In Class Activity Plan

Week 13: Investigating Spring Forces & Circular Motion

90 min **Investigating Spring Forces (**[**Word**](investigating_spring_forces.docx)**,** [**Pdf**](investigating_spring_forces.pdf)**)**

PURPOSE: Investigate situation that can’t be modeled with constant acceleration, introduce Hooke’s Law; introduce relationship between forces and energy.

Video Example: ([Predictions](../../video/week13_1a_1.html))

*Technical Notes:*

* The force sensors need to have their direction reversed so that both the motion sensor and the force sensor see the same direction as positive
* We probably want each group to have a different spring
* They’re going to be coming back to energy at the end of this lab using the force versus displacement graph and the energy stored in the spring

***Seed:***

* Consider the situation of a person just constantly stretching the spring
  + Draw pie charts for this situation
  + Where does the energy from the person go?

10 min **Whiteboard Investigating Spring Forces**

PURPOSE: Summarize results of investigation

Video Examples: ([Boarding1](../../video/week13_1b_1.html), [Boarding2](../../video/week13_1b_2.html))

1) What did you learn?

2) What rules can you make?

3) What questions do you still have?

45 min **Whiteboard Discussion**

PURPOSE: Investigate situation that can’t be modeled with constant acceleration, introduce Hooke’s Law; introduce relationship between forces and energy.

Video Example: ([Discussion](../../video/week13_1d_1.html))

*Goals:*

* Hooke’s Law
  + 
  + The slope of the F vs d graph is the spring constant
* Energy stored in the spring
  + Consider the units of the area under the F vs d curve (get to energy stored in the spring)
  + Need to point out this is negative (and makes sense b/c the integral is negative)

F

d

20 min **Whiteboard - Spring problems (2): Compression Spring (**[**Word**](compression_spring.docx)**,** [**Pdf**](compression_spring.pdf)**) & Crates from a spring (**[**Word**](crates_from_a_spring.docx)**,** [**Pdf**](crates_from_a_spring.pdf)**)**

PURPOSE: Practice modeling situations using Hooke’s law, integrating non constant acceleration situations into existing models.

*Note: Do* one in class and assign the other for homework

25 min **Board Meeting**

PURPOSE: Build consensus around modeling situations using Hooke’s law, integrating non- constant acceleration situations into existing models.

Video Examples: ([Boarding1](../../video/week13_2b_1.html), [Boarding2](../../video/week13_2b_2.html), [Boarding3](../../video/week13_2b_3.html))

40 min **Instructor led discussion - Thinking about circular motion**

PURPOSE: Introducing circular motion, special type of constant a modeling.

Video Example: ([Four perspectives](../../video/week13_3a_1.html))

*Using bowling balls and rubber mallets:*

* Ask the students, how would you have to hit the ball in order to get it to move in a circle? Try it.
* Should find that they need to hit the balls toward the center of the circle (or perpendicular to the motion or something similar).
* Confirm with video from Rutgers: <http://paer.rutgers.edu/pt3/experiment.php?topicid=5&exptid=56>
* Have the students make a motion map for the ball
* Divide the class in quarters, and have each of them find the direction of the acceleration for each ¼ of the motion map on their whiteboard
  + They already know about impulse, so it might be useful for them to be thinking about the force that is changing the momentum in this case

30 min **Whiteboard Discussion**

PURPOSE: Use motion maps to determine uniform circular motion as a special case of a constant acceleration model.

* Looking at each sections acceleration and force diagrams, what can we say about the direction of the acceleration? The net force?
* Either show the geometric derivation of the centripetal acceleration or give the handout to get to 
  + Handout: Centripetal Acceleration Derivation ([Word](centripetal_acceleration_derivation.docx), [Pdf](centripetal_acceleration_derivation.pdf))