In Class Activity Plan
Week One *(There are six hours in each week)*:
Primary goals for the week: Assessment, Community Building Activity, Good Whiteboarding, Constant Motion

How to use the instructor guides: The times for the activities are estimates, in some cases they may be wildly incorrect. Notes in italics are intended to help the instructor implement the activity. Non-italics are either instructions for or questions to ask the students.

5 min **Introduction**
PURPOSE: This is an introduction of you and the class briefly (learning names), discussion of the syllabus comes later.

50 min **Data Collection - CLASS, Force Concept Inventory, SNA**
All three of these assessments are done in a row, and in the order listed.

15 min **Create Instructions to make a paper airplane**
PURPOSE: Provide non-physics context to discuss role of representations, definitions, models. Establish framing of course.

Instructions to Class:

1) Give each group 3 sheets of paper – 1 is for practice, 1 is to create instructions on how to make a paper airplane, 1 is to set aside immediately (15 min)
2) Collect and redistribute sets of instructions
3) Use your 3rd piece of paper to make the other group's airplane

SEED:

- *When you redistribute the instruction in step (2) above, exchange one of the student examples for your own version of the "weird" plane – suggest handwriting those instructions so as to fit in with other instructions*
- *Suggest the students try following the instructions literally (what does "longways" mean?)*
- *Use of diagrams is helpful*
- *Have to make instructions*

Questions to the students during the activity:

- What characteristics define an airplane?
- Why would we have you do this activity?
- What is a model?

15 min **Board Meeting** *(Have students gather in large circle with paper airplanes)*

Q's to class:

1) What did you do to make the airplane? *Note: Choose 3 groups to discuss, 1 that did it right but made assumptions, 1 that was super literal, and 1 that used diagrams*

i. Discussion Goals
- Make assumptions (i.e. what an airplane looks like)
- Using diagrams (*using multiple representations increases communication)*
- The importance of a class negotiation of terms *(use the example of the group that literally followed the instructions to make this point)*

ii) Things to expect from them
- Follow instructions very carefully
- Most of them figure it out because they already know how to make a paper airplane.

2) Why would I do this on the first day of class?
- Learning physics is different than anything else we already know so:
  - Negotiation of terms is necessary(in this case, words like lengthwise and hot-dog style)
  - Communicating of ideas requires multiple representations (= diagrams and words are better than just words)
  - We need to understand assumptions that we've made
  - Participation is key to all of the above (and good communication)

3) What is a model? What do we use models for? What makes up a good model? When do we use models?
- This is to start the conversation about models in the context of science. At this point, there aren't wrong answers here; we want them thinking about what a model does. I would be leading the conversation toward the explain, predict, describe purposes, but there are a lot of good answers here.

20 min **Instructor led discussion** *(at tables)*

PURPOSE: Get students familiar with course policies
- Go through the syllabus
- Give HW #1 – read the syllabus and find 3 things that are interesting (Send an e-mail from an email address that they check regularly) *Note: this is as much about getting them to actually read the syllabus as it is a clever way of getting an e-mail address that they actually use and check*
- Use of textbook

- Go over cheating policy
- Group exam
- Cheating on group exam – if one person cheats on the group exam, the group cheats. So everyone in the group will suffer the same repercussions. Each person in the class to acknowledge they've received this message (eye contact and nods).

20 min **Fundamentals of whiteboarding & Equipment Introduction**

Note: It's convenient if this activity is done on the same day as the constant motion lab gets started

PURPOSE: Introduce equipment and data collection;

Instructions to Class:

1) Get out the computers & motion detectors make position vs. time graphs, velocity vs. time graphs
2) Understand how to set up the sensor to collect data & make sense of what is on the screen *(Don't worry about getting them to understand the relationship between graphs, focus on learning how to use the equipment)*

10 min **Whiteboard – Equipment Introduction Activity**

1. Instructions for collecting data with the motion sensors
2. How to use computers to represent data from motion sensors

Seed:

- *Large writing*
- *Use of colors*

20 min **Board Meeting**

PURPOSE: Principles of good whiteboarding and board meetings

- Rules of Board Meetings:
  - No students should be outside of the circle (it's a circle)
  - It's ok/good/encouraged to ask questions – if you don't get something, say so!
  - You aren't reporting to me. This is the time for you as a group to come to a consensus. This is a discussion among the group of what we learned, not a check-with-me-for-the-right-answers time. Talk to each other, learn from each other!
  - Highly suggest taking pictures of the white boards. This will be the closest thing to notes we give in the class.
  - (Summary boards – created by the students (or LAs), what is the important information we learned?) – this may be saved for a later board meeting.

- Have someone present their whiteboard. Ask a second group if they have anything else to add. Then ask the group whether they agree with everything presented, or whether they would add anything.
- Characteristics of a good whiteboard Question to ask: What makes a whiteboard useful to others?
    - Large writing
    - Use of colors
    - Multiple representations

120 min **Investigating Constant Motion Lab**

PURPOSE: Introduce velocity vs. time graphs & their interpretation; identify patterns among graphs; develop constant velocity model.

Logistic Notes:

- Emphasize working quickly through Trials 1 – 3 *(learn that we don't always need to get perfect data, looking for rough trends)*
- Probably want to stop and whiteboard after first set of question*s (talk about the lack of need for perfect data at this point)*
- Get better data using whiteboard held in front of you
- Autoscale sometimes causes issues because of messy data

SEED:

- Using whiteboard for better data
- Position
    - What would happen if you walked past Motion Detector?
      Note: You can change the "zero" of the motion sensors to get a negative position on the graph.
- Constant Velocity Model
    - Is **velocity** constant?
    - Does noise in data matter?
    - Why the approximation of velocity as a straight line?
      Answer: If you had to actually predict the position based on the data, you couldn't unless it's a straight line
- Particle Assumption – we treat the whiteboard/person as a single moving point.
    - What is moving? (particularly helpful with whiteboard held in front)
    - What do you want the motion detector to pick up?

20 min **Whiteboard – Investigating constant v lab.**

PURPOSE: Summarize findings of constant v investigation

Q's to class:

1) What did you learn?
2) What rules can you make (and what evidence supports these rules)?
3) What questions do you have?

45 min **Board Meeting**

PURPOSE: Establish definitions of relevant quantities, establish patterns in constant velocity

1) Discussion Goals

These definitions should be treated as working definitions that should be addressed as they come-up (emphasis the need for definitions in sentence,, not just it's a thing the graph measures, but "speed represents how fast a particle is moving")

- Definitions for position, displacement, speed vs. velocity, reference point, and frame of reference
    - Position: should ultimately use the reference point
    - Reference point is a point in space
    - Frame of reference include the reference point and the direction
    - Position vs displacement discussion – position is how far from reference point. Displacement is change in position.
    - Speed vs velocity – what is a scalar vs vector? Why does this matter?
- Rules for constant velocity
    - Velocity is constant
    - Direction (+/- vs "towards/away")
    - Origin
        - This is a reference to the (0,0) point on the graph
        - Starting point is a possible replacement for a "time origin"
    - Slope of position graph is the velocity – this lets us draw a velocity graph only based on the position graph.
      Note that students don't yet need to go from velocity back to position
        - Another word for slope is derivative (calculus representation) – we'll talk about this more later.
- Less detail – we're modeling!
    - Focus on salient features when representing graphs
- What does our model look like for constant velocity? (What representations does it contain?) What does it let us do?
    - Words, assumptions, graphs
    - Lets us describe what is happening as we move. We can predict what will happen x seconds from now or in y meters away.

2) Things to watch for
- Use of terms without definitions (velocity in particular)

Homework Week 1:

1. Homework #1: Read the syllabus and find 3 things that are interesting
    a. Send an e-mail from an email address that they check regularly

2. Homework #2: Constant Motion Homework.doc
    a. Practice coordinating position-time graphs with descriptions of motions.
    b. Practice coordinating velocity-time graphs with descriptions of motions.
    c. Understanding the relationship between position and velocity and how to draw one graph from information from the other.
    d. Practice the definition of displacement represented on a graph.
    e. Coordinating all representation and tools in one cohesive problem.