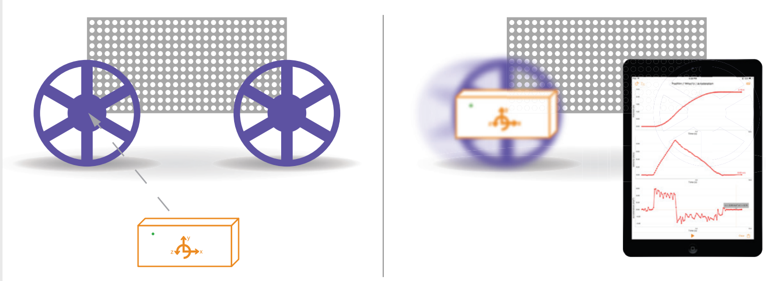
Energy Transfer: Elastic Potential Energy to Kinetic Energy

Exploration

The law of conservation of energy tells us that energy can neither be created nor destroyed. Instead it changes from one form of energy to another. Potential energy is energy that is stored in an object. Potential energy can transfer into other forms of energy, like kinetic energy. Kinetic energy is energy in an object because of its motion. For example, a rubber band that is stretched has elastic potential energy, because when released, the rubber band will spring back toward its resting state, transferring the potential energy to kinetic energy in the process.

Materials

- PocketLab with VelocityLab app
- Teacher Geek Cart Rubber Band Racer Kit
- Meter Stick
- Mass scale to mass carts



Objective

In this exploration students will:

1. Collect data to calculate the kinetic energy in a system at different instances
2. Determine how the kinetic energy of the cart's motion is related to the design and potential energy of each cart.

Formulas and Key Words

Define the following terms:

Elastic Potential Energy (EPE) Kinetic Energy (KE) Velocity (v)

Conservation of Energy Thermal Energy (TE) Friction

KE = ½ mv^2

Part A: Exploring Elastic Potential Energy

- Design a rubber band race cart using the Teacher Geek instructions. Attach the PocketLab to the wheel of the cart and connect it to the VelocityLab app.
- Select only the velocity graph. Zero the position, and begin recording data. Wind the cart and let it go.
- Observe the cart's velocity as it travels.
- How far did the cart travel?
- What was the cart's top speed?
- How long did it take for the cart to get to its top speed?
- At what distance did the cart reach its top speed?
- Use the formula for Kinetic Energy to fill in Table 1. You'll need to find the cart's mass to do this.

Location of cart	Start of run	¼ into the run	½ into the run	¾ into the run	End of run
Distance					
Velocity					
Kinetic Energy					

Mass of cart:

- Where did the kinetic energy come from, and where did it go? Explain your answer.

Part B: Engineering Challenge

Design three different rubber band carts that each have their own speciality. More details on these designs can be found in the Teacher Geek Rubber Band Racer manual. After designing each cart, test it to determine its velocity and kinetic energy at different points during a run. Fill in the data tables provided. Think critically about how the data you are collecting is changing based on the design and therefore elastic potential energy stored in the cart and then answer the questions at the end.

Cart 1: Extreme Distance

The goal of the Extreme Distance cart is to travel as far as possible.Top speed doesn't matter in this design. Read about using rubber bands in a series or in parallel in the Teacher Geek Rubber Band Racer manual for more help. Draw a diagram of your design, test it out, and fill in Table 2 below.

Location of cart	Start of run	¼ into the run	½ into the run	¾ into the run	End of run
Distance					
Velocity					
Kinetic Energy					

Mass of cart:

- What do you notice that is different between the data collected with the Extreme Distance cart compared to the original cart you tested?
- How does the data you collected (distance, velocity, kinetic energy) relate to the design of this cart and the way the elastic potential energy was stored in the rubber bands?

Cart 2: Dragster

The goal of the Dragster is to get the top speed of the cart as fast as possible. Distance doesn't matter in this design. Read about using rubber bands in a series or in parallel in the Teacher Geek Rubber Band Racer manual for more help. Draw a diagram of your design, test it out, and fill in Table 3 below .

Location of cart	Start of run	¼ into the run	½ into the run	¾ into the run	End of run
Distance					
Velocity					
Kinetic Energy					

Mass of cart:

- What do you notice that is different between the data collected with the Dragster cart compared to the Extreme Distance and the original cart you tested?
- How does the data you collected (distance, velocity, kinetic energy) relate to the design of this cart and the way the elastic potential energy was stored in the rubber bands?

Cart 3: Precision Stop/Shuffleboard

The goal of the Precision Stop/Shuffleboard cart is to travel as close to a specific distance as possible. To find your groups distance goal, average the total distance all three of your previous carts traveled. Design your cart to travel that exact distance. Draw a diagram of your design, test it out, and fill in Table 4 below.

Location of cart	Start of run	¼ into the run	½ into the run	¾ into the run	End of run
Distance					
Velocity					
Kinetic Energy					

Mass of cart:

- What do you notice that is different between the data collected with the Precision Stop/Shuffleboard cart compared to the Extreme Distance cart, the Dragster cart, and the original cart you tested?
- How does the data you collected (distance, velocity, kinetic energy) relate to the design of this cart and the way the elastic potential energy was stored in the rubber bands?

Conclusion

- For the rubber band carts to move they need kinetic energy. Where did the kinetic energy come from in each cart? Why did the carts all eventually stop? Explain in terms of kinetic energy, conservation of energy, and energy transfer.
- How did the design of your carts change as the objective for each cart changed? How did those changes in design affect the ways in which the potential energy in the carts was stored? Explain.
- When the kinetic energy of any object changes explain where that energy is coming from, where it is going, and how that relates to the law of conservation of energy.