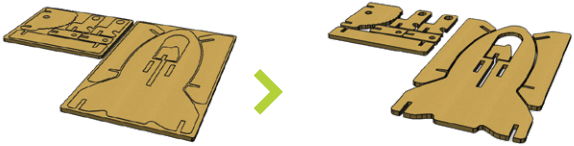
Eye protection should be worn at all times.

Adult supervision required.

MATERIALS

Durable wooden construction pieces
Rubber Bands
Adjustment Dowels
Rubber Nose Cone
Straws
Tubing
Tube Valve
Squeezy Bulb
Rocket Fins

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.

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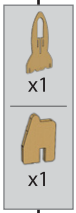

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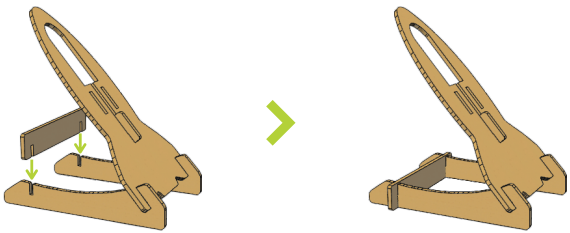

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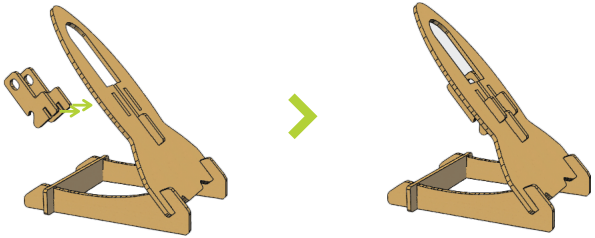

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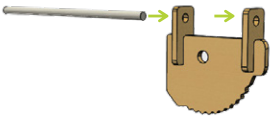

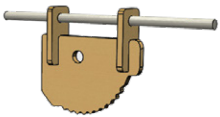

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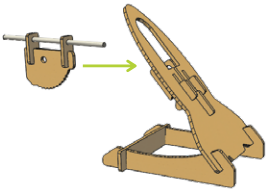

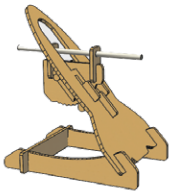

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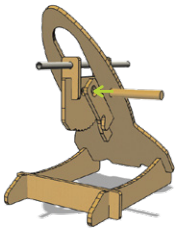

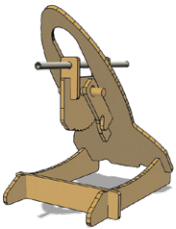

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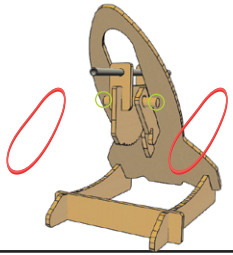

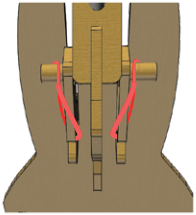

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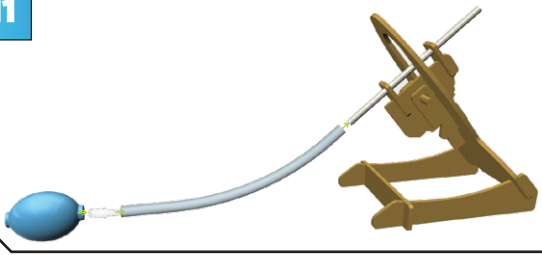

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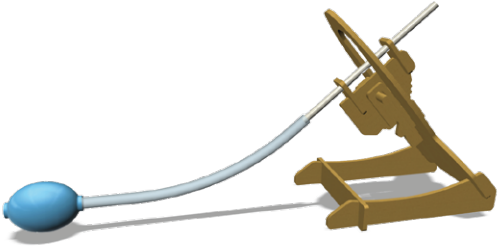

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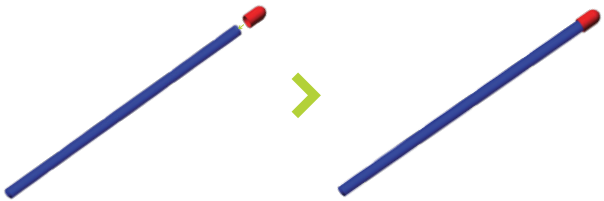

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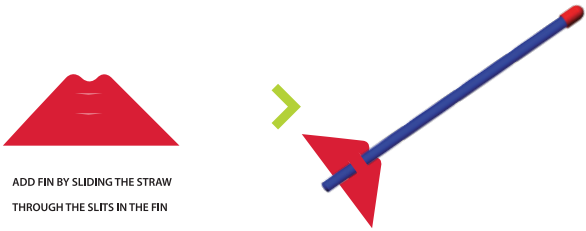

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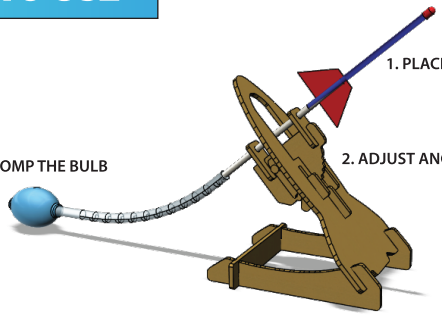
HOW TO USE



TERMINOLOGY

AERODYNAMICS

Aerodynamics is the study of how air moves around an object. Any time an object goes into the air it is subject to the 4 principles of aerodynamics; lift, weight, thrust & drag. These forces control the rocket's flight and how they move through the air depending upon how much of each force is being used at any given moment.

THRUST

Thrust is the force that pushes the rocket forward. This force is opposite of drag. In order for the rocket to keep moving forward, it would need to have more thrust than drag. Since rockets are extremely heavy, they require an immense amount of fuel to lift off the ground, so rockets are equipped with additional thrusters to allow for the extra trust needed.

LIFT

Lift is the force that allows the rocket to stabilize its flight. This force is perpendicular to the direction of flight. In an airplane, this force allows for the plane to lift off the ground. In a rocket, this force helps to control the rocket's flight path. This force is controlled by the fins at the base of the rocket.

DRAG

Drag is the force that slows the rocket down. In order to reduce drag, we would want to make the rocket more aerodynamic. This can be achieved by shaping the rocket in a way that will allow the air to pass around the rocket more effectively. The drag is controlled by the nose cone of the rocket as well as the surface area of the fins.

WEIGHT

Weight comes from the earth's gravitational pull. Every object on the earth has weight. In order for something to lift off the ground to fly, there needs to be a force opposite of gravity that is greater than the weight of the object. The less weight an object has, the less force is required to lift it off the ground.

HOW DO ROCKETS WORK?

Rockets have to burn an immense amount of fuel in order to reach outer space.

DID YOU KNOW?! At liftoff, that two Solid Rocket Boosters consume 11,000 pounds of fuel per second. That's two million times the rate at which fuel is burned by the average family car.

In order for the fuel to be used, rockets have to mix oxygen gas with the fuel and ignited. When the fuel burns, it creates a hot gas that will shoot out of the back of the chamber. Since rocket fuel requires oxygen to burn, rockets have to carry their own supply of oxygen. This allows the fuel to still be used when the rocket reaches outer space where there is no oxygen. The hot gas that shoots out the back of the rocket propels the rocket forward in a force called **jet propulsion.**

Rockets are not the only vehicles that use jet propulsion to propel themselves. Another example would be jet airplanes. The difference between these engines is that airplanes do not leave earth's atmosphere so they are able to pull oxygen gas from the environment as they fly to create the combustive propulsive force.

Engines on rockets can use either liquid or solid fuel in order to work. Each of the fuel types have their strengths and weaknesses. Solid fuels do not provide as much energy as liquid fuels and can be easier to handle as they do not release toxic fumes or require very specific cool temperatures to be stored in preparation for launch. Liquid fuels produce more toxic vapors and require very specific temperatures to remain stable, although they do provide more energy than solid fuel types. Another advantage of using a liquid fuel is the ability to shut off and restart the engines in order to control the explosive effect. Solid fuels do not have the capability of being stopped once they begin making them harder to control during the flight.

In order for a rocket to reach outer space, the rocket would need to reach an escape velocity of 6.9 miles per second. In order to provide enough thrust to get off the ground, the rockets will carry additional stages in self-contained rockets that will use their fuel and then detach and fall off the rocket after its use.

NEWTONS LAWS OF MOTION

Sir Isaac Newton was a brilliant physicist and mathematician that is recognized among the most influential scientists in history. Along with developing the theory of gravity in 1666, he was able to present his three laws of motion in his book titled, ""Principia Mathematica Philosophiae Naturalis" in 1687. These laws of motion are the basis of modern physics describing how an object reacts to the forces that act upon it.

FIRST LAW OF MOTION: LAW OF INERTIA

An object at rest will stay at rest, and an object in motion will stay in motion until acted upon by an outside force. When an object has a tendency to resist a change in its state of motion it is called inertia. If all the forces on an object are equal with no net force, the object will continue doing what it is doing. When an outside force changes the net force acting on the object the object will change its motion. In order for a rocket to launch, it would need an external force called thrust to cause it to move.

SECOND LAW OF MOTION: LAW OF FORCE / ACCELERATION

The acceleration of an object is dependant upon the mass of the object and the amount of force applied to the object. This law states that the speed of an object can be determined by the mass of an object and the amount of force that is applied to the object. If 2 objects, one heavy and one light, are given equal forces, the lighter object will experience more acceleration than the heavier one. In Rocketry, a bigger thrust will cause a rocket to accelerate more.

THIRD LAW OF MOTION: LAW OF REACTION

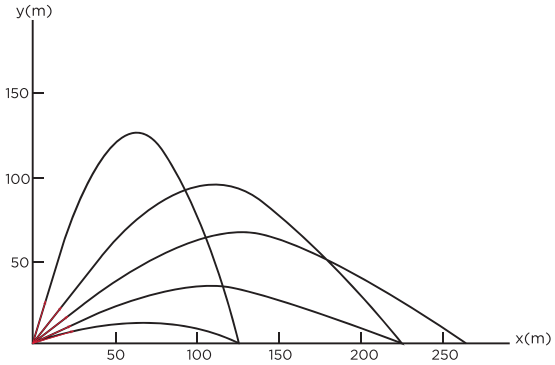
Every action has an equal and opposite reaction. If you have a ball that exerts force on a wall by hitting it, the wall exerts an equal and opposite force on the ball causing it to bounce back. In rockets the pressure that is built inside the rocket will push the gas or liquid inside downward sending the rocket upwards in an equal and opposite reaction.

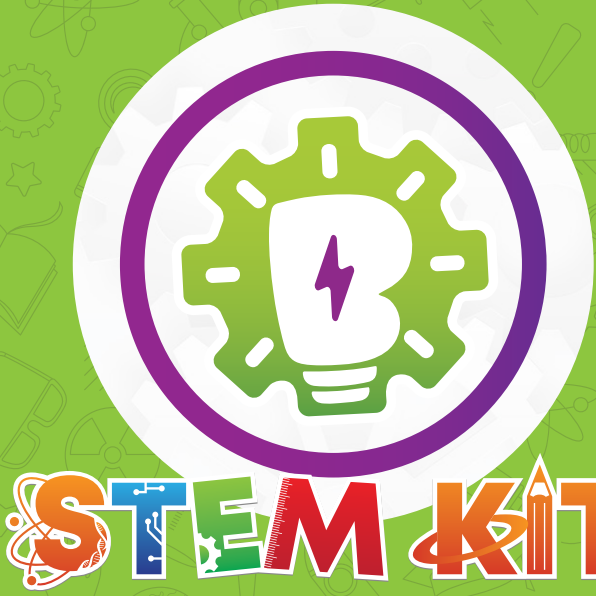
PROJECTILE MOTION

Projectile motion is the motion that an object follows as it is thrown into the air. The motion of a projectile depends on a few factors including the air resistance, the angle of release and the power of the throw. When the projectile is released, the path that it is traveling in is a parabola.

As it is flying through the air, it is constantly being subjected to gravitational pull as well as air resistance. As the object flies forward, the air resistance pushes against the object causing its forward acceleration to slow down. As the forward acceleration of the object decreases, the gravitational pull has more effect on the object pulling it down towards the ground. This causes the flight of the object to make a parabolic path.

The height and length of the parabolic path can be determined by the launch angle. The optimal angle for the furthest distance is 45 degrees. If the projectile is launched at a lower angle, it will cause a much higher path, but it will not travel as far. Whereas if the projectile is launched at a higher angle,the parabolic path will travel at a much lower path meaning it will hit the ground faster since gravity doesn't have as high of a path to pull down.





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