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Modeling Freefall with Drag Force on a Spreadsheet

Saturday, April 1, 2023 10:00 AM (15 minutes)

For many students, "calculus"is an intimidating word, while at the same time they find 1D motion with uniform acceleration to be intuitive and easy to visualize. Using a spreadsheet creates an opportunity to demystify this math connection for all students while adding a new skill and enhanced capability to the physics curriculum. Solving for any single unknown in a 1D motion problem is actually a single iteration of a numerical solution that can be "automated"with a spreadsheet model. This model can be adapted to study a wide range of non-ideal physical phenomena and objects in motion. A spreadsheet makes the ideal medium for connecting math to concepts (even for reluctant learners) while dramatically expanding computational modeling capability.

This presentation will share the pedagogical technique in which students program a spreadsheet model using the fill handle to replicate calculations of Newton's 2nd Law to model motion with changing drag force for a falling object reaching terminal velocity. With ideal physics equations and simple instructions, complex models can be built that simulate realistic motion that would otherwise require differential equations. When students assemble the model they can experiment with key variables knowing how the cells are linked in a spreadsheet including mass, cross sectional area and drag coefficient to observe an accurate representation of a real velocity versus time graph. A "living graph"responds to these changes enabling students to observe and study the dynamics of an object as it falls from rest and reaches terminal velocity using inquiry with instant, visual feedback. The presentation will demonstrate how to apply this methodology to a wide range of phenomena related to motion and how it can be efficiently delivered either remotely or in person with the same pedagogical approach. Color coding of cells and copy & pasting of formulas means this approach is readily adapted to be delivered to all student levels including English Language Learners (ELL) and special education students. Other applications include projectile motion, rockets, gravitational fields, electric fields, superposition principle and many others.

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