LIGERBOTS ▪ FIRST® Robotics Team 2877
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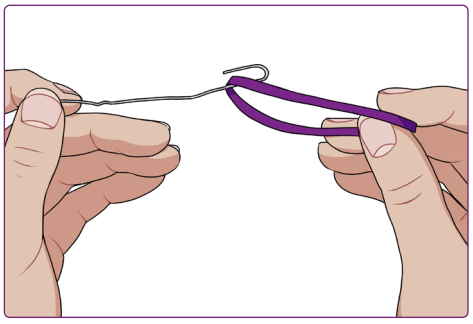
Spool Racer

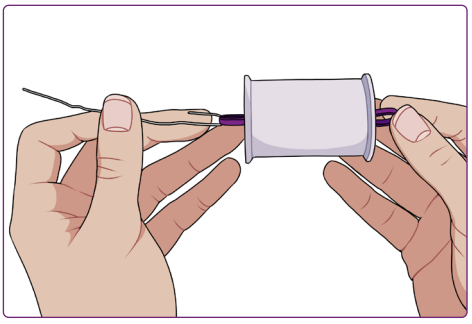
Race your friends with kinetic and potential energy!

Materials

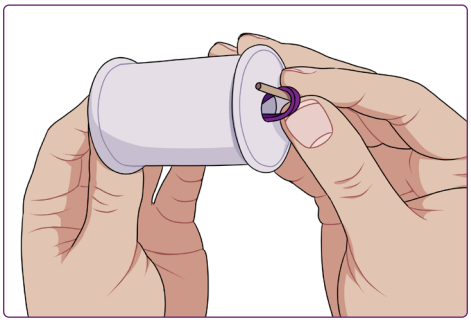
- Large thread spool
- Paper clip
- Tape
- Two toothpicks
- Thin rubber band
- Two thick rubber bands
- Small metal washer, about 1/2" in diameter



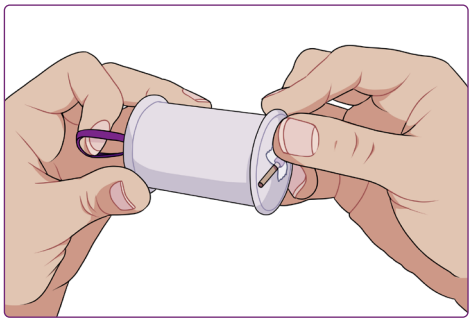
1. Straighten a paperclip, leaving a hooked end small enough to fit through the spool. Place the thin rubber band on the hook.



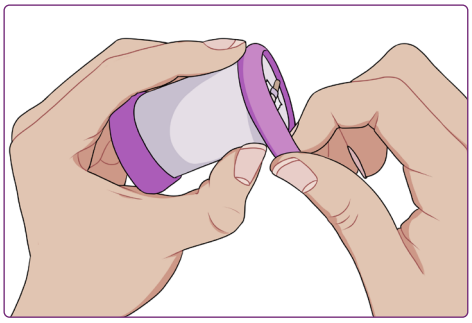
2. Push the paper clip's straight end through the hole in the spool. Pull the rubber band through until both ends of the band are sticking out.



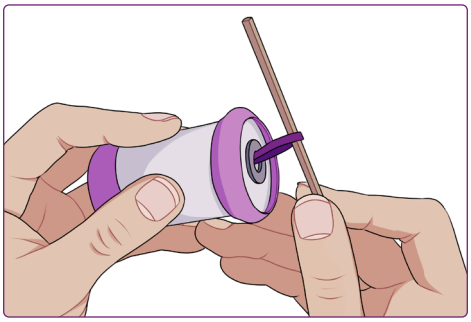
3. Break one toothpick in half and thread it through the loop in the rubber band.



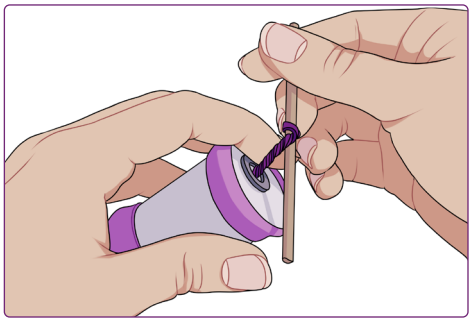
4. Pull the other end of the band so that the toothpick is held in place against the spool. Tape it.



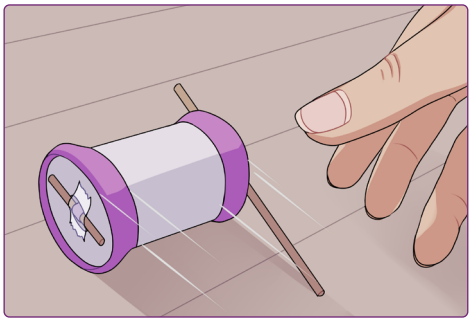
5. Add tires by stretching the thick rubber bands over the raised outer edges of the spool.



6. Thread the rubber band through a washer. Thread another toothpick through the loop in the band.



7. Wind up the rubber band using the toothpick.



8. Holding the toothpick so that the rubber band doesn't unwind, put the racer on a flat surface, then let it go!

The Science Behind Spool Racers

The most important part of any car is the engine, which turns the energy stored in a source such as gasoline, electricity, or a spring, into the energy of motion. The engine of your spool racer is a rubber band, which, when stretched and twisted, becomes a combination torsion/extension spring. Let's explore the science behind your spool racer!

Trick Out Your Racer!

Here are some ways to experiment with your racer:

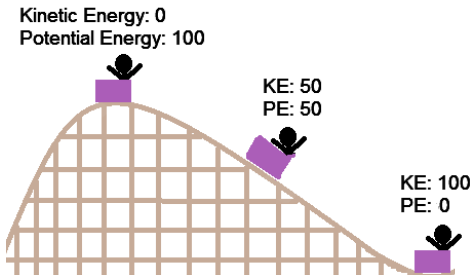
- *Replace your thin rubber band with one of a different length or thickness.*
- *Use a spool of a different size or material.*
- *Wind up your racer more or less.*
- *Decorate your spool!*

Anatomy of a Spool Racer

- The **larger toothpick** is a crank for winding the rubber band. When you release the spool racer, the toothpick drags on the surface, preventing the rubber band from untwisting rapidly in the air. This forces the potential energy in the rubber band to be expended by rolling the spool.
- The **half toothpick** anchors the other end of the rubber band permanently, which also prevents the rubber band from untwisting in the air when you release your racer.
- The **thin rubber band** is a combination torsion/extension spring that powers your racer. It stretches *and* twists as it acquires energy when you wind it up.
- The **thick rubber bands** are tires that create equal friction between each side of the spool racer and the surface so that the spool rolls in a straight path.
- The **washer** minimizes friction between the toothpick and the spool so that the spool can turn easily as the rubber band unwinds.

Potential and Kinetic Energy

Energy is the ability for things to change and move. It can be the energy of an object's motion, called kinetic energy, or it can be the energy stored in an object because of its position or state, called potential energy. Think of potential energy as kinetic energy waiting to happen! Imagine a roller coaster: when it is at the top of the hill, the car has a lot of potential energy due to its height and its ability to move downward, but it has no kinetic energy (motion). As the car zooms down the hill, its potential energy is released and converted into kinetic energy. As the potential energy decreases, the kinetic energy increases. At the bottom of the hill there is no more potential energy. It has all been used up to move the car!

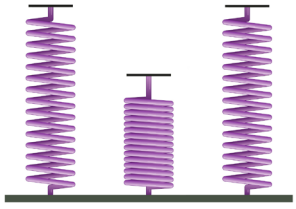


Kinetic and potential energy change places throughout the ride.

Elastic Potential Energy: Springs

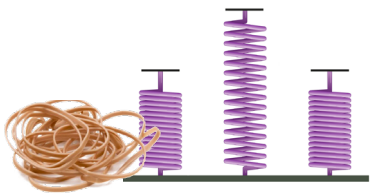
Elastic potential energy is potential energy stored in things that can change their shape when force is applied. When you stretch and twist a rubber band in your spool racer, you are using kinetic energy from your hand to store elastic potential energy in the rubber band. When you release the rubber band, its elastic potential energy is converted back into kinetic energy to power your spool racer. Any object that can store elastic energy can be called a spring. The most common types of human-made springs are compression springs, extension springs, and torsion springs, often in the shape of coils.

Compression Springs



Compression springs acquire energy when they're compressed to make them smaller. They release their energy by getting bigger in order to return to their original shape.

Extension Springs



Extension springs acquire energy when they're pulled to make them bigger. They release their energy by getting smaller in order to return to their original shape.

Torsion Springs

Torsion springs acquire energy by being twisted. They release their energy by untwisting in order to return to their original shape.