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Chart a new introductory course,

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Recently, I attended a professional development meeting on teaching to English Language Learners. I was struck by how much "language" we actually teach in our physics classrooms. Students must master our personal abbreviations ("RATN" means "read and take notes" in my class, for example.) They must learn the correct meaning of words that are often misused in casual conversations. A great example of this is the word acceleration. In physics, this term has a much wider meaning than students are used to. Students often believe that acceleration means only to speed up. Of course, acceleration is a broader term meaning defined as the rate of change of the velocity and can mean speeding up, slowing down, and/or changing direction. And then there is the language of equations. Knowing what the letters mean in an equation is a skill that is also necessary to be successful in physics.

The workshop presenter suggested that pictures and charts are very helpful to English Language Learners. I began to think about how much I could help my students learn the language of physics using charts and pictures as well. One of my mentors, Jim Hicks, uses pictures to help students study for the AP Physics exam.

What follows is David Kagan's thoughts on representing the equations of physics in a chart.

Students in the introductory physics course have been described as trying to "take a sip from a fire hose." We all know our students struggle to see the beautiful structure and organization of our science. All too often, they see physics as a rousing game of "guess the formula."

As a strategy to help students think in a more organized manner, the author has forsaken the usual equation sheets in favor of the chart presented here.* The chart is presented the first day without the bottom row of content. Every time a section of the course is completed, a box in the bottom row is added with the appropriate information. The chart, at its current state of completeness, serves as the equation sheet for each exam as the course progresses.

The content in the bottom box is organized by importance. The top portion contains fundamental laws. The middle of each box has definitions of basic concepts. The bottom includes useful relationships derived for specific cases from the laws and definitions. In this bottom portion there are, of course, as many options as to what to include as there are physics teachers.

Sadly, there are no genuine data on the effectiveness of the chart. However, the anecdotal evidence has from time to time put a smile on this old professor's face. One student actually said, "Boy, I am surprised that are so few basic ideas." Give it a try and perhaps your students will no longer find themselves in uncharted territory.

* A larger version of the chart is available at *TPT online* for readers to download at http://dx.doi.org/10.1119/1.4849164.