Euler's Disk

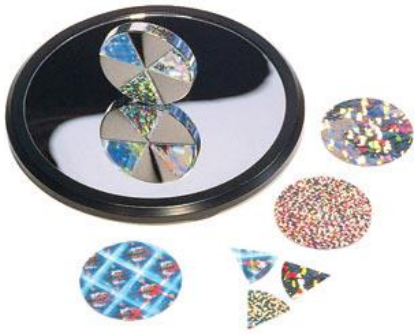
TOP-400

Introduction

The Euler's Disk is named after Swiss physicist and mathematician, Leonard Euler (whose last name is pronounced "oiler").

The Euler's Disk is widely known for the uncanny way its spin rate speeds up as the disk loses energy. It takes a mind-boggling amount of time for the disk to stop spinning.

What's in the box?



The Euler's Disk set comes with a chrome plated steel disk that is ½" thick and 3" wide. You'll also receive a concave mirror base that provides a dramatic setting for the disk.

In addition to the Euler's Disk and the plate, you will also receive nine magnetized holographic foil pieces to further enhance this captivating visual presentation.

How Does It Work?

Many people call what they see the Euler Disk doing "spinning." But in actuality, that's not correct. It's actually spinning AND rolling. This term is called "spolling."

Hold the disk upright onto the concave mirror base and give it a twist. You don't have to twist it hard or fast—just enough to get it going. That's it. That's literally all you have to do, and let science do the rest! After that, sit back for the hypnotic display that will captivate both your eyes and ears.

For Higher Grade Levels:

This link contains helpful information about how the Euler's Disk works:
www.real-world-physics-problems.com/eulers-disk.html

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Euler's Disk

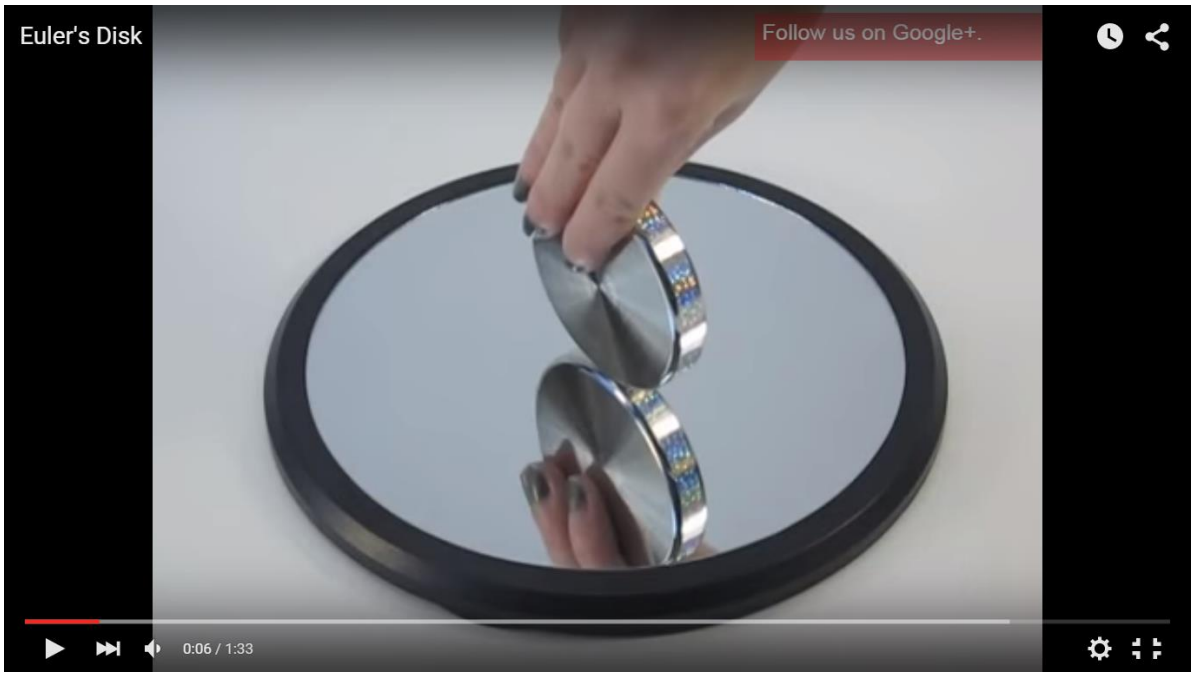
What scientific concepts does the Euler's Disk cover?

Potential Energy	**Conservation of Energy**
Kinetic Energy	**Angular Momentum**
Convex	**Concave**
Friction	**Neutron Stars**
Gravity	**Ring Puckering**
Finite-Time Singularities	**Non-Linear Oscillations**

Watch a video of the Euler's Disk in action:

Our full video runs a bit over 90 seconds… but it's well worth the time to see (and hear) this amazing demonstration.

https://youtu.be/ug2bKCG4gZY



If you're short on time, the abbreviated version is just 26 seconds:

https://youtu.be/rXY6eC1Sqrg

Classroom Ideas:

1. Athletes in Motion

Ask your students if they have ever noticed acrobats, gymnasts, ice-skaters or skateboarders tuck their arms and tightly curl their bodies while they fly and spin around.

Your students will probably recognize these motions. But **why** do athletes use them? Because they understand the science behind their moves—in other words, angular momentum and its conservation. By tucking in their extremities, the athletes are concentrating their centers of mass to a single location. Because their energy is conserved, they will rotate faster.

Angular momentum depends on two key factors:

The SPEED of the rotation and the distribution of the CENTER OF MASS.

The faster the speed, the longer the rotation. The more centralized center of mass an object has, the longer the rotation.

2. Give It a Spin

Divide the students into small groups of two to three students. Give each student a copy of the worksheet on page 4, a **MyChron Student Timer** or stopwatch, a penny, a nickel, a dime, and a quarter. Make at least one Euler's Disk available, or more if possible.

Before the students proceed, have them consider which coin they believe will spin the longest. Give students a few minutes to discuss their thoughts as a group and to write their collective hypothesis on the worksheet.

After they have prepared their hypotheses, students can start spinning the coins on top of their desks. Encourage them to try to spin each coin with about the same amount of force. They should do the same with the Euler's Disk. Using the stopwatch, spin each coin three times. Students should write those times down and calculate to find the average. (NOTE: If you only have one Euler's Disk available, you might have to rotate groups to that station.)

3. Spinning Students

For this activity, you will need to find several swiveling office chairs. Instruct a student to sit in a chair while holding objects—such as textbooks, weights, or boxes—in each outstretched arm. Ask another student to spin the first student around and then let go. Once spinning freely, ask the seated student to pull in their arms to their chest, centralizing the center of mass. If done correctly, you should see a change in the rate of spinning chair. BE CAREFUL!

4. Let Fate Decide!

Take one or more of the magnetic holograph wedges that came with your Euler's Disk and place them on the disk surface. Make sure that they are arranged so that there is a specific corner pointing out from the disk—this will be your "pointer." Now give the Euler's Disk a spin and let it help you make decisions. For instance, in your group, who will act as the spokesperson? Supply collector? Data recording secretary?

Name: _____

Give it a Spin

Materials:

- 1 Penny
- 1 Nickel
- 1 Dime
- 1 Quarter
- 1 Euler's Disk with base

Hypothesis:

Time:

OBJECT	1st spin	2nd spin	3rd spin	Average Time
Penny				
Nickel				
Dime				
Quarter				
Euler's Disk				

Interpret the Data:

Draw a conclusion:

Ask a new question:

Take Your Lesson Further

As science teachers ourselves, we know how much effort goes into preparing lessons. For us, "*Teachers Serving Teachers*" isn't just a slogan—it's our promise to you!

Please visit our website for more lesson ideas:

TeacherSource.com/lessons

Check our blog for classroom-tested teaching plans on dozens of topics:

http://blog.TeacherSource.com

To extend your lesson, consider these Educational Innovations products:

Inverting Pop Tops (TOP-300)

When these small wooden tops are spun, they start precessing until the heavier hemispherical end is lifted, seemingly against gravity. The Nobel Museum in Stockholm reports that Neils Bohr was captivated by this top when first observed over fifty years ago. These newly designed tops, with a hollowed out sphere, work extremely well!

Mysterious Spinning Top (TOP-375)

Give this top a spin and watch it move for hours without stopping. Secret revealed: the top contains a small magnet. When this magnet moves past the center of its base, the top's spinning magnetic field induces a current in a coil, which closes a switch, allowing a battery to momentarily energize a small electromagnet. The top increases its rate of spin and moves away from the center of the base.

Levitron Ultimate (LEV-300)

This ingenious top spins in mid-air, levitated above a magnetic base, and can keep spinning for several minutes at a time. Seeming to defy gravity, it harnesses the repulsion of two permanent magnets, stabilized by gyroscopic forces.

Amazing Long-Spinning Top (TOP-225)

Just a gentle spin on any hard, smooth surface and this remarkable top accelerates and soon stabilizes at a constant rotation for hours. A blinking light on the top changes colors and, thanks to persistence of vision, produces beautiful patterns. Its outside surface appears to be solid with no moving parts. Yet, listen carefully and you can even hear the top speed up. Where does the energy come from? The secret is a tiny, off-center, rotating motor. Amazing to watch and remarkably elegant. Explanation included.