# Potential Energy

Vanderbilt Students Volunteers for Science

Training Presentation

2018-2019 VINSE/VSVS Rural

# Important!

- Use this presentation to reinforce your understanding after reading the Potential Energy lesson.
- This presentation contains only selected experiments that may be difficult to visualize and/or understand.
- Please work through the lesson with your team prior to your classroom visit.

# Why is the science in this lesson important?

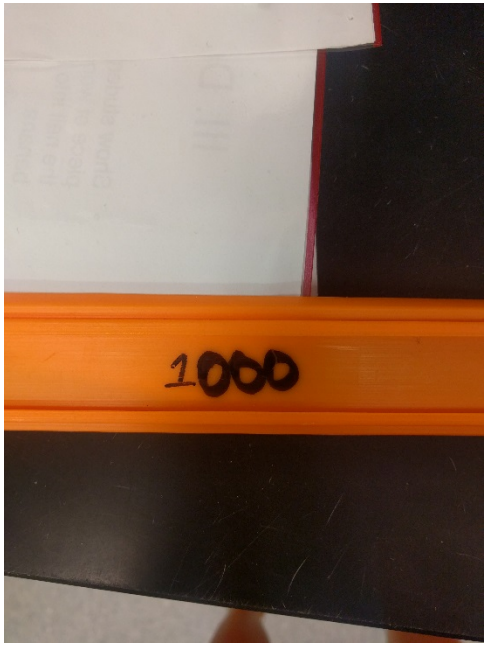
Engineers often work on projects that explore new ways to convert one type of energy to another. Dams are one example of such a project: they convert the potential energy in stored water to mechanical energy. Engineers are responsible for calculating the size of the dam and how it must be built to hold back the pressure of the water.

# I. Introduction – Energy Discussion

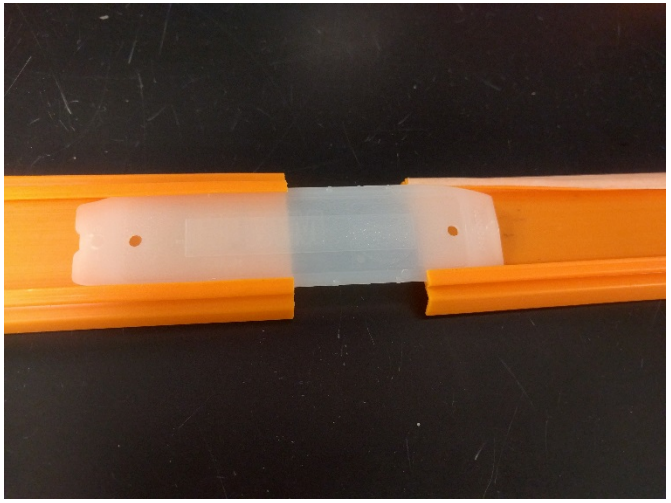
**Learning Goals: Students identify examples of potential and kinetic energy in the real world.**

- Define the following terms:
  - **Energy**: The ability to do work and cause change. (eg applying a force to move an object)
  - **Law of Conservation of Energy**: In ideal conditions energy is never lost, only converted from one form to another.
  - **Potential Energy vs. Kinetic Energy**: Give brief examples. (eg PE – a wound up spring, KE – a moving car, Gravitational PE – a boulder ar the top of a hill)

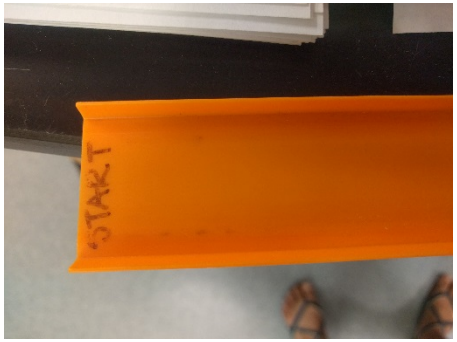
# How to assemble tracks

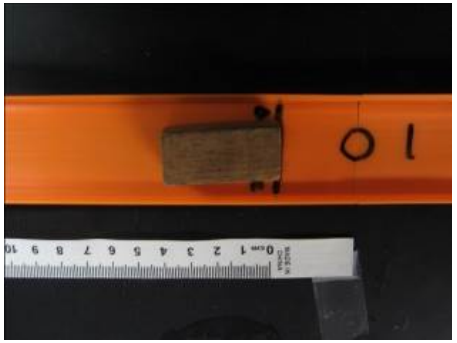



Each track piece is numbered 1-3 on the backside. Make sure that the pieces are in order when assembling



Connect the track pieces by sliding orange track pieces onto white connectors from either side.




Make sure the word “start” is on one end of the track, while the measuring line is on the other side.

# II. Demonstrations: PE/KE Conversions

**Learning Goals: Students understand conservation of energy and how energy can be converted between potential and kinetic.**

## A. Compare Dropper Popper and Tennis Ball

1. Drop **tennis ball** from shoulder height and note the height of the bounce.
    a. Explain: Gravitational potential energy at the top is converted to kinetic energy during fall. After the bounce, kinetic energy is converted back to potential energy (mention the Law of Conservation of Energy).
2. Invert the **dropper popper** and drop it from the same height.
    a. Explain: Dropper popper bounces higher due to **additional elastic potential energy**.

**See lesson for comparison details.**

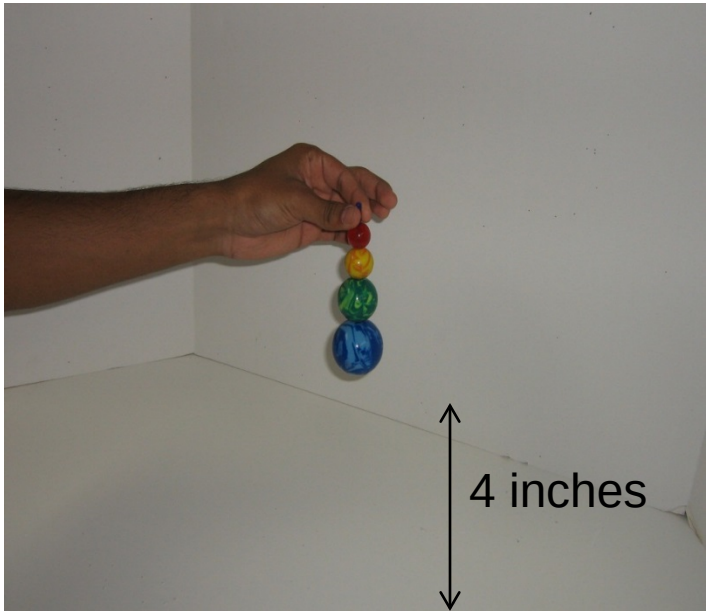
# IIB. Demo: Astroblaster

1. **DO NOT** drop the Astroblaster from shoulder height as the small ball will bounce uncontrollably and may cause injury. Wear safety goggles.

2. Remove the **small red ball** from the rod and release from a height of 4 inches above the table. Note the bounce height.

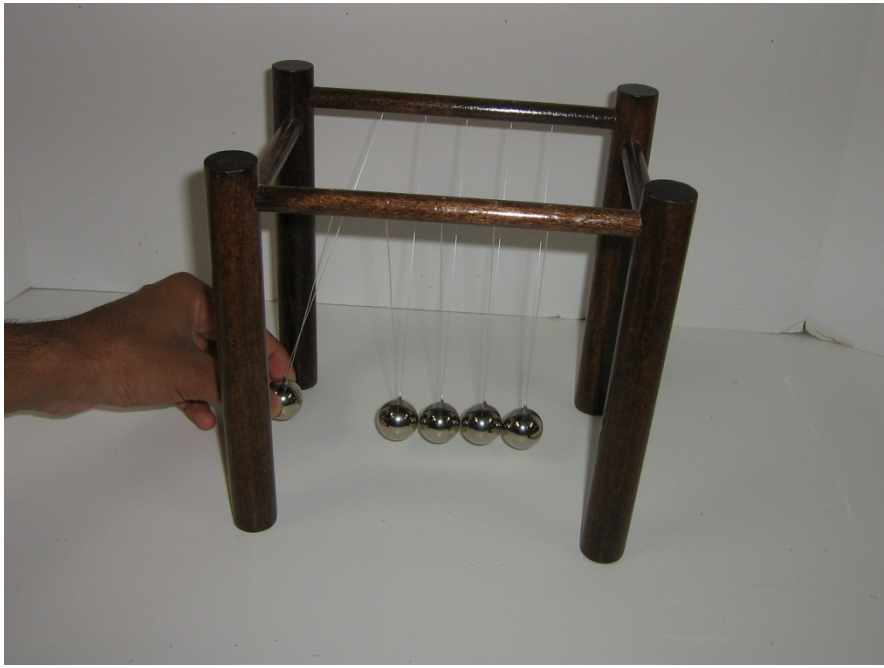
3. Put the red ball back on the rod and release the **Astroblaster** with all four balls by the tip of the rod and release from the same height.

4. Explain Point out that the astroblaster starts out with gravitational potential energy gained from its height from the floor and the total mass of all balls. As it falls, its potential energy is converted to kinetic energy until it reaches the floor. There, the four balls collide with the ground, **but three cannot bounce upward**. All their energy is transferred to the red ball in the form of kinetic energy, causing the ball to fly off the rod and reaching a higher height than before (**because of the extra energy**).



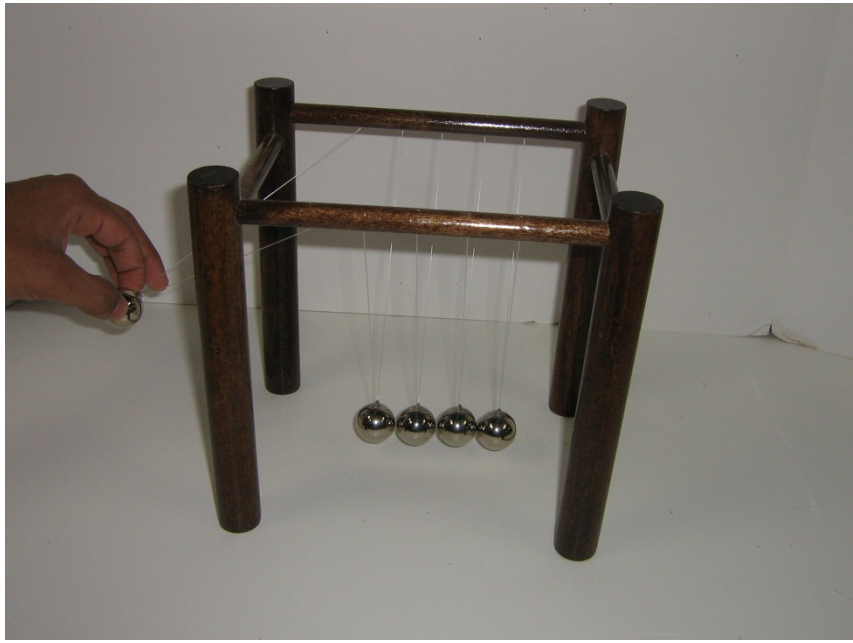
# IIC. Demo: Newton's Cradle: Conservation of Energy

1. Lift one outside ball on the left to about 3 inches from the others.
2. Release and observe what happens, and note the height of right-most ball (same height as first ball).



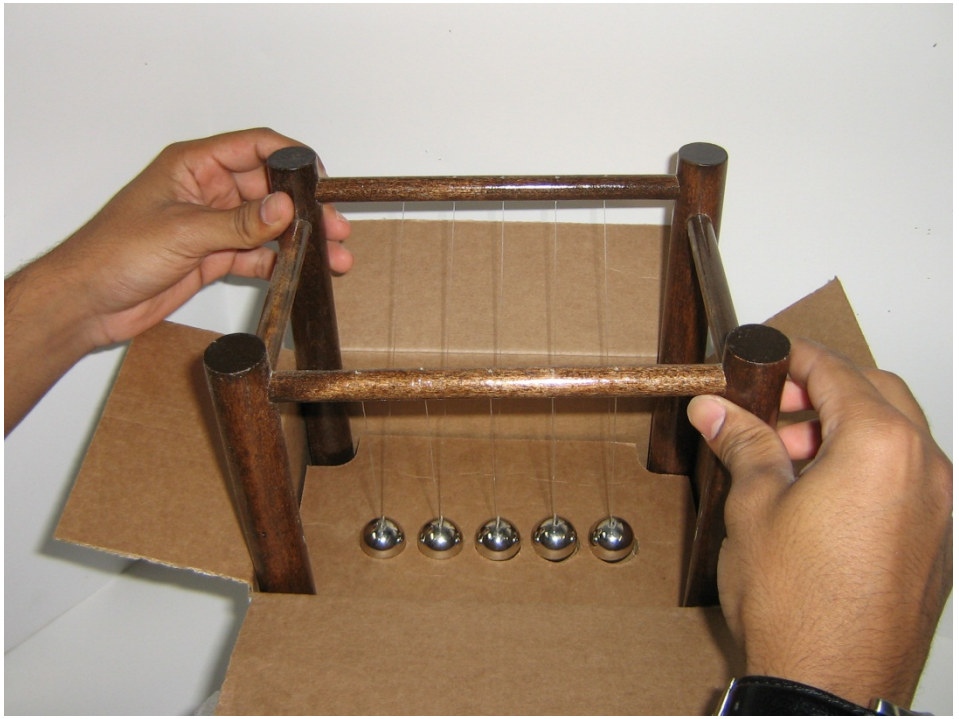
# IIC. (cont'd) Demo: Newton's Cradle: Conservation of Energy

1. Lift the left-most ball to the maximum height and release.
2. Explain: Released ball has more potential energy when lifted higher. Energy is transferred to the last ball. This demonstrates the Conservation of Energy.



# IIC. (cont'd) Demo: Newton's Cradle: Conservation of Energy

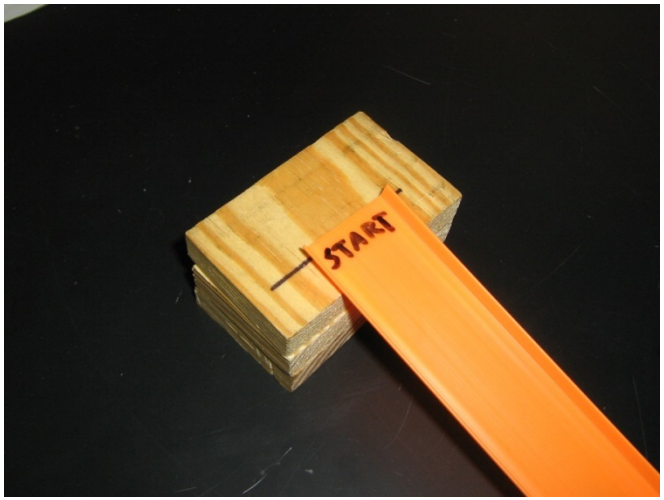
- Note: Please place the Newton's cradle back into the box as shown to prevent tangling.

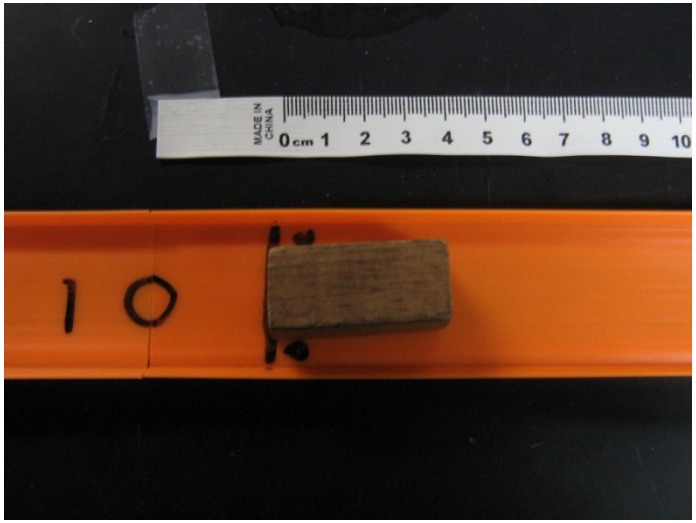


# III. Demo: Measuring Potential Energy

**Learning Goals: Students use a ramp to understand how height and mass are related to potential energy.**

- Write the equation for gravitational PE on the board:
  Gravitational PE = m*g*h. g is a constant.
- Emphasize that PE can be increased by increasing mass or height.
- Assemble the 3-piece track demonstration. Make sure that the pieces are connected in their correct order.
- Place the track on the “Start” line and place the block on the “0 cm line”.



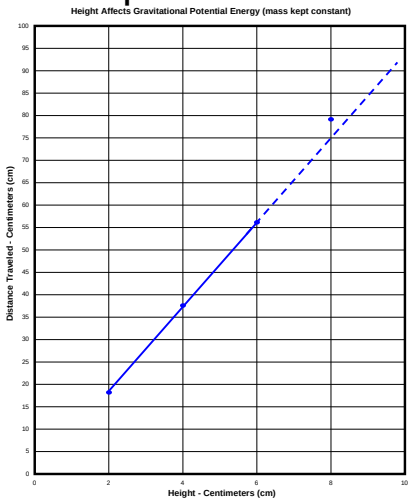
# IV. Gravitational Potential Energy Is Related to Height (Mass kept constant).

**Learning Goals: Students use a ramp to understand how height and mass are related to potential energy.**

A. Relation to Height

1. Predict the number of blocks that give the ball the most potential energy.
2. Use only the golf ball for constant mass.
3. Release ball at start line.
4. Measure distance that the block has moved.
5. Elevate the track by one 2cm wooden block each time to a final total of 3 blocks.
6. Record and graph distance traveled vs. height. Extrapolate graph. Predict distance traveled with the ball is released from 4 blocks. Explain sources of errors from prediction.

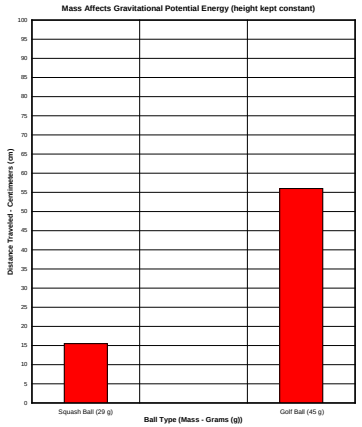
- What energy does the ball have at the start, during the roll, and at the end?
- How can you tell the ball had more potential energy at three blocks than one or two?
- How is height related to potential energy?



# IV. (cont'd) Gravitational Potential Energy due to Mass (Height kept constant).

B. Relation to Mass

1. Line up the start of the track and the small block. Elevate the track on three 2cm blocks.
2. Compare the distance that the block moved when it collided with lighter squash ball and the heavier golf ball.
3. Graph distance traveled and ball type in the bar graph.



# Clean Up/Review

- Collect all materials
- Make sure that the correct number of balls is returned.

- Review: Energy Definitions (Energy, KE, PE), Transfer of Energy, Conservation of Energy

# The Experiment In One Slide

- Definitions of energy
- Three demonstrations of Energy conservation and Conversions between PE and KE
- Relation of Mass and Height to Gravitational Potential Energy
- Review