

THE ECONOMICS OF A PHYSICS EDUCATION

COMMITTEE ON CAREERS AND PROFESSIONAL DEVELOPMENT WHITEPAPER

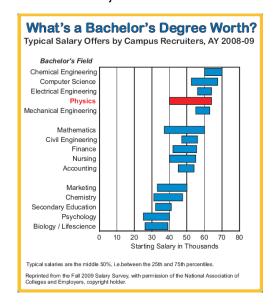
There is a lot to be said about doing what you love – especially in choosing a career, or at least a starting point. So let's assume that you are seriously interested in physics, like the subject matter, are maybe a little uncertain about a career path, but are rightfully concerned about paying for the education. The purpose of this document is to lay out a way of thinking about the expense in general terms: a view from 30,000 feet, so to speak. We will not consider the various scholarship and loan alternatives here, simply because there so many options, and to consider all of them would obscure the basic objective.

Perhaps it goes without saying, but income is related to education level. Here's an example, showing the average income levels for people in approximately the same age bracket (i.e. under 30) in 2006:

Income for a high school graduate over 25: \$32,867ⁱ
 Starting salary for a B.S. Physicist: \$45,000ⁱⁱ
 Starting salary of a M.S. Physicist: \$60,000ⁱⁱ
 Starting salary for a Ph.D. Physicist: \$80,000iiiⁱⁱ

As shown in the figure to the right, a more recent salary survey indicates an increase in average starting salary by over \$10,000: two years! Note that gender, region, employment sector (academia, industry, government) and individual skills and experience are important, but are not considered here.

Job security is another factor. In an era where the national unemployment rate is about 10%, it's 6.8% for Physicistsⁱⁱⁱ. So a degree can lead to both higher and uninterrupted income.



Undergraduate School: earning your Bachelor degree

Many factors affect the net cost of an undergraduate education, such as: the institution you select, scholarship and loan alternatives, and your family financial situation. For example, the average annual college costs^{iv} (tuition, fees, room & board) for the 2009 – 2010 academic year are:

- \$35,636 for private four year schools
- \$15,213 for a public school for in-state students (resident)
- \$26,741 for a public school for out-of-state students.
- \$2,544 for local community colleges a low cost alternative with transition to a 4 year school to complete a bachelor degree.

You should also plan to have a miscellaneous expense budget of at least \$5,000. The College Board estimates the average cost for books and supplies to be \$1,122, average personal expenses of \$1,974, and \$1,079 for travel. Entertainment, clothing, auto expenses are excluded from this discussion, as are income from summer and part time jobs.

Let's take a cost effective approach – again as a model that you can adapt to your situation - attending a community college for two years and completing a B.S. as an in-state student at a public university. If you can live with parents, there would be no room and board expense, so the cost for the first two years would be:

•	Tuition, fees	\$ 5,088
•	Misc supplies	\$10,000
	Sub Total for 2 years	\$15,088

The final two years at a resident student at a State University would be more expensive:

•	Tuition, fees, room & board	\$ 30,426
•	Misc. supplies	\$ 10,000
	Total for 4 years	\$ 55,514

We also need to consider the so-called "opportunity cost" – how much you would have earned if you were to enter the workforce right out of high school. Being a bright and eager person, you might command as much as \$10 per hour – in a climate where the US minimum wage is \$7.25/hr, and the highest state minimum is \$8.55 in Washington. Assuming a 40 hour work week, your gross income would be \$20,800 in the first year. With a 5% raise each year, your total gross income would be \$89,650 for the four years you would – and should – have been studying physics. Against this, there would be taxes (we'll estimate 20% of income for federal, state & local) and living expenses. To maintain equivalence with the student living at home at no cost for two years, we'll assume you will live at home for two years at no cost, but then have to pay the equivalent of the room and board expense - \$8,193 per year according to "Trends in College Pricing." This reduces the earned income to \$55,334. The real total cost of your four year education would be \$110.848.

Neglecting for the moment the fact that you will be working in a field you find interesting and challenging, you have attained a threshold that offers upward mobility, with an average annual starting income of \$51,000°. This is at a time when your annual income would have been about \$24,000 as a high school graduate. The question then becomes how long it would take you to "break even?" Neglecting income taxes and raises the \$27,000 per year differential means your "Return On Investment" (ROI) would be about <u>four years</u> – quite possibly less because

- raises are likely to be larger and more frequent as a graduate physicist,
- we haven't considered income from summer or part-time jobs, possibly at higher pay than a high school graduate, nor
- financial assistance in the form of scholarships and assistantships.

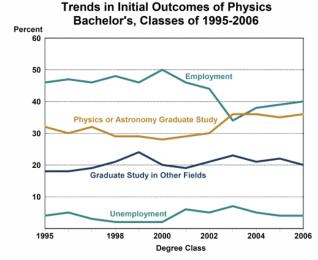
It is appropriate to comment that this low cost approach to a physics education does not mean that it is inferior. One can argue that a good student will succeed at any school and that any differences in resources between this and an Ivy League school could easily be offset by your learning to be self reliant, focused and dedicated. A survey of physicists 5 years after earning their B.S. shows that size or type of the physics department has no effect on their obtaining a career path job; their working in a Science, Technology, Engineering or Math job; the number of interviews, time spent looking for or number of offers for a first job; their perception that a physics degree helped them get a first career path job; the number of college or university resources used to find their first career path job; and the first salary offer when controlled for type of job, experience, degree, and gender. Vi

Graduate School

Once you have a B.S. degree, the doors to many professions are open; your undergraduate training is good preparation to advanced training in many fields. Physicists often have productive careers in engineering, medicine, the law, business, finance, or related sciences such as math or chemistry for

example. In fact, most Physics bachelors go on to graduate or professional school. So there are many options, including continued graduate training in Physics. Let's consider some of them briefly.

• Graduate school in Physics, leading to a M.S. or Ph.D. can qualify you for a career in academia, government or industry. As your career and interests develop you can work in pure and applied research, policy development (government), management (government and industry), and education processes for example. It is often surprising to learn that advanced degrees in Physics can be earned at almost no cost, thanks to a variety of teaching and/or research assistantships. They reimburse tuition



AIP Statistical Research Center, Initial Employment Survey

and fees, provide a stipend to offset modest living expenses, and are a valuable part of a graduate learning experience. Alternatively, if you work in government or industrial research, the costs of graduate school can be underwritten by your employer's tuition reimbursement benefits program.

- If you are interested in furthering your education and value for an industrial career, new
 Professional Master in Physics degree programs are being offered at many Universities^{vii}. This,
 perhaps combined with a MBA would provide a powerful educational background for an industrial
 career. You should know that many companies have tuition reimbursement programs, so this
 portion of your graduate education can cost you nothing.
- You can pursue a medical career by earning a M.D. and be involved in patient care and/or research. In addition, training in physics is valuable in medical radiology. More information can be obtained from the American Association of Physicists in Medicine^{viii}.

An investment in a physics education can be one of those rare instances where the financial return is fast – about four years for a bachelor's degree – and will continue to pay off at an increasing rate throughout your professional career. The only limitation to a financially secure and fulfilling career is the energy and time you are willing to devote to it – and that is a lot easier if you really enjoy what you are doing.

References:

http://en.wikipedia.org/wiki/Educational_attainment_in_the_United_States#Income

ⁱ US Bureau of Labor Statistics,2006

ii American Institute of Physics salary class of 2006 http://www.aip.org/statistics/trends/highlite/emp4/emphigh.pdf

iii Students Review, 2009 http://www.studentsreview.com/unemployment_by_major.php3
iv "Trends in College Pricing "The College Board, http://www.collegeboard.com/html/trends/?excmpid=MTG1-

v American Institute of Physics; http://www.aip.org/statistics/trends/reports/fall09a.pdf

vi "Does it Matter Where I Go To College" by R.Ivie and K.Nies, AIP Pub. Number R-433.03, available at:

http://www.aip.org/professionalmasters/mstphys.pdf
vii "Mastering Physics for Non-Academic Careers", by S.P.Morton, P.W.Hammer and R.Czujko, available at: http://www.aip.org/professionalmasters/mstphys.pdf
viii AAPM website: http://www.aapm.org/