EXPERIMENT MANUAL

IGNITION SERIES

THAMES & KOSMOS

Dear Parents,

This experiment kit will make long drives pass in the blink of an eye. And at the same time, your kids will learn playfully simple concepts from the world of science. They will be able to study the landscape with the binoculars, or try fun games with the top and the spinning disc. They can construct a miniature cable car or a simple scale. And we haven't forgotten about the fun when you get where you're going: In the box, they will find a "multifaceted" postcard that they can assemble themselves and a boomerang for flight experiments. So here's wishing you a safe trip, and lots of fun with these experiments!

CAUTION!
Not suitable for children under 3 years of age. There is a risk of suffocation due to small parts that can be swallowed or inhaled. There is a risk of strangulation if strings or cords are wrapped around the neck. Save the packaging and instructions, as they contain important information.

Contents

1 pair of binoculars	3 suction cups
5 paper clips	1 packet clip
2 lengths of string	1 top
1 die-cut cardboard	1 map

Tip

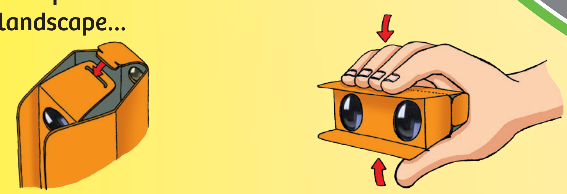
Insert a suction cup through the hole in this instruction sheet and stick it to the window. That way, you will have the instructions right in front of you while you perform the experiments.

1. How do the binoculars work?

Warning note: Caution! Never look directly into the sun, either through the binoculars or with your naked eye. You could seriously damage your eyes. Never leave the binoculars lying in the sun – fire risk!

You will need: Binoculars

Here's how: Take the folding binoculars out of the box and take a look at the landscape...

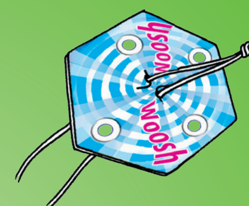


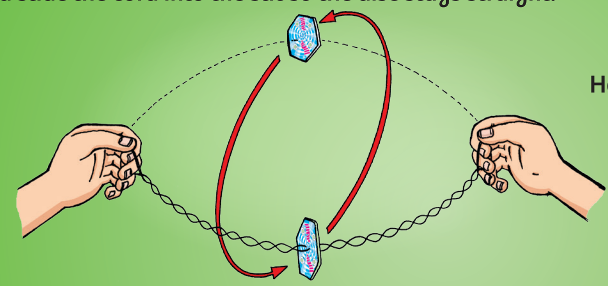
What's happening? The forward lens collects the incoming light, focuses it, and uses it to produce an enlarged image of objects farther away. This lens is also called the "objective" lens. The other lens is smaller, and enlarges the image a second time close to the eye. Unlike with a telescope, a pair of binoculars lets you see the object in three dimensions, and with the proper width-to-height ratio.

2. Whoosh! The whizzing sound of the spinning disc

You will need: Disc (die-cut cardboard), short string

Here's how: Separate the disc from the cardboard and find the shorter string in the box. Guide its ends through the small holes in the disc and carefully knot them. Slide the disc to the middle of the length of cord and slide the cord into the slit so the disc stays straight.





Holding the string tight with your fingers, rotate the disc again and again, like a jump rope, until the string is really wound up. About 30 to 40 times should do it.

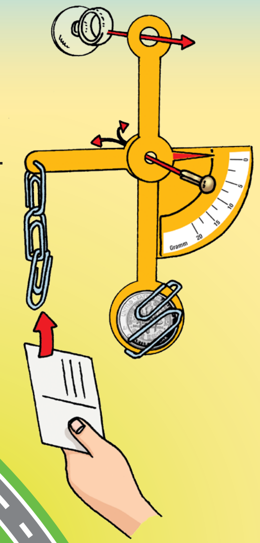
Now, pull the ends of the string apart with a lot of force and then immediately relax the tension again! Be sure that the disc stays straight. Don't give up right away — you'll soon get the hang of it. The disc will go faster and faster, and you will hear a whizzing sound.

What's happening? Why does the disc make a noise when it spins fast? The spinning disc works by the same principle as a top, except it is suspended from a string and gets its rotational momentum from the turning of the string. The turbulence of the disc makes the air around it vibrate. Depending on its rotational speed, you will hear a whizzing or a sort of howling sound with a higher or deeper pitch.

3. Measuring weights with the scale

You will need: Scale (die-cut cardboard), a packet clip, 5 paper clips, 1 suction cup, *a quarter and a dime*

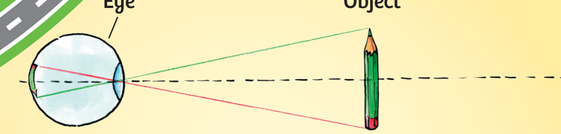
Here's how: Assemble the scale as shown in the illustration. For the scale to read the correct weight, you need to use one quarter and one dime as counterweights. Carefully clip them to the scale as shown with two paperclips.



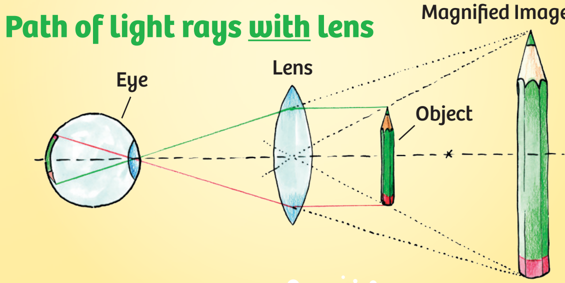
Attach each of your test objects in turn to the paper clips and read their weights on the scale. Be sure that the scale is set to "0" before each weighing.

What's happening?
All objects are pulled to the center of Earth by gravity. The greater the mass of an object, the greater its weight and the more strongly it's pulled down.

Path of light rays without lens



Path of light rays with lens



4. Spin, pretty top!

You will need: Top disc (die-cut cardboard), top

Here's how: Separate the colorful disc from the die-cut cardboard and place it on the upper surface of the top. Clear everything out of the box, which will serve as your spinning surface. Now try to get the top spinning!

What's happening? Why does the top spin? Think about what happens when a train or car goes into a curve. There's a force that pushes your body outward. This force is called "centrifugal force." Any moving body persists in its direction of motion. This goes for a car, too — and if it goes too fast, it can even fly out of the curve and lose control.

But what does all that have to do with your top? When it spins, the centrifugal force is greater than the force of gravity pulling it downward. As it spins more slowly, the force of gravity starts to take over, until it eventually topples.

5. Tricky top game

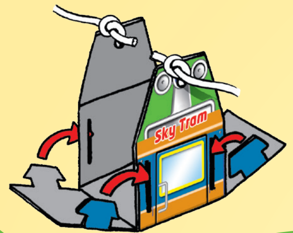
You will need: Top, map sheet

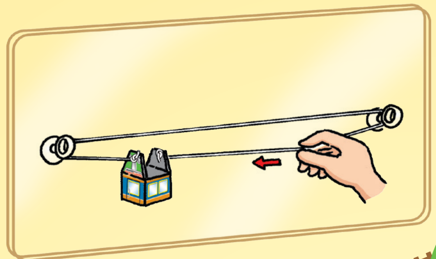
Here's how: In this game, try to get your top to travel from one state to another on your map. Clear everything out of the kit box so you can have just the map lying inside it. Spin the top on the map. By tilting the box, can you get the top to travel along the roads and get it to stay in a specific state?

6. The "window-suction cup cable car"

You will need: Gondola (die-cut cardboard), long string, 2 suction cups

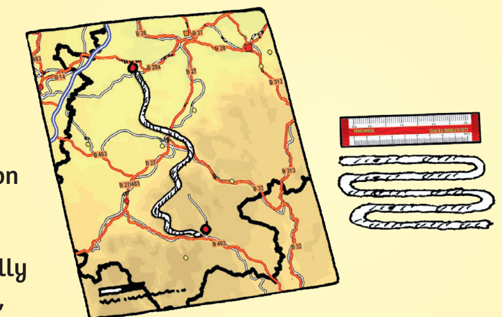
Here's how: First, separate the gondola piece from the die-cut cardboard and carefully fold it together. Take the longer string, thread its ends through the gondola eyelets, and knot it in place there. Now hang the string over the two suction cups. You will be able to move the cable car from left to right by pulling the string. What sorts of things can you transport in it?





7. Fun travel route calculations

You will need: String, experiment ruler (die-cut cardboard), *large driving map or driving atlas*



How far is my travel route (in miles)?

Here's how: Use your experiment ruler and string to measure the approximate length of the travel route on the driving map (or driving atlas). Take a look at the scale used for the map and then convert your travel distance from inches into miles. Map scales are usually represented as ratios, such as 1 inch to 63,360 inches, which can be written as 1:63,360, or one inch to one mile.

Common map scales	**What it means in reality**
1 : 24,000	1 inch on the map corresponds to 24,000 inches, or 2,000 feet, in reality
1 : 63,360	1 inch on the map corresponds to 63,360 inches, or 1 mile, in reality
1 : 500,000	1 inch on the map corresponds to 500,000 inches, or about 8 miles, in reality

How fast am I traveling?

Here's how: Would you like to calculate your average driving speed **(v, for velocity)**? If so, you will need:

d = Distance: The length of the driving route in miles. For this, you can ask your parents, the train conductor, or the flight attendant. Or measure it on your map or in your atlas.

t = Time: The travel time in hours, not including stops or breaks.

Now, if you use the formula $\boxed{v = d \div t}$ you will get the answer.

Example:

Driving route	**from New York, NY to Los Angeles, CA**
d	about 2,450 miles
t	about 44 hours
v	2,450 miles ÷ 44 hours = 56 miles per hour (mi/h)

Fun Questions

1. How far do animals travel?

A lot of animals move between summer and winter homes every year. Arctic Terns migrate from the Arctic to Antarctica and back again each year, about 12,000 miles each way. They live up to 25 years and cover as much as 1.5 million miles in a lifetime! Take a look in your world atlas to see how great the distance is between the Arctic and Antarctica.
European storks cover up to 250 miles a day as they travel back to South Africa. They take advantage of updrafts and soar like gliders in order to save energy.

Ask your travel companions to think of other animals that take long trips — in the ocean, in the air, or on land. The winner is whoever can name the most animals in 10 minutes.

2. How fast does Earth travel in its orbit?

Our planet circles around the sun. Take turns guessing how fast Earth might be moving as it does this. Who can get the closest to the right answer?

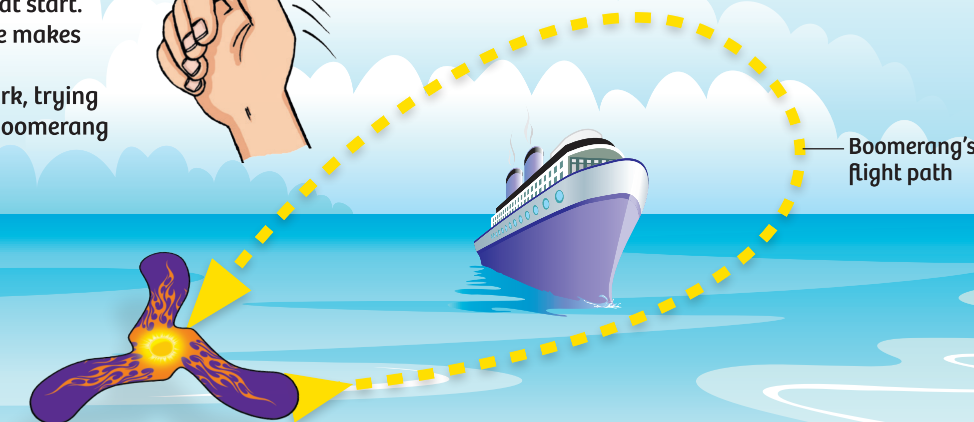
As our Earth follows its orbit around the sun, it reaches an average speed of 29,800 meters per second – or 66,660 miles per hour!

At your vacation destination: A boomerang for cool flight tests

You will need: Boomerang (die-cut cardboard)

Here's How: The boomerang can function as both hunting weapon and sporting equipment. The Australian Aborigines are expert boomerang makers and throwers. They know how to design this flying instrument so it always comes back to the person who throws it. The boomerang in the die-cut cardboard is admittedly not perfect, but with a little bit of skill and patience you can try different throwing angles to see which one works best to make it come back to you.

Tip: When you throw it, a quick flick of the wrist will help your boomerang get off to a great start. A little practice makes perfect...
If it doesn't work, trying throwing the boomerang like a Frisbee.

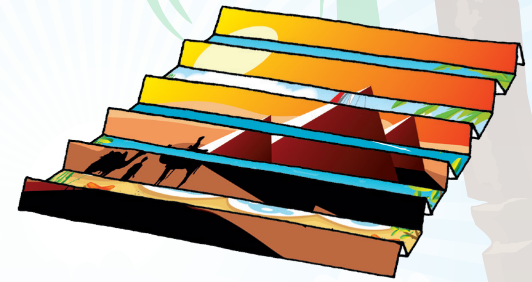


What's happening? How does a boomerang fly and why does it return to its thrower? As a boomerang spins through the air, it rotates around an axis passing vertically through its center. As it does this, it follows a parabolic path that ideally leads back to the starting point.

The "multifaceted" postcard

You will need: Postcard (die-cut cardboard)

Here's how: Fold the strips with the orange-colored picture of the pyramids facing up, as shown in the drawing. You will see a different picture depending on which side you look at the postcard from.



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