BrainStorm STEM EDUCATION


# STEM KIT

## BUILD & LEARN GUIDE

## ENERGY DRAGSTER

SUSTAINABLE MATERIAL

NO GLUE OR MESS

SAFE AND EASY USE

STEMI AUTHENTICATED

# PROJECT OVERVIEW

This project will focus on energy, forces, and how they work together to make the dragster move. Through building the Brainstorm STEM Dragster kit, you will learn how elastic potential energy becomes kinetic energy and watch how it races away. You will also learn about how real drag racers work and the forces that are considered when they are built to make the fastest dragster.

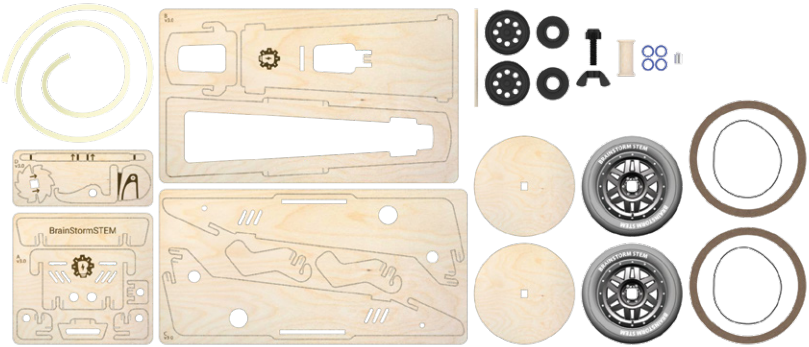
# ⚠ SAFTEY WARNINGS:

**Please read all safety warnings before use.**

- Choking Hazard – This kit contains small parts. Not suitable for children under 6 years of age or any individual who may place non-food items in their mouth.

- Adult Supervision Required – An adult must be present during assembly and use.

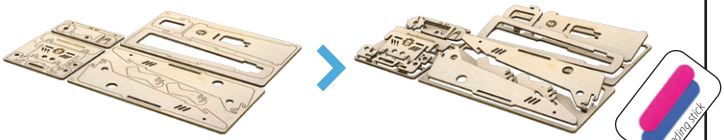
# MATERIALS:




*Disclaimer: Colors and parts may vary slightly from those shown in images or instructions, depending on available materials. All variations function the same and do not affect the performance or assembly of the kit.*

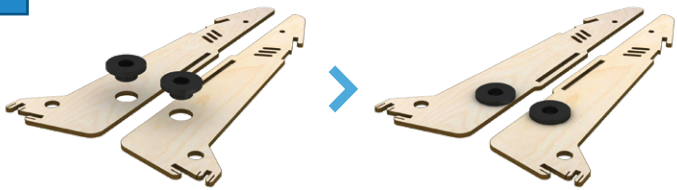
## 1

***Carefully push out all wooden pieces from the panels.***




***NOTE:*** *If any wooden pieces are hard to remove, use a blunt tool to carefully punch them out, and ask an adult for help if needed. Use the sanding stick included in your kit (it looks like a small nail file) to smooth out any rough edges or spots where pieces don't fit together easily. Just find the tight spot and gently sand the edge until it fits just right.*

## 2



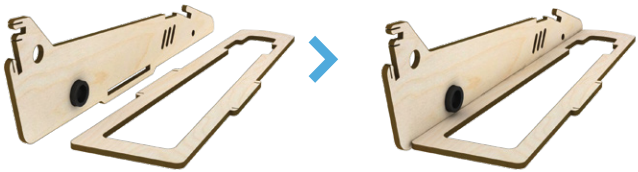
## 3

***Important:*** *Align the ratchet gear so its arrows point the same way as the arrows on the axle.*

## 4

***Important:*** *Make sure the o-ring fasteners sit fully in the engraved slot for a secure, snug fit.*

## 5



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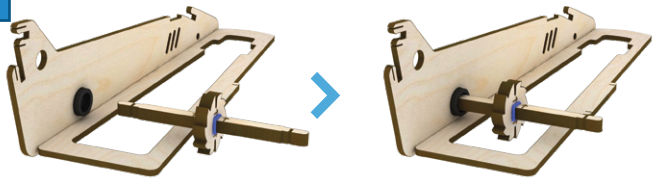
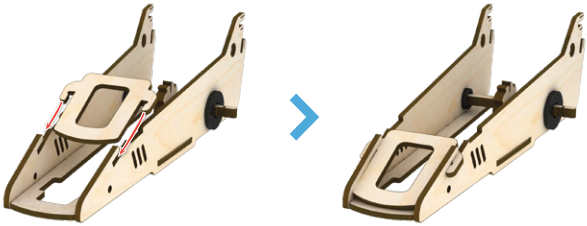


***Important:*** *Ensure the arrows on both the ratchet gear and the axle point toward the front (nose) of the Energy Dragster.*

## 7

## 8



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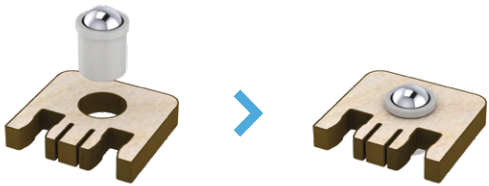
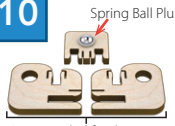
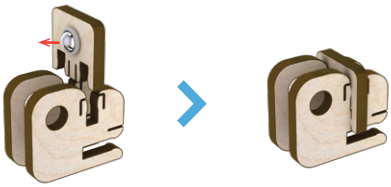


***Note:*** *The small metal piece used in this step is called a Spring Ball Plunger.*

## 10



***Important:*** *Ensure the small piece with the spring ball plunger is oriented in the correct direction before assembling.*

## 11

## 12

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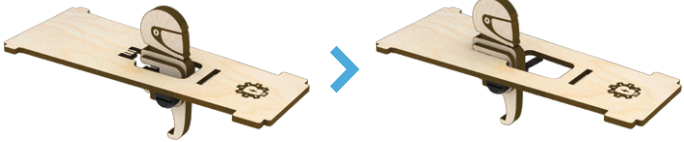

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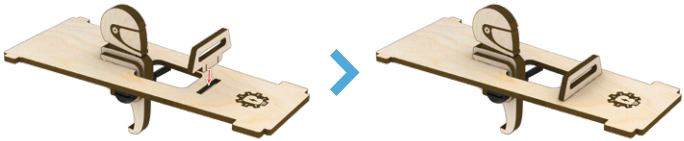

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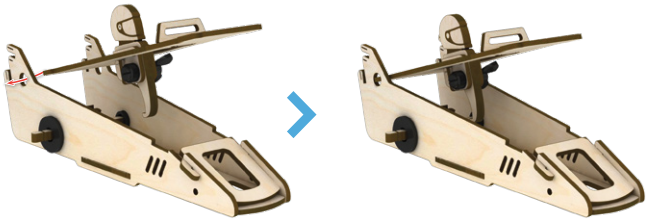

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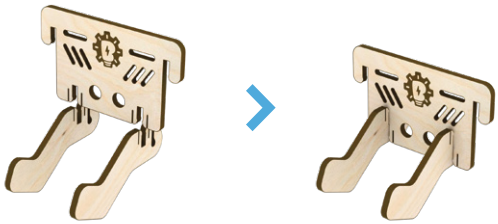

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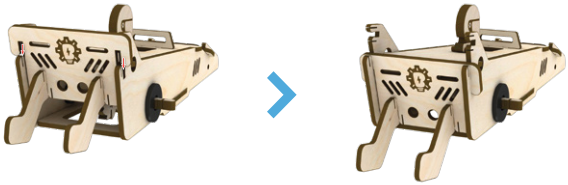

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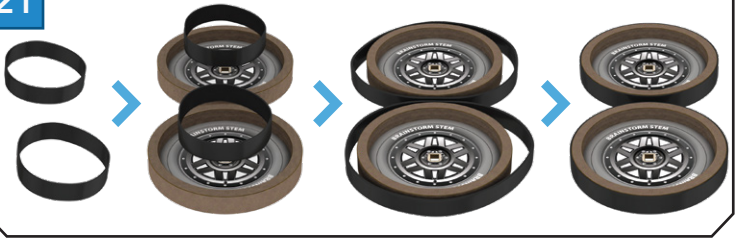


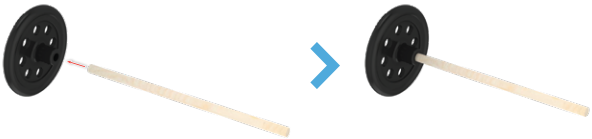
## 22

## 23

***Important:*** *Make sure the o-ring fasteners sit fully in the engraved slot for a secure, snug fit.*

**Repeat this step for both wheels**

## 24



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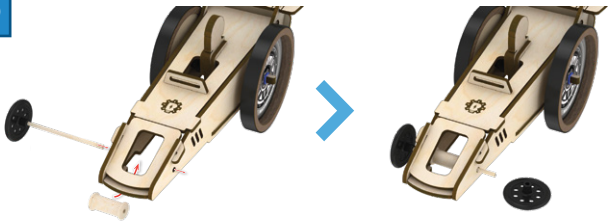

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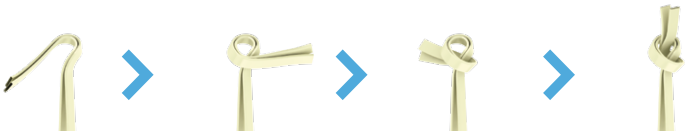
27 *Tie a secure knot in the elastic string.*



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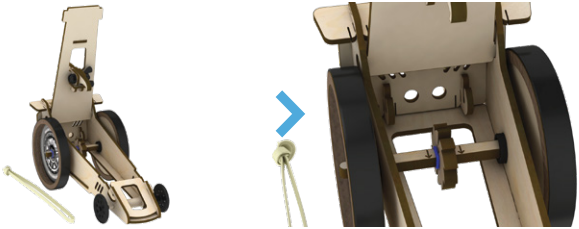

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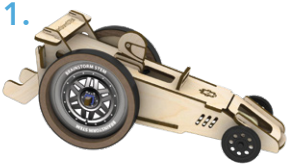
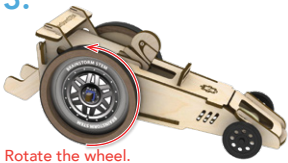
# HOW TO USE:

1.



2. Click in place

3.



Rotate the wheel.
More rotations mean more distance.

4. Disengage Lock

5. Let go!

# More to Explore:

EARTHQUAKE

SOLAR OVEN

WIND TURBINE

SOLAR RACER

AND MORE!

To find all of our STEM Kits, visit: shop.brainstormedu.com

# ENERGY DRAGSTER ACTIVITIES

## Test, Tweak, and Race Your Dragster!

Now that you've built your Brainstorm Energy Dragster, it's time to put it to the test! Wind up the rubber band by turning the back wheels, this stores elastic potential energy. When you let go, that energy turns into kinetic energy and powers your dragster forward!

## Try these fun challenges:

**Distance Test** – Mark a starting line and measure how far your dragster goes. Record your distance and try again, can you beat your record?

**Speed Challenge** – Use a stopwatch to time how fast it travels a certain distance.

**Surface Test** – Race your dragster on different surfaces (tile, carpet, cardboard) and see which one helps it go the farthest.

**Design Upgrade** – Try changing the number of rubber band twists, adjusting the wheel alignment, or reducing friction to improve performance.

Record your observations on the worksheet.

Think like an engineer, what changes help it go faster or farther? Keep testing and tweaking!

# TERMINOLOGY

## ENERGY
The ability to do work.

## KINETIC ENERGY
Energy of objects in Motion

## POTENTIAL ENERGY
Stored Energy in object due to its position or state.

## FORCE
A push or a pull. For example, if someone kicks a ball they are applying a force to the ball making it move forward.

## TENSION
When a force acts on an object, making it stretch. This may cause the object to appear longer. When a rubber band is stretched, changing shape and elongating, it is building tension.

## TORSION
When a force is applied to an object, making it twist. The more force applied, the more torsion is created. When twisting off a plastic soda bottle cap, the more the cap is twisted, the more torsion is created.

## FRICTION
The measurement of how difficult it is to move one object over another.

## MASS
Amount of matter an object is made of.

## VELOCITY
The measurement of an object's speed and its direction.

## ACCELERATE
cause to move faster.

# ENERGY 101

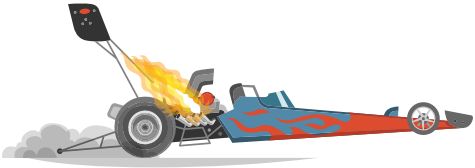
Energy is the ability to do work. Energy comes in many different forms including movement, heat, light , sound and chemical.

The two main categories of energy are Kinetic and Potential.

**Kinetic energy** is the energy of movement.

**Potential energy** is stored energy due to position or state.

The Dragster STEM Kit uses potential energy in the form of elastic potential energy. Similar to potential energy, elastic potential energy looks at the energy stored in an item. In this case, the item is elastic materials. Because of how these materials stretch and compress, they hold a good amount of potential energy. Examples of materials with elastic potential energy include: rubber bands, springs, and bungee cords.



The Brainstorm Dragster works by using torsion to create a tension force in the rubber band. When the back wheels are twisted, it will wind up the rubber band around the back axle. This twisting creates a lot of tension in the rubber band. When the rubber band has tension it had a good amount of elastic potential energy. Then when the car is place on the floor and let go, the tension will release and the potential energy turns to kinetic energy, making the car rush forward like a drag racer.

**What is force?**

A force is a push or pull. The push or pull can cause an object to change shape, change direction, and/or change speed. In the dragster, the force applied is stretching the rubber band to make it so that the car has energy to drive forward.

The stronger the force is or the more the rubber band is wound up/ stretched, the more acceleration the car will have when it is released. This concept applies to Newton's Second law of Physics.

# NEWTON'S 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 car to accelerate, the forward force needs to be stronger than the drag caused by air resistance and friction.

**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. This law explains how the more force that is applied to a lightweight car will allow the car to accelerate more than a larger, heavier car.

**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. This law explains how the backwards force of the tires pushing against the ground pushed the car forward.

# DRAG RACING

Drag racing is a type of racing competition in which two vehicles complete a set distance in a short period of time. These races are usually between cars, known as dragsters, or "diggers." The average distance of each race is 1,000 to 1,320 feet where the cars reach an average speed of 300 mph. Dragsters are classified by the type of fuel they use. The three types of fuel used are: gasoline, methanol, or nitromethane.

When designing a dragster, here are three main things to consider: Weight, Friction, and Drag.

**Weight**

The heavier the vehicle, the more thrust will be required for it to propel itself forward. It is best to keep a dragster as light as possible during the design process. To keep the cars as light as possible, they are constructed with a strong steel frame and a lightweight fiberglass or aluminum cover to keep the weight of the car down.

**Friction**

Friction on and in the vehicle must also be considered. Besides the friction acting on the vehicle from the ground, there is friction from parts of the vehicle acting on itself. When designing a dragster, designers must be mindful to keep the axles free of any additional parts, so they may move smoothly, and to keep the wheels at the correct distance from the vehicle so that they don't rub against it.

**Drag**

The final thing to consider is drag, which is a bit difficult to test for, but not impossible. Drag takes into account how air is affecting the drive and speed of the dragster. The dragsters are built with the front low to the ground so that the air can pass easily over the dragster to reduce as much drag as possible.

# WORKSHEET

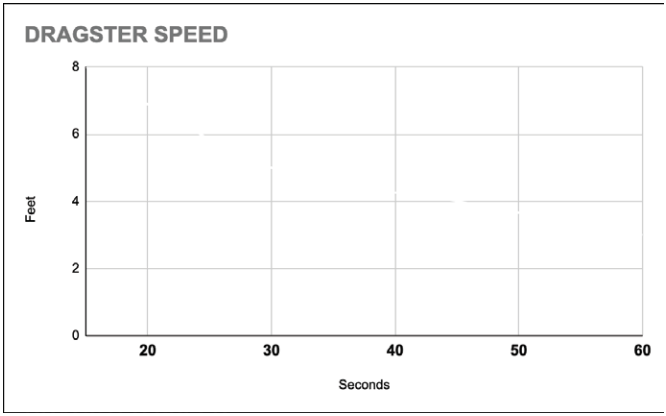
Name(s): _____

Date: _____

**Once you build your dragster, test it three times. Once you've tested your dragster, calculate the speed of your dragster by using the correct equation, and record your results in the table. Once you've filled in the table, plot the distance and time on the graph.**

**Speed = Distance / time**
**Time = Distance / speed**
**Distance = Speed X Time**

| | Distance (in.) | Speed (in./sec.) | Time (sec.) |
|---|---|---|---|
| Trial #1 | | | |
| Trial #2 | | | |
| Trial #3 | | | |



# STEM KIT

ENERGY DRAGSTER BUILD BOOKLET

For more information on our STEM Kits visit:

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