



**NSDL/NSTA Web Seminar:
Enlightening Experiences With Energy**



Thursday, June 12, 2008

6:30 p.m. – 8:00 p.m.



Agenda:

1. Introductions
2. Tech-help info
3. Web Seminar tools
4. Presentation
5. Evaluation
6. Chat with the presenters



<http://nsdl.org>



Supporting the NSDL Presenting Team is...



For additional Tech-help call:
Elluminate Support,
1-866-388-8674 (Option 2)

Jeff Layman
Tech Support,
NSTA
jlayman@nsta.org
703-312-9384



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Screenshot

The screenshot displays a web browser window titled "Eliminate Live! - DEV". The interface is divided into several sections:

- Participants:** A list on the left shows two participants: "Flavio Mendez (Moderator)" and "Leia Fitzwilliam (Me)".
- Chat:** A chat window below the participants shows a message from the moderator: "Joined on August 24, 2007 at 4:14 PM Moderator: This is the chat window." There is a "Send" button and a dropdown menu set to "Moderators".
- Audio:** At the bottom left, there are controls for "Microphone" and "Speaker" with volume sliders and a "Talk" button.
- Whiteboard:** The main area on the right is a whiteboard titled "Whiteboard - Main Room (Scaled 105%)". It features a large logo for "NSTA WEB SEMINARS" in blue and red, with a computer mouse icon to the right. Below the logo, the text reads "LIVE INTERACTIVE LEARNING @ YOUR DESKTOP". The whiteboard also includes navigation arrows and a "Follow Moderator" button.

In the bottom right corner of the window, it says "In session for 4 minutes."



We would like to know more
about you...

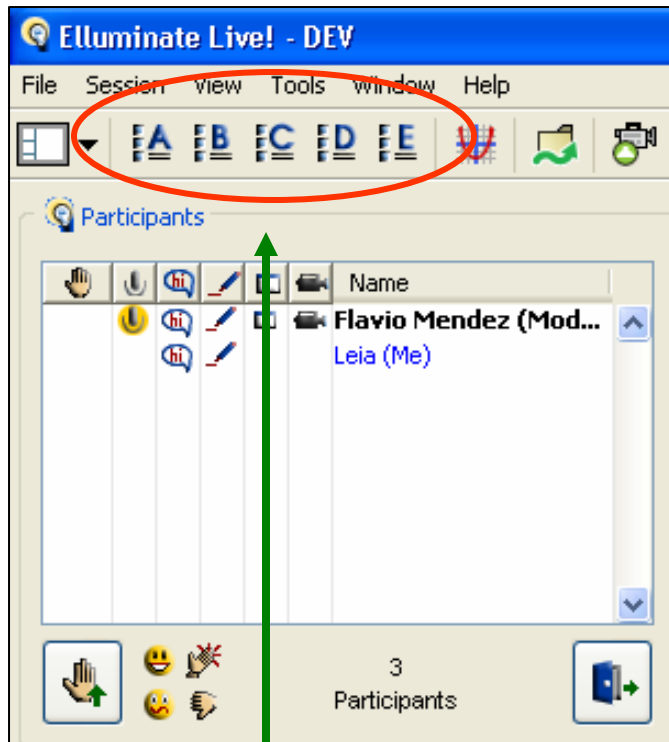


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How many NSTA web seminars have you attended?



A. 1-3

B. 4-5

C. More than 5

D. More than 10

E. This is my first web seminar

Use the letters A-E located at the top left of your actual screen to answer the poll



Where are you now?



Note:
Alaska & Hawaii
Not to scale
www.50states.com



<http://nsdl.org>





What grade level do you teach?



- A. Elementary School, K-5.
- B. Middle School, 6-8.
- C. High School, 9-12.
- D. I teach undergrad and/or grad students.
- E. I am an Informal Educator.



NSDL/NSTA Web Seminar: Enlightening Experiences with Energy



Thursday, June 12, 2008



Today's NSDL Experts



Dr. Cathy Ezrailson,
Assistant Professor of Science Education,
University of South Dakota,
Vermillion, SD



John L. Roeder,
AAPT Physics Teaching Resource Agent,
Physics Teacher, The Calhoun School,
New York, NY



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Overview



- Energy concepts can often be confusing to non-scientists because the word “energy” may be used for different ideas....
- Often, energy, power, and work are used interchangeably.
- Defining energy by how we gain it, use it or lose it can help us to grasp an understanding of what is meant by “energy.”



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Teaching About Energy: Designing a Roller Coaster Document Menu

Table of Contents

— [Main Document](#)

[Teaching About Energy: Designing a Roller Coaster](#)

ACTIVITY 1. DESIGNING A ROLLER COASTER

(Teacher's Notes)

PROCESS SKILLS: Measure, Observe, Compare, Test, Explain

OBJECTIVE: The objective of this activity is to motivate the significance of the product of force and distance to lift an object through a given height. This is done by having the student discover that this product is invariant when several alternatives are considered. The invariance of the product of force and distance motivates giving it the special name of *work* and considering the work done to result in a gain of potential energy.

IDEA: The work done to lift an object from a tabletop to a given height above the tabletop is the same, regardless of the slope of the incline along which it is pulled. This invariance of the work done motivates equating it to the potential energy gained by the object: $Work = \Delta PE_g$.

The inclined plane is also one of the basic simple machines known in ancient times. Like all simple machines, it allows objects to be lifted with less force, provided that the force acts

Teaching About Energy: Designing a Roller Coaster

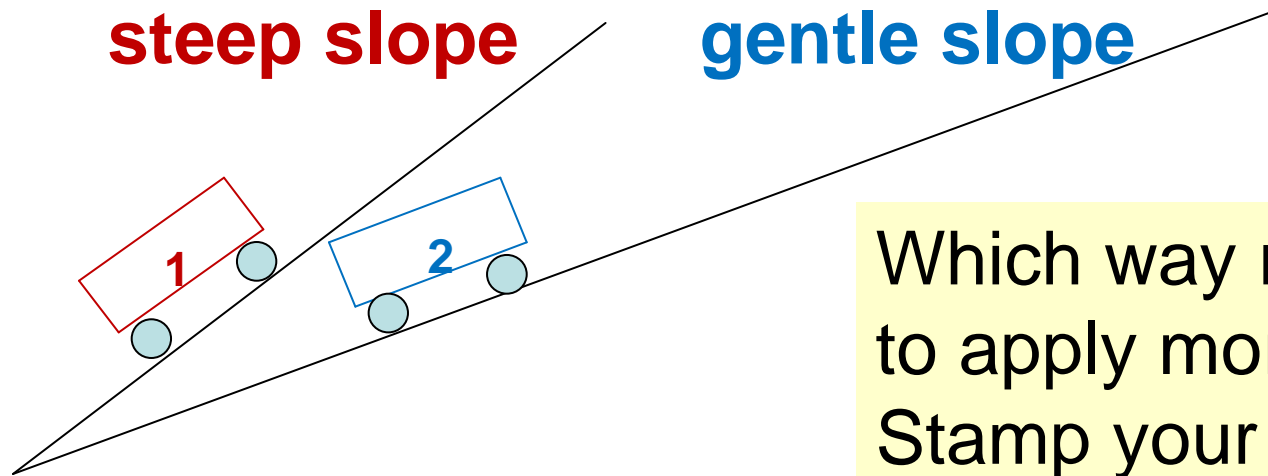
<http://www.thephysicsfront.org/document/ServeFile.cfm?ID=3375&DocID=69>



<http://nsdl.org>



Suppose you have a choice of two ways to **pull** a cart to the top of a hill:



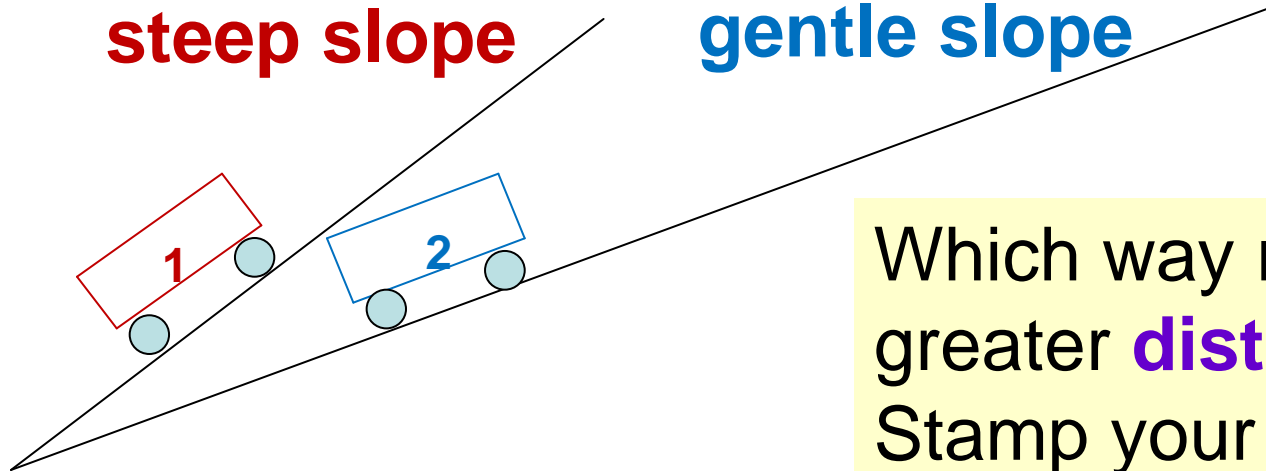
Steep	Gentle	Neither

Suppose you have a choice of two ways to **pull** a cart to the top of a hill:



steep slope

gentle slope



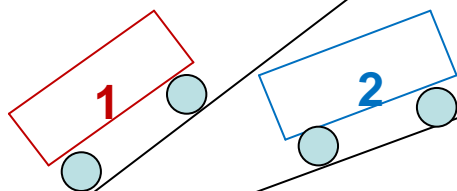
Which way requires a greater **distance**?
Stamp your answer:

Steep	Gentle	Neither



steep slope

gentle slope

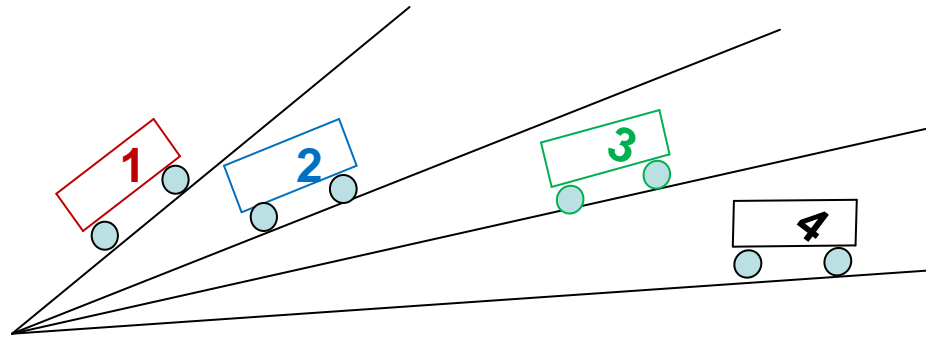


FORCE × distance

Which of the following would be true?

- A. Product for steep slope is larger than products of gentle slope.
- B. Product for gentle slope is larger than products of steep slope.
- C. Products same for both slopes.

Trials at different heights:



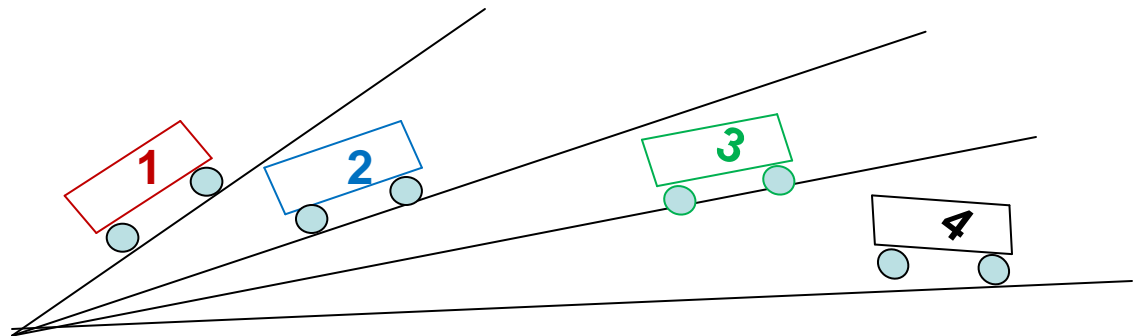
Force (N)	Distance (m)	Force x Distance (J)
2.2	0.50	1.10
1.7	0.64	1.09
1.2	0.87	1.04
1.0	1.12	1.12

What do you recognize as *an important trend* in the last column above *for all of the data*?

Did you notice that **all** products of *force* \times *distance* are very close to the **same** *for all slopes*?



Force \times Distance (J)
1.10
1.09
1.04
1.12



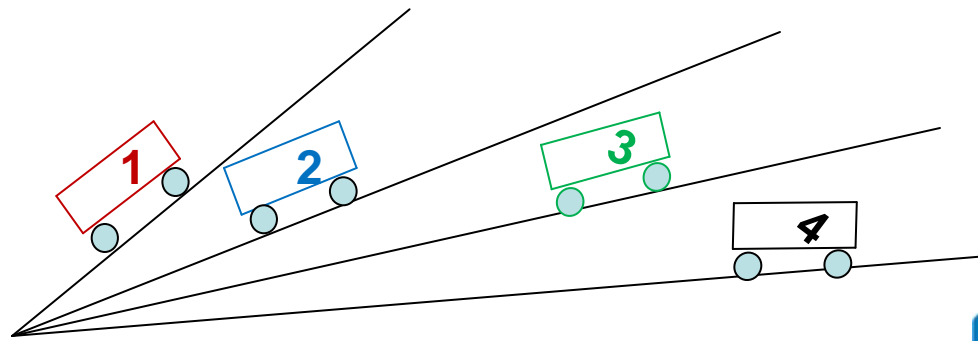


Sonya Kovalevsky

Whoo hooo!



Physicists get excited when they find that a ***combination of variables*** gives something that is ***nearly constant***



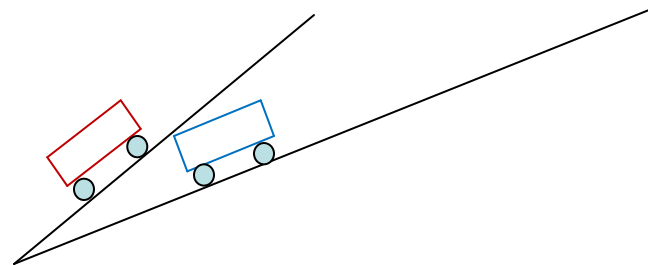


...AND they give it a special name:
WORK --- the product of *force x distance*

The product of the *force* acting on the cart (in the direction of motion) times the *distance* it acts equals the *work* done *on the cart*.



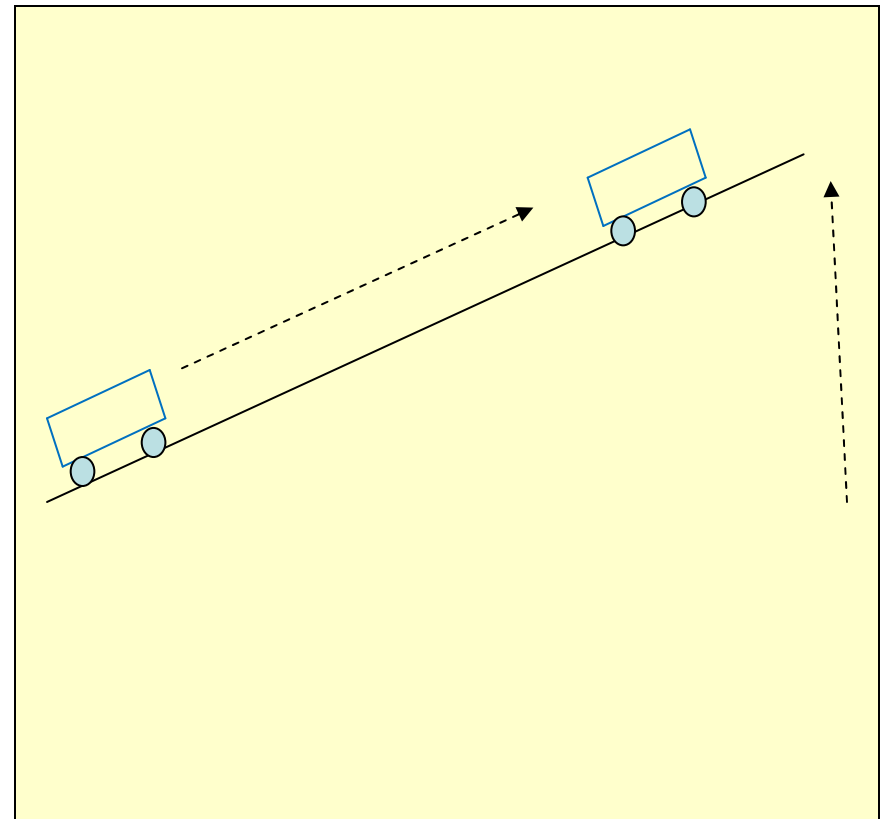
Lise Meitner





When **work** is done on an object, we say that the object **gains energy**

Since **work** is done **against gravity** and the cart has the **potential** to roll down the hill again, the cart is said to gain **gravitational potential energy (GPE)**





Let's pause for
questions from
the audience....

Try Your Hand in this Work-Energy Simulation: Energy Skate Park



http://phet.colorado.edu/new/simulations/sims.php?sim=Energy_Skate_Park

The screenshot displays the 'Energy Skate Park (2.04)' simulation interface. The main window shows a skater on a U-shaped track. The right sidebar contains various controls:

- Buttons: Reset, Return Skater, Choose Skater...
- Checkboxes: Measuring Tape, Potential Energy Reference, Show Grid
- Path: Show Path, Clear
- Energy Graphs: Show Pie Chart (checked), with Thermal, Bar Graph, Energy vs. Position, Energy vs. Time
- Location: Space, Moon, Earth (selected), Jupiter
- Gravity: 9.81 N/kg, with a slider for Space, Earth, and Jupiter
- Buttons: Clear Heat, Track Friction >>, Edit Skater >>
- Help! button at the bottom right.

The bottom of the window features a speed slider (slow to normal) and Pause and Step buttons.



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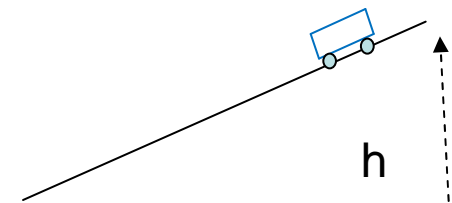


Gravitational potential energy

(GPE) comes from the **work** done to lift the object directly upward. Since the force needed to lift the cart must offset its weight:

$$\mathbf{GPE}_{\text{gain}} = \text{force (weight)} \times \text{height}_{\text{gained}} =$$

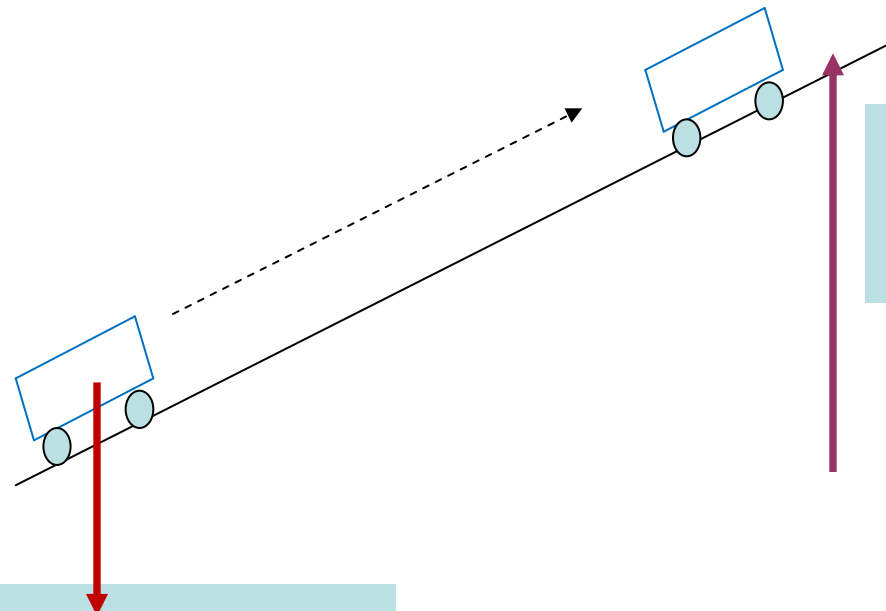
$$\text{mass} \times g_{\text{earth}} \times \text{height}_{\text{gained}}$$



An example.....



Earth's
gravity =
10 N/kg



Mass = 0.5 kg

Height =
0.24 m

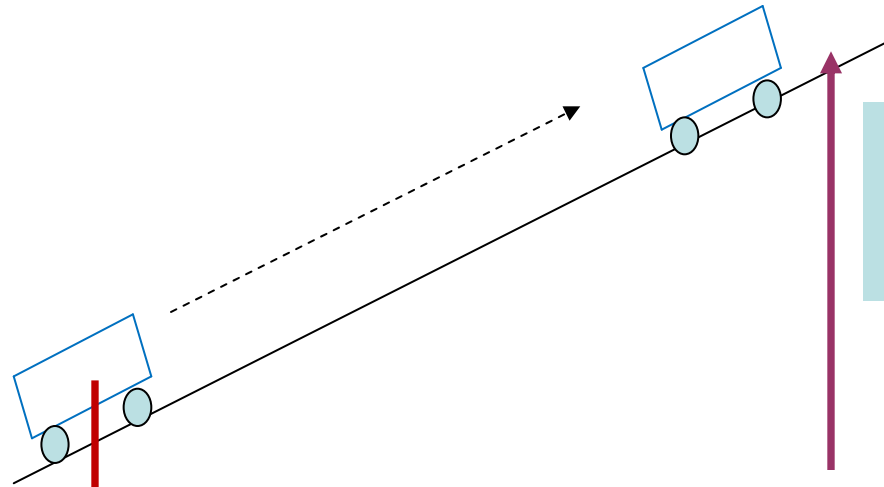
The cart gains:

$$0.5 \text{ kg} \times 10 \text{ N/kg} \times 0.24 \text{ m} = \mathbf{1.20 \text{ J of GPE.}}$$

What if we doubled the mass?

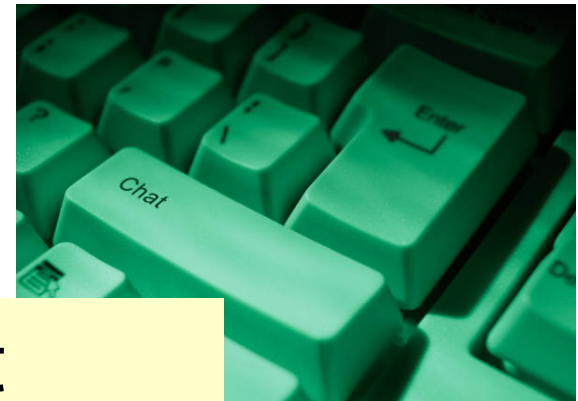


Earth's gravity = 10 N/kg



Height = 0.24 m

Mass = 1.0 kg

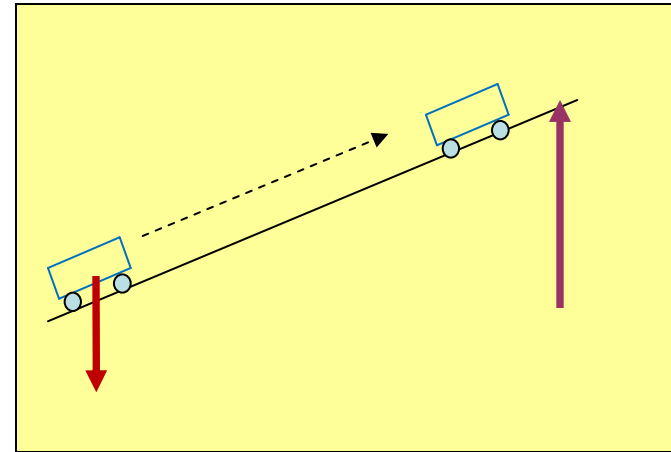


Solve the equation in the chat



Special things to note:

1. The **work** done to lift the cart depends only on its weight and the vertical height gain, not the slope.



2. The **work** done to lift the cart equals the gain in GPE, not the total GPE.

$$\text{Work} = \text{GPE gain}$$



Now, suppose you let the cart roll down from the top of the hill.....



What would happen to the GPE it had gained?

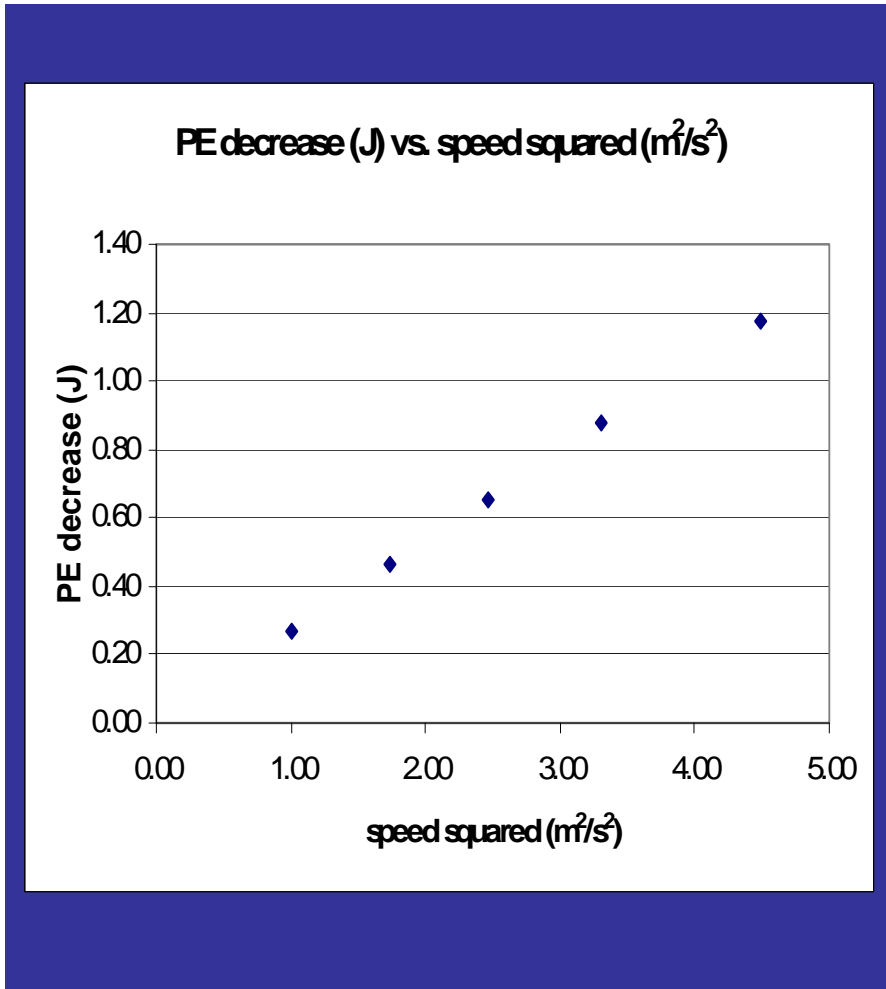
- A. GPE decreases, cart gains more energy from the motion it acquires.
- B. GPE decreases, cart gains energy from its motion, but not as much.
- C. GPE decreases, cart gains the same amount of energy from its motion.



Quiz Question

On graph:

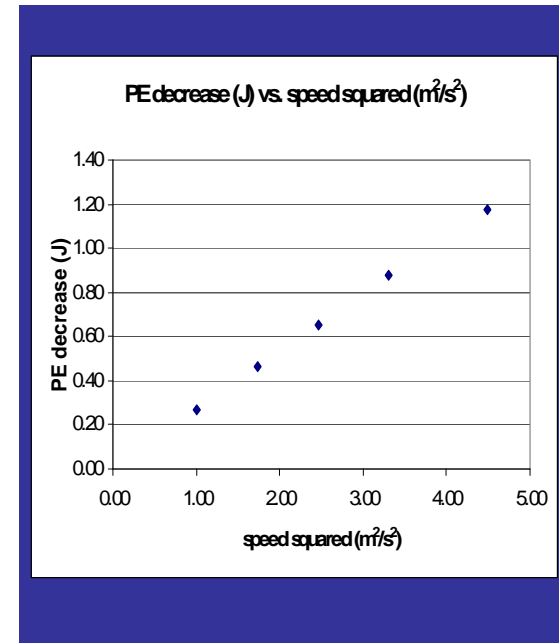
How is the decrease of the cart's GPE related to the speed it gains?



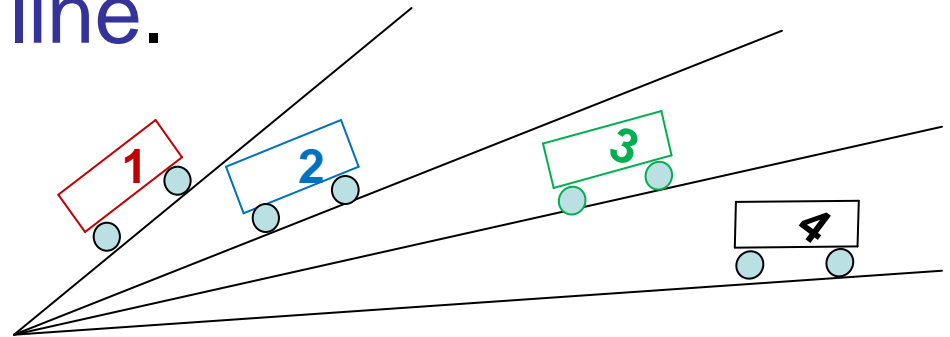
Write your responses in the chat

Answer

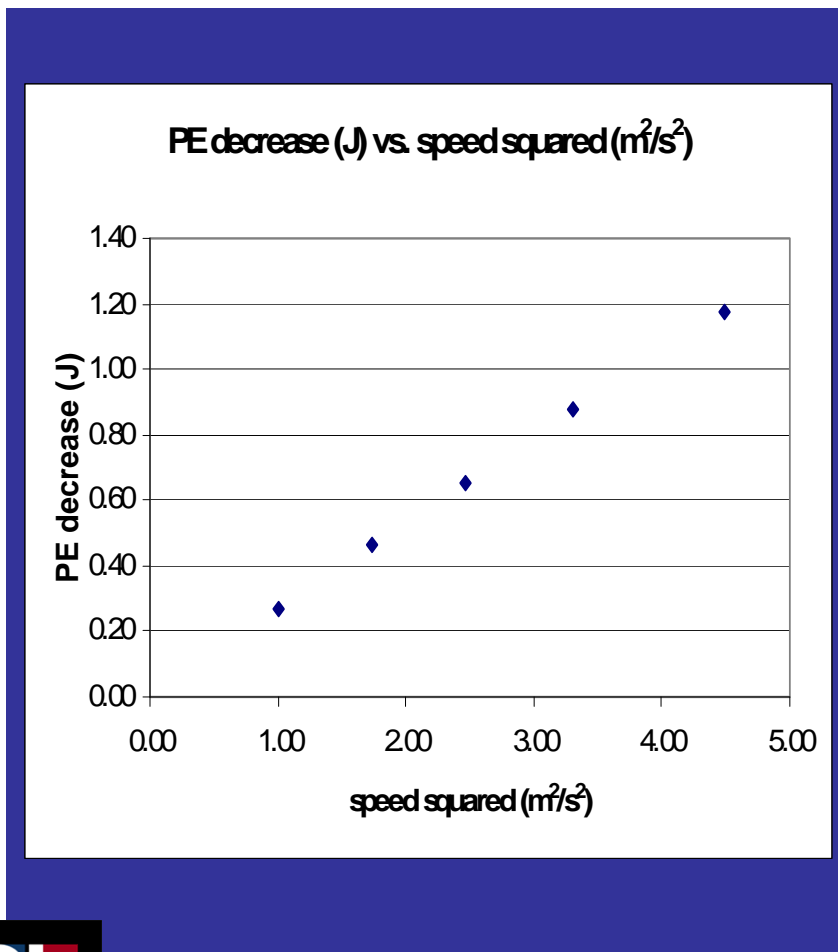
If the speed of the cart is measured at the bottom of the hill after release from different heights, the graph of decrease in GPE vs. speed squared is found to be a straight line.



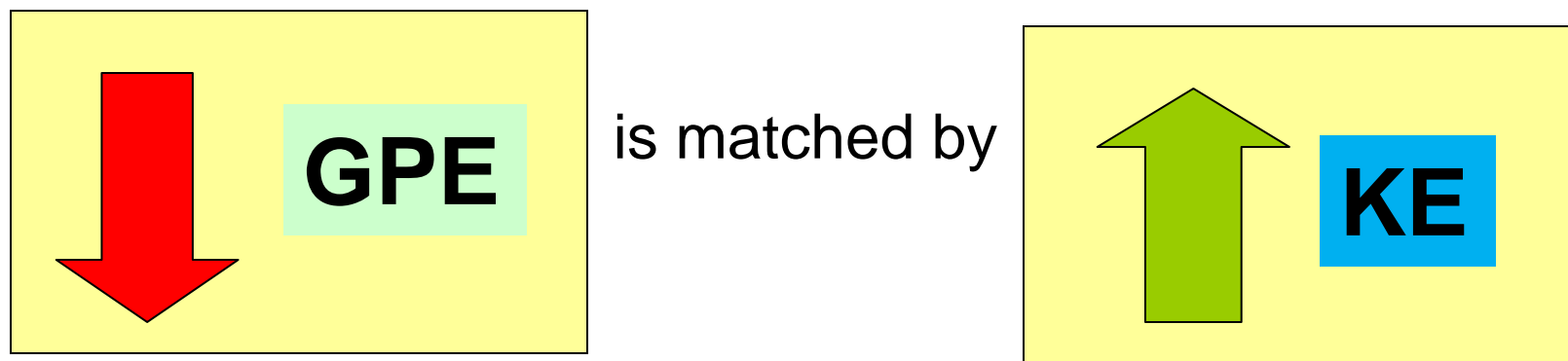
Speed measured at bottom of hill



The slope of the straight line is half the cart's mass. Therefore, the **GPE decrease = $(1/2)mv^2$** .



The quantity $(1/2)mv^2$ is called the kinetic energy, so named because it is energy associated with motion.



...And, some of the cart's **gravitational potential energy (GPE)** can be considered to be **converted** to **kinetic energy (KE)**.

Unless work is done **on** an object to increase the object's energy



OR

the object does work to *increase the energy* of another object, the amount of energy of that object **stays the same.**



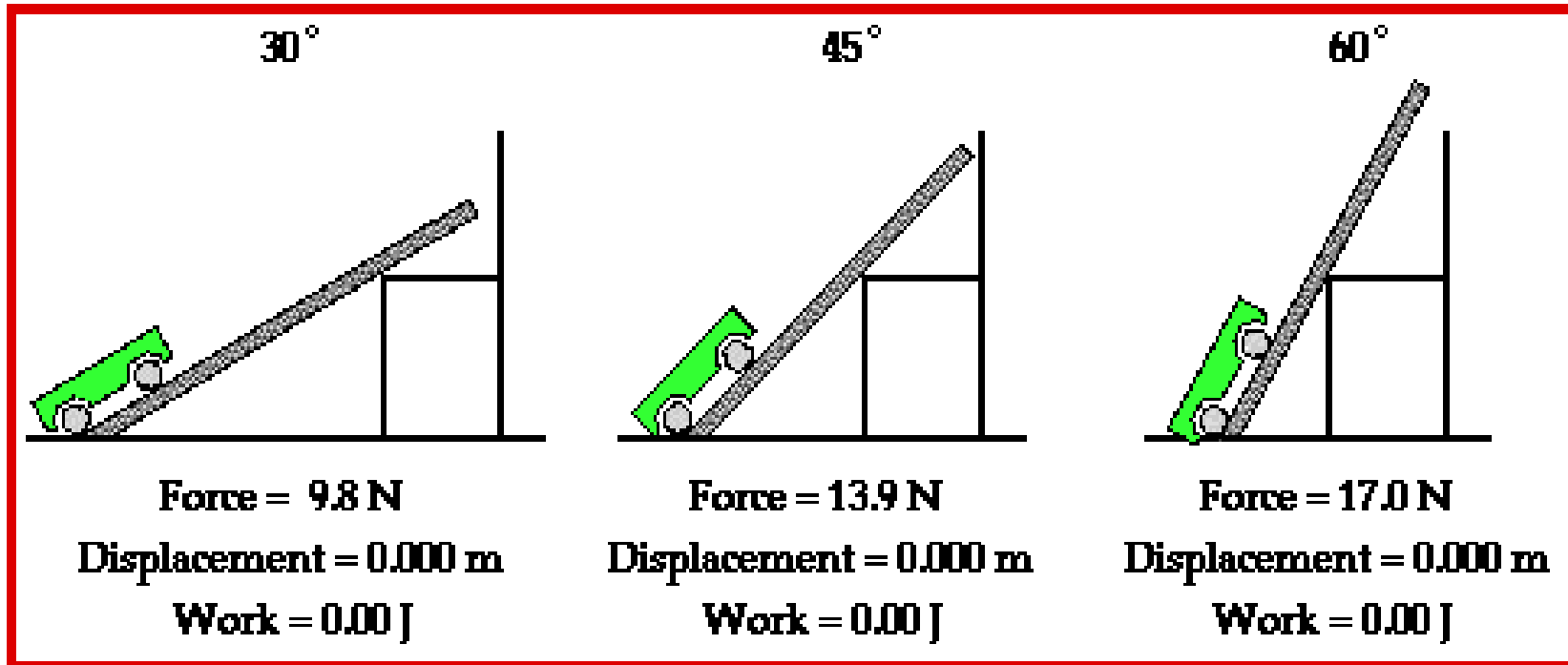
Lisa Randall

We say that its energy is conserved.



Let's pause for
questions from
the audience....

So, in terms of Force and Displacement:



A

B

C

In which of the pictures above is the amount of work done to raise the cart from the floor to the top of the step the most?

<http://www.glenbrook.k12.il.us/gbssci/Phys/mmedia/energy/au.html>



Review



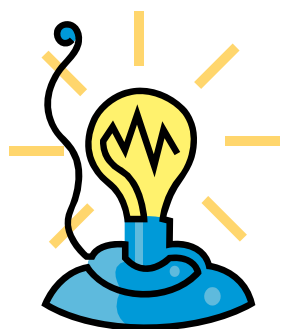
The energy of something **stays the same** unless it does **work** on something else or something else does work on it.

“**Using**” energy requires converting it into a form we need. But some conversions lead to forms less useful than others.



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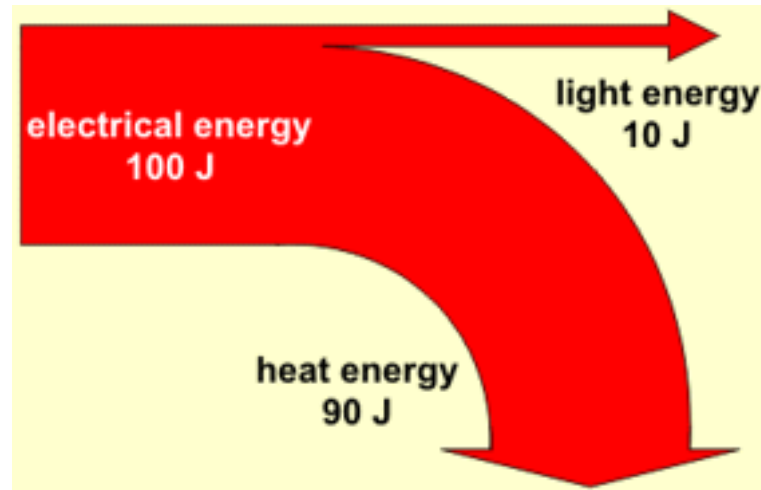
And although energy can be converted among many forms

Thermal energy, the **kinetic energy** of *randomly* moving molecules, is **less useful** than the more *orderly motion of electric charge* moving in an electric circuit.

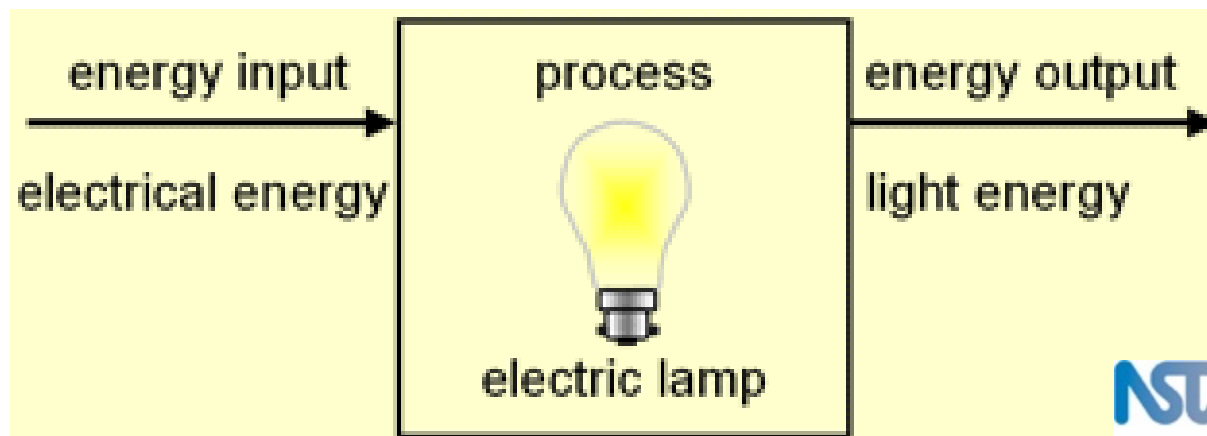


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While all of the energy in electric charge in a circuit can be converted to thermal energy, only some of the thermal energy can be converted to electric charges in a circuit.



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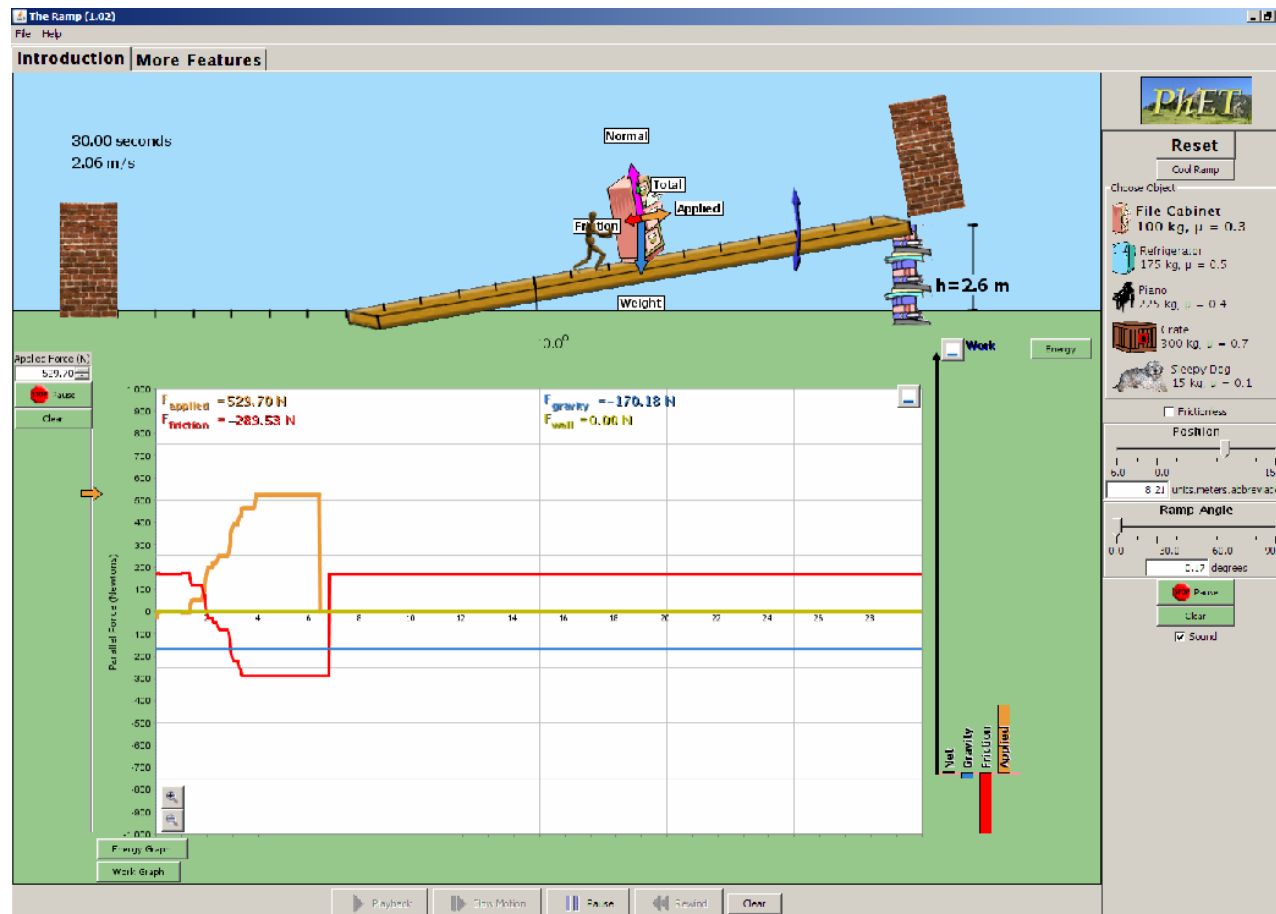


Inclined plane interactive

The screenshot shows a physics simulation of a block on an inclined plane. The block is on a yellow slope. Four force vectors are shown: a blue arrow pointing up the slope, a red arrow pointing down the slope, a purple arrow pointing perpendicular to the slope, and a green arrow pointing vertically downwards. To the right is a control panel with a green background. It includes a 'Reset' button (cyan), a 'Pause' button (yellow), and two radio buttons: 'Springscale' (unselected) and 'Force vectors' (selected). Below these are several input fields and labels: 'Angle of inclination: 30 °', 'Weight: 5.0 N', 'Parallel component: 2.5 N', 'Normal force: 4.3 N', 'Coefficient of friction: 0.00', 'Force of friction: 0.0 N', and 'Necessary force: 2.5 N'. At the bottom of the panel is the copyright notice '© W. Fendt 1999'.

<http://www.walter-fendt.de/ph14e/inclplane.htm>

Physics Education Technology (PhET): The Ramp

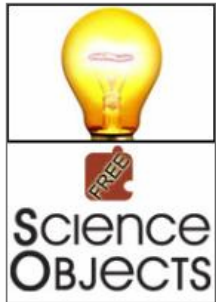


<http://phet.colorado.edu/new/index.php>

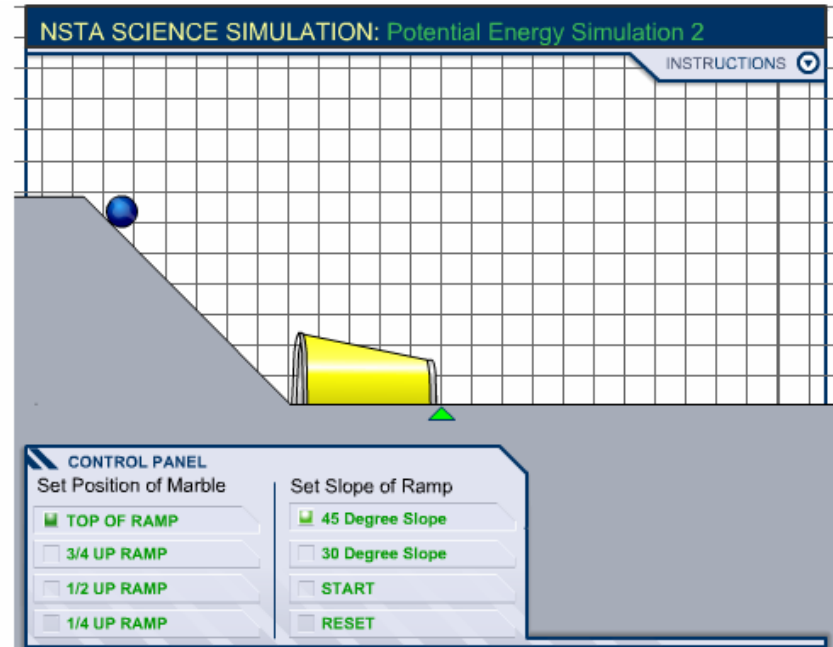
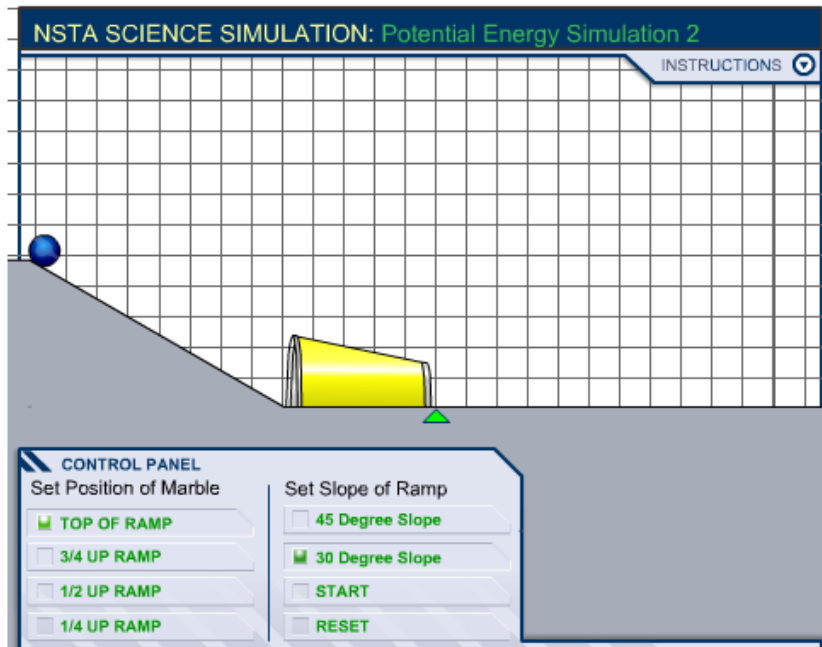


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Different Kinds of Energy



The NSTA Learning Center

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