

ESSENTIAL STEM TOOLS

GYROSCOPE

INSTRUCTION MANUAL



THAMES & KOSMOS

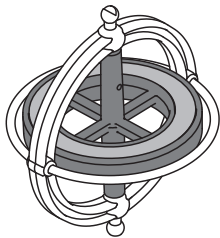
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SAFETY INFORMATION

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

INTRODUCTION

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. Essentially, a gyroscope is a spinning wheel mounted inside one or two gimbals.



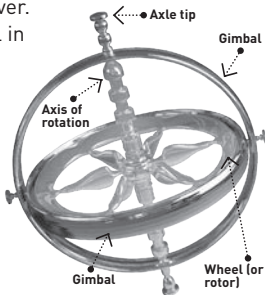
WHAT'S HAPPENING?

Why do gyroscopes behave the way they do? A gyroscope demonstrates **gyroscopic motion**, which is the tendency of a spinning object to maintain the orientation of its rotation. Rotating objects have **angular momentum**, and this momentum must be conserved. Any change in the orientation — or angle — of movement is a change in the angular momentum, and the object will resist this change.

Bicycles and motorcycles take advantage of gyroscopic forces. An upright bike that is moving forward has two spinning wheels that naturally resist tipping over.

Gyroscopes work extremely well in zero-gravity environments like outer space. The movement of the International Space Station is controlled by four huge gyroscopes on its four corners.

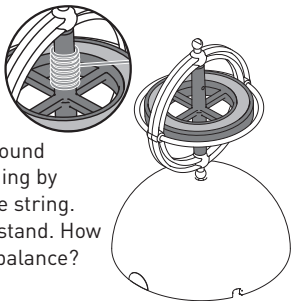
Your gyroscope has a weighted rotor in the center. Its large mass gives it greater angular momentum, which allows it to spin for longer.



EXPERIMENT 1

Balancing on the stand

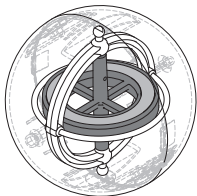
Place the half sphere on the table. Thread the string through the hole in the axle and wind it up tightly around the axle. Start the gyroscope spinning by pulling quickly and smoothly on the string. Quickly place the axle tip onto the stand. How long can you get the gyroscope to balance?



EXPERIMENT 2

Gyroscope in the sphere

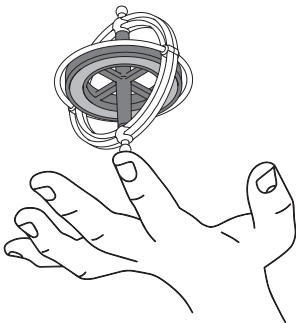
Wind the string around the axle as you did in experiment 1. Place the gyroscope in the sphere with its axle tips resting in the cradles. Guide the string out slightly through the notch. Hold the sphere in one hand and pull the string swiftly with the other hand. Roll the sphere around. What do you notice about its behavior?



EXPERIMENT 3

Balancing on your finger

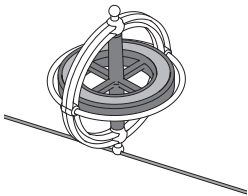
Start the gyroscope spinning using the string. Carefully place the axle tip of the spinning gyroscope onto your fingertip. How long can you balance the gyroscope? What other objects can you balance it on? A pen? A ruler?



EXPERIMENT 4

Balancing on a string

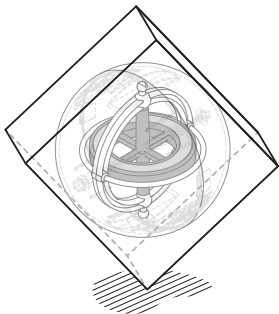
You will need a helper for this. Start the gyroscope spinning using the string. Then hold the string very tight between two hands approximately 6 to 12 inches apart. Place the notched axle tip of the gyroscope on the string. For how long can you balance the gyroscope?



EXPERIMENT 5

Spinning box

Start the gyroscope spinning inside the sphere as you did in experiment 2. Quickly place the sphere back into its original box, with the axle pointed diagonally from one corner to another corner. Close the box. Place the box onto its corner. What do you notice? Can you get the box to balance on its corner?



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