You may have had some fun playing with our Wacky Racers exhibit in ***Dr. Forces Travelling Energy Extravaganza***. There are two different track set ups in the exhibit. You can race your racer down either set of tracks. One set of tracks is lower than the other. How does that affect the speed of your racer? In this design lab you will learn about potential energy and kinetic energy using a simulation app.

Important Questions:

- How can we determine the amount of potential and kinetic energy in an object?
- What is the relationship between an object's potential energy and its kinetic energy?
- How does a change in the potential energy affect kinetic energy and the speed at which on object moves?

You can find the answers to these questions through an investigation of a simulation of a skate park. A skate park is like our Wacky Racers exhibit. We both have ramps of different heights and slopes.

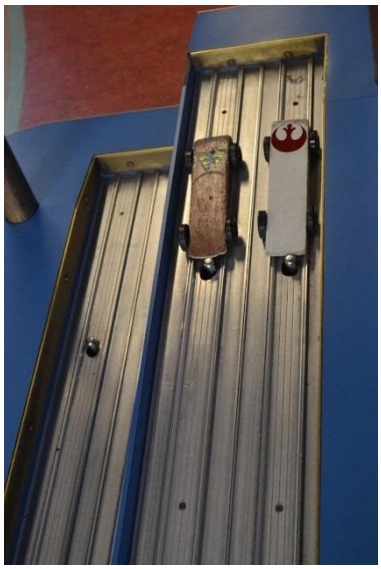
CHILDREN'S MUSEUM OF VIRGINIA PORTSMOUTH

Instead of one of our Wacky Racers, you can substitute a skate board! Heck they both have 4 wheels right?

Let's Get Started!

Engage:

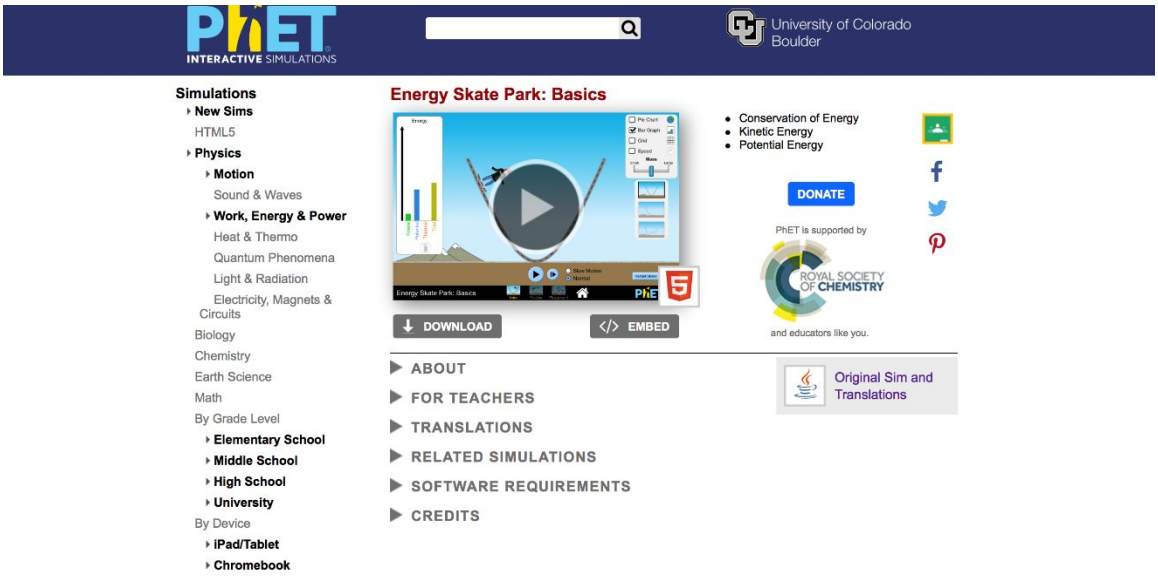
Two Wacky Racers are placed side by side. Seems like a fair race right? What is you were to place the brown car in the set of tracks that are lower? Would that be fair? Why or why not?



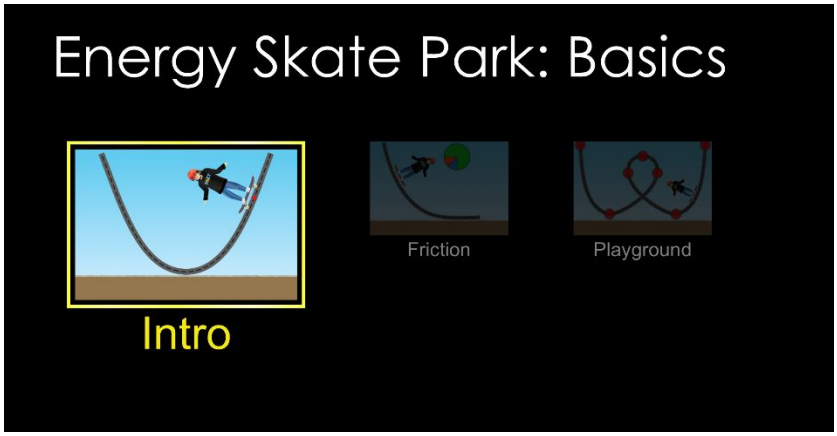
Explore:

Click this link:

https://phet.colorado.edu/en/simulation/energy-skate-park-basics



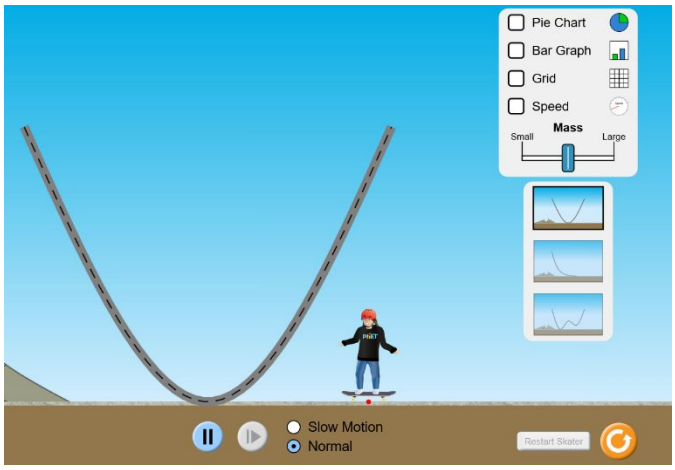
Click on the play button and this screen appears:



(5 – 7 minutes) Click the "Intro" button.

Notice that you can place your skater into the half pipe by dragging and dropping along the sloped track.

You can place your skater at various positions along the track. How does your skater move when you place the skater high on the track? How about when you move the skater lower?



You can restart your skater by clicking the Restart Skater button.

You can quickly reset your skater by clicking this button

There are a lot of ways to display the data while the skater is moving. Try clicking each one.

The grid button is useful in measuring the height of the start of the slope.

Finally you can try the two other tracks by clicking on the curved ramp or the "W" shaped ramp (it has a hump in the middle).

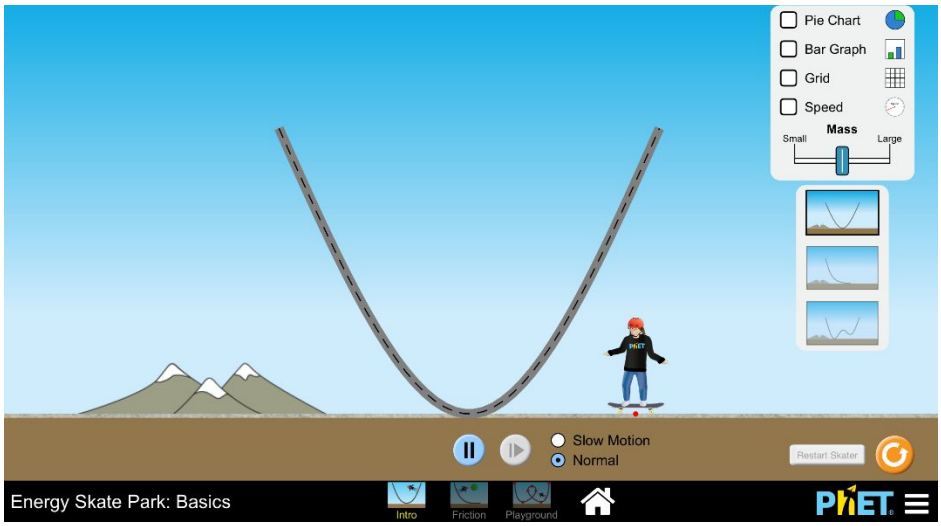
Explanation:

(25 – 30 minutes)

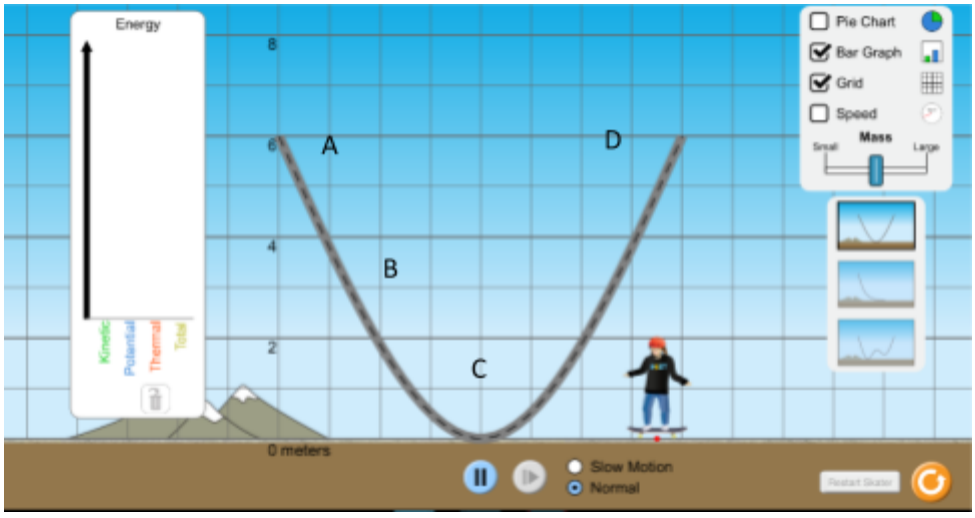
This phase has an investigative goal.

Aim: Explore the relationship between the skater's potential energy and kinetic energy. Can you come up with a rule to explain that?

Reset all the settings you have placed on the screen by clicking the orange button. (Your screen should look like this.)



- Check the box that says "Grid".
- Use the ramp shaped like a U.
- Select the box next to "Bar Graph".
- Your screen should now look like this (without the letters).



<u>Directions:</u>

1) On the top right corner there is a grey box with different types of tools used for collecting data. Click and make sure there is a check next to the speed meter and the pie graph.

2) Click the slow-motion option at the bottom to make it easier to see the change in the speed meter and the pie graph.

3) Click and drag the skater to the top of the ramp's left side. Release the skateboarder.

Half-Pipe:

The first time, just watch prior to collecting data. Observe the changes of energy with the pie chart. After observing with the pie chart, observe the changes of energy on the bar graph (make sure there is a check).

Reset the Skater and be sure that the same data tools are being used.

In the table below, write down whether the quantity of potential, kinetic, and total energy *increases, decreases*, or *stays the same.*

Position	Potential Energy	Kinetic Energy	Total Energy
A			
B			
C			
D			

Questions

1. Where does the skater have the most potential energy?

_____

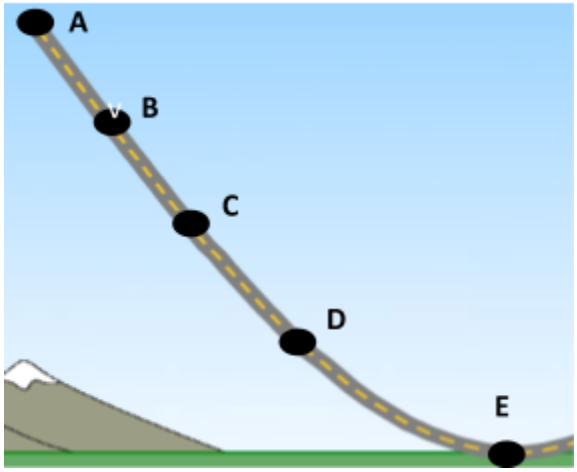
2. Where does the skater have the most kinetic energy?

_____

3. How does the mass of the skater affect the total amount of energy?

_____

Curved Ramp:



The first time, just watch prior to collecting data. Observe the changes of energy with the pie chart. After observing with the pie chart, observe the changes of energy on the bar graph (make sure there is a check).

Reset the Skater and be sure that the same data tools are being used.

In the table below, write down whether the quantity of potential, kinetic, and total energy *increases, decreases*, or *stays the same.*

Position	Potential Energy	Kinetic Energy	Total Energy
A			
B			
C			
D			

Questions

1. Where does the skater have the most potential energy?

_____

2. Where does the skater have the most kinetic energy?

   _____

3. How does the mass of the skater affect the total amount of energy?

_____

Wavy Ramp: (A is the first point on the left, E is the last point on the right)

The first time, just watch prior to collecting data. Observe the changes of energy with the pie chart. After observing with the pie chart, observe the changes of energy on the bar graph (make sure there is a check).

Reset the Skater and be sure that the same data tools are being used.

In the table below, write down whether the quantity of potential, kinetic, and total energy *increases, decreases*, or *stays the same.*

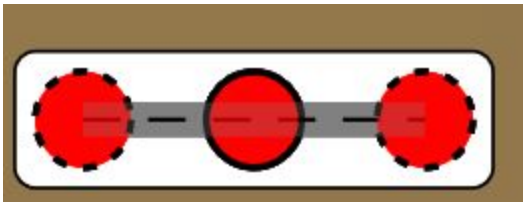
Position	Potential Energy	Kinetic Energy	Total Energy
A			
B			

C			
D			
E			

Extend:

1. Now that you know a little bit about potential and kinetic energy, you are going to get your creative juices flowing.

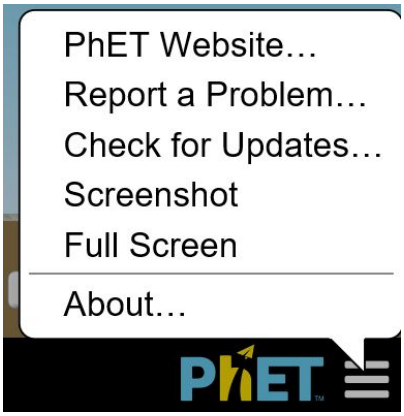
2. You are going to go to the tab on the bottom that says "Playground" and create your own ramp and test the kinetic and potential energy.



- Note the three red dots on the bottom of your screen. Drag and drop them to the playground. You can drag and drop multiple sets of track to connect.

3. Make multiple different versions and see if you can change the maximum amount of energy that your ramp has. You can get really creative making jumps and loops. If you want your skater to catch some "air" select the button that is off the track.

4. Choose one of the ramps that you have created. Post a picture or Children's Museum of Virginia Facebook page and tell us where the skater has the most potential energy and the most kinetic energy. You can take a screen shot by clicking the tab in the lower right side of the PHET app.



Evaluate:

Questions

1. Where does the skater have the most potential energy?

_____

2. Where does the skater have the most kinetic energy?
   _____
3. How does the mass of the skater affect the total amount of energy?

_____

Conclusion:

As the speed increases, how does the potential, kinetic, and total energy levels change?

_____

_____

_____

_____

_____

Compare and contrast the energy levels on the half-pipe, the curved ramp, and the wavy ramp. What were the similarities or differences between the potential, kinetic and the total energies on these three ramps?

_____

_____

_____

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