NSTA WEB SEMINARS

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NSDL/NSTA Web Seminar:

Enlightening Experiences With Energy

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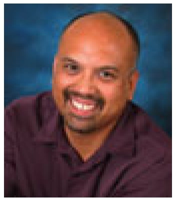
Thursday, June 12, 2008

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…

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

For additional Tech-help call:

Elluminate Support,

1-866-388-8674 (Option 2)

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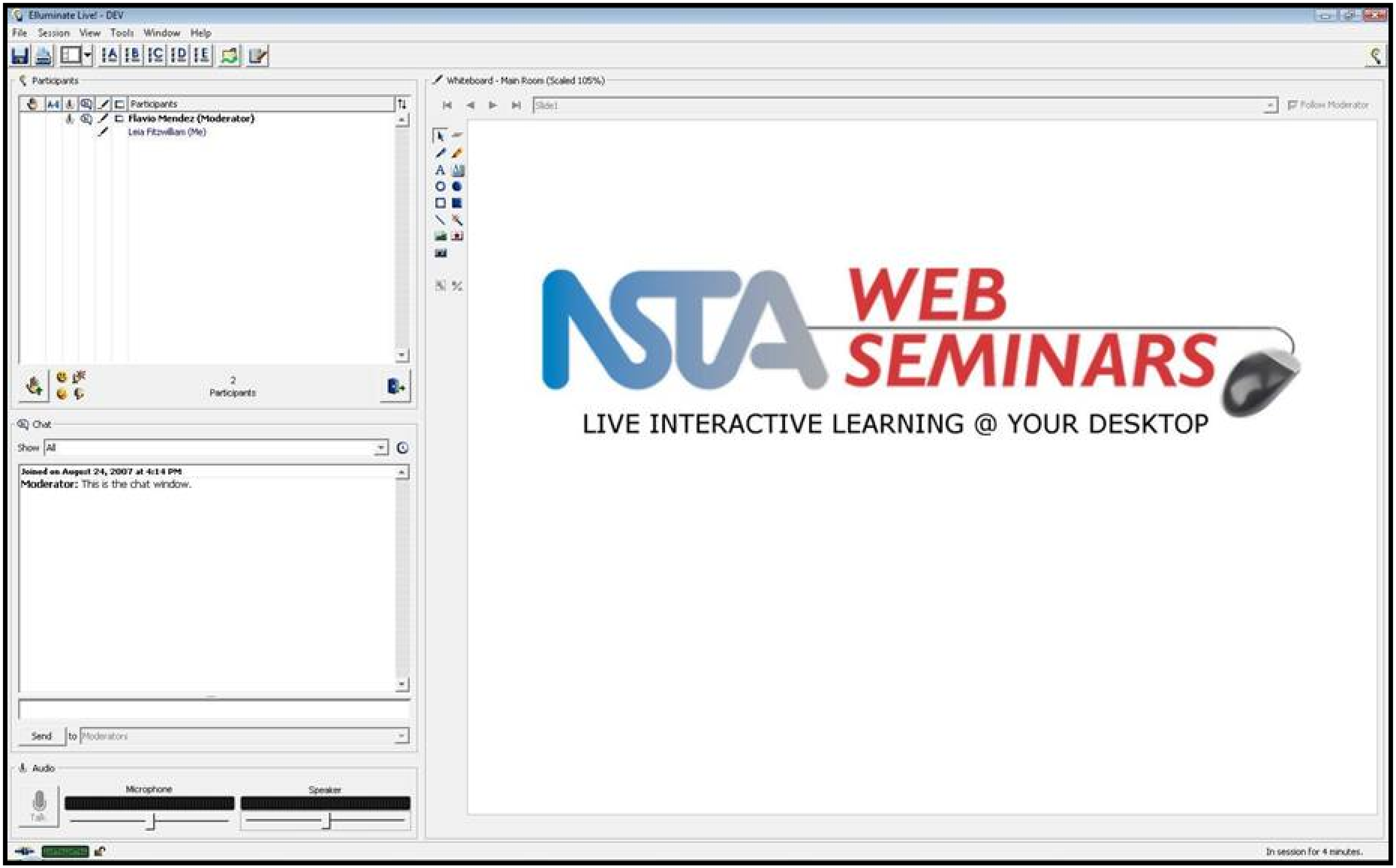
Screenshot


Elluminate Live! - DEV
File Session View Tools Window Help
Participants
Flavio Mendez (Moderator)
Leia Fitzwilliam (Me)
2
Participants
Chat
Show All
Joined on August 24, 2007 at 4:14 PM
Moderator: This is the chat window.
Send
to Moderators
Audio
Microphone
Speaker
Talk
Whiteboard - Main Room (Scaled 105%)
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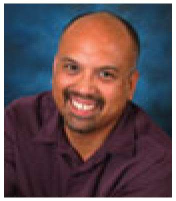

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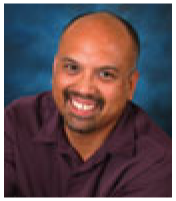
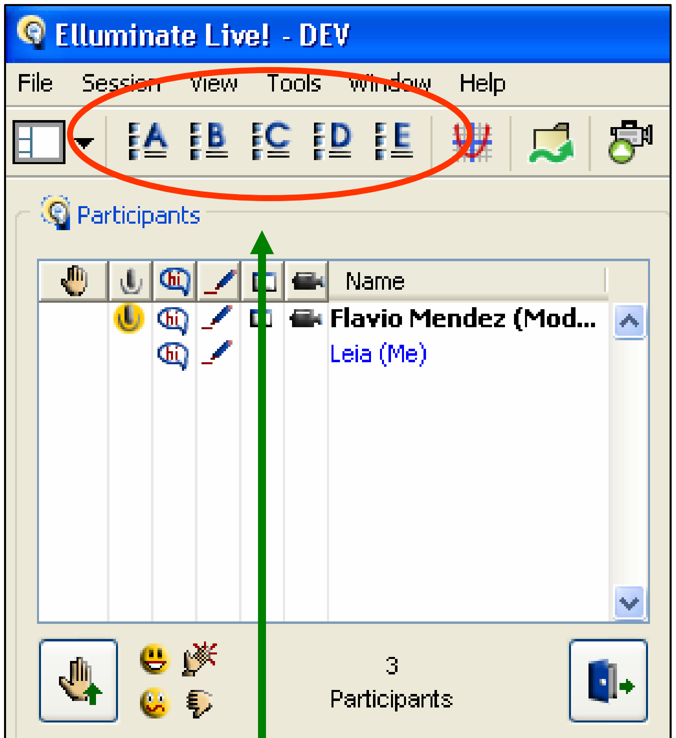


How many NSTA web seminars have you attended?



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

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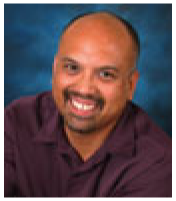

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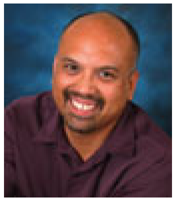

What grade level do you teach?

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.

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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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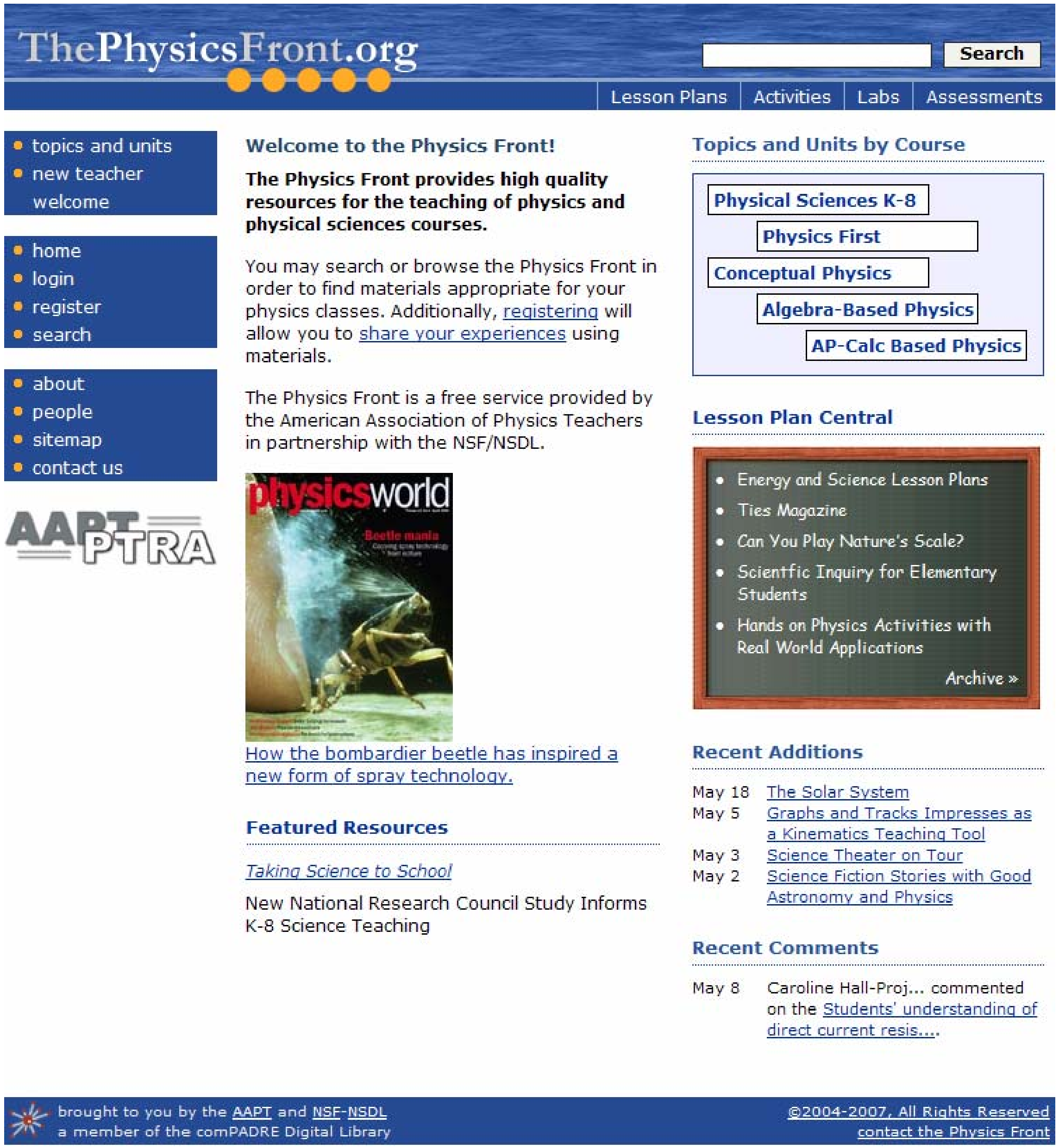
Overview

- 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.”

http://www.thephysicsfront.org



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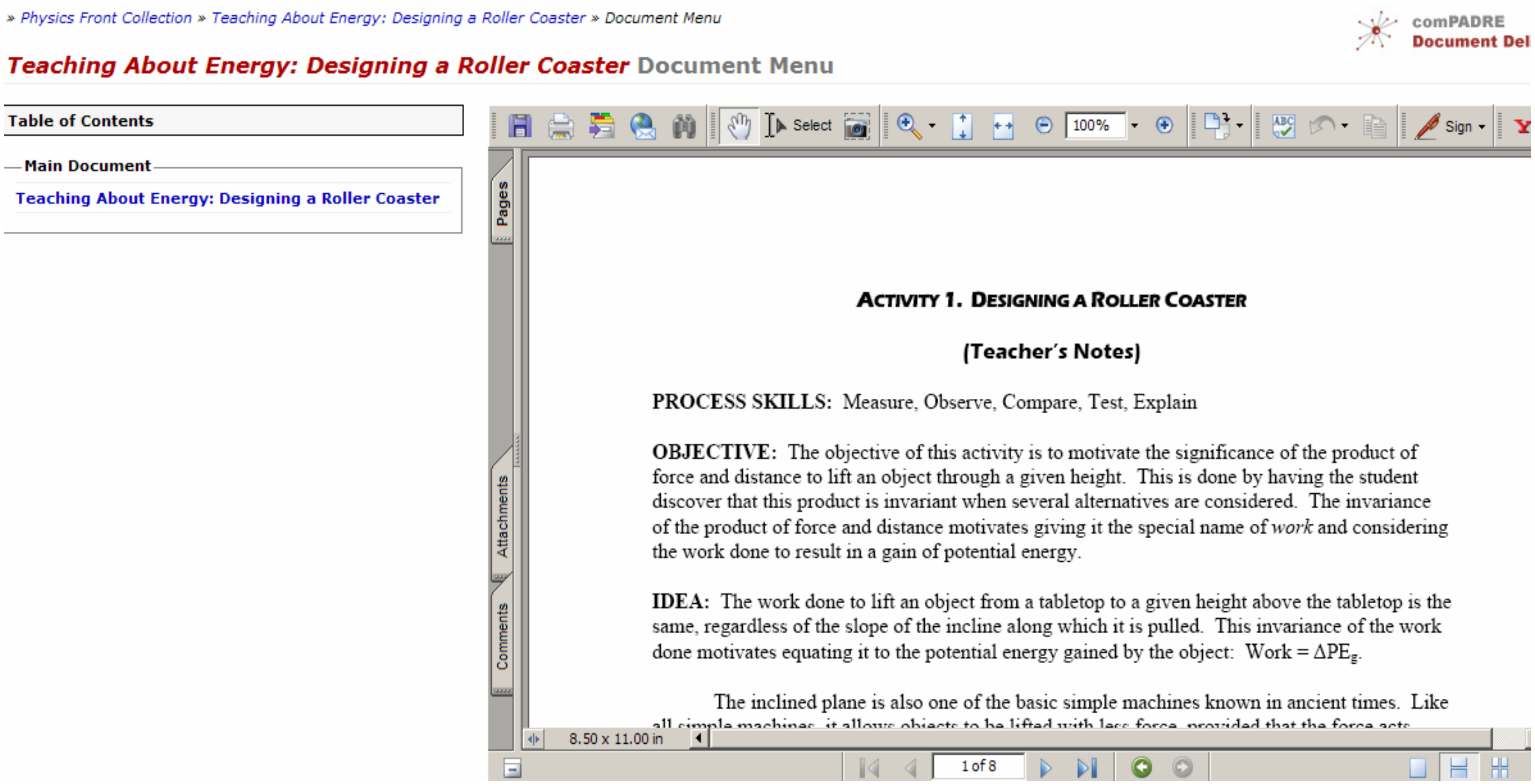
» Physics Front Collection » Teaching About Energy: Designing a Roller Coaster » Document Menu

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Teaching About Energy: Designing a Roller Coaster Document Menu

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 = ΔPE_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

8.50 x 11.00 in

1 of 8

Teaching About Energy: Designing a Roller Coaster

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

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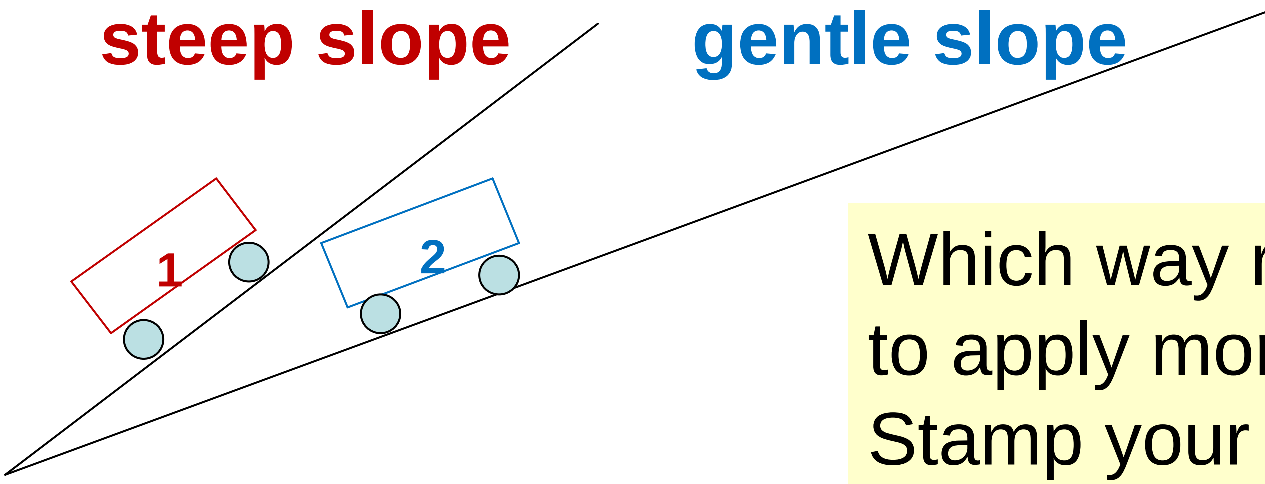
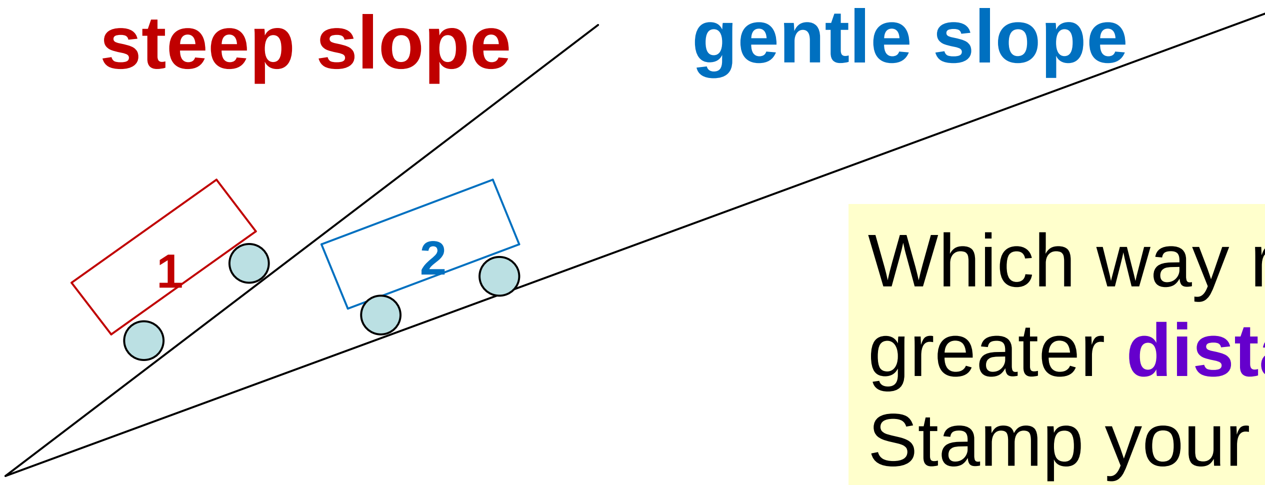
Suppose you have a choice of two ways to ***pull*** a cart to the top of a hill:



Which way requires you to apply more **force**? Stamp your answer:

Steep	Gentle	Neither

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



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

Steep	Gentle	Neither

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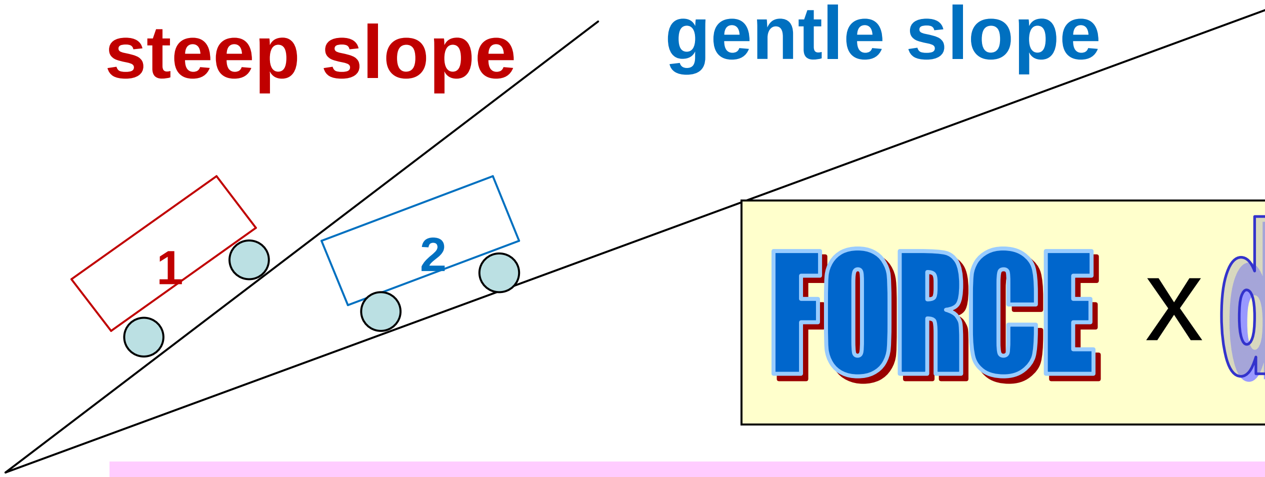


FORCE x distance

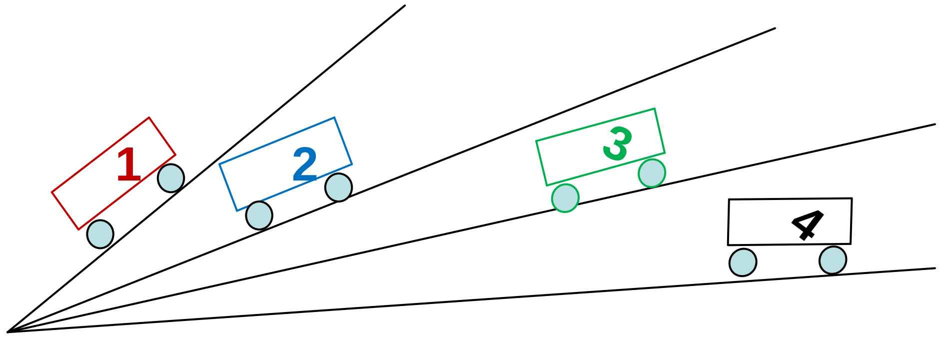
Which of the following would be true?

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:

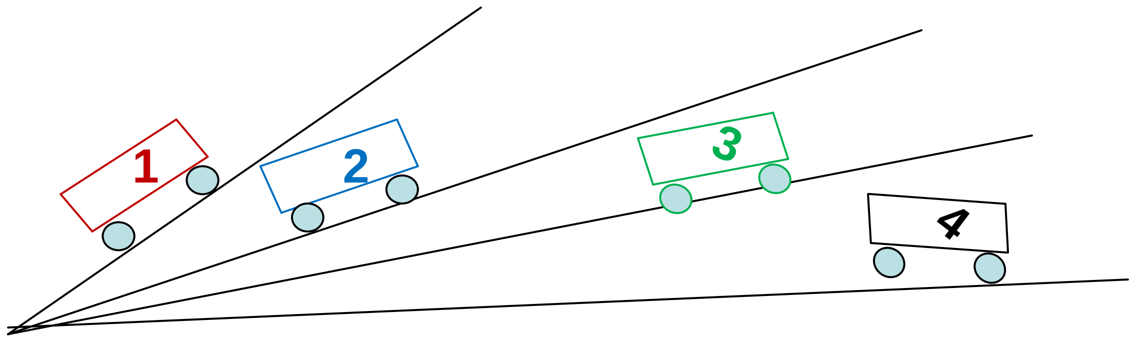


Force (N)	Distance (m)	Force x Distance (J)
2.2	0.50	1.10
1.7	0.64	1.09
1.2	0.87	1.04
1.0	1.12	1.12

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 x distance* are very close to the ***same for all slopes***?

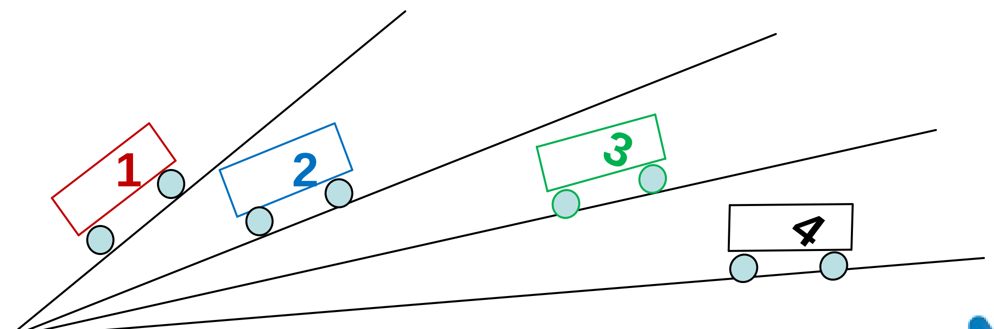
Force x Distance (J)
1.10
1.09
1.04
1.12



Sonya Kovalevsky

Whoo hooo!

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



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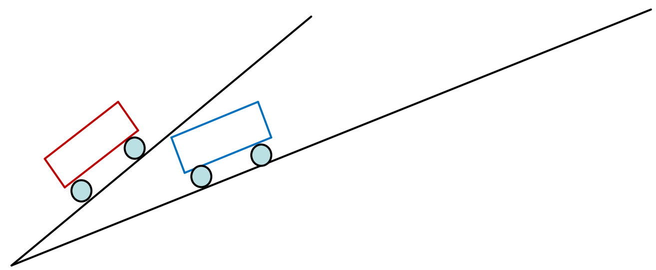
…AND they give it a special name:

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



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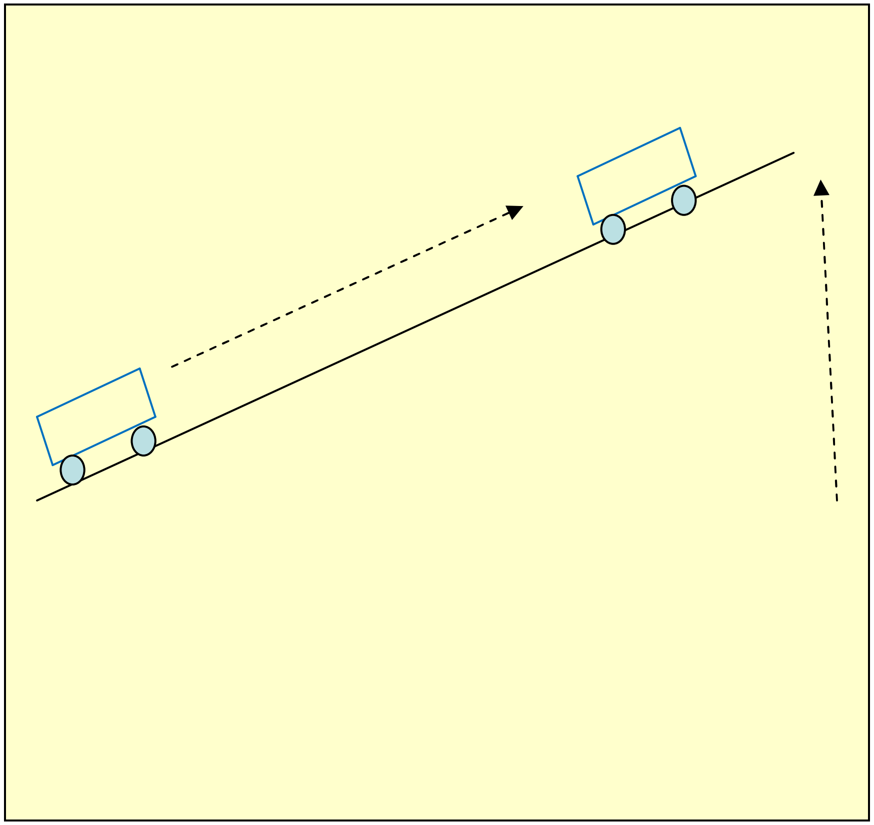
When **work** is done on an object, we say that the object **gains energy**

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)**



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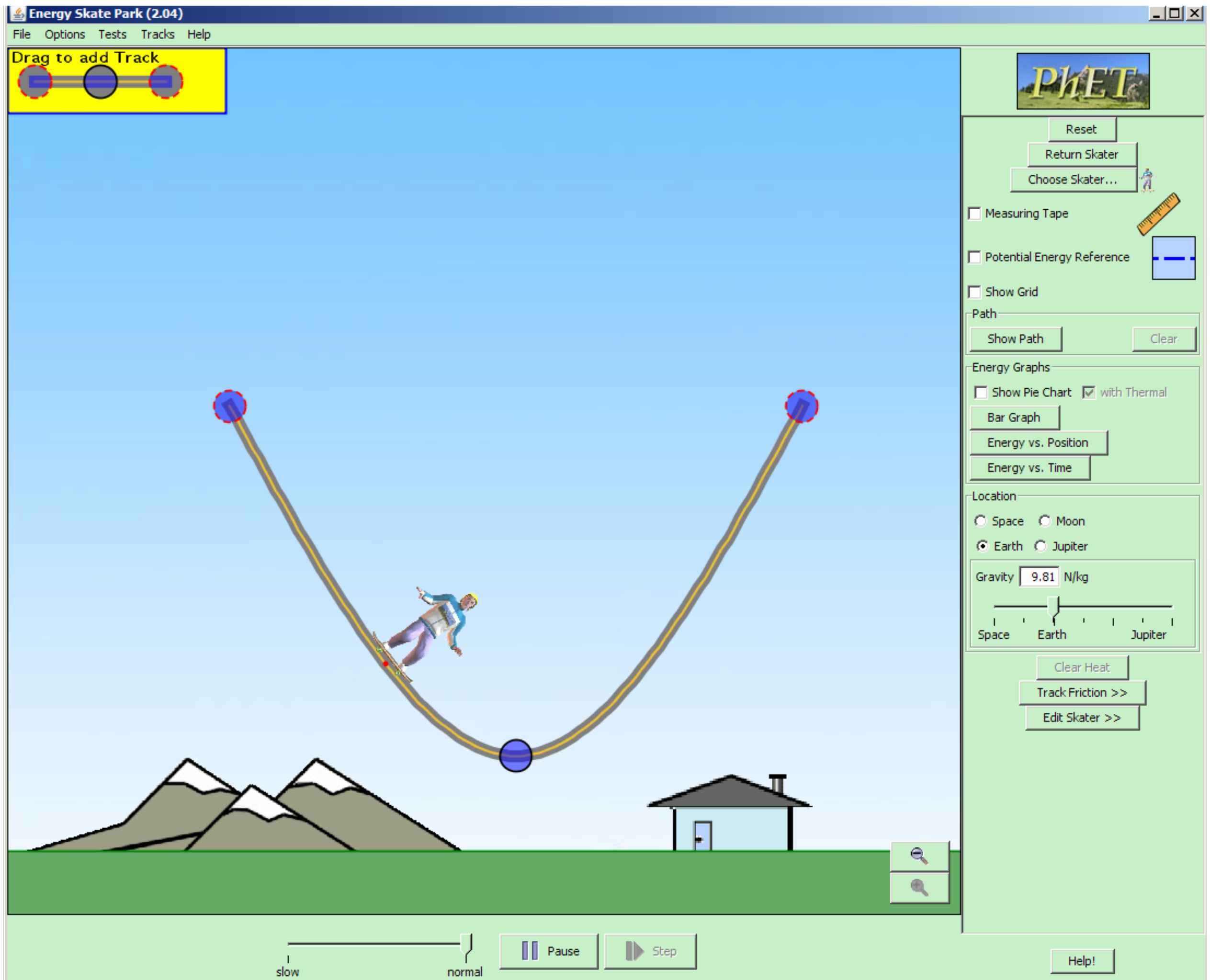
Let's pause for questions from the audience….

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

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



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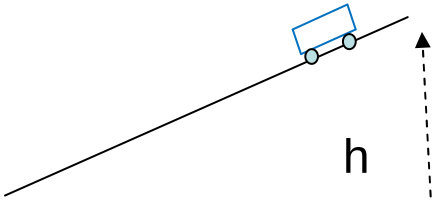
Gravitational potential energy (GPE) comes from the **work** done to lift the object directly upward. Since the force needed to lift the cart must offset its weight:

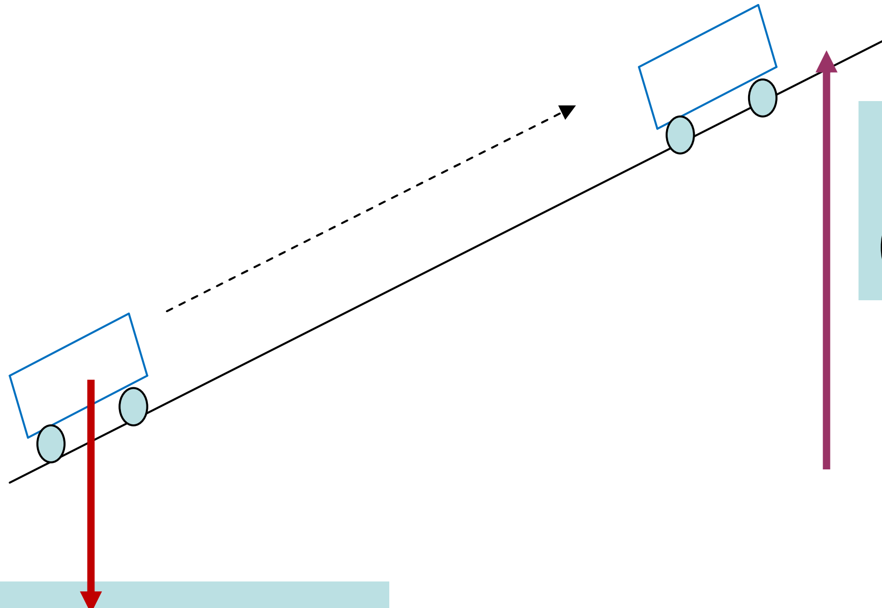
$\textbf{GPE}_{gain}$ = force (weight) x height_{gained} =

mass x g_{earth} x height_{gained}



An example…..

Earth’s gravity = 10 N/kg



Mass = 0.5 kg

Height = 0.24 m

The cart gains:

0.5 kg x 10 N/kg x 0.24 m = **1.20 J of GPE.**

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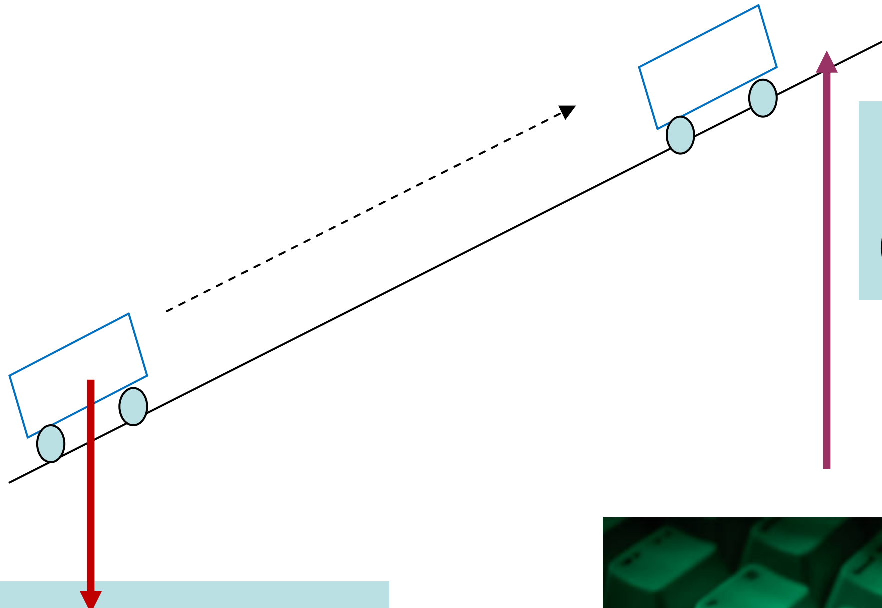
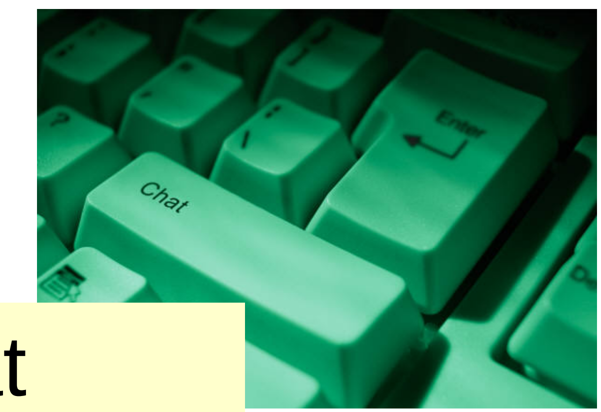
What if we doubled the mass?

Earth’s gravity = 10 N/kg



Height = 0.24 m

Mass = 1.0 kg



Solve the equation in the chat

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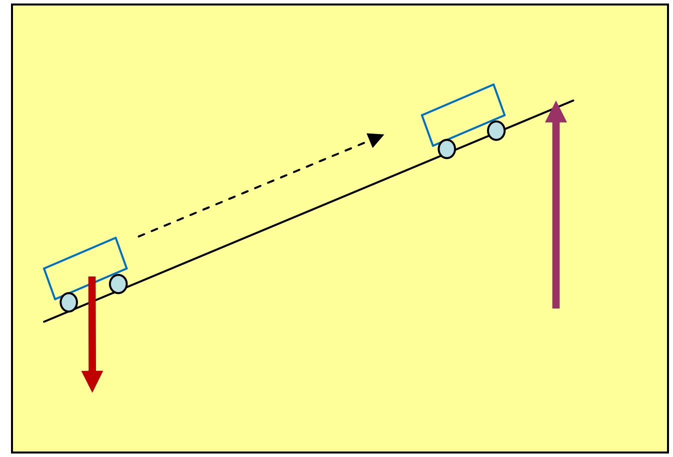
Special things to note:

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.

Work = GPE gain

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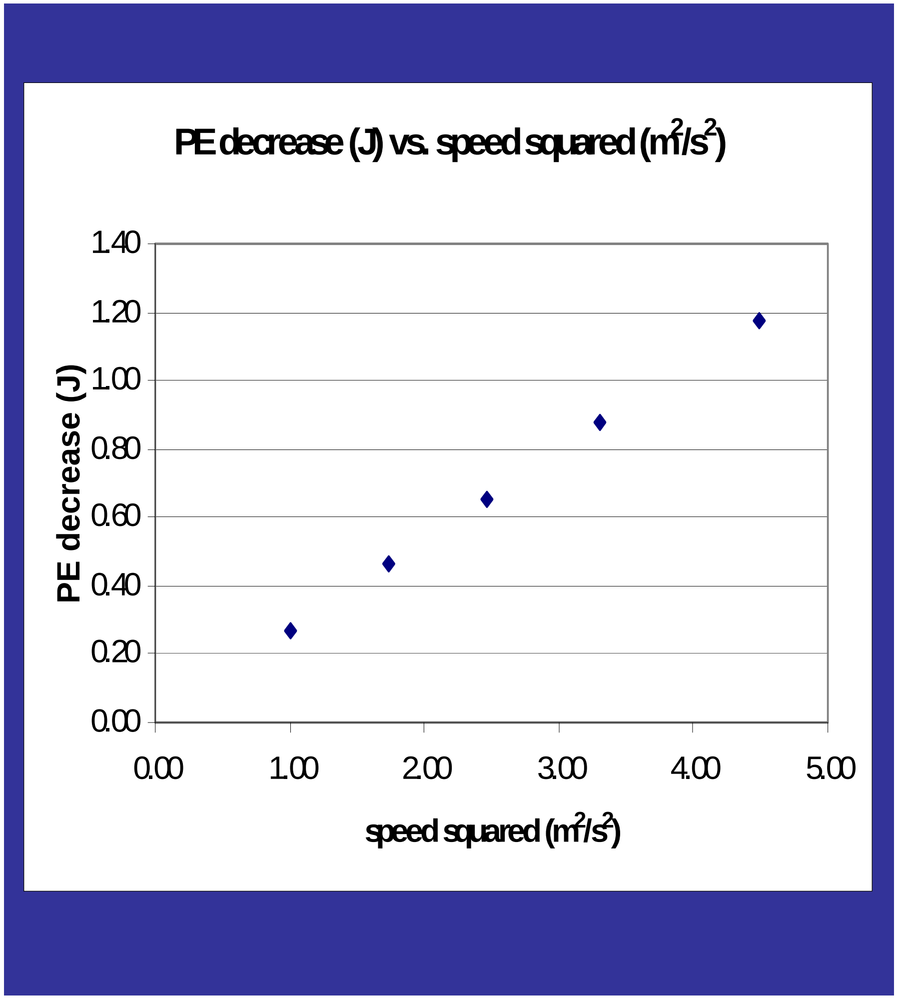
Now, suppose you let the cart roll down from the top of the hill…..

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

<u>On graph</u>:

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

Write your responses in the chat

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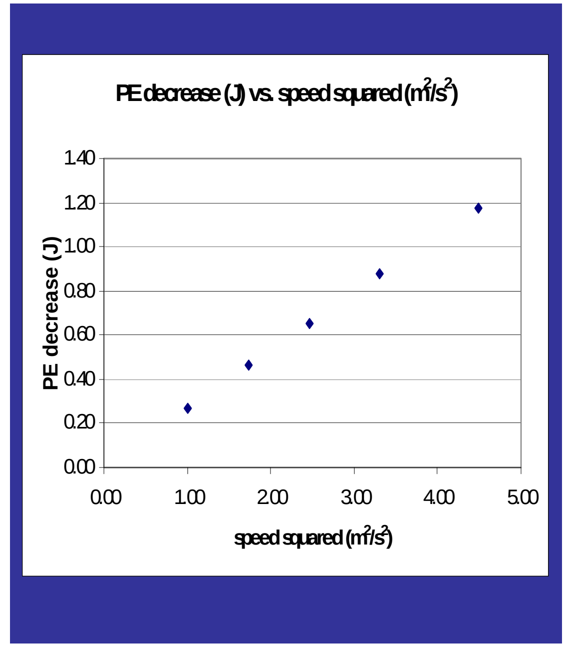
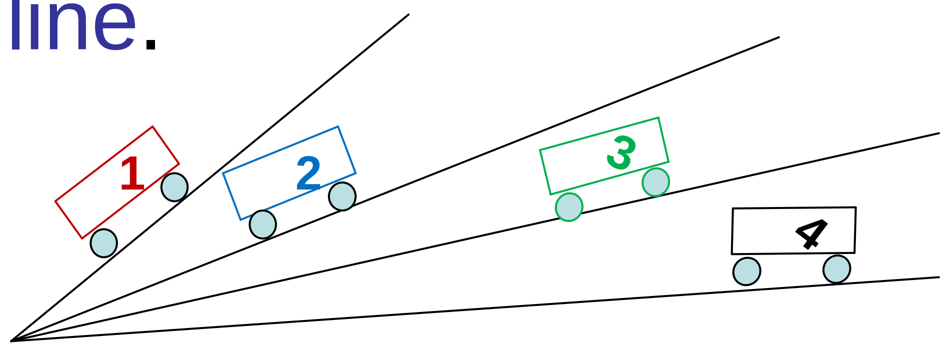
Answer

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



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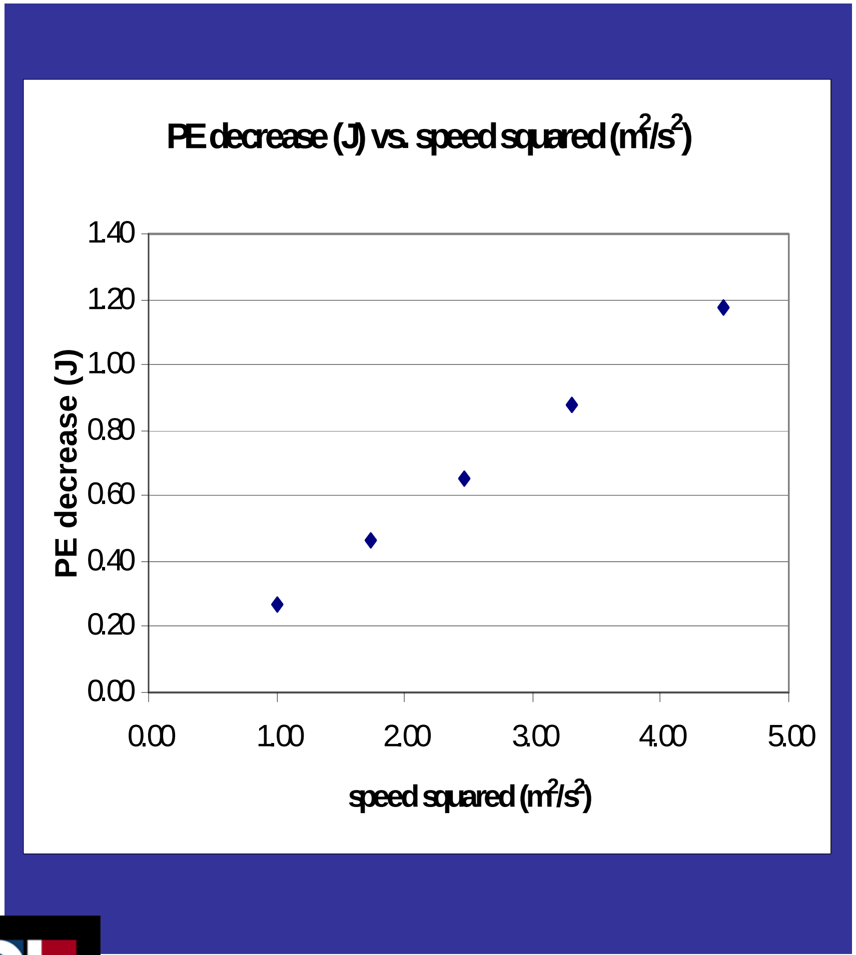
The slope of the straight line is half the cart's mass. Therefore, the GPE decrease = $(1/2)mv^2$.



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

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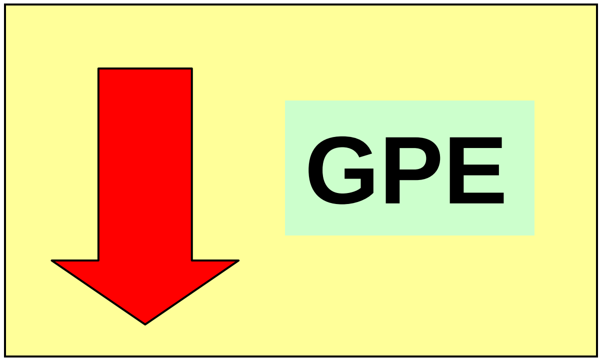

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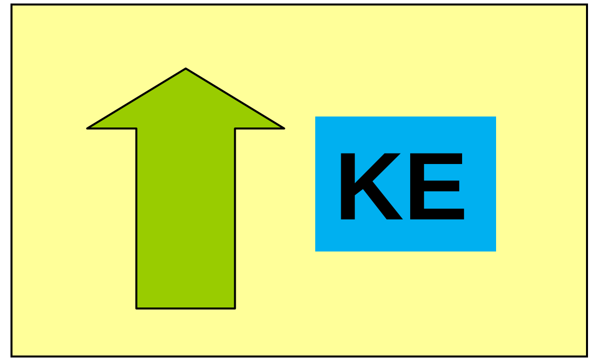

…And, some of the cart's gravitational potential energy (GPE) can be considered to be converted to **kinetic energy (KE).**

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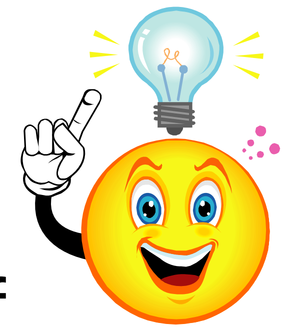
Unless work is done **on** an object to increase the object's energy

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.

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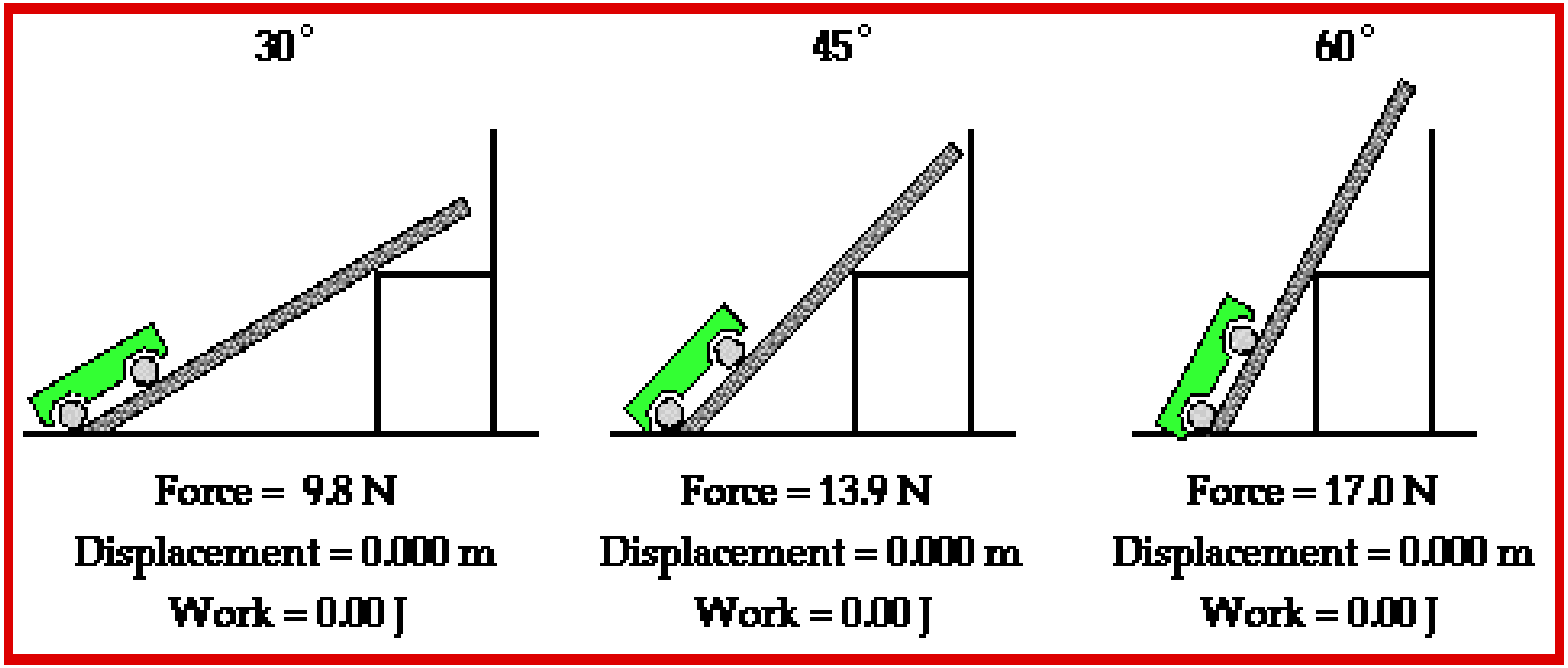
Let’s pause for questions from the audience….

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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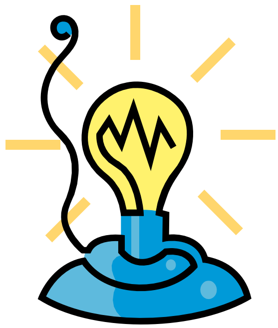

And although energy can be converted among many forms

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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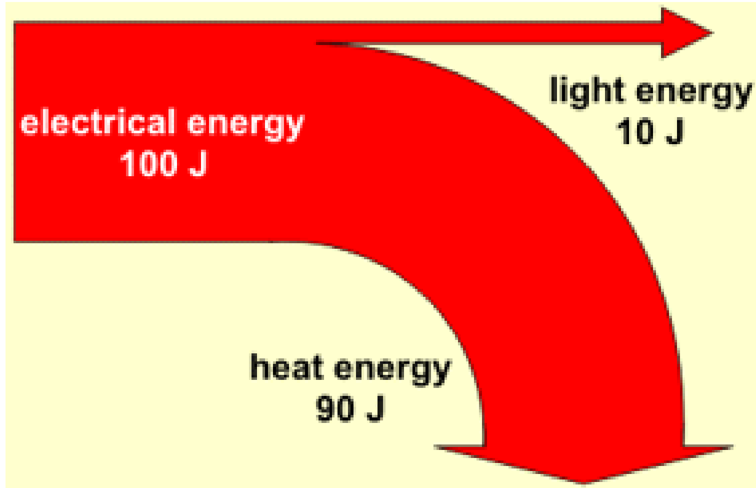
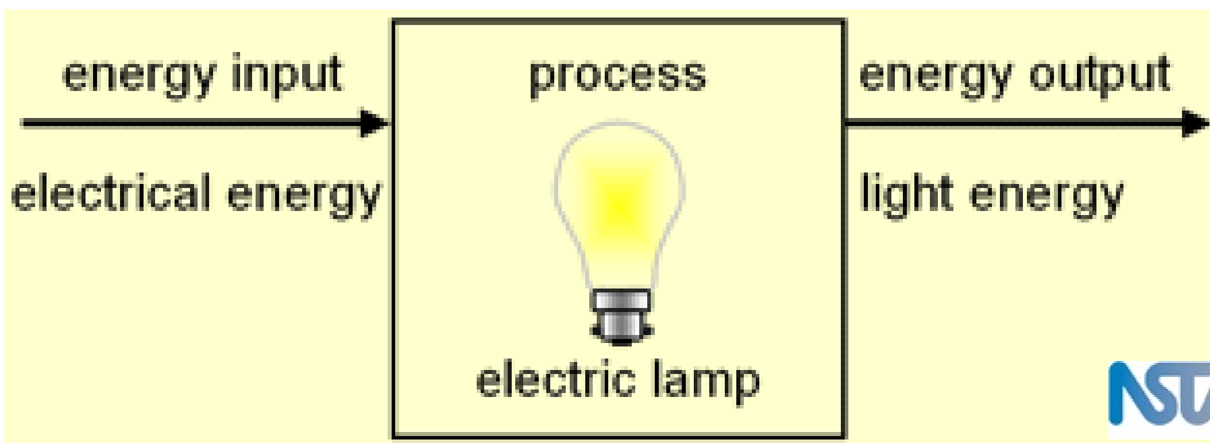


While *all* of the energy in electric charge in a circuit can be converted to thermal energy, only *some* of the thermal energy can be converted to electric charges in a circuit.



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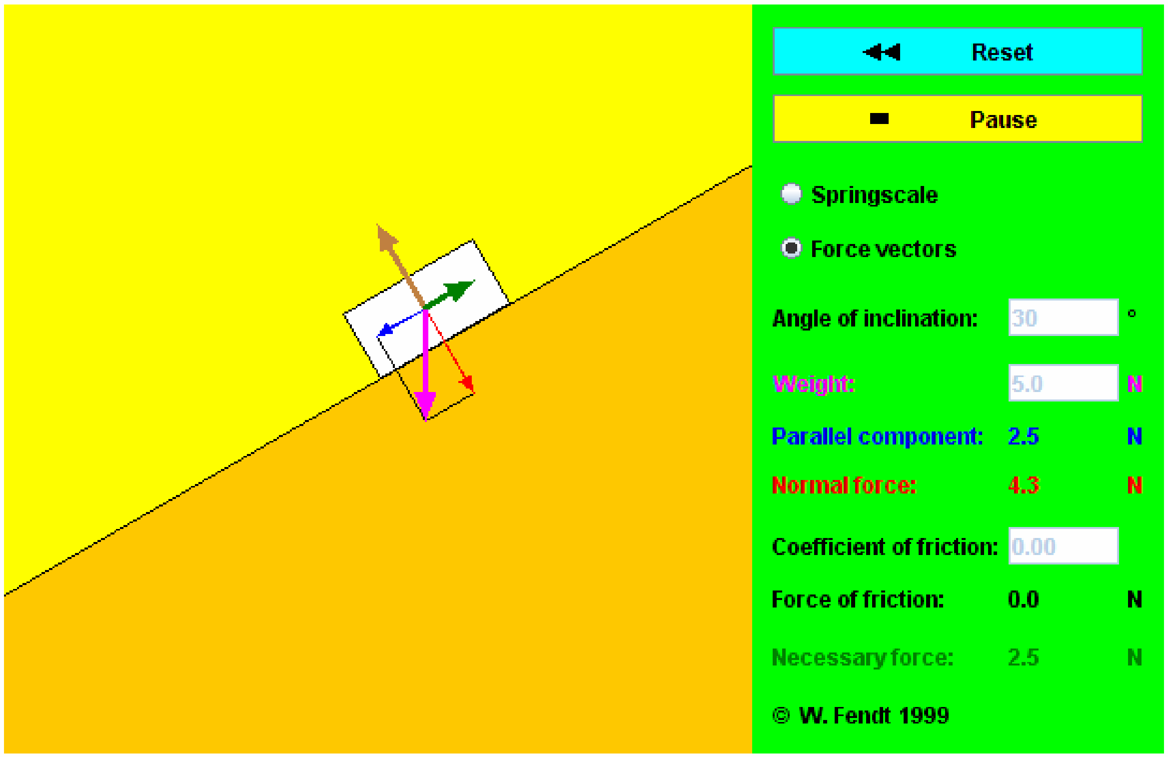
Inclined plane interactive



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

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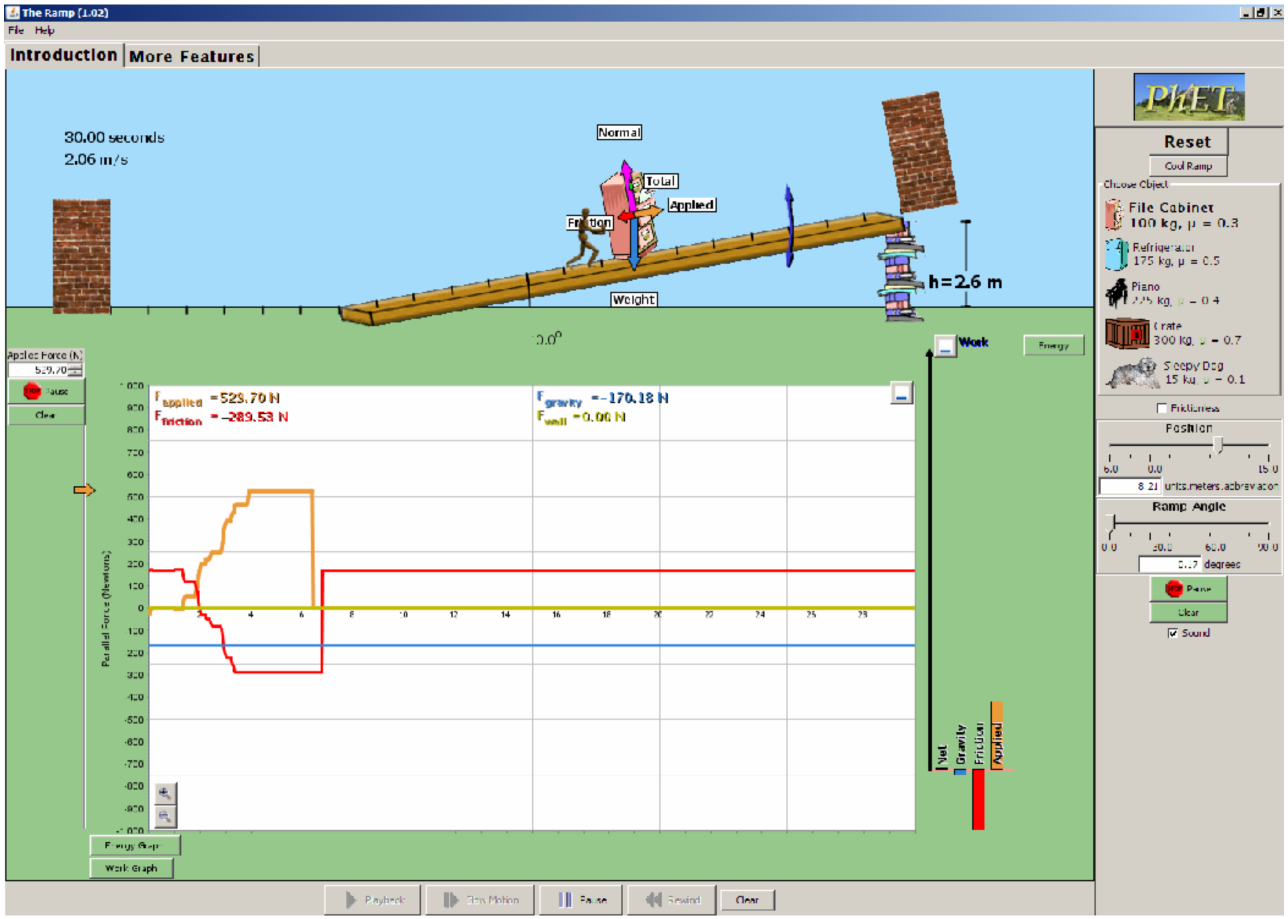

http://phet.colorado.edu/new/index.php

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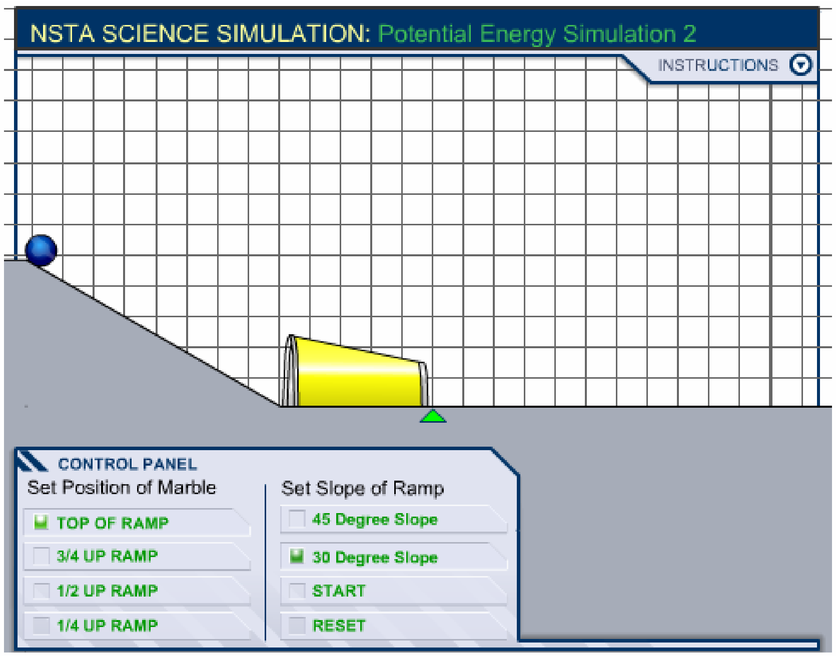
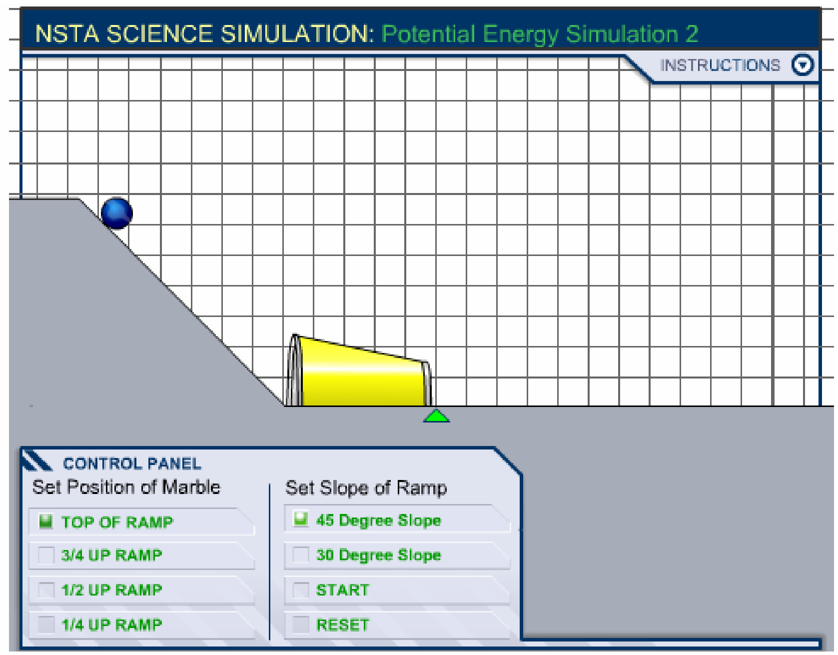
Different Kinds of Energy





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