Unit V: Forces: Multi-body Systems
Lesson Plan

Observations

- Car is accelerating
  - How do you know?
  - What does this mean about the forces? Unbalanced or $\Delta v \neq 0$, $\Sigma F \neq 0$
  - What factors affect acceleration? Mass
- Block is accelerating
  - What does this mean about the forces? Unbalanced or $\Delta v \neq 0$, $\Sigma F \neq 0$
  - How is it accelerating relative to the car?
  - How do you know? Tension in string
- Draw System Schema (SS) and two Force Diagrams (FD)
  - Draw system schema objects in "same" position as real system
- If only talk about CAR → GO TO SS and FD with CAR THEN block
  - Is anything else moving? The block → create FD
- Define axes? Direction of motion?
  - When on an inclined plane what direction did we call the direction of motion? Refer back to Unit IV
  - What is the direction of motion in both cases (generally)? Down the ramp
  - What does pulley do? Change direction, not apply another force
  - ERASE pulley from SS
  - Draw SS without pulley, straighten out string
- Define System
  - When we define our system, how do we define it?
  - What do we look for?
  - What things are "moving?"
- Redefine system → car, string AND block
- Draw new FD
- Refer back to forces; is anything unbalanced?
  - What do we notice about the forces?
  - Is anything unbalanced? What direction?
  - How could we measure this unbalanced force?

Measurements

- Acceleration: motion sensor → velocity versus time graph, get slope
- Force of gravity on Block: Fg=m (9.8N/kg)
- Mass of system: keep it constant, just move it around

Objective

- How does $\Sigma F \neq 0$ affect acceleration?
- What are the two variables we're studying? What do we want to keep constant
  - Force and acceleration
  - Mass of system stays constant
  - Can change force on block by moving mass around

Data Collection

- Data table
- Graph of ΣF versus acceleration even though we're taking data in the opposite order
- Graphing this way makes the slope come out to system mass (N/m/s^2) instead of inverse
- Get graph and best fit line and equation for data

Post-Lab

- Get graphs and best-fit equations, whiteboard
- What can you tell me about the slope?
    - Mass of the entire system
    - Units of N/m/s^2
- Does this number look familiar? What units do we usually use? Are these units related?
- Do unit analysis showing how N/m/s^2 = kg
- Definition of unit Newton (N) = kg (m/s^2)
- Can we write the general best-fit equation for this graph?
    - ΣF = ma
    - Summation of forces is equal to the mass of the system times the acceleration
    - Define as Newton's Second Law