Microteach: Constant Acceleration

Understanding by Design Concepts:

1. Identify desired results
    a. To derive a method for investigating the relationship between velocity and position of a car rolling down an incline plane
    b. To show with mathematical and graphical methods that a car's velocity increases (it experiences a constant acceleration) as it rolls down an incline plane
2. Determine acceptable evidence
    a. Students will recall from Unit II: Constant Velocity that one can measure speed by marking off a distance after equal time intervals but realize that this method will not work in the new situation.
    b. Students will create data tables and graphs to display their data. Students will create two graphs: position versus time and velocity versus time. Graphs will be linearized and include best-fit curves and equations.
    c. Students will use the midpoint formula to the calculate values in order to graph velocity versus time as well as using linearization to produce the same graph.
    d. Students will define the slope on the velocity versus time graph as a change in velocity over change in time using similar techniques as in Unit II and be able to explain in words what is happening to the velocity as time increases.
    e. Students will define the best-fit line in terms of the new variables.
3. Plan learning experiences and instruction
    a. Students will engage in the paradigm demonstration. They will be asked to list any observations they can make about a car rolling down a (frictionless) track. From these observations, students will list all things that they can measure from the given observations about the system. Students will devise a question for investigating the relationship between velocity and time by studying position versus time.
    b. Students will run their own experiments using a car, frictionless piece of track, motion sensor and applicable computer software to graph the position versus time movement of their car.
    c. Students will create a graph of their car's position versus time and from that, derive the car's velocity and acceleration through the use of slope.

Behavioral Objective (Mager):

After watching a car roll down a frictionless ramp, students will create a list of observations and possible things to measure in order to (1) formulate questions about the relationship between velocity and position and position and time to guide their research and (2) determine the relationship between these three variable using graphical and mathematical means.

Facets of Understanding attempted:

- Explanation
- Interpretation
- Apply

Materials:

- Ramp/track (as frictionless as possible)
- Car (with as frictionless wheels as possible)
- Motion sensor
- Computer Interface for Motion sensor
- Graphical Analysis (graphing software)

Lesson Details:

- Set up apparatus such that the track is on a slight incline (no more than 30˚) and place car at top of ramp. Tell students to begin observing when you say "now" (after release of the car) and to stop when you say "stop" (right before you've grabbed the car)
- Ask students to tell you all things they Observe (guide them towards observations related to the car)
    - Students will try to say "it sped up" → How do you know? Can you measure speed with your eye? How did we measure speed in the last unit?
    - Students might mention friction → have a frictionless track, don't need to worry about it
    - Might say there is a force acting on it → Can you see forces? What is force? (Do not entertain "force" ideas yet)
- Ask students what they can Measure
    - Cannot measure speed or velocity directly → don't have speed gun
    - Prompt them to think about previous units. Might want to use similar method to Unit II lab → explain why won't work because of short distance, would be difficult to tape every second, ask for other methods
    - Introduce motion sensor and graphical analysis software to gather data
- Ask students to come up with an Objective / something to Prove
    - Guide them to investigate relationship between position and time
    - Can be question or statement
- Describe methods for data organization → what should data table look like; what types of graphs should the students produce

Rationale:

I chose to teach about constant acceleration because not only is it required by state standards but it is an essential concept to understanding movement.

Concerns:

Time

Evaluation Criteria:

- How much students came up with ideas without me telling them
- How much I built off of what other students had previously said
- What the data looks like

Pennsylvania State Standards

C. Apply the principles of motion and force