EXPERIMENT MANUAL

SPARK
SCIENCE IN A FLASH

AMAZING GYROSCOPE

THAMES & KOSMOS

1ST EDITION 2014

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SAFETY

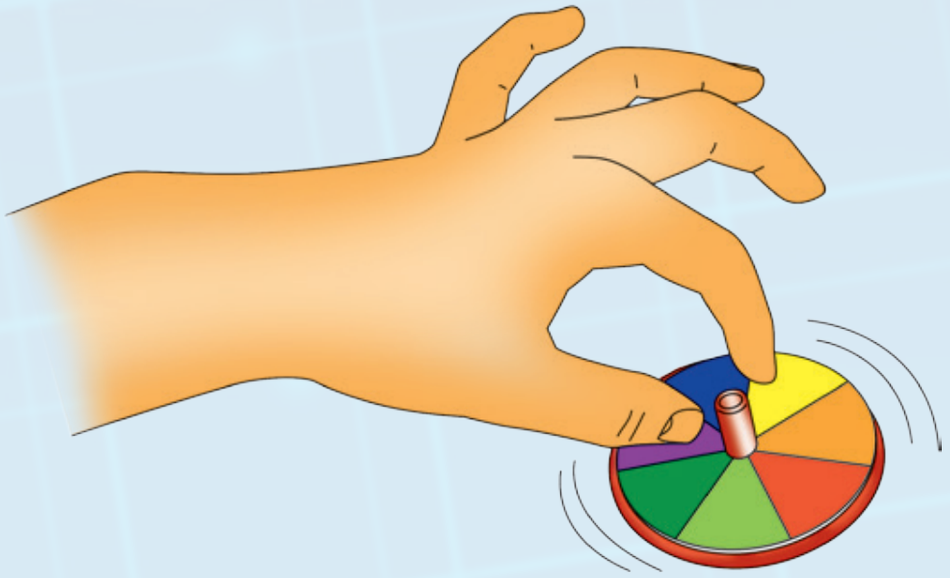
WARNING!
Not suitable for children under 3 years. Choking hazard — small parts may be swallowed or inhaled. Strangulation hazard — long cords may become wrapped around the neck.
Keep the packaging and instructions, as they contain important information.

THE AMAZING GYROSCOPE!

From smartphones, tablets, and video game controllers to airplanes and telescopes, gyroscopes are found in many places. With this kit, you can explore the astonishing powers of the gyroscope and learn some of the physics principles behind its behavior. The word “gyroscope” comes from the Greek words *gyro*, for “circle” or “rotation,” and *skopeein*, meaning “to see.” The name was originally coined by a scientist who built the device in an experiment to see Earth’s rotation.

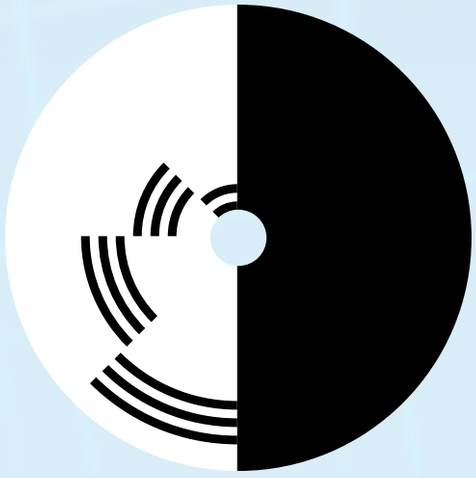
EXPERIMENT 1: SPINNING TOP

1. Try to get the top to balance on its tip with no other part of it touching the tabletop and without spinning the top. Can you do it?



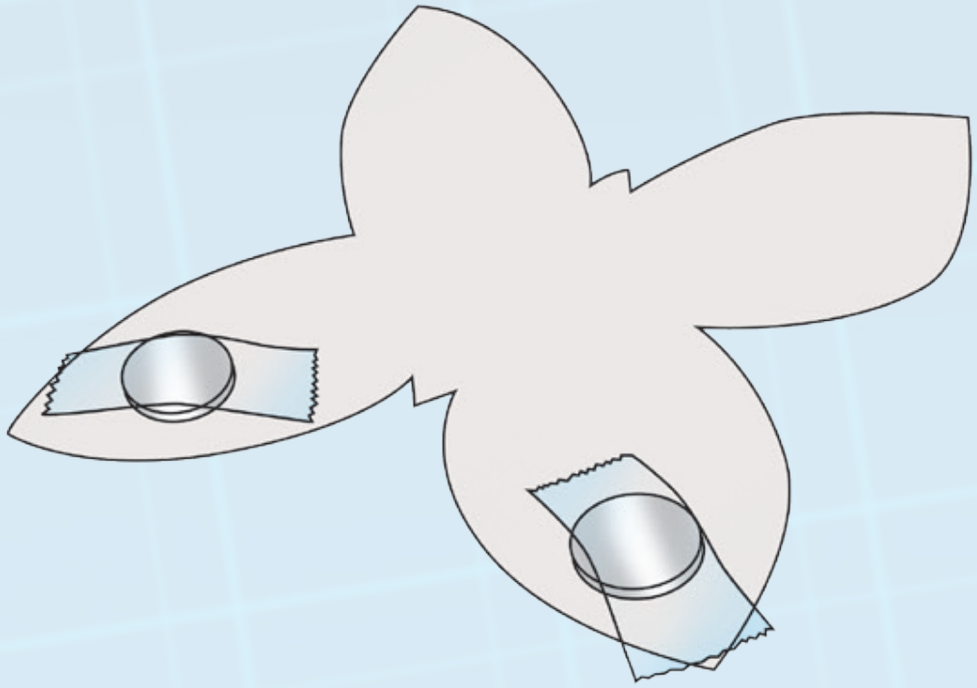
2. Now try spinning the top by flicking the handle quickly with your fingers. Can you get the top to balance on its tip?

3. Try putting the three different pattern cards onto the top to help you observe how the top is spinning.

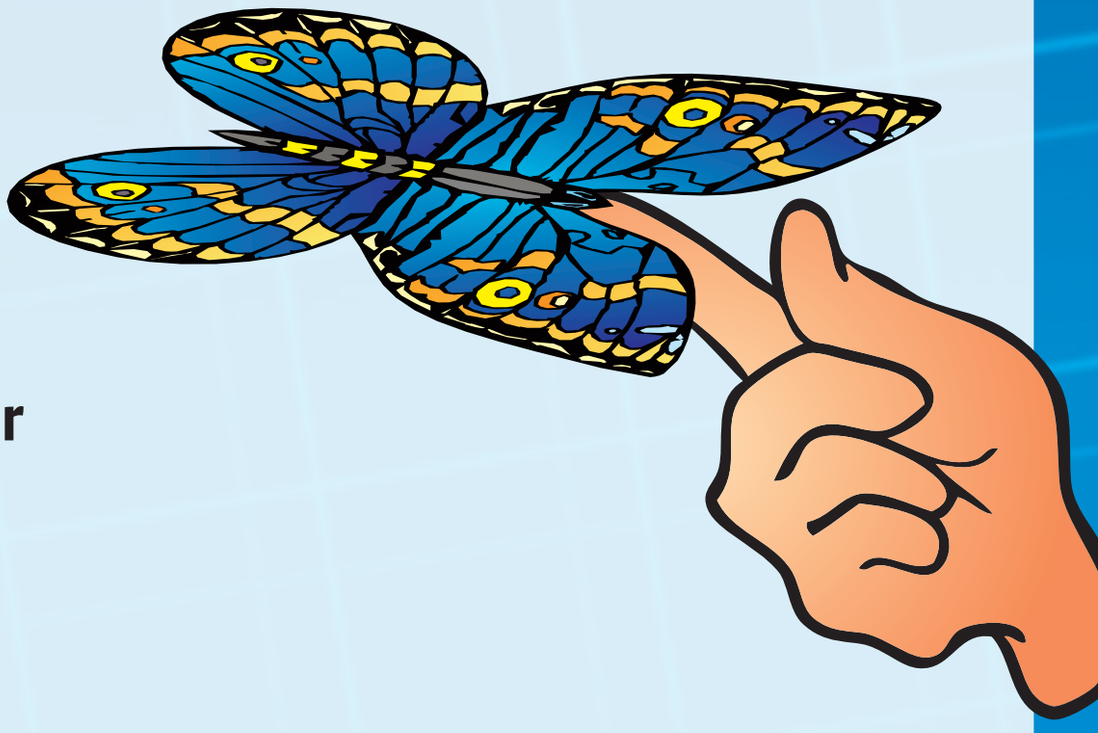


EXPERIMENT 2: CENTER OF GRAVITY

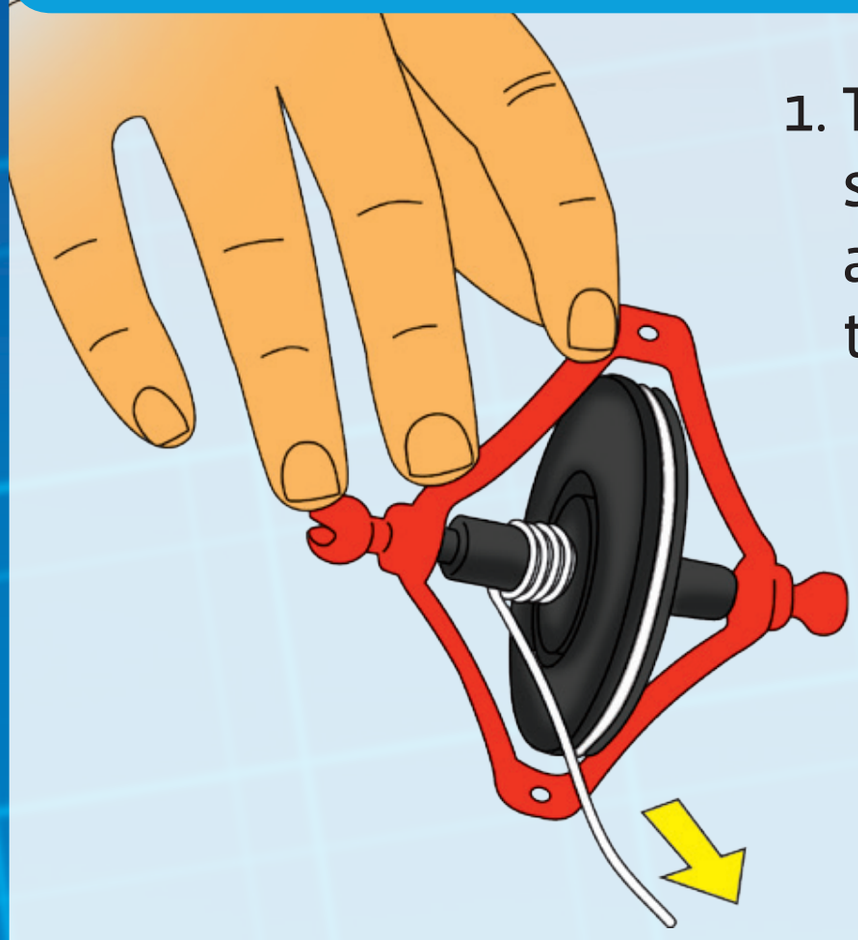
1. Tape a dime to the underside of each upper butterfly wing. Now you can balance the butterfly at its head.



2. Because of the coins you taped on, the center of the butterfly's gravity is right at the head, rather than in the center. An object can be balanced if it is supported by its **center of gravity**. That's how you can balance it on your finger with your finger at its head.

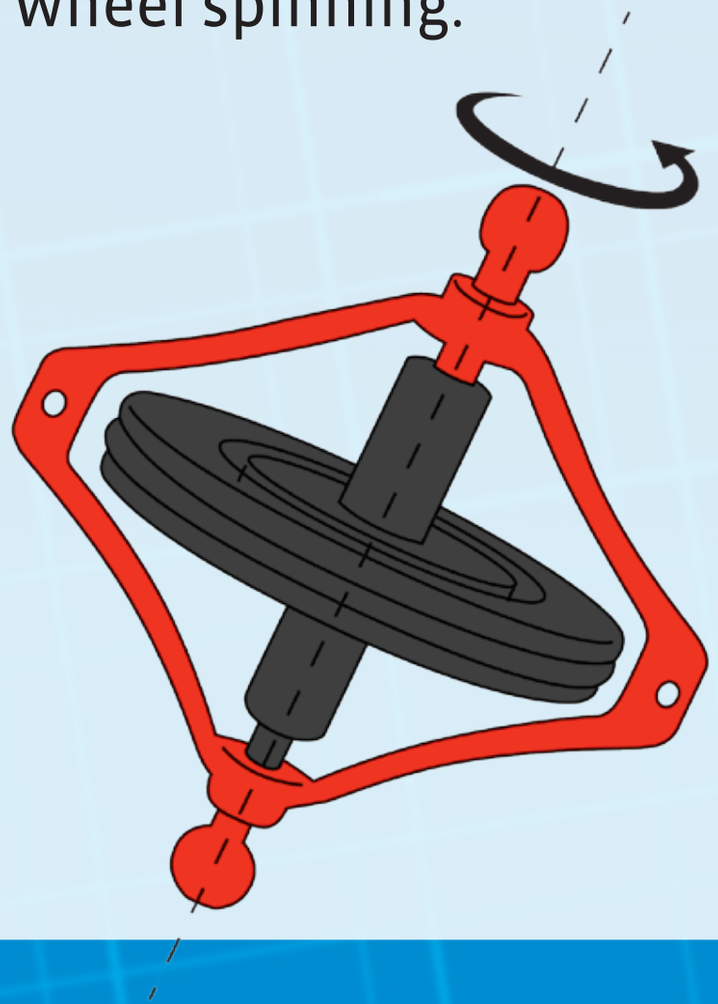


EXPERIMENT 3: GYROSCOPE



1. Thread the string through the small hole in the gyroscope's axis. Roll up the string around the axis.

2. Hold the gyroscope frame tightly and pull hard on the string to get the rotor wheel spinning.

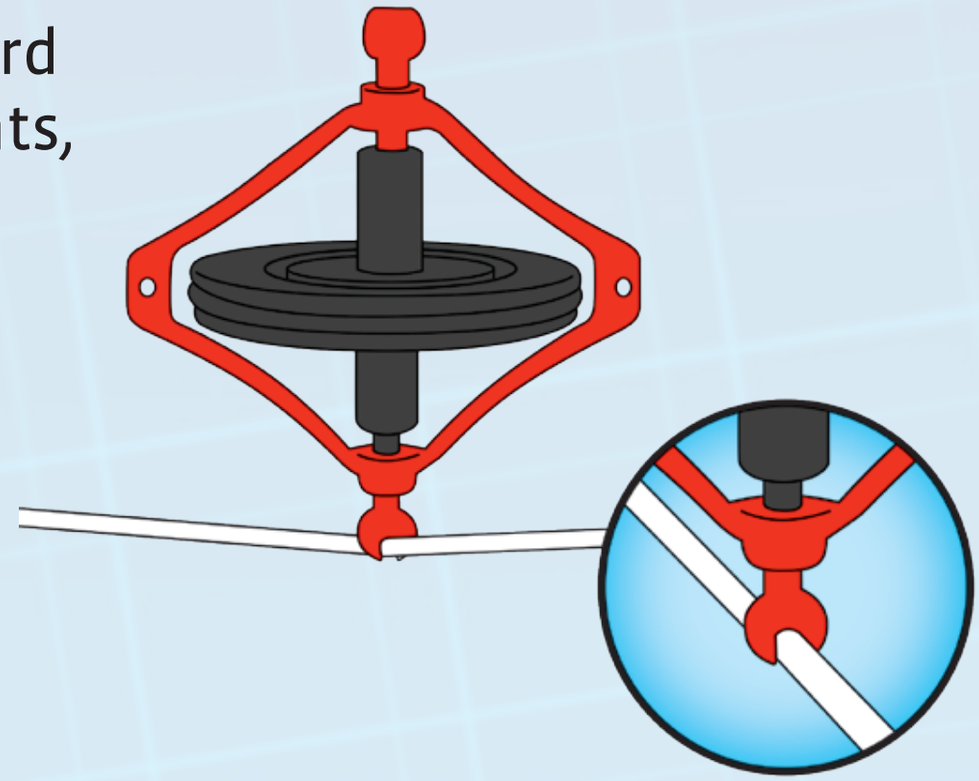


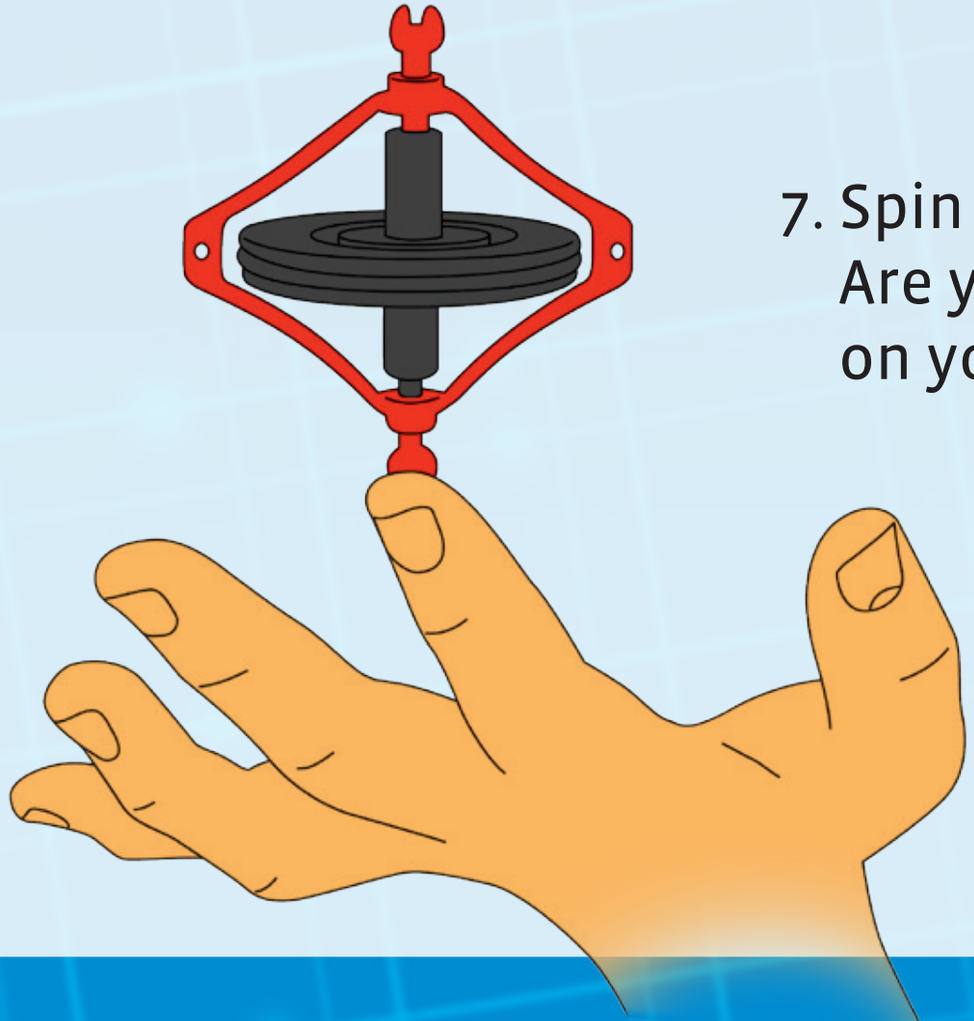
3. For the first spin, hold the gyroscope and feel the forces.

4. Spin it a second time and put it down on the table. How long can you get it to stay spinning?

5. Tie a piece of yarn or cord between two fixed points, such as two table legs.

6. Spin the gyroscope with its string. Balance the gyroscope on the tightrope by placing its notched tip on the tightrope.





7. Spin the gyroscope again. Are you able to balance it on your fingertip?

THE PHYSICS OF THE GYROSCOPE

Gravity is a force of attraction between objects. The more massive an object, the stronger its gravity. Earth's gravity acts so strongly on us because it is so large compared to us. Earth's gravity pulls all objects near Earth toward its **center of gravity**.

The spinning top in Experiment 1 stayed balanced because of the **gyroscopic principle**, which says that a spinning object tends to stay in its plane of rotation unless an external force acts on it. The gyroscopic effect counters the force of gravity and keeps the top from falling over. **Friction** between the top and the tabletop as well as between the top and the air eventually cause the top to slow down and fall over. That's why a top can't stay spinning forever! How long can you get your top to spin?

A top spins so fast that as soon as its weight becomes unbalanced and it starts to fall to one side, the imbalance has spun around to the other side. As long as it is spinning fast enough, it's like the top is falling to all sides evenly and therefore staying balanced.

A gyroscope is like a spinning top held inside a frame by its axis. They were invented as tools to help scientists study Earth's rotation. Today gyroscopes are used in many applications such as compasses, flight instruments, and stabilization devices.

The gyroscopic effect keeps the gyroscope upright. However, it will respond to external forces with a change in the direction of its axis of rotation. This change in movement is called **precession**.