

# ROLLBACK CAN

A clever way to investigate energy

**Curriculum topics:**

- Potential Energy
- Kinetic Energy
- Energy Conversion
- Motion
- Scientific Investigations

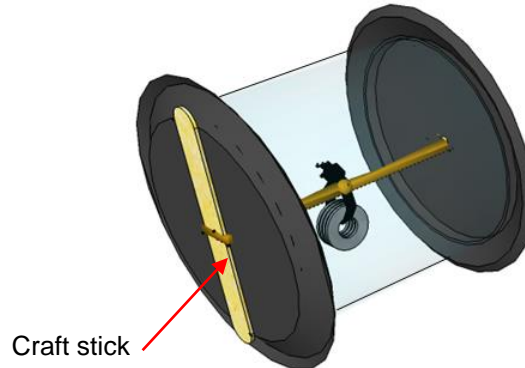
**Subject:**

**Physical Science,  
Engineering**

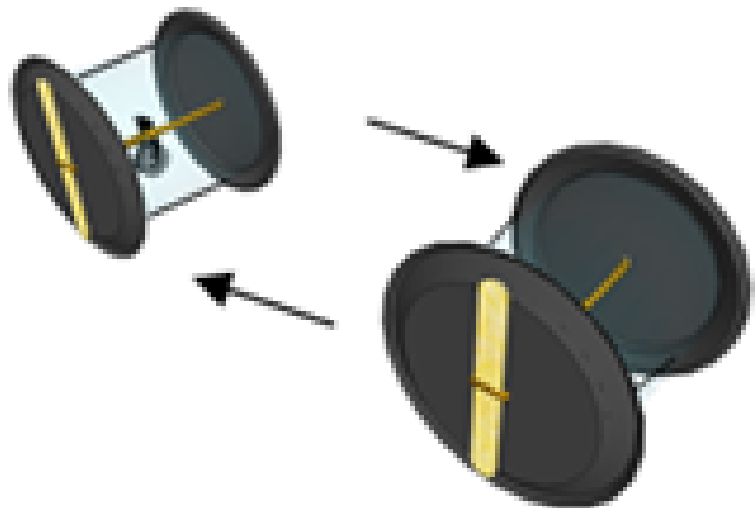
**Grade range: 2 – 12**

**Who we are:**

Resource Area for Teaching (RAFT) helps educators transform the learning experience by inspiring joy through hands-on learning.



The Rollback Can is a relatively simple device for investigating the transfer between potential energy and kinetic energy. It returns to its starting point on its own!



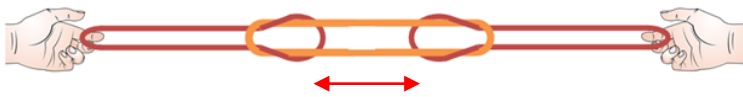
# Materials required per device

- Plastic plates w/ holes (x2)
- Corrugated cardboard (x1)
- Paper clips, jumbo (x2)
- Rubber bands (x3)
- Flat metal washers (x4)
- Craft sticks, jumbo (x2)
- Releasable zip tie
- Scissors, not included

**WARNING: Rubber bands contain natural rubber latex which may cause allergic reactions.**

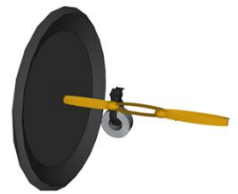
## Set-Up (Assembly below shows a clear cylinder for illustrative purposes)

- 1 Interlock the 3 rubber bands, leaving them loosely connected (shown below left). Insert the thin zip tie end through one of the 2 rubber band knots. Pull the rubber bands until tight.



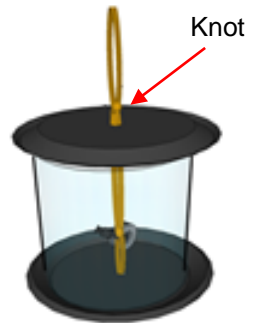
- 2 Insert the thin zip tie end through all four metal washers. Put the thin end through the locking head of the zip tie and pull until the washers hang loosely near the rubber band knot. Cut off the slack (see above right).

- 3 Push the rubber band loop through the food side of one plate (right). Pull the rubber band through the hole, forming a loop to insert a craft stick (see title page). Pull the rubber bands to tighten.



- 4 Place the plate with craft stick side-down on a flat surface. Put the cylinder on the plate. Grab the end of the rubber bands and pull it up.

- 5 Insert the rubber bands through the hole in a second plate. Hold the second plate food side down and pull the rubber bands upward until a knot comes through the hole.



- 6 Insert and center a craft stick into the rubber band loop under the knot.

## To do and notice

- 1 Place the Rollback Can on a smooth, level surface or tightly woven carpet about 10 feet long.
- 2 Give the Rollback Can a firm push in a direction that is clear of obstacles. Observe its motion. What happens as it rolls? Does it keep going? What do you think is happening to its kinetic energy (energy of a moving object)? Is energy being stored in the device, and if so, where?
- 3 If a rapid rattling sound is heard while the device is rolling, the weights are too close to the rubber band and are causing it to unwind. Loosen the zip tie to make more room for the washers. Adding more washers to increase the weight can also fix this issue.
- 4 Get creative with the Rollback Can and its motion. Try using a ramp, different surfaces, or make larger or smaller versions of the device. The choice is yours!

## Content Standards:

### NGSS

#### Forces & Motion:

3-PS2-1

3-PS2-1

MS-PS2-2

HS-PS2-1

#### Kinetic & Potential Energy:

4-PS3-1

MS-PS3-2

MS-PS3-5

#### Engineering:

K-2-ETS1-3

3-5-ETS1-2

MS-ETS1-2

MS-ETS1-4

# The science behind the activity

Much of the kinetic energy (moving energy) provided by pushing the Rollback Can is stored as potential energy in the stretched rubber band as it twists. The potential energy is converted back into kinetic energy as the rubber band unwinds. The narrow edges of the plates minimize the rolling friction so that the Rollback Can will come back almost to (or even past) the starting point when rolled on a level surface.

The weight of the washers is pulled down by gravity. If the weight does not lift over and around the rubber band, the rubber band will become twisted tighter and tighter as the Rollback Can's ends rotate. The twisting rubber band stores elastic potential energy. At some point all the kinetic energy of motion has been changed into the potential energy stored in the tightly twisted rubber band and friction. When all the kinetic energy has been changed, the Rollback Can will stop moving forward. The rubber band applies a twisting (torsional) force to the ends of the can and the weight in the middle. Only the ends are free to rotate as long as the weight cannot be lifted over and round the rubber band. The potential energy in the twisted rubber band is released as the Rollback Can rotates in the opposite direction, moving back towards the starting point.

Sometimes the rubber band can become so tightly wound that the weight is lifted up and then rotates around the rubber band in the opposite direction, unwinding the rubber band. Some of the stored elastic potential energy is then converted into the kinetic energy of the rotating weight, therefore the device will not return as closely to the starting point as when the weight stays below the twisting rubber band.

## Learn more

- Wind the Rollback Can by holding and turning it or by shaking it in a circular motion
- Find ways for the Rollback Can to move unaided using inclines or other simple machines
- Create an "x-ray" version of the device using foldable plastic instead of a cylinder
- Vary the weight hanging inside by changing the number of washers

Visit <https://raft.net> to view the following related activities!

Car on a Roll  
Roller Racer  
Retractor Car  
Racing Cups  
Rolling Explorations

## Resources

- YouTube (4:38), Potential & Kinetic Energy - <http://bit.ly/38WNFEp>