

Why College-Bound Students should take Physics in High School

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Adapted from a presentation by prof. Harry Tom

What we will discuss

- Inland Empire statistics for HS Physics vs the state and national average
- The advantages of taking HS Physics.
- Barriers to more students taking HS Physics.
- UC admissions Lab Science course criterion.

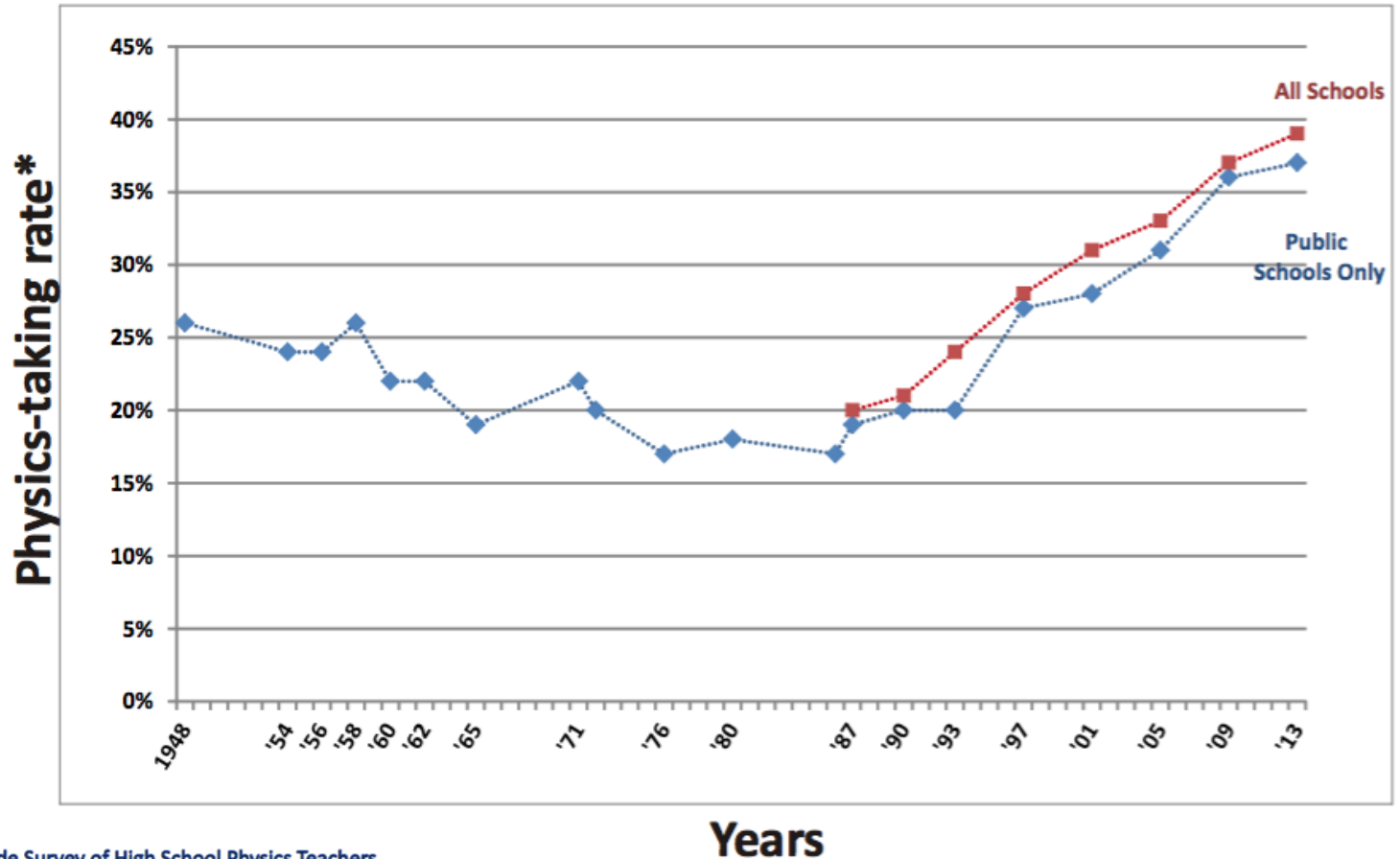
High School Physics

- Inland Empire HS Physics enrollments lag the State by 2x and the nation by 3x.
- This deprives Inland Empire youth of the following advantages
 - Increased success in college prep courses
 - Increased success in college science majors
 - Increased access to physical science and engineering careers.

US High School Physics Enrollment

37% of public HS seniors have taken physics.

Most private HS seniors have taken physics.



Source: The 2012-2013 Nationwide Survey of High School Physics Teachers.

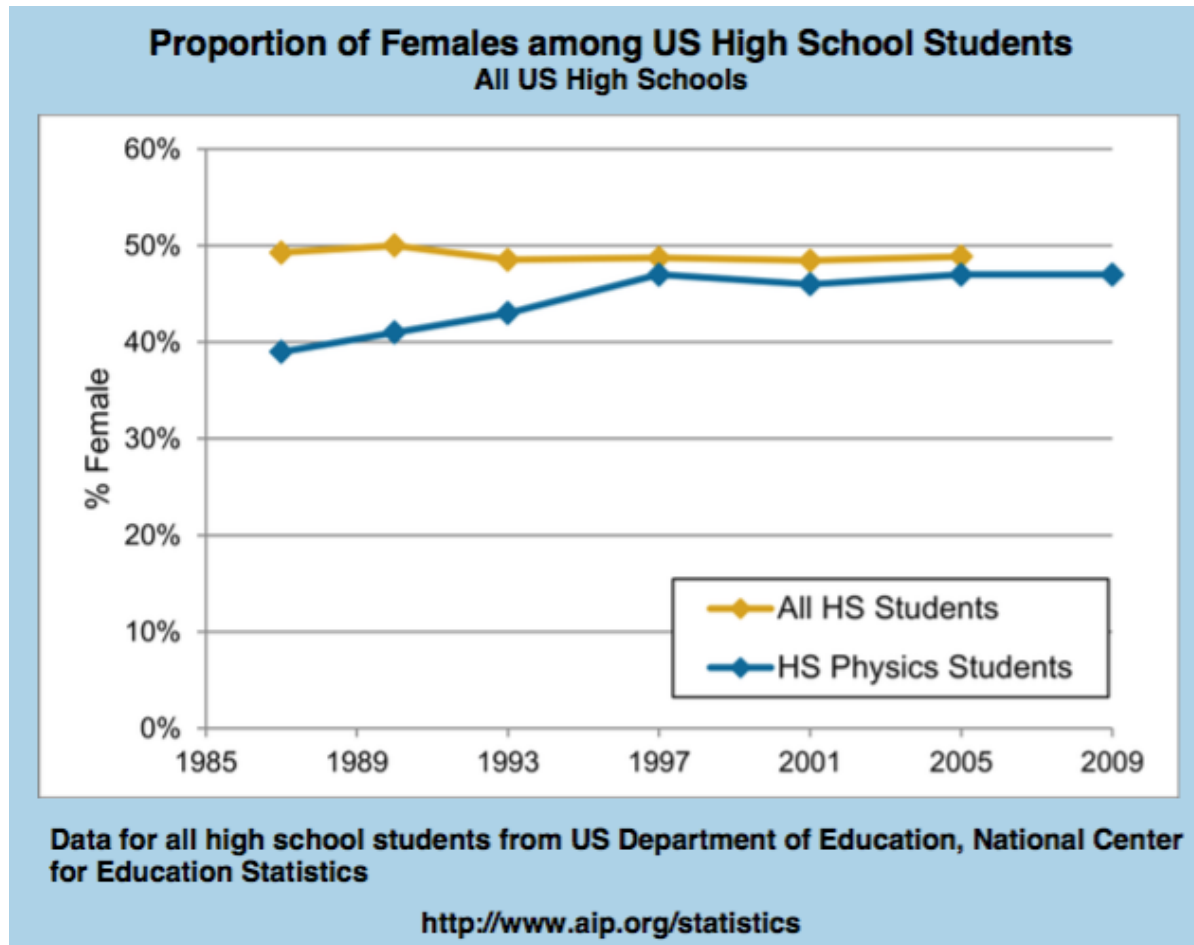
Data prior to 1987 compiled by AIP staff from U.S. Department of Education National Center for Education Statistics and its predecessors.

*The physics-taking rate is the proportion of high school graduates who will have taken at least one high school physics course.



Source: <https://www.aip.org/statistics/highschool>

Female Student Enrollment



Female enrollment in HS physics is about the same as male enrollment.

Riverside County

County Name	Female					Male					
Ethnic Group	Intermediate Algebra	Advanced Math	1st Year Chemistry	1st Year Physics	9-12 Enrollment	Intermediate Algebra	Advanced Math	1st Year Chemistry	1st Year Physics	9-12 Enrollment	Total 9-12 Enrollment
AM IND	60 (13.3 %)	37 (8.2 %)	44 (9.8 %)	12 (2.7 %)	451	40 (10.0 %)	27 (6.8 %)	24 (6.0 %)	11 (2.8 %)	399	850
ASIAN	365 (20.8 %)	575 (32.8 %)	426 (24.3 %)	143 (8.2 %)	1,751	392 (20.8 %)	580 (30.8 %)	403 (21.4 %)	207 (11.0 %)	1,885	3,636
PAC ISLD	57 (19.7 %)	33 (11.4 %)	56 (19.3 %)	6 (2.1 %)	290	42 (13.7 %)	29 (9.4 %)	42 (13.7 %)	6 (2.0 %)	307	597
FILIPINO	309 (22.4 %)	378 (27.4 %)	308 (22.3 %)	83 (6.0 %)	1,379	307 (22.2 %)	310 (22.4 %)	277 (20.0 %)	114 (8.2 %)	1,386	2,765
HISPANIC	4,569 (13.6 %)	3,182 (9.5 %)	3,690 (11.0 %)	691 (2.1 %)	33,623	3,907 (11.1 %)	2,640 (7.5 %)	3,012 (8.5 %)	748 (2.1 %)	35,256	68,879
AFR AM	839 (15.3 %)	517 (9.4 %)	881 (16.1 %)	104 (1.9 %)	5,471	744 (12.8 %)	358 (6.2 %)	708 (12.2 %)	106 (1.8 %)	5,818	11,289
WHITE	3,654 (17.9 %)	3,536 (17.4 %)	3,314 (16.3 %)	709 (3.5 %)	20,371	3,391 (15.8 %)	3,274 (15.3 %)	2,934 (13.7 %)	1,112 (5.2 %)	21,407	41,778
MULT./NO RESP	181 (14.5 %)	175 (14.1 %)	212 (17.0 %)	35 (2.8 %)	1,244	166 (12.8 %)	163 (12.6 %)	168 (13.0 %)	51 (3.9 %)	1,292	2,536
County Total	10,034 (15.5 %)	8,433 (13.1 %)	8,931 (13.8 %)	1,783 (2.8 %)	64,580	8,989 (13.3 %)	7,381 (10.9 %)	7,568 (11.2 %)	2,355 (3.5 %)	67,750	132,330
State Total	172,404 (17.6 %)	140,317 (14.3 %)	143,066 (14.6 %)	50,137 (5.1 %)	979,886	159,922 (15.5 %)	128,241 (12.4 %)	127,588 (12.4 %)	56,632 (5.5 %)	1,032,653	2,012,539

National: 37 % take physics

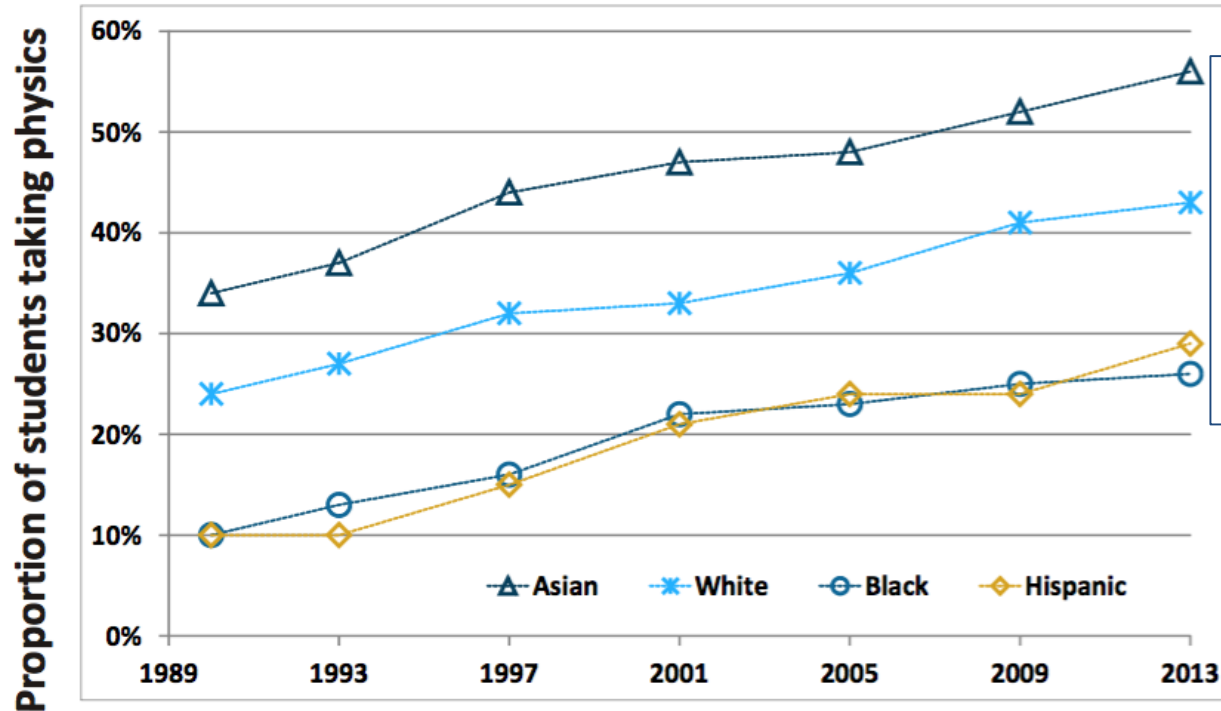
State (CA): $4 \times 5.3\% = 21.2\%$ take physics

Riverside : $4 \times 3.13\% = 12.5\%$ take physics (half state rate, 1/3rd the national rate)

Riverside is a lot closer to the state rate for Chemistry and Advanced Math
We are lagging behind in physics.

<http://dq.cde.ca.gov/dataquest/mathcrse2.asp?RptYear=2007-08&RptName=CoMath&CoName=33,RIVERSIDE>

Physics Enrollment by Ethnic Group



Riverside County proportion taking physics

Asian	38.4% (US/1.5)
White	17.2% (US/2.5)
Hispanic	8.4% (US/3.5)
Black	7.6% (US/3.4)

Riverside physics gap is widest for Hispanic and Black students.

AIP | American Institute of Physics

Source: <https://www.aip.org/statistics/highschool>

Riverside County demographics

Asian	2.7%
White	31.5%
Hispanic	52.1%
Black	8.5%

Impact on Inland Empire Youth

- 3 times lower access to high tech education, jobs, and careers than national average.
- Less competitive for 4-year colleges, which look favorably on harder college prep. courses.
- Lack of experience with quantitative science, applied math, physical intuition, and technical problem solving.
- Physics teachers spend less time teaching physics.

Why Physics is important for all students

- Physics is one of three fundamental core sciences, with biology and chemistry.
 - Physics is equally important to understanding modern life and technology
 - Physics is more fundamental to modern technology and the modern economy
 - Physics builds intuition and analytical problem solving skills

Physics teaches important skills for all college-bound students

- Physics applies math in practical, meaningful ways
 - useful practice in algebra and geometry
 - good for SAT prep
- Physics word problems combine math, physical intuition, and analytical reading skills.
- Exposes students to fundamental principles underlying all technology

Physics is the gateway to physical science, engineering, and computer science careers

- Students are unlikely to find these careers interesting if they don't take physics in high school.
- Middle school physical science is the last physics course that most (88%) of Inland Empire students take!

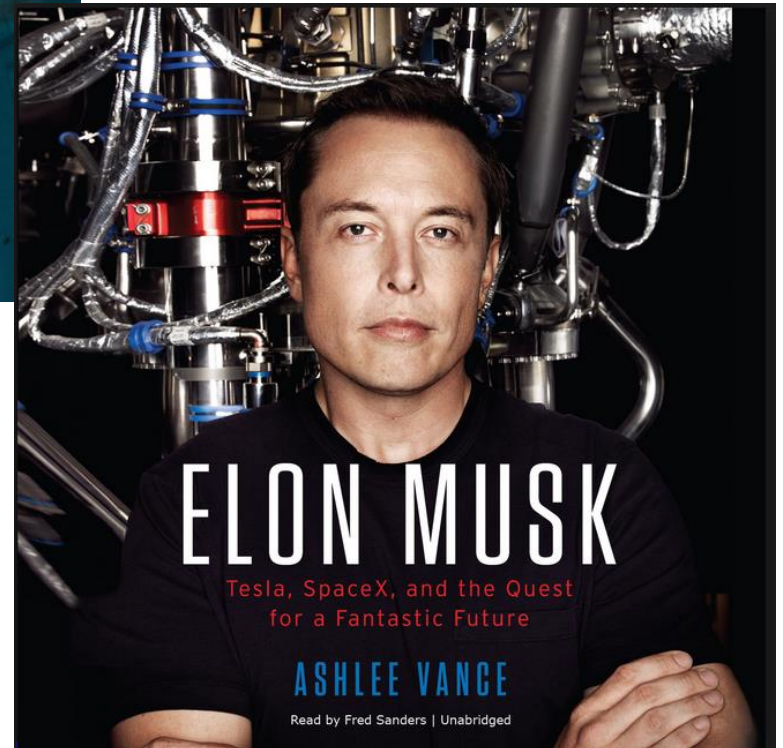
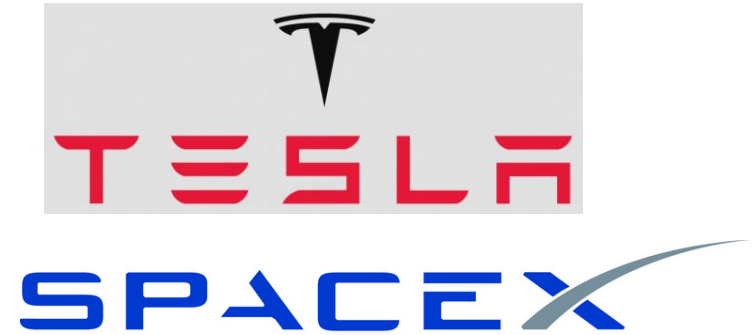
Why High School Physics is important for physical scientists and engineers

- Engineering is applied physics
- Analytical thinking, problem solving, and mathematical training are the heart of the discipline of engineering.
- Today's engineers need physical intuition, differential equations, and computer modeling more than "hands-on" mechanical experience.

The real world Tony Stark (Iron Man)

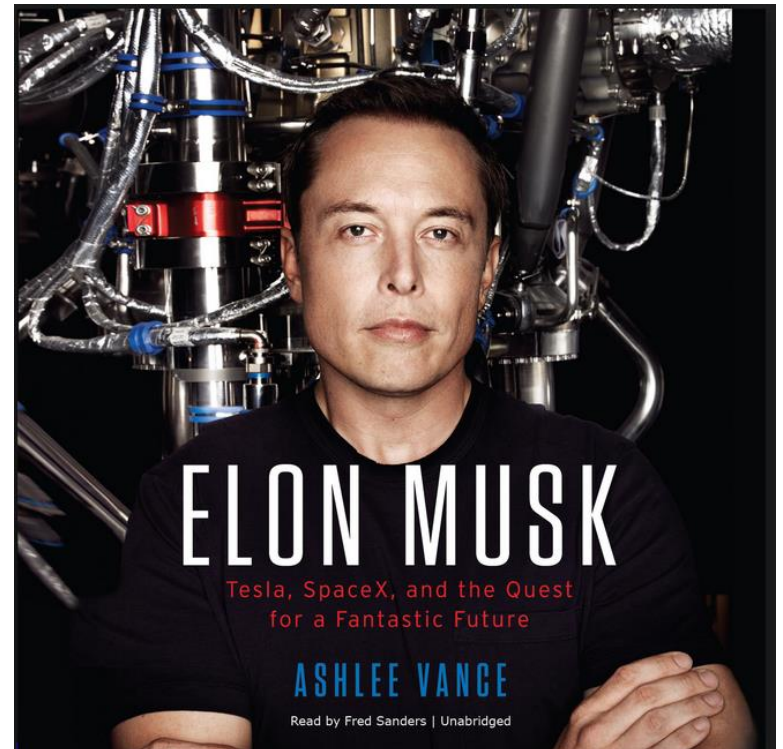


The real world Tony Stark (Iron Man)



The real world Tony Stark (Iron Man)

"Study physics and learn how to reason from first principles rather than reason by analogy."



<https://www.youtube.com/watch?v=lgKWPdJWuBQ>

<http://www.aps.org/publications/apsnews/201310/profiles.cfm>

STEM Careers and physics

- 1.5 times more physics-related jobs than life-science-related jobs.
- 3 times more computer-related jobs than life-science-related jobs.
- Life science and chemistry jobs are only 30% of the STEM total

High School students who don't take Physics are unlikely to pursue the majority (70%) of STEM careers.

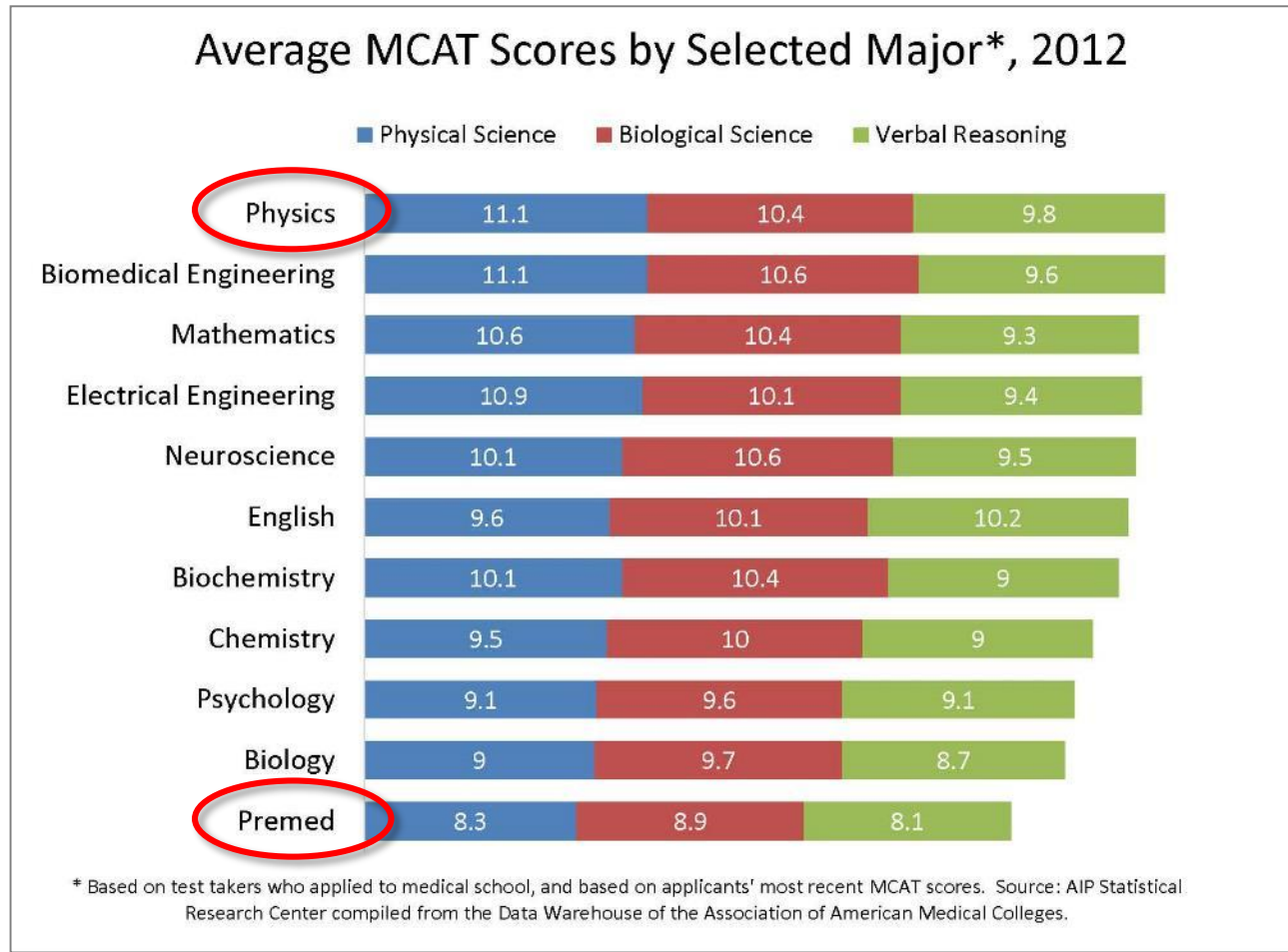
Physics is essential for college bound students

- All science and engineering majors must take 1 year of college level physics.
- Not taking physics in high school puts students at a disadvantage and at higher risk of failing in a STEM major.

College Physics Course Requirements

- Engineering (mechanical, electrical, civil, ...)
 - 2 years math, 1 year chemistry, 1 year physics
- Computer Science
 - 2 years math, 1 year physics
- Life Science
 - 1 year math, 2 years chemistry, 1 year physics
 - 25% of science knowledge tested on the medical school admission test (MCAT) is physics.

For those that want to be doctors...



kind of ironic.

Why aren't more Inland Empire students taking physics?

- Parents and students don't know how important physics is
 - Relative importance of physics has increased as the economy has become more technology driven.
 - Silicon Valley is the 7th largest economy in the world!
 - Physics-related careers are growing relative to the population
 - College physics courses are required.
 - Students who have taken HS physics have an advantage.

Why aren't more Inland Empire students taking physics?

- School administrators and counselors think physics is too difficult: lowers school test performance, worried that low grade in physics will lower student GPA and derail college admission
 - BEST advice to student is to take Biology, Chemistry, *and* Physics (not anatomy, earth sci, env sci)
 - Administrators and counselors should be informed about the importance of physics and the physics gap in the Inland Empire (1/3rd the national rate).

UC Admissions D requirement: Lab science

- 2 years (3 recommended) in 2 of the 3 foundational subjects: biology, chemistry, and physics.
- 9th grade Earth Science, Anatomy, Physiology, and non-AP Environmental Science do *NOT* count.
 - Some integrated science courses count but aren't really competitive.
- Solid preparation for a STEM major:
 - Bio (9th), Chem (10th), Phys (11th), AP science (12th).

<http://admission.universityofcalifornia.edu/freshman/requirements/a-g-requirements/>
<http://www.ucop.edu/agguide/a-g-requirements/>

Special role for AVID

- Additional counselor opportunity to put students on college bound track
 - Inform students about careers and job market
 - Inform students that success in college in ANY science requires physics in college (HS physics is important).
 - Can create a culture of students taking physics, helping each other to learn and succeed in physics.

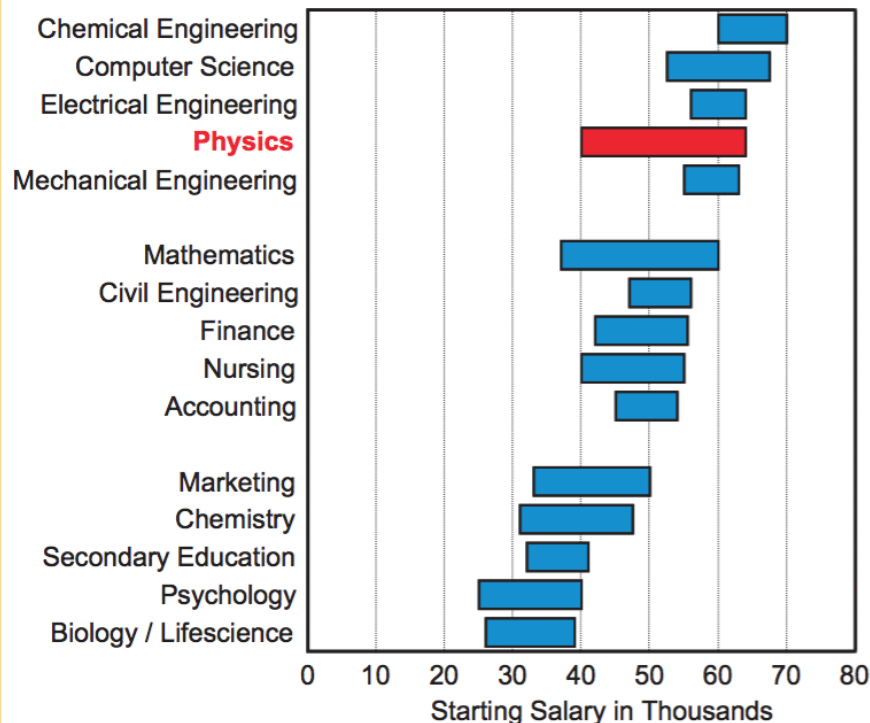
More information

- American Institute of Physics
 - *Lots* of statistics on physics at the high school, college, and grad school level
 - Information on careers in physics
 - <https://www.aip.org/>
- American Physical Society
 - Main professional organization for physicists in US. Lots of career info.
 - <http://www.aps.org/>
- Society for Physics Students (SPS)
 - Student org for physics majors. Career advice is very good.
 - <https://www.spsnational.org/>
- Feel free to contact me
 - Owen Long: owen.long@ucr.edu

What's a Bachelor's Degree Worth?

Typical Salary Offers by Campus Recruiters, AY 2008-09

Bachelor's Field



Typical salaries are the middle 50%, i.e. between the 25th and 75th percentiles.

Reprinted from the Fall 2009 Salary Survey, with permission of the National Association of Colleges and Employers, copyright holder.

Of the basic sciences (Physics, Chemistry, Biology), Physics on average has the best salary for employment with a BS (no graduate degree).

Engineering salaries are strong, but it's common for engineers to begin their careers with a BS.

More than half of Physics BS recipients go on to graduate school (MS or PhD), which leads to careers with higher salaries than shown here.