

## WHY THE NEED TO DOUBLE THE PHYSICS ENROLLMENT in ARIZONA

In Greater Phoenix, only 20% of high school students take physics, whereas nationally, the percentage has grown to almost 40%. Arizona has ~350 physics teachers, but only ~160 teachers who are certified in physics and are currently employed. Most physics teachers teach primarily other subjects. Three-fourths do not have a degree in physics or physics education.

Why is this important? Because physics is prerequisite for almost all STEM careers. **High school physics is the chief STEM pathway.** STEM jobs are growing twice as fast as other fields.

Two policy statements recommending that high school physics be a **core course** are:

1) ACT policy platform: K-12 (2013):

"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 [MY CAPS] ...** "

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

2) Position Statement of the National Alliance of Black School Educators (2012):

<http://vector.nsbp.org/2012/03/16/national-alliance-of-black-school-educators-endorses-physics-first/>

**"Physics is a gateway course for post-secondary study in science, medicine, and engineering, as well as an essential component in the formation of students' scientific literacy.** Physics classes hone thinking skills. An understanding of physics leads to a better understanding of other science disciplines. Physics classes help polish the skills needed to score well on the SAT and ACT. College recruiters recognize the value of taking high school physics. College success for virtually all science, computing, engineering, and premedical majors depends in part on passing physics. The job market for people with skills in physics is strong. Knowledge of physics is helpful for understanding the arts, politics, history, and culture.

Currently only 25% of Black and Hispanic high school students take any course in physics. Thus many do not even get to the gateway." ...

### Quotes: High school physics is crucial for college & career readiness

The ACT policy platform: K-12 (2013) states (on page 8):

*\* Students who take the ACT-recommended core curriculum [including rigorous physics] 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>

*"... students who take an upper-level sequence of science courses that includes **Physics** are substantially more likely to reach the College Readiness Benchmark in Science (24) than*

students who took only Biology and Chemistry or less.” (ACT 2006, p. 3. 45% are ready vs ~20%), <http://files.eric.ed.gov/fulltext/ED493179.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 (below).

<http://eric.ed.gov/?id=EJ1034751>

*“... 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.

MORE EVIDENCE:

\* Physics majors score higher than almost all other majors, on the MCAT.

\* Physics and math majors score highest on the law admission test: the LSAT.

High school physics is needed for college physics; thus crucial for success in medicine & law!

<http://www.aip.org/statistics/reports/mcat-lsat-and-physics-bachelors>

**Interactive engagement** high school **physics** programs (e.g., Modeling Instruction) are associated with an increase in the number of students who intend to major in STEM, compared to lecture-based physics. They are **highest in the world in science literacy**. *TIMSS Physics Achievement Comparison Study* (2000. Table 15: 47% intend vs 32% in US. Table A4: 595 mean literacy vs 480 in USA) [http://modeling.asu.edu/Evaluations/TIMSS\\_NSFphysicsStudy99.pdf](http://modeling.asu.edu/Evaluations/TIMSS_NSFphysicsStudy99.pdf)

MORE REFERENCES on the need to vastly increase enrollment in high school physics:

High school physics enrollments and availability in U.S.A.

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

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

Data on physics-taking in Greater Phoenix and Arizona:

<http://modeling.asu.edu/AZ/AzCrisisInPhysics.pdf>

ACT data for Arizona Hispanic & White student readiness for college/career in science/STEM:

[http://www.act.org/content/dam/act/unsecured/documents/2015\\_CRR\\_Arizona.pdf](http://www.act.org/content/dam/act/unsecured/documents/2015_CRR_Arizona.pdf)

List of Arizona physics teachers and their certification (or lack thereof). (Search on physics):

<https://oacis.azed.gov/PublicOACIS/NormalPages/EducatorCredentials.aspx>

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More information at <http://modeling.asu.edu> in the section called “Arizona community”.

The graph below shows that “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.” Almost 5000 college students participated in the research study by Philip M. Sadler et al. (2014). *Science Educator*, Vol. 23, No.1, pp. 1-13.

