

# UCR

# Why College Bound Students should take Physics in High School

Patriot High School  
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# Goals

- › IE students should be taking HS Physics at the State and National average
- › Explain the advantage of taking HS Physics
- › Explain barriers to more students taking HS Physics
- › Explain UC admissions Lab Science course criterion

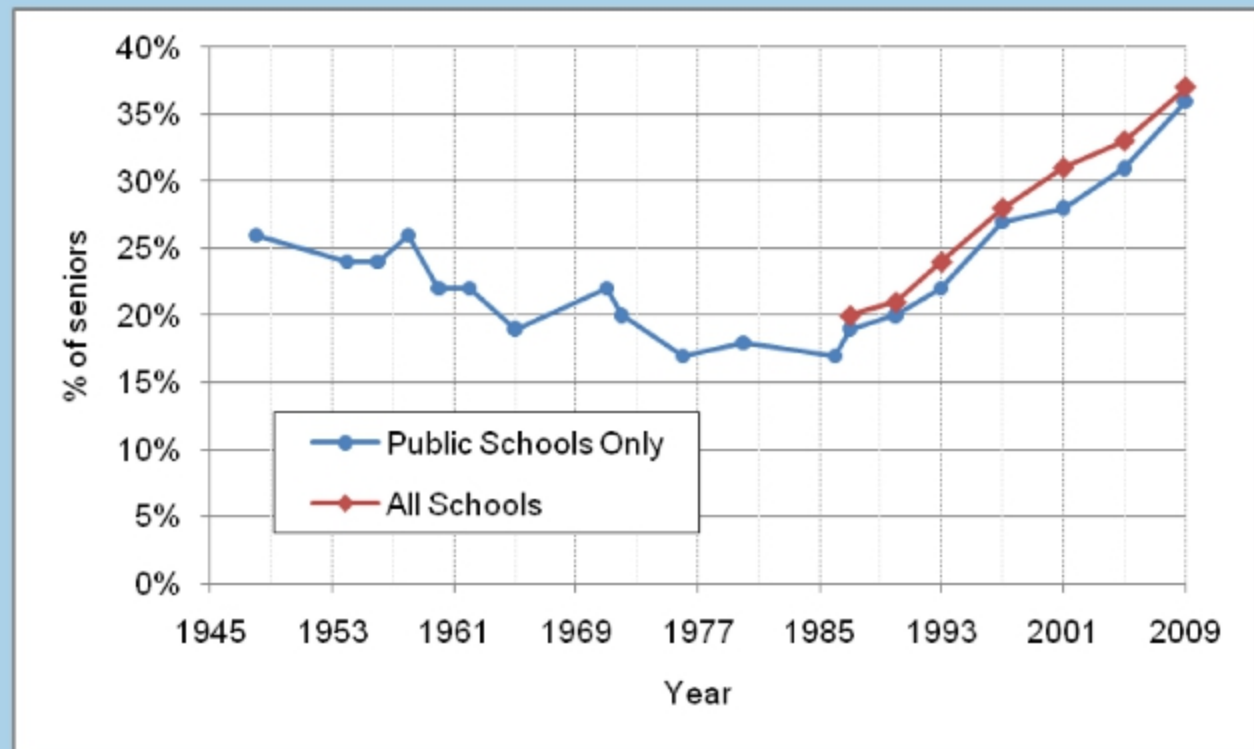
# Why should we increase # of HS students taking physics?

- ▶ Inland Empire HS Physics enrollments lag State by 2X and lag nation by 3X
- ▶ Inland Empire youth are deprived of the advantages that others have:
  - ▶ Increased success in college prep courses
  - ▶ Increased success in college science majors
  - ▶ Increased access to physical science and engineering careers

# US HS Physics Enrollments

- › 36% of Public HS seniors have taken Physics
- › Virtually 100% of Private HS seniors take Physics

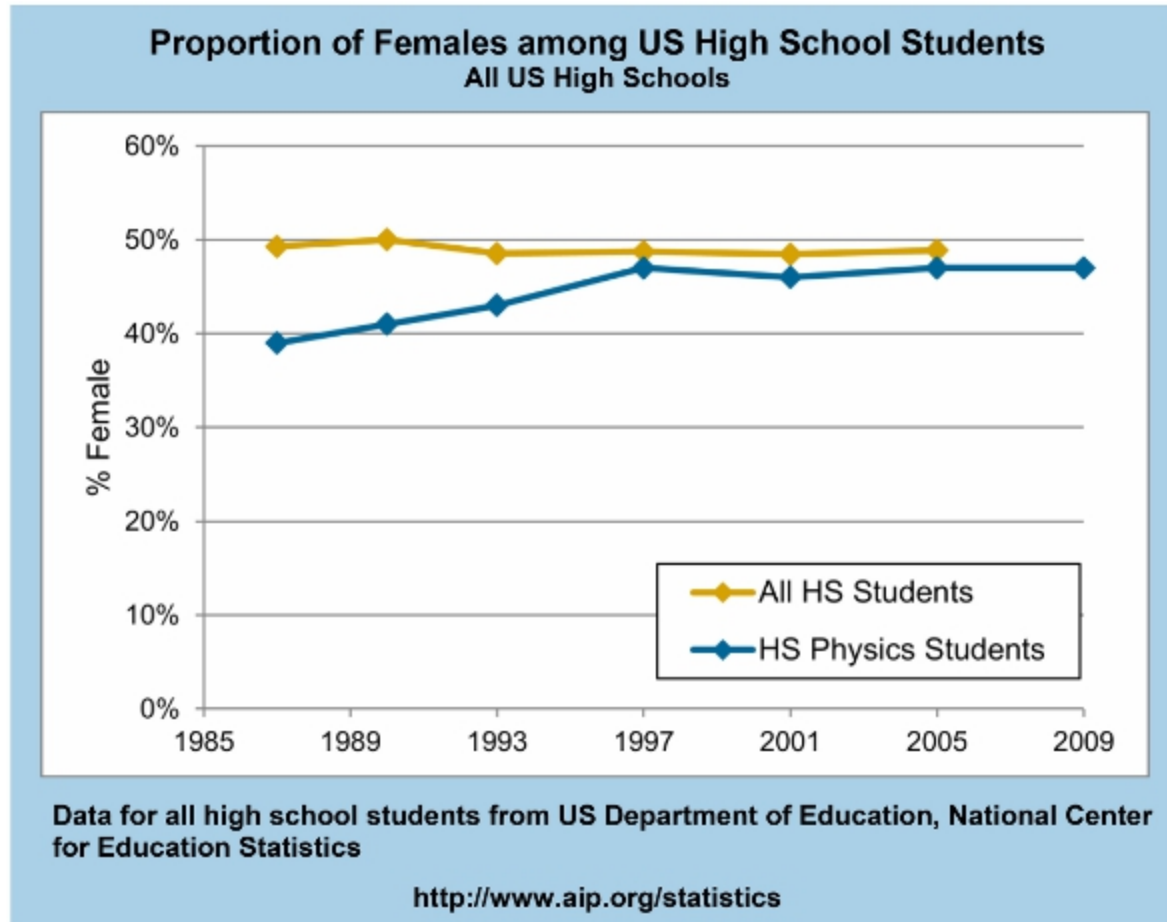
**Physics Enrollment\* in U.S. High Schools: 1948 – 2009**  
\*Percent of seniors who have taken at least one physics course prior to graduation



Source: 1987 – current, AIP; data prior to 1987 from NCES

<http://www.aip.org/statistics>

# Female Student Enrollment



Female enrollment in Physics matches other classes

# Riverside County 2007-8

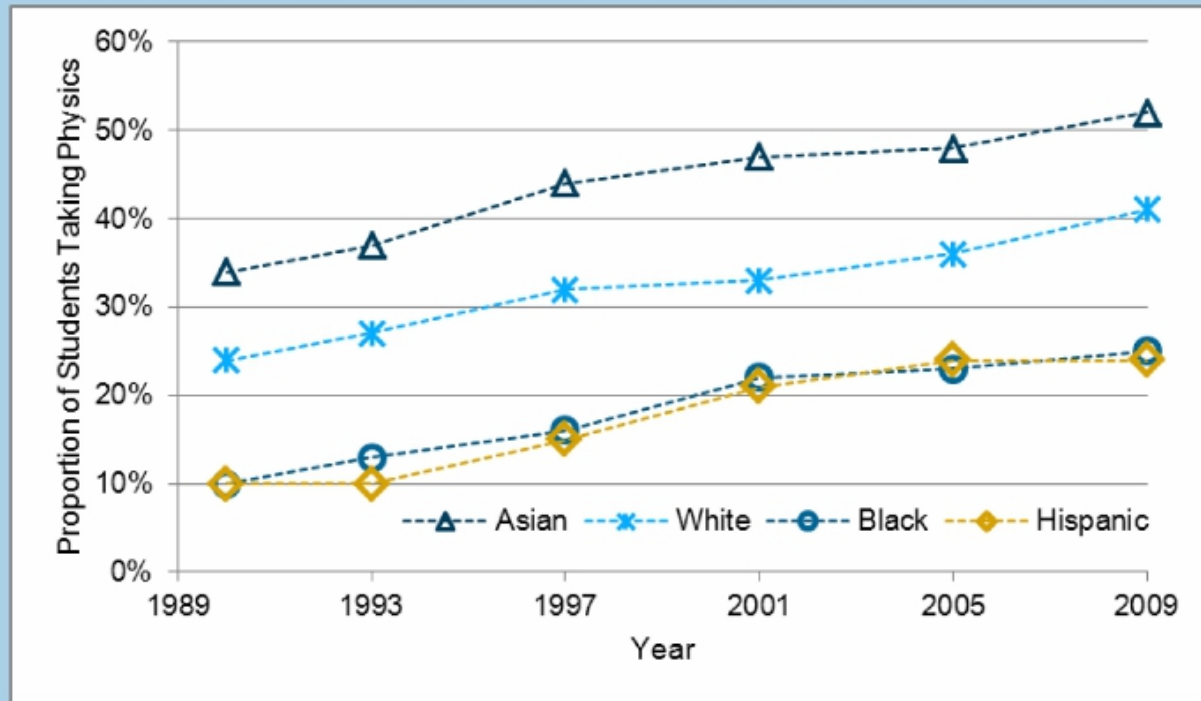
Riverside	Female					Male					Total 9-12
Ethnic Group	Intermediate Algebra	Advanced Math	1st Year Chemistry	1st Year Physics	9-12 Enrollment	Intermediate Algebra	Advanced Math	1st Year Chemistry	1st Year Physics	9-12 Enrollment	Total 9-12 Enrollment
AM IND	60 (13.3 %)	37 (8.2 %)	44 (9.8 %)	12 (2.7 %)	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
<u>County Total</u>	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
<u>State Total</u>	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

# Riverside Physics Enrollment

- › USA: 36% of public HS graduates take Physics
- › CA State: 21.2% of graduates take Physics (5.3%X4)
- › Riverside: 12.6% of graduates take Physics (3.15%X4)
  - › Slightly Lower for San Bernadino County
  
- › All Students:
  - › 93% of State Average in Chemistry
  - › 60% of State Average in Physics
- › Female Students:
  - › 92% of State Average in Advanced Math
  - › 95% of State Average in Chemistry
  - › 55% of State Average in Physics
- › Male Students:
  - › 88% of State Average in Advanced Math
  - › 90% of State Average in Chemistry
  - › 64% of State Average in Physics

# US Enrollment by Ethnic Group

Proportion of Students in Each Racial or Ethnic Group Taking Physics\*  
All U.S. High Schools



\* A closer examination of the data reveals that these differences are likely driven more by socioeconomic factors than by race.

<http://www.aip.org/statistics>

RCOE

- 38.5%
- 17.4%
- 7.4%
- 8.4%



# Impact to IE Youth

- 3X lower access to high tech education, jobs, and careers than national average
- Less competitive for better 4-year colleges which look favorably on harder college prep
- Lack experience with quantitative science, applied math, physical intuition and technical problem solving
- Quality of HS Physics teaching is lower because teachers do not teach Physics full time

# Why is Physics important for all students

- ▶ Physics is one of three fundamental core sciences, with biology and chemistry
  - ▶ Equally important to understanding modern life and technology than biology and chemistry
  - ▶ More fundamental to modern technology and modern economy
  - ▶ Builds physical intuition and physical problem and analytical solving skills—different but as important as mathematical skills

# Physics teaches important skills for all college bound students

- Uses math in practical, meaningful way: gives student practice in algebra and geometry useful for SAT prep
- Uses word-problems, combining math, physical intuition and analytical reading skills
- Exposes students to fundamental principles underlying all technology—technology they will use, purchase, create or sell

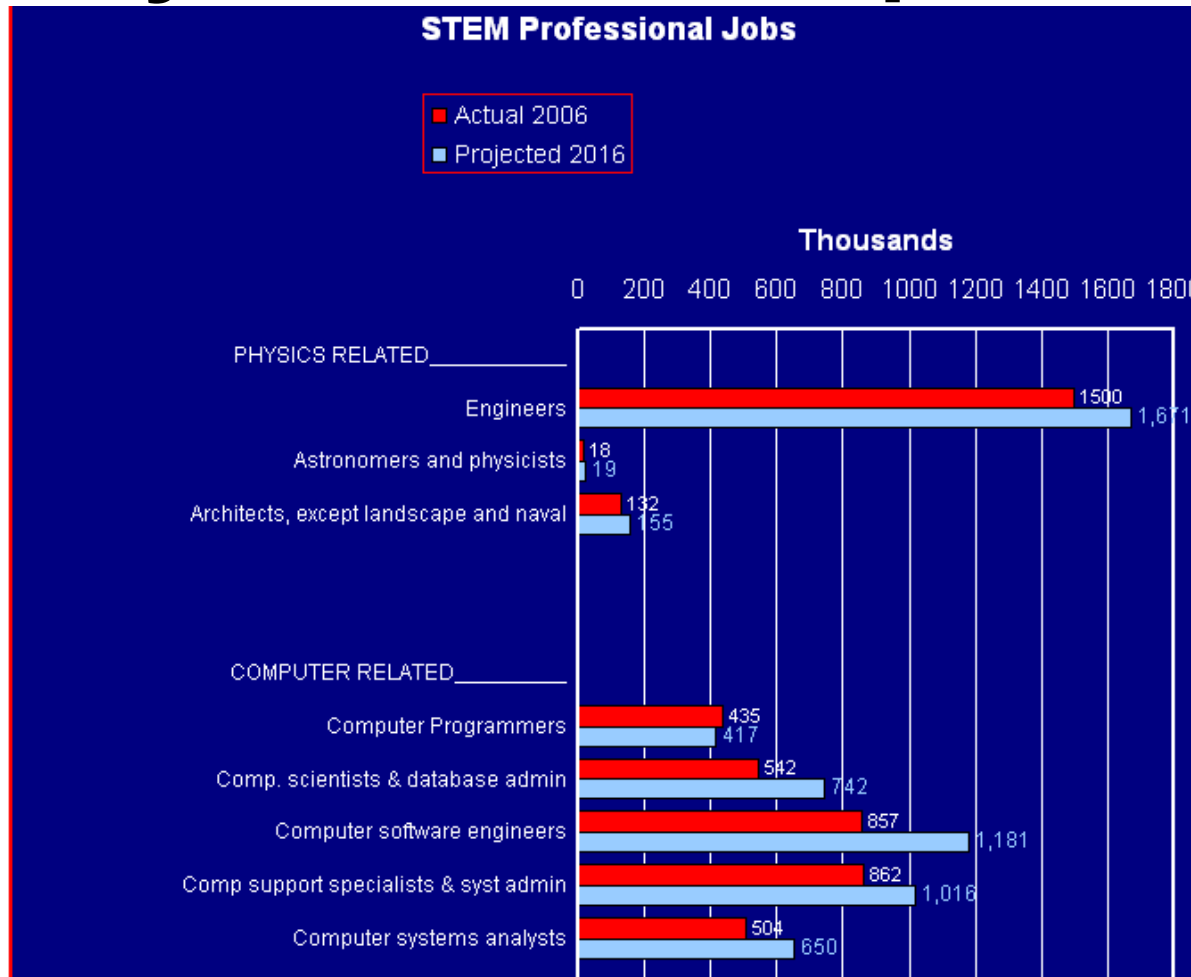
# Physics is the gateway to physical science, engineering, and computer science careers

- ▶ 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 88% of IE students take!

# Why HS 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

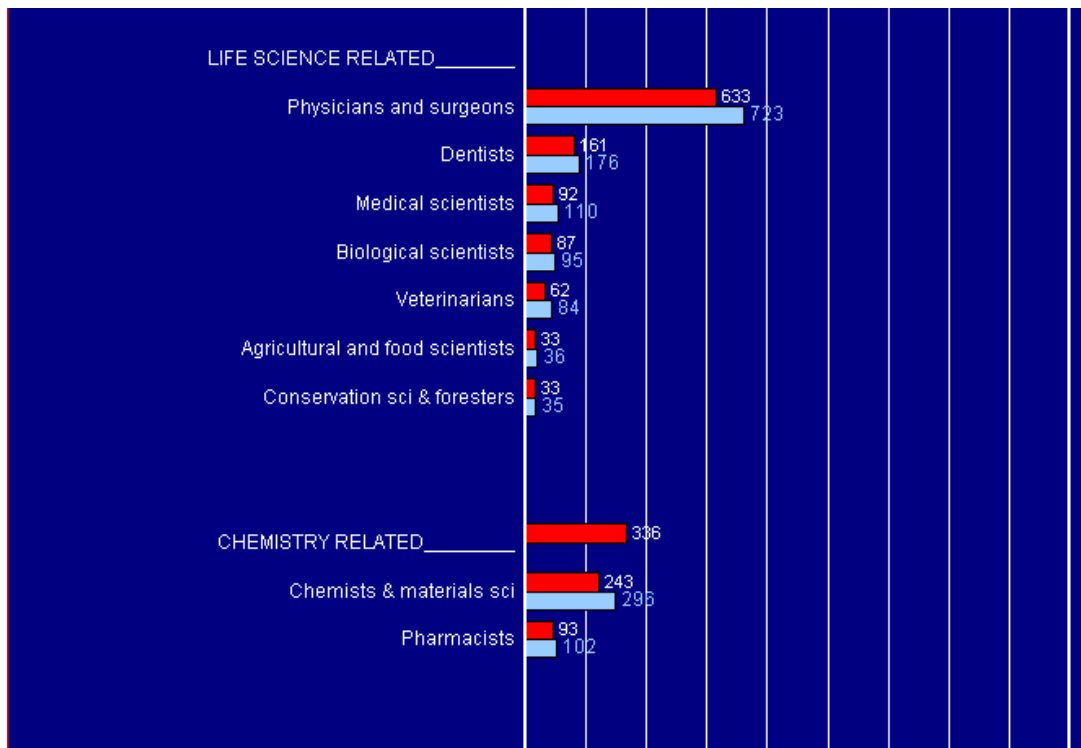
# STEM Careers are dominated by Physics and Computer



➤ 1.65M

➤ 3.1M

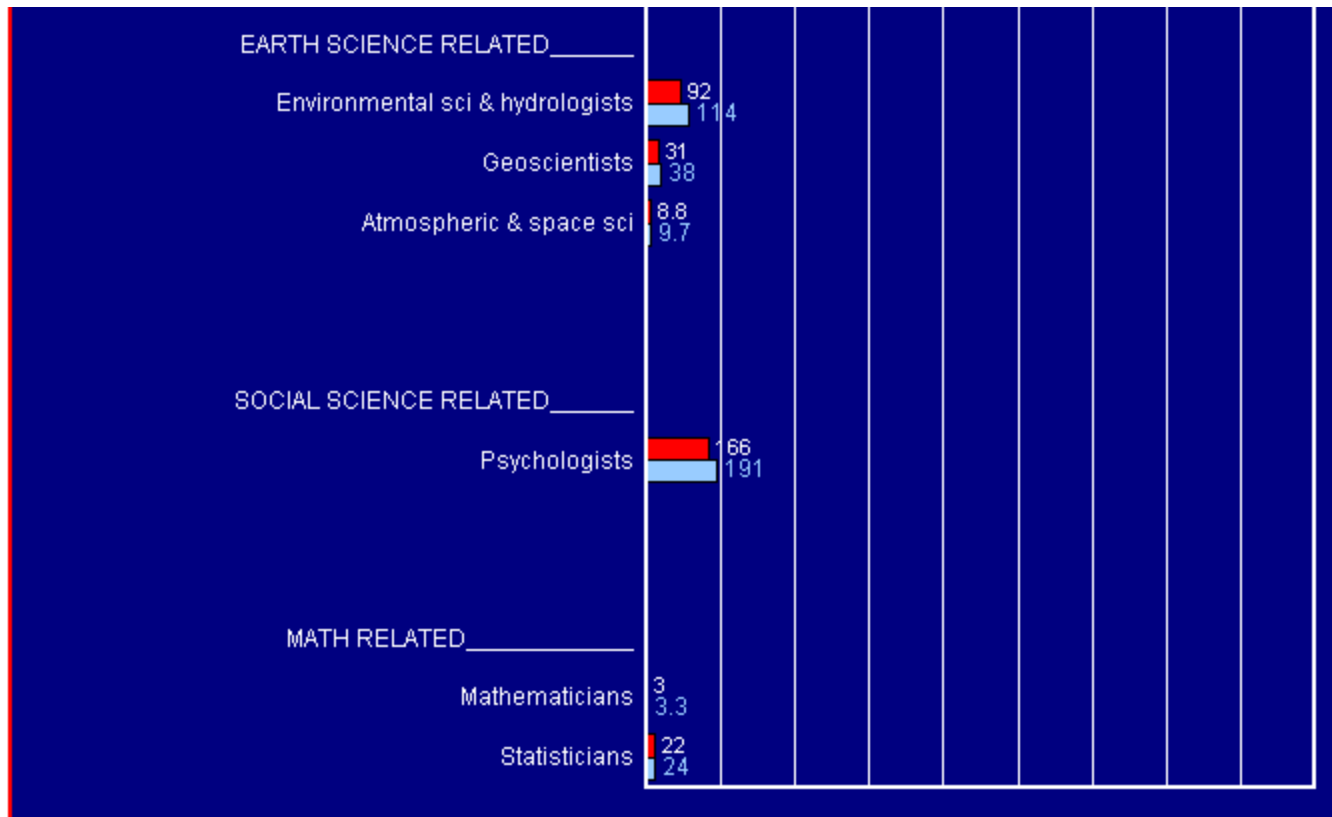
# Engineering and Computer Science sectors > Life Science/Chemistry sectors



> 1.1M

> 0.7M

# Compare to other sectors: earth science, social science, math





# Summary of STEM job future

- ▶ 1.5X more Physics-Related jobs than Life Science-related
- ▶ 3X more Computer-Related jobs than Life Science-related
- ▶ Life Science and Chemistry jobs are 30% of STEM total

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

# The job market for people with skills in physics is strong and large

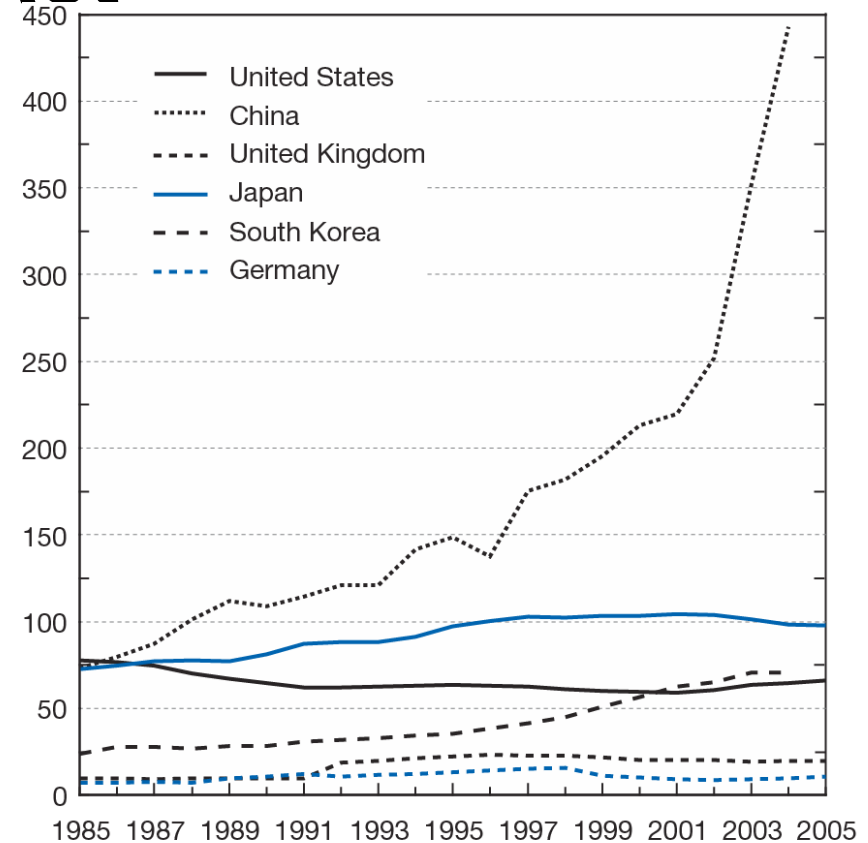
- › Engineers are applied physicists and comprise the second largest profession in America (second only to teaching) with about 1.4 million members. By comparison, there are about 600 thousand medical doctors and only around 100 thousand biologists. Knowledge of physics is a prerequisite for many forms of employment.

# US Competitiveness: America Competes Act

First University Engineering  
Degrees, by selected country:  
1985-2005

US has not increased number in 20  
years, per capita Engineering  
BS has decreased despite  
Silicon Valley, Dot.com,  
Biotechnology

	Population (millions)	Engineering BS/year (1000)	% per capita
USA	304	67	0.02%
China	1330	450	0.03%
S Korea	49	75	0.15%
Japan	128	100	0.08%
UK	61	21	0.03%
Germany	82	12	0.01%



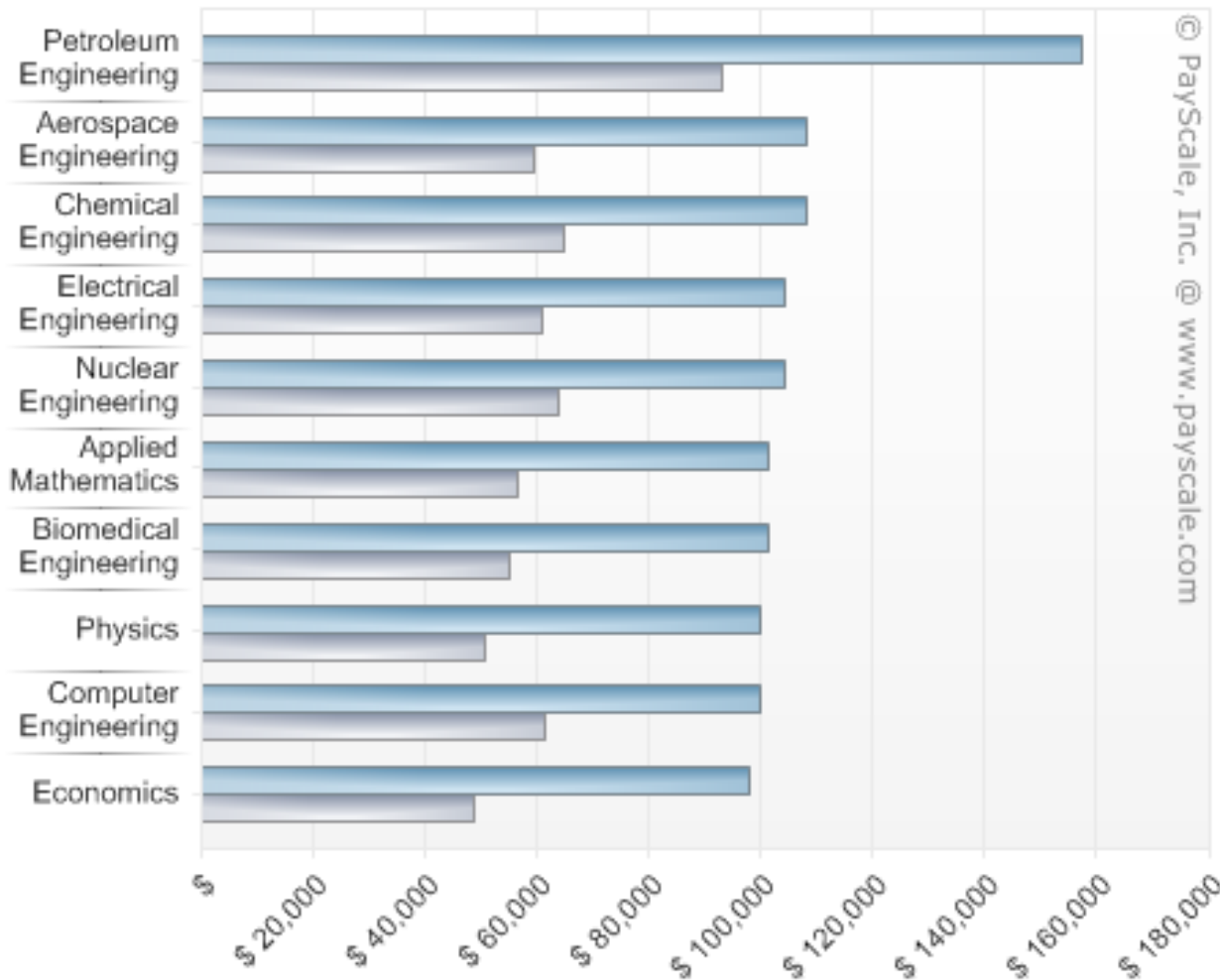
NOTES: German degrees include only long university degrees  
required for further study.

# Impact of US Engineering and Physics competitiveness

- US needs to increase per capita Engineering and Physics BS production to sustain its #1 technology position in the world
- Lack of US-trained engineers has forced hiring of large numbers of foreign-trained engineers. Engineering BS and PhD have excellent job prospects
- Threshold for good positions is “lower” in Engineering/Physics than for Medical School

# Salaries for BA/BS grads reflect this

Top 10 College Majors That Lead to High Salaries



© PayScale, Inc. @ www.payscale.com

Starting Median Pay  
Mid-Career Median Pay

> <http://www.payscale.com/best-colleges/degrees.asp>

# Physics is essential for college bound students

- › Success in school and on SAT is built on skills—physics builds analytical, critical reading, and problem solving skills.
- › All science and engineering majors must take a 1 year college level Physics course. Not taking high school Physics puts students at disadvantage—lower grades, higher rate of changing majors.
- › All non-science majors must take a Physical Science course

# College Physics Course requirements

- ▶ Engineering is applied Physics:
  - ▶ 2 years Math, 1 year Chemistry, 1 year Physics
  - ▶ Engineering uses Physics content and analytical skills
    - ▶ Mechanical Engineering
    - ▶ Electrical Engineering
    - ▶ Aeronautical Engineering
    - ▶ Civil Engineering
- ▶ Life Science majors
  - ▶ 1 year math, 2 years Chemistry, 1 year Physics
- ▶ Medical/Dental/Pharmacy School
  - ▶ 1 year math, 2 years Chemistry, 1 year Physics, 1 course in Biochem
  - ▶ MCAT or similar Admission Test: 25% of the science knowledge tested is based on Physics

# Physics is a *literal* gateway

- › All College Science and Engineering Majors require a minimum of 1 year of College Physics—in UC this is a Calculus-Based Physics Course
- › Lower Division Requirements include Physics must be completed before advancing in the major
- › Success rate in Science and Engineering majors is low due to poor performance in lower division courses:
  - › Students who have a high quality HS Physics course do better in College Physics (typically 1/2 -2/3 of letter grade)
- › Junior Transfer students must have completed Physics to be accepted in UC



# Why aren't more IE students taking Physics

- ▶ Parents and Students don't know how important Physics is
  - ▶ Physics has changed in importance in economy as technology has become increasingly important
    - ▶ Silicon Valley is the 7<sup>th</sup> largest economy in the world!
    - ▶ Physics-related careers are growing relative to population
  - ▶ College Physics courses are required and assume HS Physics
    - ▶ 31% of nation's HS graduates have taken Physics, i.e., ALL college majors in Science and Engineering

# Why aren't more IE 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.)
  - ▶ School should build a student culture that expects 20-30% will take Physics and succeed in Physics
  - ▶ Schools should hire good HS Physics teacher who can teach Physics full time (5-6 periods/day)

## UC Admissions D requirement: Lab science

- 2 years (3 recommended) in 2 of the 3 foundational subjects, biology, chemistry and physics
- NOTE: 9<sup>th</sup> grade Earth Science, Anatomy, Physiology, non-AP Environmental Science do NOT count. Some integrated science courses count but aren't really competitive
- Non-science students should take biology and chemistry and a 3<sup>rd</sup> allowed science: Physics or AP Bio or AP Chem
- Science students should take: Biology (9<sup>th</sup>), Chemistry (10<sup>th</sup>), Physics (11<sup>th</sup>). Most competitive will take 4<sup>th</sup>, AP Bio, Chem or Physics

# Special role for AVID

- ▶ Additional counselor opportunity to put students on college bound tracks
  - ▶ Can inform students about careers and job market
  - ▶ Can inform students that success in college in ANY science (including pre-med) requires Physics in college and therefore HS Physics
  - ▶ Can create a culture of students taking Physics, helping each other to learn/study Physics, and to succeed in Physics. AVID resources can be used to tutor students in Physics (same as for math).
  - ▶ Can help students apply for STEM awards/fellowships/scholarships

# Want to learn more?

- ▶ Get information on the web:
  - ▶ [www.physics.ucr.edu](http://www.physics.ucr.edu) (UCR Physics and Astro)
  - ▶ [www.aps.org](http://www.aps.org) (American Physical Society)
  - ▶ [www.aip.org](http://www.aip.org) (American Institute of Physics)
  - ▶ <http://www.spsnational.org/cup/> (Society for Physics Students, Careers Using Physics)
  
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