Lesson plan for *Energy Skate Park* Activity 2:
Relating Graphs, Position and Speed (no time graphs)
Time for activity 100 minutes

Learning Goals
Students will be able to:

1. Describe Energy -Position, -Bar, and -Pie Charts from position or selected speeds. *My thoughts about "selected" are zero, maximum, ½ max, etc*
    a. Explain how changing the Skater affects the situations above. *The simulation treats all the objects the same (the same contact area and center of mass is one the track), so changing the type only changes the mass.*
    b. Explain how changing the surface friction affects the situations above.
2. Predict position or estimate of speed from Energy -Position, -Bar, and -Pie Charts
3. Look at the position of an object and use the Energy -Position, -Bar, and -Pie charts to predict direction of travel or change in speed. *By "change in speed" I mean increasing or decreasing if for example the graph shows increasing PE, decreasing KE etc.*

Possible Extension: How does changing PE affect chart?

Background:
My students will have done Energy Skate Park Activity 1 and some concept questions from the text.

Energy Skate Park **Introduction:**
Since my students will have done my first lesson, I won't have to show much how to use the simulation. I'll show a track with the Energy-Position chart and discuss the purpose of the vertical line. If you use Pause and Step this is easy to explain. In the first lesson plan, there are some hints that might be useful. My students are familiar with Excel and so I decided to use the term "chart" for the graphs and chart like it does.

Pre-Lesson: I projected clicker questions 1-3 to have the students think about their present understanding, but I wouldn't go over the answers until the post-lesson. The track is saved under CQ 1-3.

Lesson:
Have the students use the lab sheet for guidance. The activity took my honors physics students about 100 minutes.

Post lesson: Use the clicker questions with the simulation during discussion of the answers. I would open Skater and the track for questions 1-3 before class and change the character to the female one because the track saves with the male skater. The blue dots on the questions were drawn in paint and I couldn't make the same track using track pieces to get the blue dots. The track for the next questions are saved too.
Next lesson: I have the students design an experiment to determine how well the relationship between Potential Energy of a cart at the top of a ramp and the Kinetic Energy of the cart at a lower height compares to the predicted equation. We use high quality physics carts and Vernier Photogate timers to find the speed of the cart. The students are able to predict that the relationship should be linear with a slope of one and we generally get good accuracy and precision. Then, we continue our study with Energy Skate Park 3 Speed and Height calculations.

Student directions *Energy Skate Park* Activity 2:
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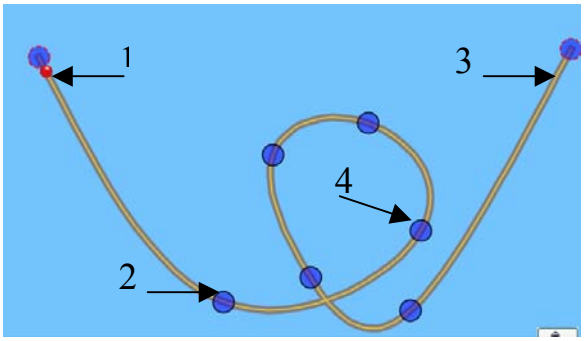
Learning Goals: Students will be able to:

1. Describe Energy -Pie, -Bar, and -Position Charts from position or selected speeds.
    a. Explain how changing the Skater affects the situations above.
    b. Explain how changing the surface friction affects the situations above.
2. Predict position or estimate of speed from Energy -Pie, -Bar, and -Position Charts
3. Look at the position of an object and use the Energy -Pie, -Bar, and -Position charts to predict direction of travel or change in speed.

1. Josie made a *frictionless* hot wheel track that looks like the one shown. She placed a red rubber ball on the left top of track at 1.
    a. Make a data table like the one below
    b. Fill in the Prediction column by sketching what you think the Pie chart will look like for the ball at points 1-4.
    c. Use the **Loop Track** with the **Ball** Skater to test your ideas and make any adjustments



	Pie chart		
	Prediction	Simulation	Explain differences
1			
2			
3			
4			

2. Pretend that Josie can magically change the ball to different things like the simulation can.
    a. What do you think would change about the Pie Charts?
    b. Explain why you think the charts would similar or different.
    c. Check your reasoning using the simulation and make corrections if necessary.

3. Josie has a friend, Phillip that can magically change the friction on the track like the simulation can.
    a. What do you think would change about the Pie Charts?
    b. Explain why you think the charts would similar or different.
    c. Check your reasoning using the simulation and make corrections if necessary.

4. Work with your partner to build a track and sketch it.
    a. Make a table like the one you did for question 1.
    b. Predict what you think the charts will look like.
    c. Use the simulation to check your ideas.
    d. Test your ideas from questions 2 and 3. Make changes to your answers if necessary.

5. Explain how you can use what you understand about pie charts to predict bar charts.

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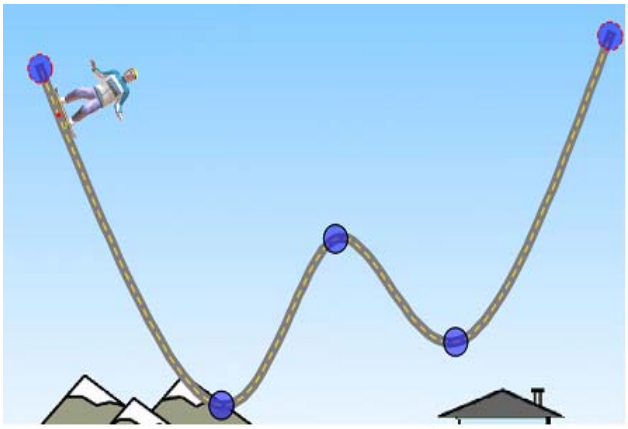
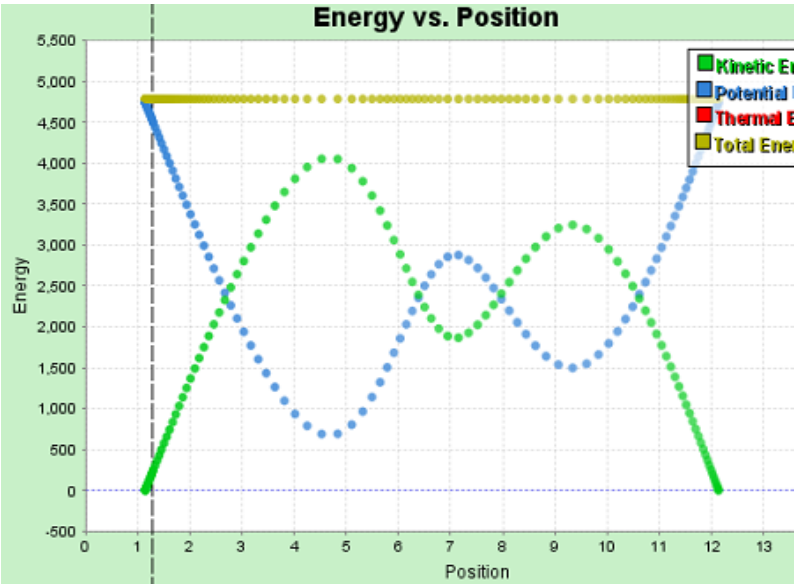
6. Sketch this track and label where the 5 spots could be.
   a. He is at his maximum speed
   b. He is stopped
   c. He is going his average speed
   d. He is going slow
   e. He is going fast



7. Sketch this energy-position graph and label where you think the same 5 spots are.
   a. Test your ideas using the **Double Well Roller Coaster** track.
   b. If one of your friends in the class asked you for help making sense of this type of graph, what would you say?



8. Talk about how you could use the Energy -Pie, -Bar, and -Position charts to predict direction of the ball is rolling.
   a. Check your ideas using the simulation.
   b. Talk about how you could tell if the ball is going to be moving faster, the same, or slower.
   c. Pretend you are writing a test for this unit.
      Type a question that includes at least one type of graph and a Skater on a different track.
      Then, give it to another group to see if they can predict the direction and changing speed of the ball.
      Make sure to attach your question.