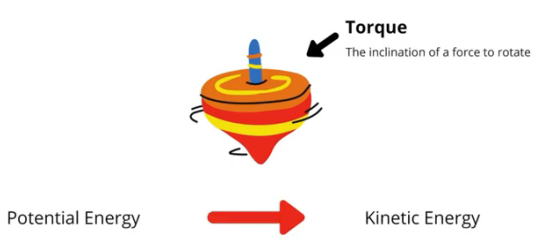
DARK MATTER
ROBOTICS TEAM, FTC 14374

SPINNERS

While the spinning top may seem very simple, there is actually a lot of advanced physics and mathematics that go into making a top spin. The spinning tops illustrate several physics concepts including angular momentum, inertia, momentum, centripetal force, potential energy, kinetic energy, torque, friction and gravity.

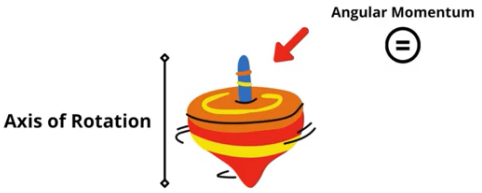
When you spin a top into motion, you're applying a force that converts the top's potential (stored) energy into kinetic energy, or energy of motion.

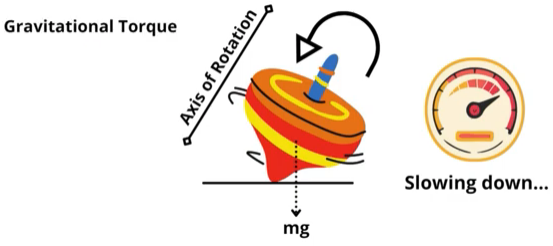
As it spins in its upright position, it rotates around an invisible vertical axis. The principle of conservation of angular momentum is “when no external torque acts on an object, no change of angular momentum will occur.” So the top would keep spinning indefinitely if there were no other external forces acting upon it.



However, that is not the case. Tops are never perfectly balanced and weighted. Also, the surfaces they spin on aren't perfectly level either. These imperfections allow other forces, including friction and gravity, to come into play.

When it's spinning, the top balances on a tiny tip. This minimizes the amount of friction generated by its contact with the surface below it. Eventually, though, friction will begin to slow the top's spin. When this occurs, the top begins to wobble, demonstrating a scientific principle called precession.





As it begins to wobble, the axis of the top tilts to the side, which allows the force of gravity to exert a force known as torque on the top. The effect of the torque is to create additional spin while also causing the top to swing outward. As the top's spin continues to slow, it swings faster in an attempt to conserve its total angular momentum. This is why the wobbling gets worse right before it falls and comes to a stop.

WHIRLYWIG

Whirligigs demonstrate conversion of energy from potential energy (stored energy) to kinetic energy (energy of an object in motion). By alternating the tension of the wound string, the potential energy is turned into kinetic energy.