Kinematics

Essential Questions and Enduring Understandings

Asking the Big Questions - We want to create experiences that have students truly thinking about what they are learning and how it actually applies to life. These are essential questions. Enduring understandings stem directly from the essential questions. They often are not simple answers!

Essential Questions

Essential Question	Enduring Understanding
When an object is accelerating, how is the motion described using a graph, a story and an equation?	Express the motion of an object using narrative, mathematical, and graphical representations.
How is position, velocity and acceleration of an object experimentally determined.	Design an experimental investigation of the motion of an object.
Once data is collected, how is the data used to explain how the object moves?	Analyze experimental data describing the motion of an object and be able to express the results of the analysis using narrative, mathematical and graphical representations.
How fast is an accelerating object moving based on its position at a particular time?	Make predictions about the motion of a system based on the fact that acceleration is equal to the change in velocity per unit time, and velocity is equal to the change in position per unit time.
If two or more objects are moving, how do we find the velocity and acceleration of the center of mass?	Create mathematical models and analyze graphical relationships for acceleration, velocity, and position of the center of mass of a system and use them to calculate properties of the motion of the center of mass of a system.

TIP: Help students make connections about motion that flow from position to velocity and ultimately to acceleration. If students can easily

move from one to the other in both directions, the other topics that follow will be easier for them to formulate.

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Detailed Learning Plan

Suggested Items by Day

Day 1	Teacher Story
Course Introduction (Syllabus, Rules, etc.) Graphing Introduction	During this day you'll do all of the "first-day" items on your school's agenda (syllabus rules, etc.). As an introduction to graphing, have students watch and take notes on the Graphing Types and Linearization "Notes" video. I never liked showing videos in class for the sake of watching a video. I started to use "video watching guides" and didn't like the fact students were "copying"...cell phones made this worse! EdPuzzle is a free online service that allows me to ask questions within the video (MC and Free Response). Students cannot fast forward but can rewind. I can see the results for each student on the teacher side of the program. I still have them take notes...it's up to the students to be honest about copying the notes. **From here on you should be able to find an EdPuzzle Video (usually from Flipping Physics) to get kids thinking about the topics covered for the unit.** It's not exactly a "flipped classroom" but does have students work through some ideas via video and gives them manageable homework. Graphing Types and Linearization Notes Video
NMSI Resources:	See video link above

Day 2	Teacher Story
How to Write a Physics Equation! This is a	Now is the time to practice! Students

"reference sheet" that will give students an idea of how to write a physics equation from a mathematical model. It is color coded and straightforward for the most part.	should be proficient at writing model equations which I refer to as "physics equations." Make sure you go through the notes/reference document, have the students practice, and then use whiteboarding to go over the answers.
NMSI Resources:	How to Write a Physics Equation Handout

Day 3	Teacher Story
Students are asked to determine the number of marbles that can be held by a strand of spaghetti. They need to graphically determine this relationship by plotting load (number of marbles) vs. strength (number of strands of spaghetti). They then use this information to write an equation for the relationship between "load" and "strength."	This is a fairly simple activity for the students to complete but it is an integral activity for students to understand how physics "works" through the rest of the year! This activity will help students see the true meaning of a physics equation: it's a "model" by which students may predict the number of marbles held by any number of strands of spaghetti. Students will learn that MOST of the physics they learn will use this same type of process. They will learn to plot two variables, determine the relationship, find the slope and its meaning, and write a "physics" equation. Make sure your students are proficient with this activity and all of the elements of writing a "physics equation" from the data and graph!
NMSI Resources:	Spaghetti Bridge Graphing Introduction

Day 4	Teacher Story
The Graphing Activity Using Google Sheets introduces students to graphing and linearization through Google Sheets. There are four different sets of data each with a different initial curve.	This activity is critical for student practice and understanding of the digital solution for linearization. It will "help" them through the linearization process and gives them a definite value for the slope of the line. Interestingly, students will need a lot of practice finding slope on their own!
NMSI Resources:	Graphing Activity Using Google Sheets Document and Spreadsheet