In Class Activity Plan
Week Two: Practice Constant Motion & Introduce Motion Maps, Develop Constant Acceleration Model

30 min **Constant Motion Activity (Word, Pdf)**

PURPOSE: Introduce Motion Maps; practice with representations

Goals for the students to focus on:

- *Coordination of representations (Consistency between the p-t graph, the v-t graph, and the frame of reference)*
- *Application of constant velocity model rules (see the instructor guide from Week 1)*
- *Introduce Motion Maps (if not done previously)*
  - *See Motion Maps.doc for more information (you can hand this out to students after the discussion if you like)*
  - *Points (dots) represent position at a time*
  - *Arrows represent velocity (speed and direction)*

Seed:

- *On #2 point out that you don't know the initial position from a v-t graph. Get two groups to put different initial positions.*

10 min **Whiteboard – Constant Motion Activity**

Note: Assign individual groups to whiteboard their models for specific problems. Have two groups present that have different answers for #1 and two more groups #2.

20min **Board Meeting**

PURPOSE: Share problem solutions, provide feedback on solutions.

- *Emphasize internal consistency within problem solution - This means both the instructor and students should look for the model for each group is consistent. Note that all groups doing a particular problem do not need to have identical solutions, they may vary by choice of reference frame, so it depends on how each group has chosen to model the situation.*

120 min **Investigating Constant Acceleration Lab (Word, Pdf)**

PURPOSE: Extend graphs and motion maps to now include constant accelerated motion.

Video Examples: (Group1, Group2)

Logistic Notes:

- *Need to add acceleration graph to Logger Pro*
- *Hurry students through page 1 & 2, don't let them spend too much time here*
- *If the lab is too long for a single day, you may want to do a whiteboard discussion after page 8*
- *If graphs are too noisy, the instructor can do some examples with fan carts to get the point across*

Seed:

- Is it ok to throw out the noise in the data?
- Is acceleration actually constant?
- How are position graphs in trials 1-4 different (concavity)?
- Previously, the slope of the position vs. time graph gave the velocity, is this still true?
  - *Consider: How do we now modify this statement "The slope of the position vs. time graph equals the velocity"? (Answer: We have to insert "at any point")*
- Are any of the trials 1-4 similar with respect to velocity graphs?
- Can velocity be negative?
- Can acceleration be negative?
- Can you have a negative acceleration, but be speeding up?
- Table of (1) Direction of Motion (2) Direction of acceleration and (3) Speeding up/Slowing down

15 min

Whiteboard – Investigating Constant Acceleration Lab

PURPOSE: Summarize results from constant acceleration investigation.

Video Examples: (Whiteboarding)

- What did you learn?
  - *Note: "Learning" does not require evidence. Possible examples of learning statements:*
    - *Definitions*
    - *Using the equipment*
    - *Experimental technique (e.g. minimizing the error)*
- What rules can you make (and what evidence do you have to support those rules)?
  - *Note: If you look ahead to the discussion section, as the instructor you'll want to make sure all of those rules appear on various whiteboards*
- What questions do you still have?

45 min

Board Meeting

PURPOSE: Establish consensus on defined terms, and rules for interpreting graphs and motion maps with constant acceleration.

Video Examples: (Discussion1, Discussion2)

Note: Today is a day that you will be in the center of the circle many times (thus, you may not want to wear a short skirt this day)

Terms to define:

- Acceleration must include:
  - Motion maps have changing lengths of arrows
  - Velocity-time graphs are straight lines, not necessarily horizontal
- Get rid of deceleration

- *Here you might ask what deceleration means, and you get multiple answers such as slowing down and negative acceleration, and then you point out this is not a helpful term*

Rules – constant acceleration model

- When constant acceleration, constant v rules don't apply
    - Which rules still apply?
        - Slope of position tells us velocity (*Note: derivative = slope of the tangent line)*
        - Area under the curve of velocity tells us the change in position
- Acceleration is the slope of velocity-time graph
    - Direction
    - $a = \Delta v/\Delta t$
- Area under the curve of acceleration graph tells us change in velocity
    - $\Delta v = a\Delta t$
- In the Motion Maps the change in length of velocity vector is proportional to the acceleration
- Chart of relation between direction of velocity, direction of acceleration, and speeding up/slowing down

60 min **Accelerated Motion In-Class Activity (Word, Pdf)**

PURPOSE: See relationships between representations and apply rules of constant acceleration model

Note: Finish for homework. This is getting turned in for a grade.

Goals:

- Coordination of representations (Consistency between the p-t graph, the v-t graph, the a-t graph, motion map, and frame of reference)
- Application of constant acceleration model rules