



Undergraduate Program

Tom Cohen

Outline



- Basic Statistics
- The Program
- New initiatives
- Challenges

Basic Statistics

Majors

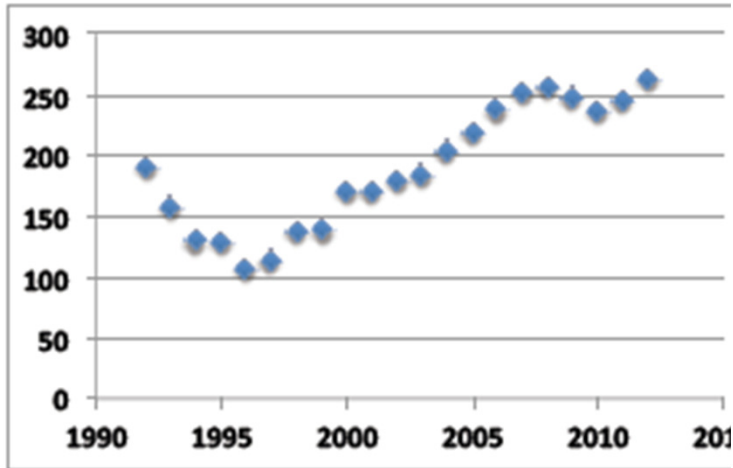


Figure 4. Physics majors.

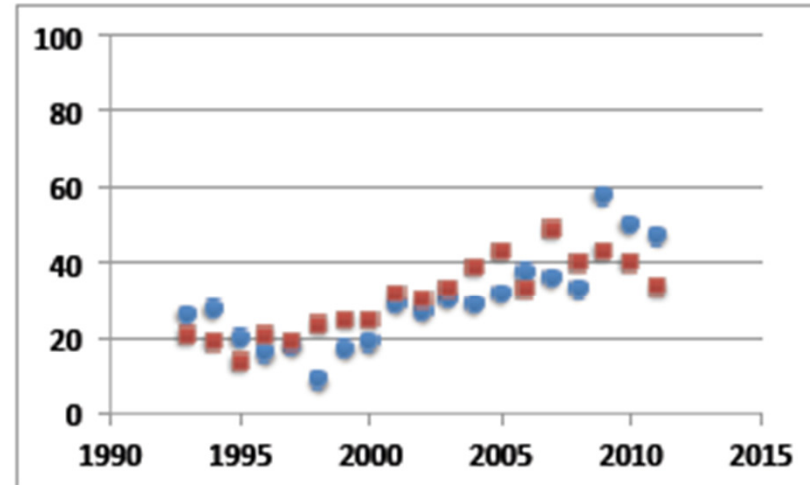


Figure 5. Number of BS degrees granted (circles) and incoming freshmen (squares).

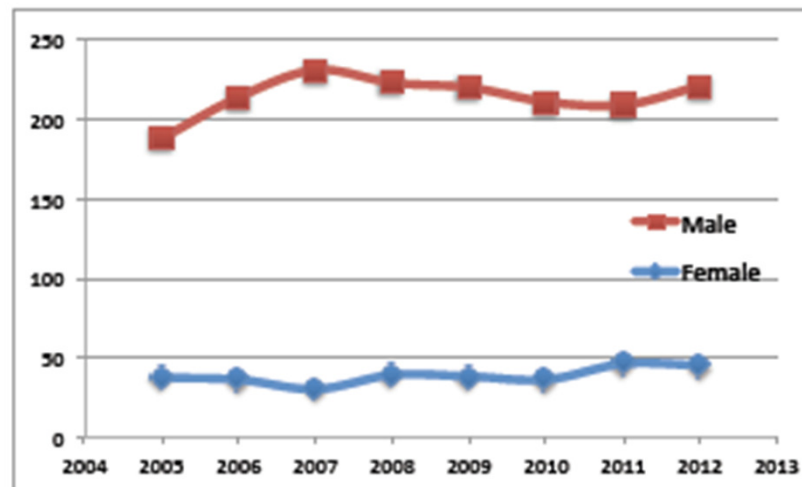


Figure 6. Physics majors 2005-2012

Basic Statistics



Majors

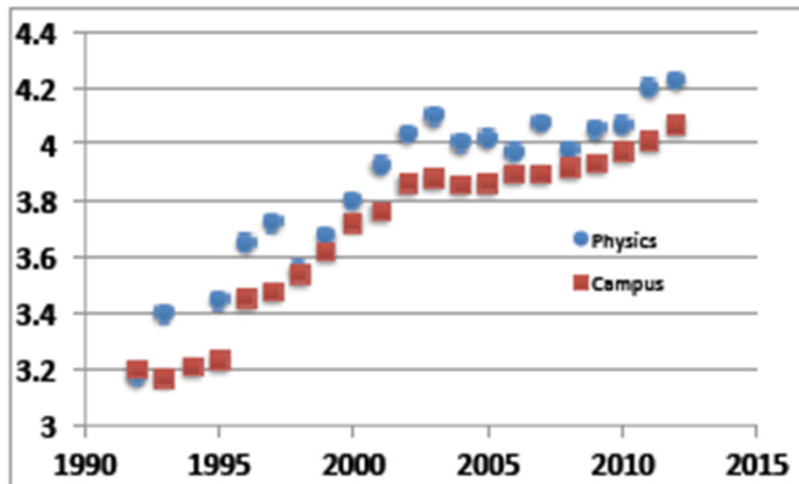


Figure 7. Average GPA scores of all incoming freshmen (squares) and all incoming physics majors (circles)

- The number of majors is large and on a secular upward trend.
- The fraction of women in the program has remained stubbornly small.
- The overall quality remains fairly strong and the best of the students are quite good.
- More than 70% do research during their undergraduate years

Basic Statistics



Service Courses

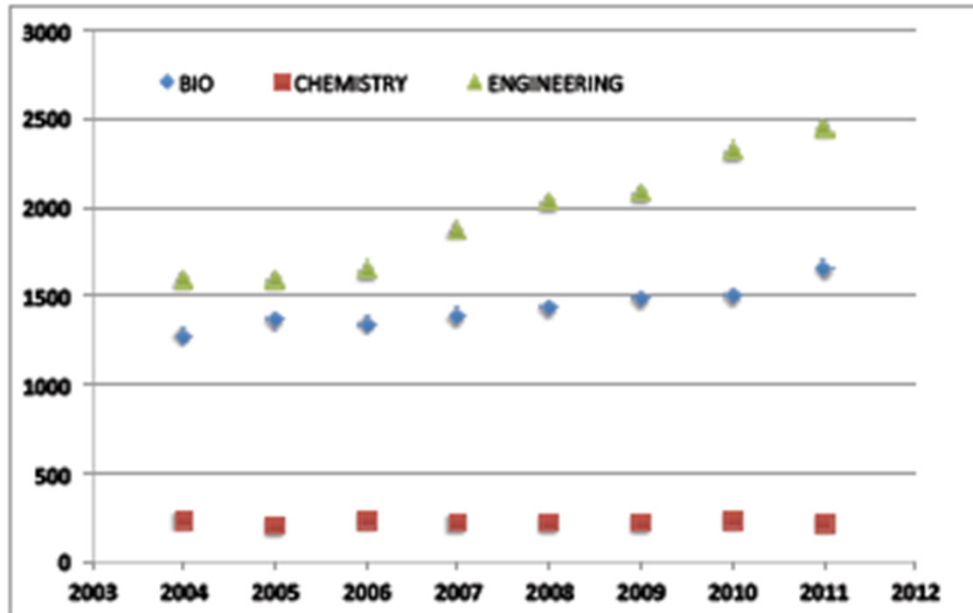


Figure 8. Enrollment in service courses.

- There has been a very rapid increase in the number of students in the service courses—particularly engineering students

- This has come at a time of very constrained resources—particularly for teaching assistants.



The Program

Majors

- Three Semester Intro Sequence
 - **Separate from the engineering sequence**
 - Classical Mechanics
 - E&M
 - Waves
- A bridge course (300 level “Intermediate theoretical methods)
- Advanced Classes
 - QM I&2
 - Classical Mechanics
 - E&M
 - Stat mech



The Program

Majors

- Math requirements, 2 semesters of calculus, multi-variable calculus, diff eq. linear algebra
- Optional advanced topical courses in CM, particles & Nuclei; Optional low level computational physics class
- 5 semester lab sequence
 - 1 credit freshman intro lab
 - 2 credit sophomore level lab in CM
 - 2 credit sophomore level lab in E&M
 - 3 credit junior level optics lab
 - 3 credit senior level advanced lab



The Program

Service courses

- 3 STEM main service sequences + 1 pilot
 - 2 Semester algebra-based sequence aimed at biology, architecture, etc.
 - 2 semester calculus-based sequence aimed at chemistry students
 - 3-semester sequence for engineers
 - Piloting a new 2 semester calculus-based sequence for biology students.
- Numerous general education course
 - Physics of Light, Physics of Sound, How things Work, The Manhattan Project*, Physics for Decision Makers* are taught regularly.
 - Physics for elementary education majors is taught regularly
 - Several other gen-ed class on the books but now taught rarely

*I-series course



New Initiatives

Majors

- We are in the midst of a major revision of the program.

Principal issues we addressed

- General sense that the math preparation was not well aligned with needs of physics students. In addition, there is a sense that our bridge course—Phys 374—had no fixed curriculum which caused much student unhappiness.

Plan: Replace diff eq. + linear algebra + Phys 374 with a 2 semester sequence on math for physics taught in the department

- A realization that a considerable amount of what physicists (and others with physics degrees) do, involves computation.

Plan: Require a computational physics class (either at a low level for those who have never programmed or a 400 level course for those who have)

- A sense that relativity is not treated well in our curriculum (eg. 4 vectors not seen until the last course in the sequence) and that quantum ideas should be introduced before the formal junior level QM class

Plan: Add a “modern physics” class to our intro sequence for majors

- Students can leave our program with knowledge of some basic tools but very little idea of what physicists do

Plan: Offer more advanced electives and require that students take two.

- The jump from the low level classes to the advanced classes

Plan: have the level of the classes ramp up gradually.



New Initiatives

Service Courses

- We are developing a new sequence for the biological sciences. This development has been supported from a grant from the HHMI
 - The courses are aimed at using physics ideas in contexts of relevance to biology.
 - Ideas like diffusion which are typically ignored in intro physics classes are stressed.
 - Requires students to have a year of calculus, a year of bio and a semester of chem. All of these are used.
 - A new and appropriate set of labs



New Initiatives

Administrative/climate

- We have hired a new director of student services, Donna Hammer who will help oversee the program, including advising, labs, lecture demo... as well as the graduate side.
- The Department recognizes the importance of a welcoming climate for women and minority students. Dr. Sonali Shukla, a relatively recent hire, has been tasked with developing a “Bridge Program” to address the lack of diversity among the physics major population and to improve retention and graduation rates of underrepresented groups. The program’s activities involve community building and research are intended to improve the climate for all students, but with some focus on issues related to underrepresented groups.



Challenges

- The principal challenge we are facing is due to limited resources.
 - Despite the rapid growth in the number of students over the past few years—particularly in engineering—the number of teaching assists has decreased. This has forced us to cut back on the labs. **Ideally, as new funds become available more TA positions should be added.**
 - Despite having a large faculty, we do not have the resources to teach the classes we have traditionally taught in the way we have without hiring a large number of adjuncts.
 - **in Spring 2012, tenured and tenure track faculty covered only 32% of the teaching assignments for the service courses.**
 - **Additional pressures on our teaching resources will come about due to the changes in our majors program which adds ~2-3 more teaching assignments per term.**

Challenges



- Origins of the problem.
 - Several faculty members doing administrative functions in the university and are relieved of teaching and one is on long term leave as Chief Scientist at BP. There is nothing we can do about this.
 - A culture of strong levels of teaching relief both in recruitment and retention and to induce faculty members to take on administrative responsibilities exists in the department. Ideally, in the future teaching relief will serve a smaller roll in keeping the department functioning.
 - There is a very high level of faculty “buy outs” —typically of order 5 or 6 per term. One faculty member has not taught a standard class in the past decade and has already bought through the 2021-2022 academic year. The Department has a strong financial incentive to encourage buyouts and has done so. Ideally, in the future, buyouts would be sharply curtailed and used only for essential cases (eg. a faculty member on Ice Cube is needed at the south pole) —however, at the moment the Department depends on the money generated.

Challenges



- Solutions

- Hire excellent full time non-tenure-track lecturers so that we can meet our teaching obligations without sacrificing quality.
- Reduce the number of faculty members doing non-class room teaching duties (eg. lab coordinators for service classes) and replace them with teaching assistants.
- Reduce the number of general education classes taught. To make sure we meet our teaching obligations to the college we should increase the number of seats in the one's we do teach.
- Increase the size of the the lecture sections in the Engineering classes.
- Negotiate with Chemistry to eliminate the chemistry track and have the chemists choose between, the physics track, the engineering track or the new bio track