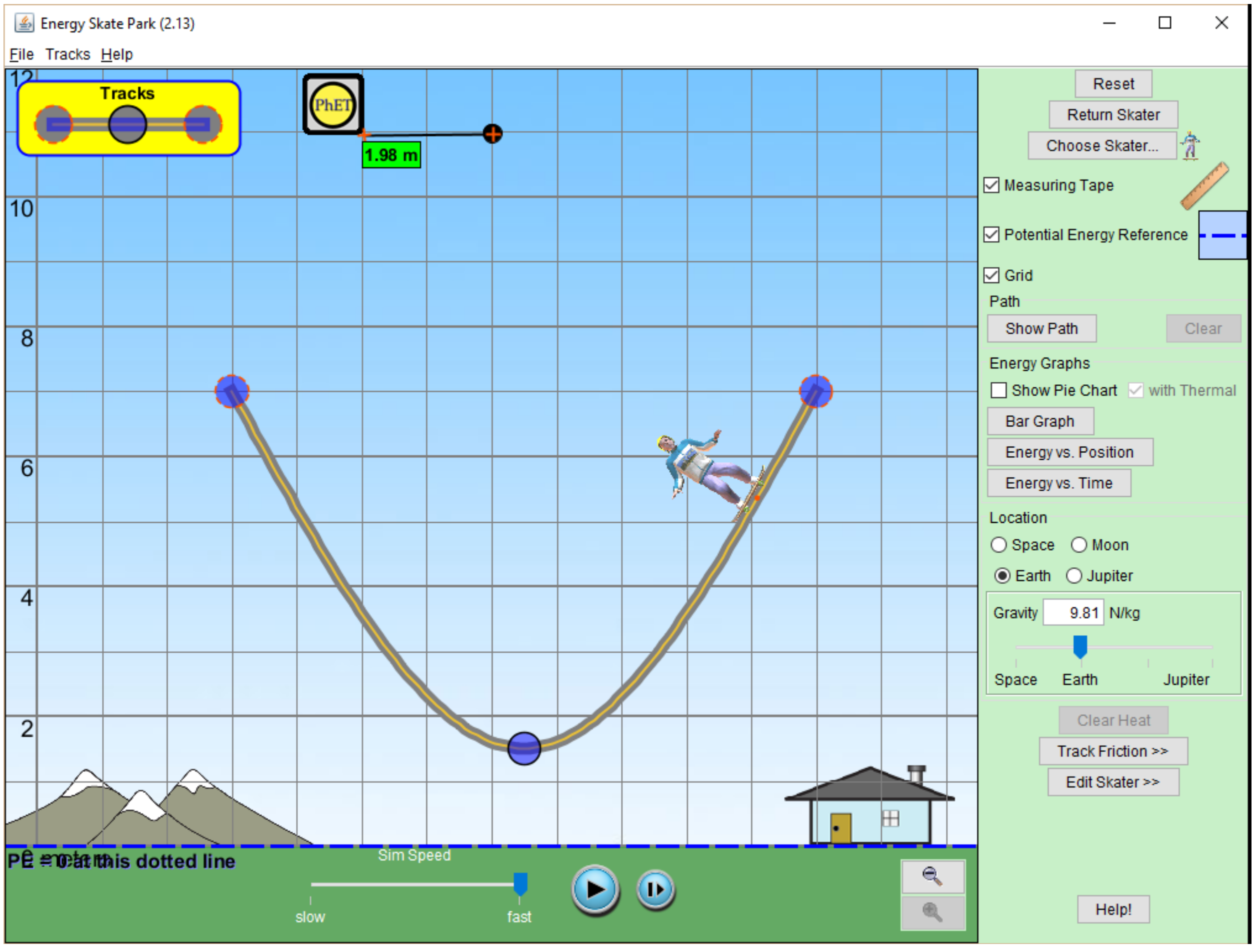
Potential Energy and Motion

Lab Procedure – Answer questions in red.

Download and run the Java application “energy-skate-park_en.jar”. You should see a skater on a simple U-shaped ramp. If the skater is moving, press the pause button.



From the right column on the app, check “measuring tape”, “potential energy reference” and “grid”. Click and drag the middle of the ramp so that the bottom-most part of the ramp is right at the zero potential energy reference level.

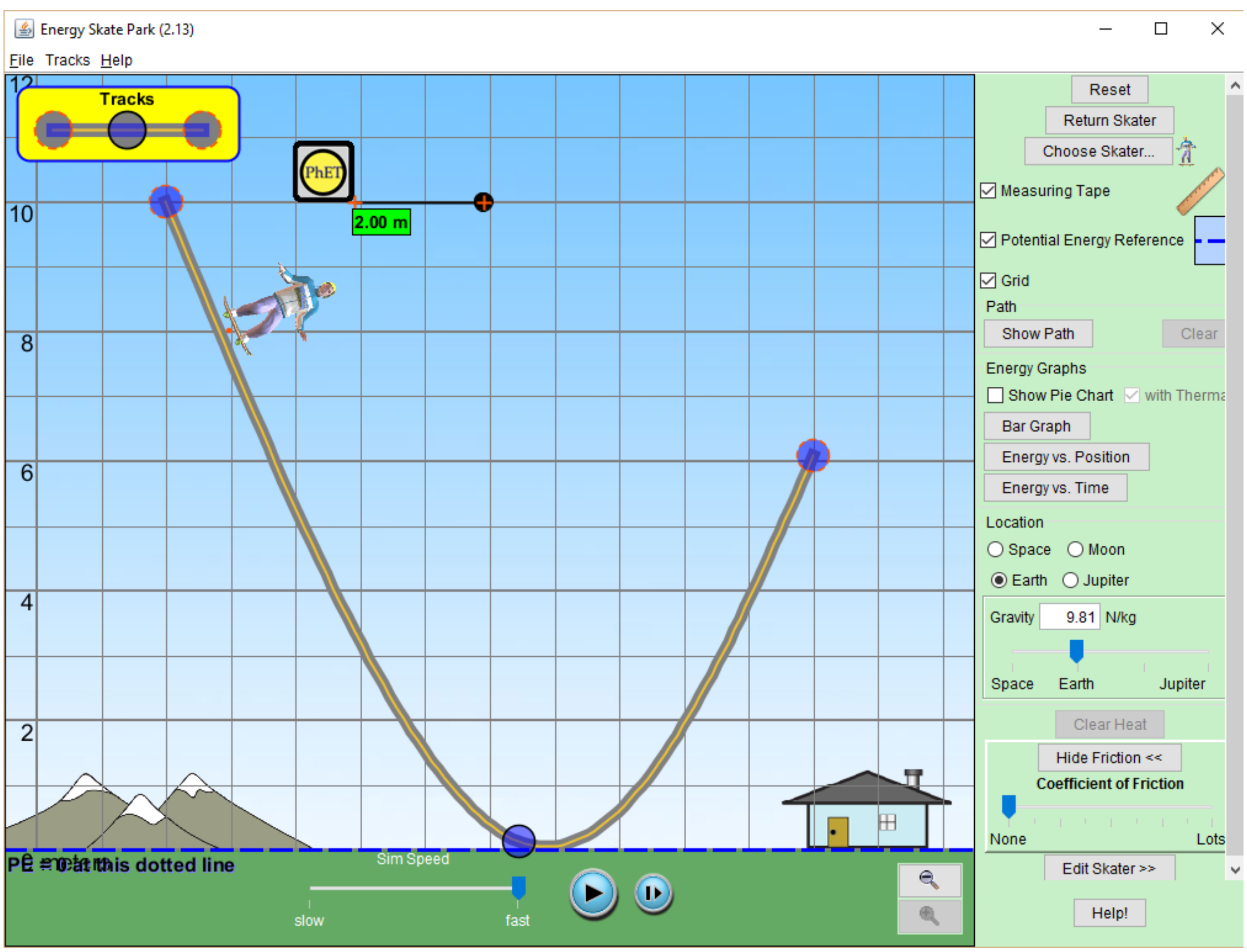
Note: If you mess up on track or other selections, you can always use the reset button on the upper right to get back to the original starting point.

1. Investigate the app. Try raising the left top of the track, then starting the skater from there by dragging him up there.

a) What happens when he is released?

You should try adding some track, changing shapes or building jumps. You can select some pre-made tracks from a drop-down menu at the top if you like. Remember to "reset" if you need to return to the original track.

2. Create the track shown below. Note the starting and ending heights (10m and 6m). The lowest point is at the ground.



a) Position the skater stationary on the left of the track at 8m high. Calculate the skater's potential energy and kinetic energy. Explain your calculation.

b) If you were to release the skater, calculate their potential energy and kinetic energy when they reach the very bottom of the track. Explain your calculation.

c) When the skater reaches the 6m height at the top of the track on the right, calculate their potential energy and kinetic energy. Explain your calculation.

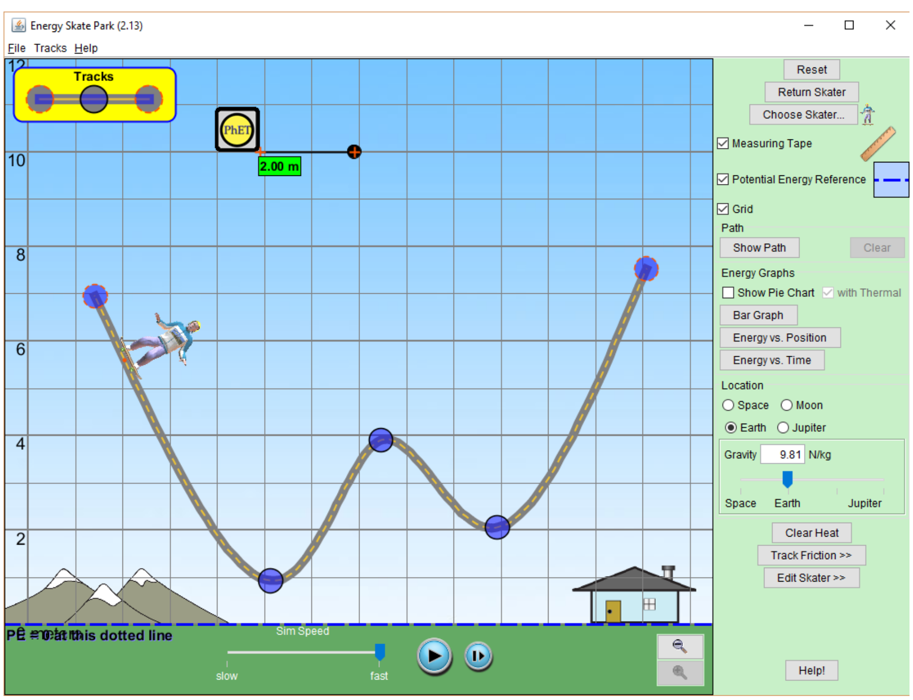
d) Run the simulation described above. Based on your energy numbers from above, explain why the skater flies off the track.

3. With the same track configuration as above, you can add friction to the track. Add just enough friction to the track so that the skater does not fall from the track on the right side. Just try a few values of kinetic friction from the "track friction" button on the lower right of the app. until you find one that works.

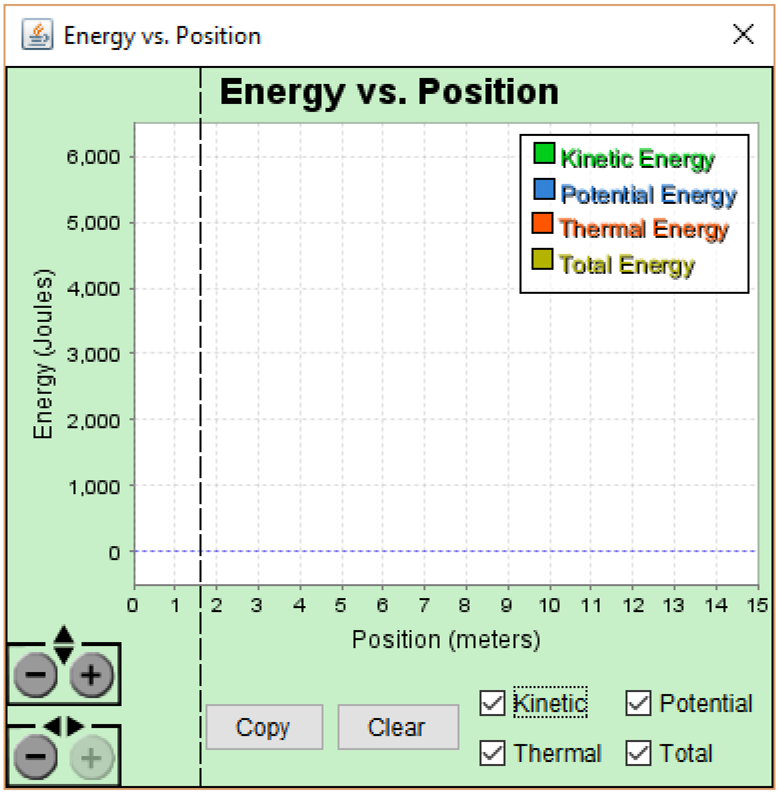
a) Describe what happens to the skater from the moment he is released until he stops with this friction setting.

b) From the standpoint of energy, discuss why the skater moves as he does in (a).

4. Select the "Double Well Roller Coaster" track from the tracks menu at the top of the app.



Also, click the “energy vs. position” button on the right to display an energy vs. horizontal position graph on your screen.



Assume you were to position the skater on the left portion of the track at a height of 6m, then release the skater. Assume zero friction. Predict the following:

a) At what point on the track will the skater have his maximum kinetic energy? Calculate a value.

b) At what point on the track will the skater have his minimum kinetic energy? Calculate a value.

c) At what point on the track will the skater have his maximum potential energy? Calculate a value.

d) At what point on the track will the skater have his minimum potential energy? Calculate a value.

5. Position the skater at the 6m height mark as described above. Play the simulation and stop after one complete cycle of the track. You should see energy plots kinetic, potential, and total energy on the energy graph you opened.

a) Were your predictions and calculations from above reasonably correct? If not, explain why they were not.

b) If you add friction to the track, what happens to the thermal energy over one track cycle for the skater?

c) Can you explain why the total energy on the energy graph did not change, or remained constant, even with friction on the track?