

LESSON 1:

KINETIC, POTENTIAL, THERMAL, & CHEMICAL ENERGY

NEXT GENERATION SCIENCE STANDARDS

- MS-PS3-2** Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.
- MS-PS3-5** Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.
- MS-PS3-1** Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.

Time: 1 50-60 minute class period

Introduce students to energy and energy conservation.

Complete the online simulation.

The activity can be done individually or in groups.

Hand out the worksheet included to guide them through the simulations.

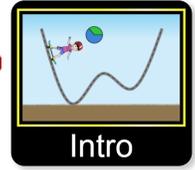
***Have you ever ridden in a roller coaster or gone down a ramp with a skateboard?
If so, you've definitely experienced energy transformations.***

Go to the following site to learn more:

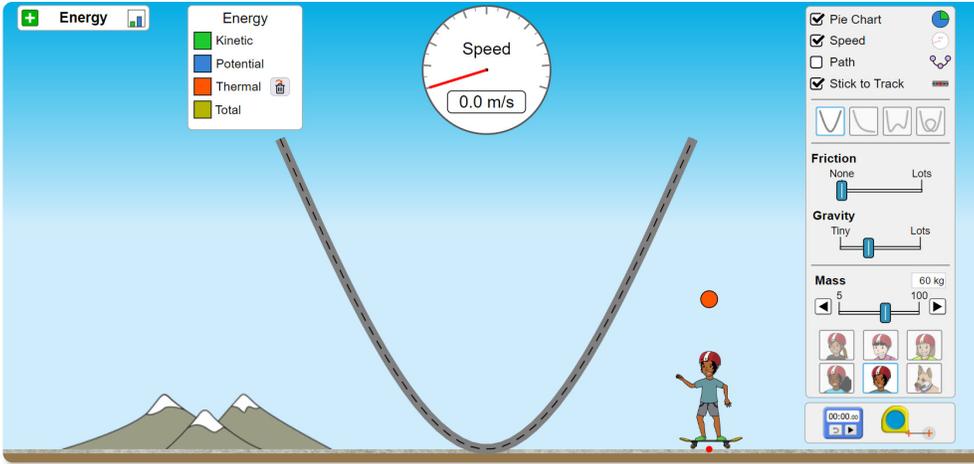
https://phet.colorado.edu/sims/html/energy-skate-park/latest/energy-skate-park_en.html

Student Worksheet

Go to PhET Interactive Simulations *Energy Skate Park* and begin with the "Intro"  https://phet.colorado.edu/sims/html/energy-skate-park/latest/energy-skate-park_en.html



- 1) Start with this screen and check the pie chart and the speed as shown below. Choose the skateboarder that you want and then pull them up to a starting position on the ramp.



Press play and watch the skateboarder go back and forth. The kinetic energy of the skateboard is shown in green and the potential energy is shown in blue on the pie graph.

Experiment for awhile.

Work through the following exercises and jot down your observations and answer the questions:

- 2) Increase and decrease the mass of the skater. How does this change the pie-chart diagram? Explain.



- A) What affects the potential energy and what causes it to increase or decrease?

- B) What affects the kinetic energy and what causes it to increase or decrease?

- C) How are potential energy and kinetic energy connected? Explain.

Lesson Credit: PhET Interactive Simulations, University of Colorado Boulder, <https://phet.colorado.edu>.

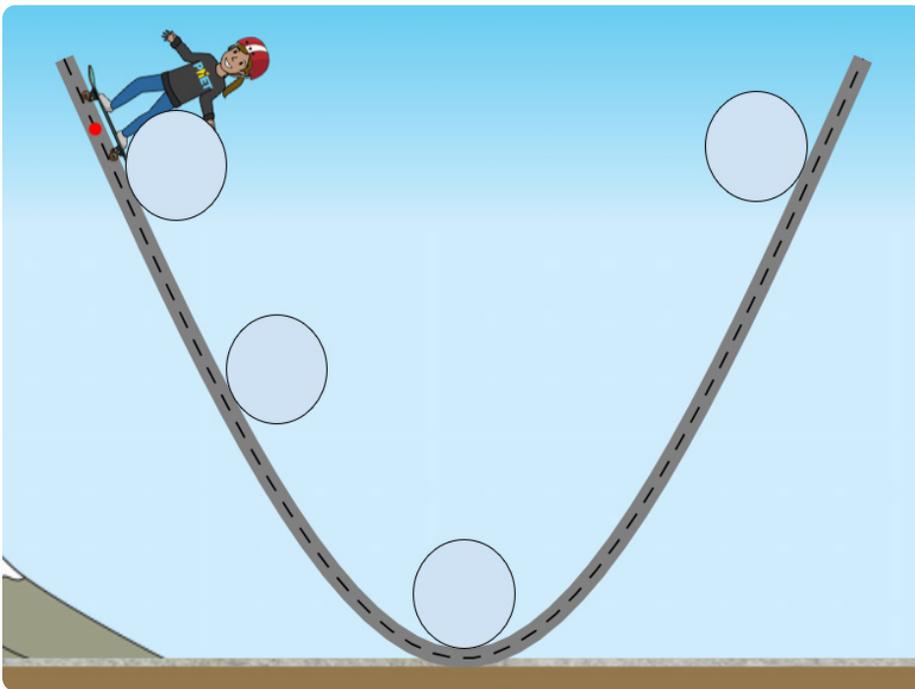
Student Worksheet

3) Now move the friction slider about $\frac{1}{3}$ of the way like this: Drag the skater to the top again and release the skateboarder. Observe the skater moving back and forth.



A) How have things changed now that friction is turned on?

4) Fill in the pie chart for each of the positions shown below:



A) How many times does the skater go back and forth until they stop? Where does the energy go?

B) Where does the initial potential energy eventually go?

C) Where does the kinetic energy eventually go?

D) Does thermal energy ever turn back into potential or kinetic energy?

Lesson Credit: PhET Interactive Simulations, University of Colorado Boulder, <https://phet.colorado.edu>.

Student Worksheet

5) Based upon your observations, answer the following questions and prepare to share your answers to the class.

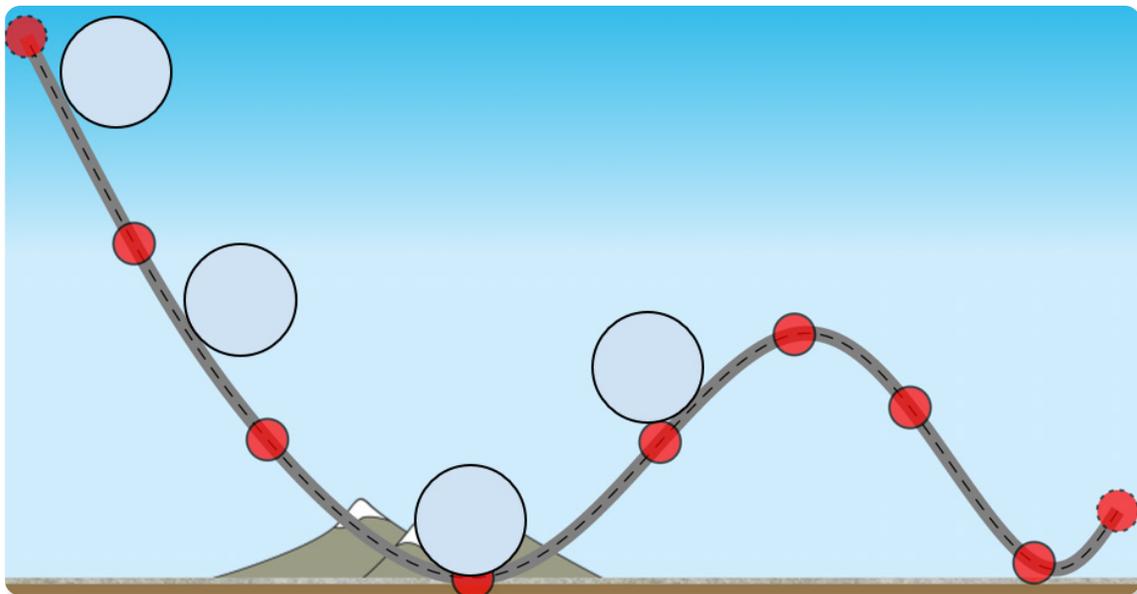
A) What is potential energy? What does it depend upon? Explain.

B) What is kinetic energy? What does it depend upon? Explain.

C) How are potential and kinetic energy related?

D) What is thermal energy? How does it affect the motion of the skater?

E) Using what you've learned so far, fill in the following pie charts for the roller coaster. The roller coaster starts from rest at the top and there is friction.



Lesson Credit: PhET Interactive Simulations, University of Colorado Boulder, <https://phet.colorado.edu>.

Teachers Notes:

A whiteboard is a great way for students to present their findings to the class.

Possible Correct Answers

- 5) Based upon your observations, answer the following questions and prepare to share your answers to the class.

A) What is potential energy? What does it depend upon? Explain.

Potential energy depends on the mass of the object and the height above the surface of the earth. Potential energy increases with height. Potential energy also increases with mass.

B) What is kinetic energy? What does it depend upon? Explain.

Kinetic energy depends on the mass of the object and how fast it's moving. An object does not have kinetic energy if it's not moving. Kinetic energy increases with velocity and with mass.

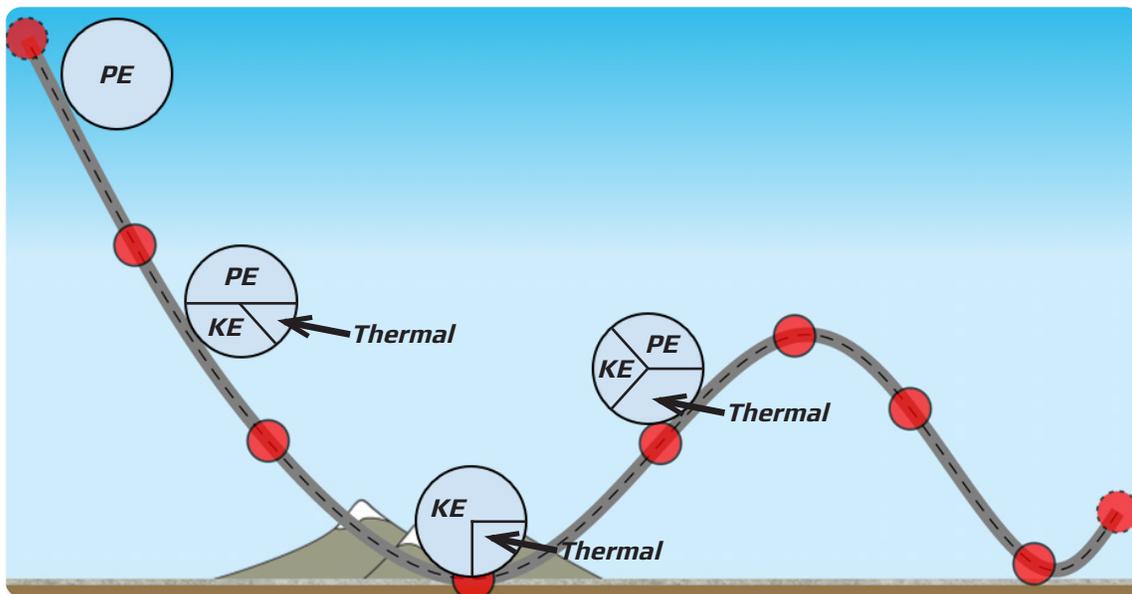
C) How are potential and kinetic energy related?

Energy can change from one form to another. Potential energy can turn into kinetic energy and then back into potential energy.

D) What is thermal energy? How does it affect the motion of the skater?

Potential energy and kinetic energy can turn into thermal energy also known as heat. Heat does not turn back into potential energy or kinetic energy (nonconservative). Kyle spoke about heat in the video. Most of the race car's chemical potential energy turns into heat.

E) Using what you've learned so far, fill in the following pie charts for the roller coaster.
The roller coaster starts from rest at the top and there is friction.



Lesson Credit: PhET Interactive Simulations, University of Colorado Boulder, <https://phet.colorado.edu>.