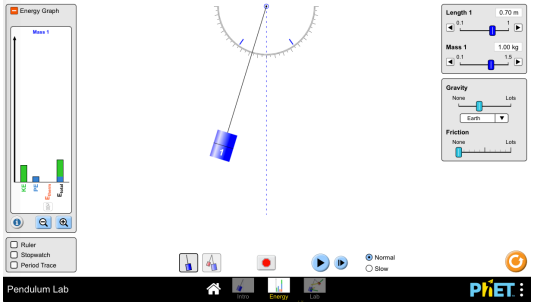
Energy Simulations

PURPOSE:
To learn about energy conservation for pendulums, springs and roller coasters

Part A – PENDULUMS: Google *"**Phet Pendulum**"* and select https://phet.colorado.edu/en/simulation/pendulum-lab



Press PLAY on the web site and select ENERGY (middle choice). Click and drag the pendulum to 35 degrees to start the motion. Press the SLOW button in the bottom for a slower animation.

Watch the ENERGY GRAPH on the left side as the pendulum swings.

1. Explain what happens with the kinetic and potential energy as the pendulum swings.

2. Draw and label the energy levels for (1) when the pendulum is at the highest point, (2) when the pendulum is about halfway to the lowest point, and (3) at the lowest point.

3. Press the PAUSE button and then drag the pendulum back to 35°. The pendulum will be at rest. Adjust the LENGTH, MASS, and GRAVITY using the sliders. Describe what happens to the pendulum's potential energy. Be sure to refer to the equation for gravitation potential energy in your explanation.

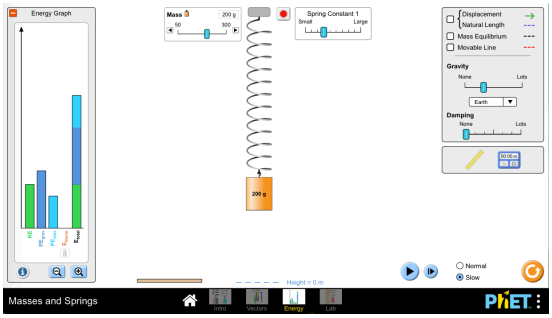
4. Does the total energy ever change? Why or why not?

5. Reset using the orange button in the lower right. Then adjust the slider for FRICTION to past half way. Drag the mass to 35° Explain the energy that now appears and this does to the pendulum?

Part B – MASS/SPRING ENERGY: Google ***"Phet Masses And Springs"*** and select
https://phet.colorado.edu/sims/html/masses-and-springs/latest/masses-and-springs_en.html

Press PLAY on the web site and select ENERGY (2nd from right).

Set MASS to 200 g. Set DAMPING (friction) to ZERO. Press PAUSE and SLOW. Drag the mass down to the 0 m HEIGHT position.



<u>You will be working with the following energies.</u>
Kinetic (KE) – *energy while MOVING*
Potential from gravity (PEgrav) – *energy with HEIGHT*
Elastic potential (PEelas) – *Energy due to SPRING*
Thermal (Etherm) – *Energy lost to FRICTION (heat, internal)*

1. Press PLAY and observe the mass/spring oscillation. Explain what happens with the kinetic and potential energy as the mass oscillates on the spring.

2. Draw and label the energy levels for (1) when the mass is at the highest point, (2) when the mass is about halfway to the lowest point, and (3) at the lowest point.

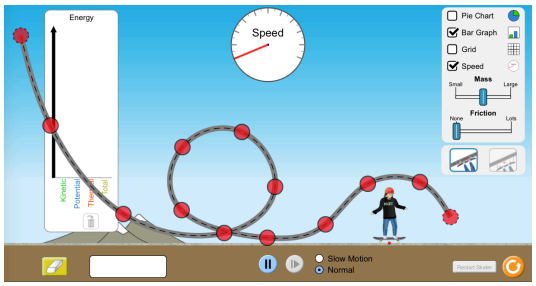
3. Circle the following answers

Where is PEgrav the highest?			Where is PEelas the highest?			Where is KE the highest?		
Bottom	**Middle**	**Top**	**Bottom**	**Middle**	**Top**	**Bottom**	**Middle**	**Top**

4. Press the PAUSE button and then drag the mass/spring about the middle height. Adjust the MASS, GRAVITY, and SPRING CONSTANT using the sliders. Describe what happens to the pendulum's potential energies. Refer to equations for gravitation potential energy and elastic potential energy in the explanation.

5. Set DAMPING (friction) on and press PLAY. What changes occur in the energy bars? What eventually happens to the mass/spring mechanical energy? (ME = KE + PE)

Part C – ENERGY SKATE PARK: Google ***"Phet Energy Skate Park"*** and select
https://phet.colorado.edu/en/simulation/energy-skate-park-basics



Select PLAYGROUND. Check on "BAR CHART" and "SPEED".

Slide the FRICTION to NONE and click on the icon below that locks the skater onto the track.

Create a skate track that looks similar to the figure shown to the right, with a tall incline, a loop, and a small hill.

1. Click on the skateboarder and raise them up to the top of the incline. When you let them go, do they make it around the loop? Why or why not?

2. Click on the skateboarder and raise them to about halfway up the incline. When you let them go, do they make it around the loop? Why or why not?

3. Originally the skater had no energy of any type at rest on the ground. You picked up the skater, giving the skater height and potential energy to start. What physics equation describes what you did to transfer energy to the skater by doing this? *Hint you pulled the skater up, causing and upward displacement.*

4. Increase the mass of the skater and repeat step 1. What happens? Why? Decrease the mass and repeat step 1. What happens? Why?

5. Slide FRICTION to LOTS and repeat step 1. What happens? What did friction do in all three parts of the lab?

6. **HONORS**: Slide FRICTION back to NONE. Select the icon below that unlocks the skater from the track. Adjust the starting point to find the lowest initial height that allows the skater to complete the loop without falling off the track. Is this the same height as the loop height? Why or why not? (Hint: remember there is a minimum speed for a mass around a loop to maintain the necessary centripetal force.)