



Curiosity Guide #304

Football Science

Accompanies Curious Crew, Season 3, Episode 4 (#304)

Gyroscopic Footballs

Investigation #4

Description

Investigate the moves of a gyroscope! Can you figure out how a gyroscope is like a football pass?

Materials

- Gyroscope
- String
- Plastic support that comes with the gyroscope
- Football

Procedure

- 1) Wind up the gyroscope with a string and spin it.
- 2) Try several activities:
 - Stand the gyroscope up on end.
 - Hold the gyroscope in your hand and feel the resistive force when the gyroscope is turned.
 - Balance the gyroscope on the plastic stand.
 - Lift the spinning gyroscope with a looped string around one end of the metal axis.
- 3) What do you notice?
- 4) Try to throw the football in a spiral pass to your friend.
- 5) How is the spiral of the football like the gyroscope?

My Results

Explanation

The spinning gyroscope has angular momentum, which makes the gyroscope's position very stable. The gyroscope begins to move or tilt only when it slows down or is pushed.

A football thrown in a spiral also has angular momentum, which allows the football to keep its position in the air and makes the air resistance flow more consistently around the ball. This reduces the drag on the ball and enables the quarterback to complete a much more accurate throw. Eventually, as the ball loses speed and gravity's force is constant, the nose of the ball also begins to shift just like the gyroscope did. The nose will shift a little to the right with a right-handed quarterback and slightly to the left with a left-handed quarterback.

More to think about: A spiral pass is amazing to see, but did you know that the ball could be spinning 600 times every minute?

The ball has angular momentum, just like a spinning gyroscope, so the ball's flight path becomes more predictable going through the air. Although the ball hits air molecules, they flow around the consistently spinning shape of the ball.

Now an end-over-end kick is a different story, as the ball meets unpredictable air resistance, making this kind of kick hard for the other team to catch. A good spiral pass doesn't really travel any further because some of the energy is required to make the ball rotate, but a spiral pass sure is more accurate. Touchdown!

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