An Example of a Multi-track Physics Curriculum

C. Steven Whisnant
Physics & Astronomy
James Madison University
1994-95 Catalog

• BS degree had two options, not formal tracks
  – One track with a few electives to choose
  – For the graduate school bound: ‘Professional’
  – For the work-force bound: ‘Applied Physics’
  – Differences were 6-9 credit hours

• Physics minor
1995-2000

• An Engineering 3/2 program was added
  — Agreement with UVA
    • 3 years at JMU, 2 years at UVA
    • Earn physics BS from JMU in 4\textsuperscript{th} year
    • Earn ME in the 5\textsuperscript{th} year

• Applied Physics Concentration Created
  — Two tracks
    • Electronics & Materials
    • Computation
1995-2000

• Fundamental Studies
  – Graduate school bound students take this track
  – Includes the ‘Big 4’
    • Quantum
    • E&M
    • Mechanics
    • Thermo/Statistical
1995-2000

• Individual Option
  – Add flexibility
    • Major requirements determined in consultation with Academic Advisor and Department Head
    • Allow students to combine physics with other areas to tailor academic career
  – In principle, this is all we need
    • Can create programs to send students in any career direction
Why do more?

• Marketing
  – Physics is poorly known by prospective students/parents
    • Many people know an engineer
      – Have at least a vague idea of what an engineer does
    • Few know a physicist
      – Have very limited ideas about what careers are possible
  – Use the catalog to connect physics to careers
    • Educate prospective students and parents
    • Physics is not just a path to academics/research

• Advising
  – With few options, there any many exceptions
  – Takes lots of time to sort out options for students
  – The burden is on advising
Making room for Options

• Add variety to the curriculum
  – All students do not take all upper level classes
  – Quantum is absent from many tracks
  – Applied track requires only 2 of the Big 4
    • Mechanics and either E&M or Thermo
• But, does not limit student options
  – Graduate school bound students often take other Big 4 courses as electives even if not required
2000-2005

• Applied physics further divided
  – Computational
  – Electronics and instrumentation
  – Materials

• Add an Astronomy minor
2005-2010

• “Physics” $\rightarrow$ “Physics and Astronomy”
  – The astronomy minor is growing
  – Astronomy is good for recruiting
  – Planetarium upgrade attracting attention

• Create Multidisciplinary concentration
  – Tracks in Business, Biophysics, 2nd Ed., Technical writing
    • Combine minors with physics major
    • Biophysics is for pre-med students
  – Combine physics with possible career choices
    • Spell out the options where Mom & Dad can see them
    • Clarify how physics leads to a paying job
2005-2010

• Revive moribund BA degree
  – Independent option
  – Physics & philosophy
    • Fundamental studies + philosophy minor
Expansion Costs

- Additional course work required is minimal
  - 3 courses added to create astronomy minor
  - 1 course added for biophysics track
  - Repackage existing courses
    - Include courses from other departments
    - Codify advising
- Coordination w/ other departments
  - Changes in other units means changes in our catalog copy
2010-Present

• Add geophysics to multidisciplinary concentration
• Update the BA degree
  – Remove the philosophy & physics
  – Add ‘Professional’ track
  • Minimal laboratory work, subset of upper level courses
  • For students not interested in research
– Add ‘Physics Specialist’ track
  • Broad introduction to physics, astronomy, and materials
In the Near Future...

• Revise pre-med track (MCAT changes)
  – Separate it from the biophysics track
  – Consider moving it to BA?

• Add Applied nuclear physics
  – Developing nuclear physics laboratory on campus
In the Near Future...

• Reintroduce Physics & Philosophy into BA
  – Working with Philosophy to craft a better option

• Consider moving 2\textsuperscript{nd} Ed. to BA
  – More room to fit the education requirements
  – Working to move from 5 year to 4 year program
  – Driven by reform of intro classes
In the Near Future...

• Revise and expand the 3/2 program with UVA
  – Streamline the process
  – Spell out the JMU & UVA UG curriculum clearly in the catalog
  – Move beyond ME to MS and PhD programs
• Initiate local Engineering minor
  – Discuss with JMU engineering department this summer
Secondary Education

• Added the possibility explicitly in 2008-2009
  – Number of freshmen interested is now ~4 each year
  – Graduated 1st with license this year
• Introduced LA’s in 2010-2011
  – Follow Univ. Colorado-Boulder model
  – Use upperclassmen to assist with concept questions
• PhysTEC grant begins in Fall 2013
  – All sections of intro physics will be ‘flipped’
  – Pedagogy course developed by phys/psyc (includes TIR)
  – On track to increase the teacher output significantly
Lessons & observations

• Individual option
  – Hasn’t been used since about 2010
  – Only minor changes to existing tracks now required

• Interest in 2nd Ed growing

• Interest in pre-med growing
  – Meet with incoming pre-med students each fall to give sales pitch
Lessons & observations

• Many options are rarely used
  – Many students attracted by the 3/2 program
    • Good for recruiting
    • Few follow through
  – BA has never been chosen
    • But we now see viable possibilities for expanding it
      – For 2nd Ed., perhaps pre-med, revised phil. Track

• Allow students to explore options
  – Make the options available
  – Let them find their own way
Tracks are Working For us...

![Graph showing University Enrollment and Physics Majors over academic years 1995-96 to 2012-13. The graph illustrates an increase in university enrollment by a factor of 1.8 and an increase in physics majors and graduates by a factor of 4.](image)

- **University Enrollment/100**
- **Physics majors**
- **Graduates**

Academic Year:
- 1995-96
- 1996-97
- 1997-98
- 1998-99
- 2000-01
- 2001-02
- 2002-03
- 2003-04
- 2004-05
- 2005-06
- 2006-07
- 2007-08
- 2008-09
- 2009-10
- 2010-11
- 2011-12
- 2012-13