

WHY REGULAR/CORE PHYSICS IS NEEDED FOR THE 95% OF HIGH SCHOOL STUDENTS WHO ARE NOT GIFTED.

by Jane Jackson, Department of Physics, ASU (May 2019)

Josh, my plumber, age 28, went to a public high school in Greater Phoenix. He regrets that he didn't take physics. *"It scared me",* he said. *"I took earth science. I wish I had taken physics, because it's very practical knowledge that we use every day, whereas earth science is not practical."*

"Being 10 years out, I feel that physics has a very practical daily use. I clean drains; drains have to be sloped and use gravity. That's physics."

"To learn physics, you must have someone guiding you, explaining it. But earth science you can learn on your own. Don't get me wrong; I had a great earth science teacher. Earth science was easier, but it doesn't make my life easier now. "

If Josh were in high school now, he might not have the opportunity to take physics. Several of the 100 comprehensive public district high schools in greater Phoenix no longer have a physics teacher.[i] Others offer only advanced (AP / dual enrollment) physics. Josh and most high school students need REGULAR / CORE physics, which does not require advanced math.

High school physics is the chief STEM pathway to careers and college, research shows.[ii] It is crucial for health careers. Yet only 20% of Arizona high school students take physics. This is **half** the nationwide average of almost 40%.[iii]

Physics is a prerequisite for nearly every STEM job. When schools deny students access to physics, they unilaterally limit students' future opportunities. Most science and technology-related jobs require a basic understanding of physics.

Colleges want incoming students to have biology, chemistry, and physics, and most science majors require at least one physics course for graduation. College physics is packed with content and fast-paced; pre-med, pre-dental, pre-optometry students struggle and fail if they haven't had high school physics.[iv]

Unfortunately, one's zip code too often dictates their access to high school physics. This is harmful; **all** students need opportunities and encouragement to take physics.[v]

Furthermore, we jeopardize Arizona's economic future by not prioritizing high school physics. The STEM economy is here: half of new jobs in the 21st century will require skills that only 20% of the current workforce have. No one has realized that these 20 percenters are the ones with physics skills. Businessmen and politicians have failed to realize that physics is STEM! More than any other course, physics combines science, technology, engineering, and math.

ENDNOTES:

[i] In 2015, nine high schools lacked a physics teacher; the problem has worsened since then.

[ii] The ACT policy platform: K-12 (2013) states (page 8): "ACT research has demonstrated the benefits to student academic performance of a minimum core curriculum that includes the following: ... Three years of science, including rigorous courses in Biology, Chemistry, and Physics ... " Specifically:

* "Students who take the ACT-recommended core curriculum in high school achieve higher ACT scores than those who do not. Compared to graduates who do not take the core curriculum, graduates who take the core curriculum earn composite ACT scores that are, on average, three points higher." ...

* "Compared to high school graduates who do not take the recommended core curriculum, graduates who take the core are more likely to be ready for workforce training programs."

<http://www.act.org/content/dam/act/unsecured/documents/Policy-Platforms-k-12-online.pdf>

"We find that the number of years of a science or math subject taken in high school is associated with significant increases in STEM career interest, with results differing by subject. Taking AP courses in science or calculus appear to have no significant impact on STEM career interest over that of other advanced, non-AP courses. Taking calculus, a second year of chemistry, or one or two years of physics all predict large increases in STEM career interest. Additional years in biology and other subjects show no such relationship."

Philip M. Sadler et al. (2014). *Science Educator*, Vol.23, No.1, pp. 1-13. See Fig. 3.

http://nsela.org/images/stories/scienceeducator/Summer2014/Sadler_231.pdf

"... students in the highest levels (Physics I and Chemistry II or Physics II) are significantly more likely than students in the Chemistry I only group to obtain a baccalaureate degree in a STEM major. ... This finding may also suggest that Physics I, Physics I with Honors, AP Physics B, or AP Physics C are higher level courses than comparable Chemistry I courses ..."

Will Tyson et al., (2007). Science, Technology, Engineering, and Mathematics (STEM) Pathways: High School Science and Math Coursework and Postsecondary Degree Attainment, *Journal of Education for Students Placed at Risk*, Vol. 12, No. 3, pp. 243-270.

Research by others is cited at <http://modeling.asu.edu/AZ/PhysicsEnroll-NeedDouble.htm>

[iii] American Institute of Physics data on high school physics enrollments and availability in USA:

<https://www.aip.org/statistics/reports/high-school-physics-courses-enrollments-0>

<https://www.aip.org/statistics/reports/high-school-physics-availability-0>

[iv] A university physics professor in Phoenix wrote the following listserv post in October 2018.

"Students with a desire to go into a health career (medical doctor, dentist, pharmacist, P.A., P.T., etc.) seem to have no idea that College Physics (PHY-111 and PHY-112) will be required courses for their undergraduate degree – and neither do their high school guidance counselors (and perhaps neither their science teachers)."

"Every year I teach College Physics to 200+ pre-health students, of which only about 1/3 took physics in high school. When asked why they did not take physics, the typical answer is that they did not know it was going to be important. Occasionally I will have a student tell me that it was not offered at his/her high

school, but far more common is that it was offered, but they chose - or were directed - to take life science classes (e.g. AP Biology, Anatomy and Physiology), since that was going to be “their field”.”

“Not only is Physics a requirement for most health care graduate programs and subsequently usually a requirement for the chosen undergraduate program (e.g. BS in Biology), it is also included on many of the graduate school admission tests (e.g. MCAT, Dental Admission Test, Optometry Admission Test). With the College Physics courses ideally covering all the topics on those graduate school admission tests, the courses end up packed with content and the pace is generally quite fast. Every semester I have countless students telling me how they now regret not having taken physics in high school, and other students telling me how glad they are that they did take physics.”

“Nationwide, physics, along with organic chemistry, take the top ‘honors’ for being the courses that stop the most students from getting into medical careers because of the low scores (or even difficulty passing at all). Not exactly an ‘honor’ to be proud of. And largely preventable if the students came to college with a background of high school physics.”

[v] ACT report (March 2018): STEM Education in the U.S.: Where We Are and What We Can Do. <https://www.act.org/content/act/en/research/stem-education-in-the-us-2017.html>

“ACT research has shown that taking rigorous science courses, including physics, in high school is vital to college readiness ... however, in 2015, fewer than 50 percent of high-poverty high schools offered any physics courses” ... See Rigor at Risk: Reaffirming Quality in the High School Core Curriculum (Iowa City: ACT, 2007). In pdf at <https://eric.ed.gov/?id=ED496670>
[See pages 28 and 30.]

“The American Physical Society calls upon local, state and federal policy makers, educators and schools to:

* Provide every student access to high-quality science instruction including physics and physical science concepts at all grade levels; and

* **Provide the opportunity for all students to take at least one year of high-quality high school physics.**” [2013 policy]