In Class Activity Plan

Week Nine: Investigating Forces Part II

*So it turns out that the plan from week 8 was a little more than a single week could hold, so we’re still doing some of that stuff.*

20 min **Practice with Force Diagrams (**[**Word**](practice_with_force_diagrams.docx)**,** [**Pdf**](practice_with_force_diagrams.pdf)**)**

PURPOSE: Practice making, using, and interpreting force diagrams in conjunction with system schema.

*Notes:*

* Have them draw two different system schema for each of the similar situations, particularly for the ball leaving the hand problem
* This is a reasonable worksheet to give as a homework as well

10 min **Board Meeting**

PURPOSE: Build consensus on the practice of making, using and interpreting force diagrams in conjunction with system schema.

Video Examples: ([Discussion1](../../video/week9_1d_1.html), [Discussion2](../../video/week9_1d_2.html))

* System schemas should have an arrow for every interaction
  + So the case where the ball is no longer in the hand, there is no interaction between the ball and hand and thus there can’t be any force
  + Watch for students trying to put 2 labels on a single arrow!
* System schema and Force Diagrams should be consistent with each other
  + Fnet­ is the direction of the acceleration
  + Directions are important

20 min **Whiteboard – Scales in an Elevator (**[**Word**](scales_in_an_elevator.docx)**,** [**Pdf**](scales_in_an_elevator.pdf)**)**

PURPOSE: Gain experience reasoning conceptually with force diagrams.

Video Examples: ([Boarding1](../../video/week9_2b_1.html), [Boarding2](../../video/week9_2b_2.html), [Boarding3](../../video/week9_2b_3.html))

*Note:* Probably want to whiteboard this, watch for same things as above. Emphasis on the direction of the acceleration matching the direction of the Fnet

20 min **Board Meeting**

PURPOSE: Gain experience reasoning conceptually with force diagrams.

*Note:* Probably want to whiteboard this, watch for same things as above. Emphasis on the direction of the acceleration matching the direction of the Fnet

15 min **Whiteboard - Newton’s Second Law Variations on a Theme problem #1 (**[**Word**](newton_second_law_variations_on_a_theme.docx)**,** [**Pdf**](newton_second_law_variations_on_a_theme.pdf)**)**

PURPOSE: Practice modeling phenomena with new law, N2, and new representational tools.

*Notes:* They will try *very* hard to just answer the question without making a model

10 min **Board Meeting**

PURPOSE: Build consensus about modeling phenomena with new law, N2, and new representational tools.

15 min **Whiteboard - Newton’s Second Law Variations on a Theme problems #2 & 3 (**[**Word**](newton_second_law_variations_on_a_theme.docx)**,** [**Pdf**](newton_second_law_variations_on_a_theme.pdf)**)**

PURPOSE: Practice modeling phenomena with new law, N2, and new representational tools.

*Notes:* Split up #2 & #3, have half of the class do one and the other half do the other.

*Individual Problem notes:*

* #1 - #3: All the same situation
  + Why bother? – Different quantities are given so we can find certain other quantities
  + It’s always the same system schema and force diagram

10 min **Board Meeting**

PURPOSE: Build consensus about modeling phenomena with new law, N2, and new representational tools.

Video Examples: ([Discussion](../../video/week9_4d_1.html))

25 min **Whiteboard - Newton’s Second Law Variations on a Theme problems #4 or 5 (**[**Word**](newton_second_law_variations_on_a_theme.docx)**,** [**Pdf**](newton_second_law_variations_on_a_theme.pdf)**)**

PURPOSE: Practice modeling phenomena with new law, N2, and new representational tools.

*Notes:* Split up #4 & #5, have half of the class do one and the other half do the other.

20 min **Board Meeting**

PURPOSE: Build consensus about modeling phenomena with new law, N2, and new representational tools.

Video Examples: ([Discussion1](../../video/week9_5d_1.html), [Discussion2](../../video/week9_5d_2.html))

*Notes on each problem*

#4 They don’t like the force from the rope on the child, and will try to put the force of the child on the rope in their force diagrams

#5: Using energy to get the velocities is a lot simpler. There are two parts to this problem (the way up and the way down)

***Homework:* Box on Box Problem (**[**Word**](box_on_box_problem.docx)**,** [**Pdf**](box_on_box_problem.pdf)**)**

*Note: You will come back to this homework at the end of the upcoming lab. So it’s important that it is assigned before finishing the Newton’s 3rd Law Lab.*

60 min **Newton’s 3rd Law Lab: Investigating Forces Part Two (**[**Word**](investigating_forces_part_two.docx)**,** [**Pdf**](investigating_forces_part_two.pdf)**)**

PURPOSE: Introduce Newton’s third law to models

*Technical Notes:*

* Have the students open the file for Newton’s Third Law in Logger Pro
  + Logger Pro 🡪 Experiments 🡪 Physics with Vernier 🡪 11 Newtons Third Law.cmbl
  + (This automatically has one of the force sensors with direction reversed so that you get positive values for one and negative for the other)
* Remember to calibrate the force sensors upon plugging them into the LabPro
  + Go to: Experiment 🡪 Calibrate 🡪 Calibrate Now 🡪
    - (1) Enter 0N into the box when nothing is on the hook of the force sensor 🡪 Press KEEP
    - (2) Enter 9.8N into the box with a 1kg mass hanging from the force sensor 🡪 Press KEEP
* The force probes on the carts need to have the wide stoppers on them so that when they collide together, they actually push evenly on the stopper.
* The sampling rate should be increased to at least 500 samples/sec
  + Go to Experiment 🡪 Data Collection… 🡪Sampling Rate

20 min **Whiteboard**

PURPOSE: Describe results of Newton’s 3rd Law Lab

Video Examples: ([Boarding1](../../video/week9_6b_1.html), [Boarding2](../../video/week9_6b_2.html))

* What did you learn?
* What rules can you make?
* What would you say to your friend about the SUV argument?

45 min **Board Meeting**

PURPOSE: Synthesize results of Newton’s 3rd Law Lab; introduce N3 to as law that models must obey.

Video Examples: ([Discussion](../../video/week9_6d_1.html))

*Goals:*

* System schema for each different set-up
  + The force sensors measure the contact interaction in the schema
  + Each sensor reads one force, but it is the same interaction (2 forces for each interaction)
* Newton’s 3rd Law: “For each interaction, there are two forces one on each object, the forces are equal in magnitude and opposite in direction.”
* Rethink your box on box problem, carefully label each force, what is the same?
* Define Newton 3rd Law pairs as: the two forces that describe the same interaction

25 min **Whiteboard - Identifying Newton’s 3rd Law Pairs (**[**Word**](identifying_newtons_third_law_pairs.docx)**,** [**Pdf**](identifying_newtons_third_law_pairs.pdf)**)**

PURPOSE: Integrate N3 into use of force diagram representational tool.

20 min **Board Meeting**

PURPOSE: Build consensus about integration of N3 into use of force diagram representational tool

60 min **Whiteboard - Practice with doing Force Problems**

PURPOSE: Build consensus about modeling phenomena with Newton’s laws, new representational tools, integrating force with other approaches to modeling phenomena.