



# **Instructions for Scientific Fun**

Spark Imagination... Inspiration... Innovation

**CREATED AND PROVIDED BY**  
**4-H EXPLODING BACON ROBOTICS CLUB**  
**TEAM 1902**



**Spark** was created by the ***FIRST*** robotics team **Exploding Bacon**, in Central Florida, USA.

We love science and our hope is to give children in every corner of the globe the opportunity to explore the wonders it has to offer.

Our goal is to give you the tools and inspiration to develop innovative solutions to problems in your communities.

This program is only beginning and we look forward to feedback on how we can make this program even better for all children.

# Simple Machines

## Basic Overview

Everything that we create comes from a few basic simple machines. Exploring these machines is key to having a good understanding of how things work. Each one has a variety of uses that can make every day life more simple, or maybe just easier to understand.

## What it Teaches

This set of simple machine experiments teaches how and why each simple machine works, as well as giving some examples of where they are used in everyday life.

## What it uses

Pulley

String

Wheel and axle

Popsicle stick (optional)

Some sort of weight (not provided)

## Step by Step Instructions

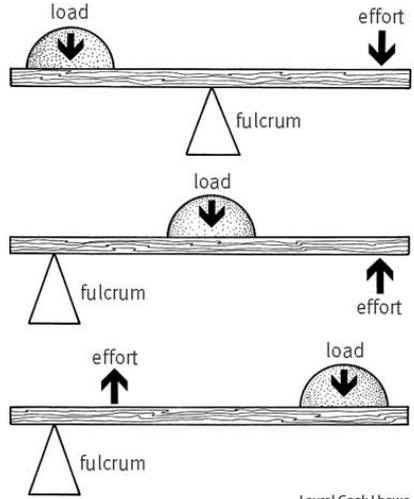
### PULLEY

1. Setup the pulley in the kit by hanging it from one of the hooks anywhere that you can find
2. Wrap the string in the groove around the disk of the pulley and tie it to any object or weight
3. Pull down on the pulley string so that the object goes up
4. Explain that by pulling down on the string you transfer the force through it and pick up the object
5. This can be useful for lifting heavy objects and moving them, or any other time you might need to pull in a different direction than you want to move an object



## LEVER

1. Place a popsicle stick or any long flat object on top of a point (the fulcrum) that will act as a rotating point for the lever
2. Place a small weight at one end of the lever. (example: magnets or rock)
3. Make the end opposite the lever about twice as long as the side with the weight
4. Demonstrate how much easier it is to lift the weight with the longer lever arm than the shorter lever arm
5. Have the kids try to push down on the lever each way and see which one is easier

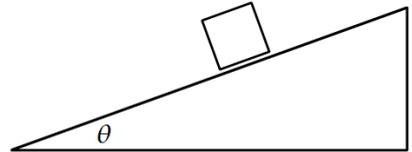


Laurel Cook Lhowe

6. Explain that this makes it easier to lift heavy objects and the longer the lever arm is the easier it will be to lift an object

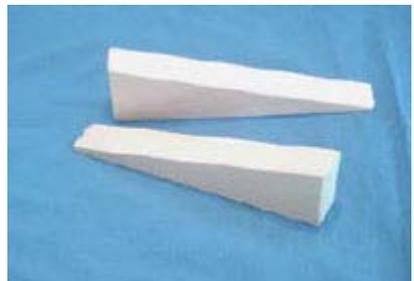
## INCLINED PLANES

1. Inclined planes can be found everywhere. Any ramp or even hill is an example
2. Ask the kids if it's easier to lift something 5 meters (or feet) or push it up a ramp 5 meters (or feet)
3. Explain how it makes it easier to move weight than by pushing things up steps



## WEDGE

- A wedge can be used to cut through objects, or, like the ones found in this kit, push object apart
2. Make a small gap out of boxes or tables and show how you can not put the large end of the wedge through



3. Then put the small end and see that it fits, and if you push down it opens the gap
4. If you keep pushing you can get it all the way through
5. This is really useful for cutting through objects like wood because it pushes apart the wood until it gets wide enough to cut

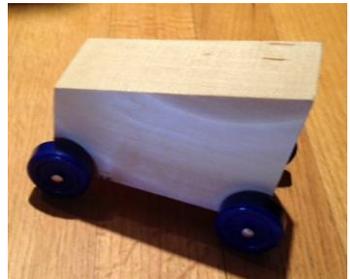
## SCREW

1. Screws are wedges wrapped around a cylinder
2. This means that the wedge slowly cracks open a piece of whatever it's trying to go into and pulls itself in
3. Take the screw and push the tip into the paper
4. Once there is a small hole spin the screw so that it pulls itself into the paper
5. Notice the screw can hold two pieces of paper together this way
6. This can be very useful for attaching two things, such as wooden panels.



## WHEEL AND AXLE

1. Show how the block with wheels is hard to push up side down
2. Flip it right side up and show how easy it is to roll
3. Show how the wheel turns around the axle so that they can roll
4. Explain that this makes it easy to move things because you can roll objects around.



## Recommendations for Further Fun!

Simple machines can be useful on their own, but when they're brought together they can do anything! Everything we have is made of simple machines, so try to combine some! Make a lever connected to a pulley to more easily lift objects, put a pulley at the end of an inclined plane and try to pull an object on wheels up the ramp. The possibilities are only as endless as you can imagine!

# Colors

## Basic overview

This experiment uses a prism to split light into all of the different wavelengths, explaining how light is made up of every color and each one reacts differently than the other.

## What it Teaches

This experiment teaches the basics of light and color.

## What it Uses

Prism

Sunlight

Paper can help you see the spectrum

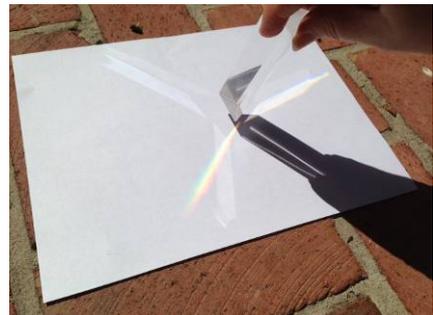
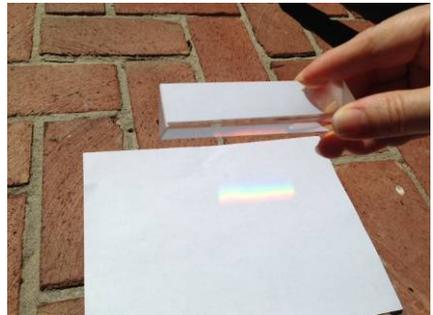
Other light sources (optional)

## Step by Step Instructions

1. Ask if they think that light is a color or if it is made up of a bunch of colors
2. Have a student put the prism in the sunlight, turn to get the right angle with the sun
3. Ask if they see all of the different colors
4. Ask them if they now think that light is one color or a bunch
5. Explain that when the light hits the prism each color bounces off the triangles in the prism differently than the others and shows all of the colors of the light

## Recommendations for Further Fun!

Try seeing what happens when you hold the prism up to different light sources. Does it have the same colors as the sun or different ones? If they are different that means that light source doesn't have all of the same colors that the sun does. [Have a laser available? See if the laser splits into multiple colors!](#)



# Heat

## Basic overview

This experiment shows how different colors absorb more heat than others because of their different wavelengths. It is recommended that you do the prism experiment first so that the students have an understanding that sunlight is made up of many colors.

## What it teaches

Different colors have different properties, and some, like white, are made up of many colors. When light hits the **same color that it is it bounces back**, but when it hits a different color it is absorbed as heat.

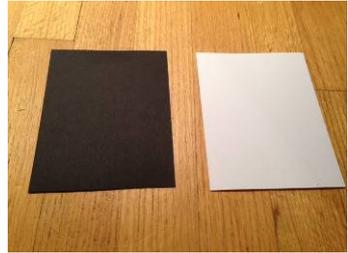
## What it uses

Small black paper

Small white paper

## Step by step instructions

1. Take the white and the black pieces of paper and leave them in the sunlight outside.
2. Ask which they think will be hotter.
3. Wait for several minutes, this can be a good time to do the prism experiment
4. Go back to the papers and feel the black and white pieces of paper
5. Notice that the black one is hotter than the white one
6. Ask if they remember that the white has all of the different colors, explain that the black has none of them
7. Explain that when **light runs into something of its own color it bounces back**, but when it runs into something of another color it gets absorbed as heat energy



## Recommendations for further fun

Test other colors! If you have different colors of paper or clothing see if any get as hot as the black one in the same amount of time. You can even test every day objects that are other colors, does shade make a difference since there's less light?

# Magnetism

## Basic overview

The kit includes 10 magnets that can be used for various experiments. Included are some possible experiments to do with them, but they're fun to play with all on their own!

## What it Teaches

It's usually easy to see when forces push on things because they make contact with them first. Show the student by pushing something. With magnets they can push and pull over long distances. These experiments teach some of the basics of magnetic forces, from a compass to pulling them along from underneath another object.

## What it Uses

- 10 Magnets
- 1 Paperclip
- 1 bowl, container to hold water
- 1 leaf
- Water
- Popsicle stick

## Step by step instructions

### COMPASS IN A BOWL (OR CONTAINER)

1. Fill a container with water
2. Rub one end of a magnet against one end of the paper clip for about 2 minutes
3. Explain that this makes the paper clip a magnet by transferring some of the magnet onto it
4. Push the paper clip through the leaf so that leaf curves around the paperclip (see picture)
5. Place the paper clip in the container, laying on the water
6. Does it point in a certain direction?
7. Explain that the Earth is a giant magnet and that the paper clip is pointing exactly north and south
8. Explain that this is how a compass works, so you can always tell which way is north

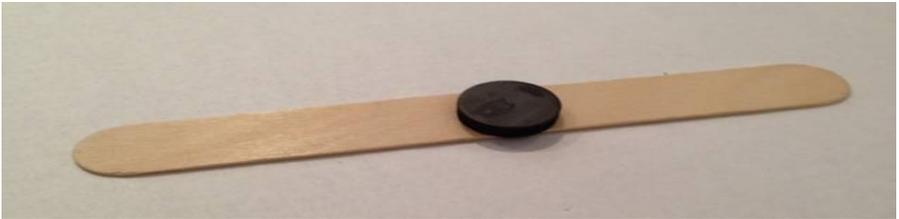


9. See if the magnet will make the paper clip turn in another direction, when you bring the magnet close to the paperclip
10. Explain that the closer a magnet is to a metal object, the stronger it pulls on it.
11. Test this by putting the magnets closer together and seeing if they pull more than when they're further apart



## MOVING MAGNETS

1. Put a magnet on top of the object, like a wooden stick in the kit
2. Take another magnet and put it on the underside of the wooden stick or a table



3. Drag the magnet underneath the object and see how the magnet on top moves with it or not
4. Try it on thicker surfaces to see if the magnets still move
5. How far apart do they need to be to not move each other?
6. Explain that the further apart the magnets get the less force they put on each other

### Recommendations for further fun

Magnets are endless fun! Try and use them to push each other around, magnetize other objects like you did the paperclip, maybe try and even build things out of them!

# Pressure Drop

## Basic overview

This experiment is very simple, but uses some very cool physics principles. When a half full water dropper that barely floats on the surface of a water bottle is put in a closed water bottle and the bottle is squeezed it increases the water pressure. The water pressure pushes the air in the dropper to be more dense and the dropper sinks to the bottom as a result of the change in pressure.

## What it Teaches

Change in pressure in both water and air.

## What it uses

Water dropper

Water bottle

Water



## Step by step instructions

1. Add water to the supplied water bottle to the marked line
2. Fill water dropper, about 2/3's so it barely floats on the surface.
3. Then fill the water bottle to the top with dropper floating inside
4. Seal water bottle with cap
5. Squeeze the water bottle and watch the dropper fall to the bottom
6. Explain that this happens because when things float on water they have to be lighter than water is, which the air is usually
7. Explain that when you squeeze the water bottle it pushes in the water, which pushes the air closer together and makes it heavier than the water is for how much space it takes up
8. This means that the dropper sinks to the bottom because it's now heavier
9. Let go of the water bottle and watch it float to the top, reversing the process.



## Recommendations for further fun

Try the water dropper with different amounts of weight, is it harder to move or easier? Why do you think this would be?

# Ball Drop

## Basic overview

This experiment has been performed throughout history, even on the moon, to prove that gravity acts the same on everything on the Earth or the Moon.

## What it teaches

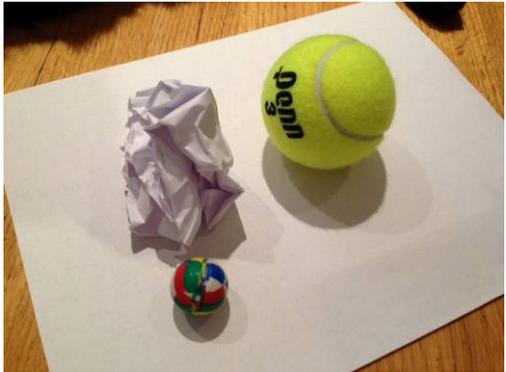
Just because something is bigger or heavier it doesn't mean that it's going to fall faster. Everything will fall at the same speed no matter what it is, the only difference is air resistance.

## What it uses

Tennis ball  
Small bouncy ball  
Paper

## Step by step instructions

1. Take both balls and drop them at the same time
2. Notice that they hit the ground at the same time
3. Explain that gravity pulls equally on all things and that is why they fall at the same rate
4. Try and drop a piece of paper next to a ball
5. Explain that the air makes it fall slower and if there was no air pushing on it it would fall at the same speed.
6. Try crumpling up the paper and seeing if it falls closer to the same speed as the balls



## Recommendations for further fun

Test other objects! You can never run out of things to test and maybe you can get up even higher to test them! What about rolling the balls down a hill, does that work the same way as dropping the balls?

# Double Bounce

## Basic overview

Due to conservation of energy and momentum, you can make a ball bounce higher than it normally could by dropping it on top of a larger ball.

## What it teaches

This experiment teaches concepts of energy and momentum transfer, along with elasticity of the bouncy balls.

## What it uses

Tennis ball

Small bouncy ball

## Step by step instructions

1. Hold both balls at shoulder height, with one in each hand
2. Ask how high they think the balls will bounce by having them put their hands where they think the ball will bounce up to.
3. Drop them and see if they were right
4. Now put the small one on top of the large ball and hold them at shoulder height
5. Ask how high they think each one will bounce now
6. Notice how the small one bounces even higher than it was dropped before
7. Explain that the big ball has a lot of momentum and energy, and when it stops at the bottom all of that goes into the small ball, since it is smaller and lighter and shoots up really high
8. Now reverse the process, put the big ball on top and the small ball on bottom
9. Ask about the heights of the bounce again
10. Explain that since the ball on top is bigger and heavier it doesn't bounce as high



## Recommendations for further fun

Try dropping from greater heights! The higher you drop the balls from the more they'll bounce! What about bouncing off of other surfaces? See if they can figure out that they bounce less on dirt than a flat floor because they have longer to slow down. Have any other balls? See how they work with the experiment!

# Construction Kit

## Basic overview

This kit is full of pieces that will allow construction of many different structures for various experiments

## What it teaches

Each experiment teaches solid building structures and various key elements to building.

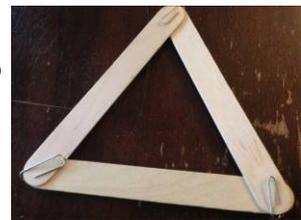
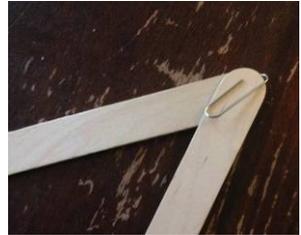
## What it uses

- 250 wooden sticks
- 1,000 paper clips
- 1,000 rubber bands

## Step by Step Instructions

### ACTIVITY 1: SIMPLE SHAPES

1. Show them how to connect the pieces of wood together by clipping them inside the paperclips
2. Instruct them not to bend the paper clips so you can use them again
3. Have them build a square
4. Show how you can push it from the side
5. Have them build a triangle
6. Show that it pushes back and doesn't fall over like the square does
7. Explain that the triangle supports both up and down and side to side motion so it's much stronger than the square
8. Ask them what shape would be good to use in building things given this information



## **ACTIVITY 2: BRIDGES**

1. Explain that when you build something with enough support on either side, it can stand up in the middle
2. Divide the students and materials into groups (recommended 5 groups)
3. Give them each an even amount of materials
4. Challenge them to build a bridge across a gap, usually between tables or chairs
5. Encourage them to develop a plan before starting to build.
6. Move their bridges to the gap and see who can go the farthest
7. We recommend not putting additional weight on as it may break the wooden sticks
8. Carefully take apart the bridges so the materials can be reused

## **ACTIVITY 3: TOWERS**

1. Divide them into groups
2. Once they are in groups, challenge them to build the tallest tower they possibly can
5. Encourage them to develop a plan before starting to build.
4. Give them the materials and time to build
5. Measure the towers and see who has the tallest one

### **Recommendations for further fun**

These materials can be used to make many things, develop new challenges and structures to build! The world is full of building materials, you can bring in other items from your environment to help build.

# SPARK KIT PACKING LIST

Wooden sticks	300
rubber bands	300
paper clips	100
Wheel and axle	1
Prism	1
Magnets	10
Water dropper	1
Water bottle	1
Tennis ball	1
3-4 inch bouncy ball	1
Pulley	1
String	10 ft
Wedge	1
Large Screw	1
Black & White Paper	2
Sheets of paper	20

## **We Love Pictures and letters!**

We hope you learned something new.

Please share your thoughts and  
recommendations with us to help us make  
this the best science experiment kit  
for kids everywhere!

### ***For more information visit:***

[sparkimagination.org](http://sparkimagination.org) and [explodingbacon.com](http://explodingbacon.com)



**4-H Exploding Bacon Robotics Club  
Orange County 4-H**

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