

Teach Physics First in High School

Guest Column
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The lack of science literacy is a serious national problem. All citizens have to be more scientifically literate in order to be able to make informed decisions on matters that could directly influence their lives. In addition, we will need an increasing number of scientists, engineers and mathematicians in order to maintain our technological and hence economic position in the world. The U.S. congress has recognized this and, among other things, has mandated the various scientific funding agencies be involved in trying to improve the situation. The Laboratory for Elementary Particle Physics (LEPP) at Cornell is funded by the National Science Foundation. Our research goals are to study the fundamental building blocks of matter. In addition, education and outreach is an important part of our mission. We felt it was appropriate to host the first workshop of its kind devoted to the Physics First movement which has the potential of having a profound influence on science literacy.

The majority of us learn most of our science content in high school. So, it is only logical to look at the way science is taught there. The present sequence of Biology, Chemistry and Physics was instituted at the end of the 19-th century based on the notion that physics is the most abstract and mathematical of subjects while biology is entirely descriptive and, thus should be taught first. Today, in the 21-st century, this makes no pedagogical sense.

One of the main goals of Physics First is to put the high school science sequence in a rational order. Physics is the foundation of all the sciences, hence it is the basis for understanding important concepts in both chemistry and biology. For example, how can students understand modern molecular biology without some understanding of both physics and chemistry? Yet, they now encounter these topics only after they have finished their biology course, if they see them at all.

Also, presently, in this country, only 30% of all high school students ever take physics. If physics was the first course in the science sequence, then all students would be exposed to the concepts and methodology of this most fundamental science.

We fully realize that any time there is an attempt to make a revolutionary change, especially in something as far-reaching as the entire high school science curriculum, there are many logistic, cultural and pedagogic challenges. The purpose of the Physics First workshop was to gather high school

science educators together to explore the nature of these challenges and the possibility of overcoming them with the hopeful outcome being a much more scientifically literate citizenry.

One of these challenges is to answer the arguments of the opponents that if physics is taught too early then students do not have the math background and hence get a "watered-down" course. It seems to us there are two fallacies with this:

1) It assumes physics and math are inseparable. Math is indeed a very valuable tool for the professional physicist but math is not physics. In the present high school courses, too many students lose sight of the concepts because there is so much emphasis on problem solving. Mathematics should be used to enhance the physics concepts, not obscure them.

2) It assumes that students who take the present problem solving based course come away with a good understanding of the physics taught. (Otherwise, why insist that this type of course be maintained?) While there is not enough space to go into the details here, national statistics and the experience of college instructors who teach these students in their physics courses seem to belie this.

Finally, it might be of interest to note that the Physics First idea is becoming a national movement. Over 250 individual high schools plus entire public school districts have already adopted it. For example, the San Diego district with 10,000 students completely switched to the physics first sequence 2 years ago; Prince Georges County school district with 13,000 students is adopting it as well as the Cambridge, Mass. district. For those of you who think that it would be difficult in New York because of the regents, the North Babylon school district on Long Island is also adopting the Physics First sequence. Of course, since we are here in Ithaca, we would hope the Ithaca School system and/or districts in the surrounding area would seriously consider it.

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