Life of an Industrial Physicist

… Some alternate uses of your physics degree

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COM DEV International, Cambridge, ON

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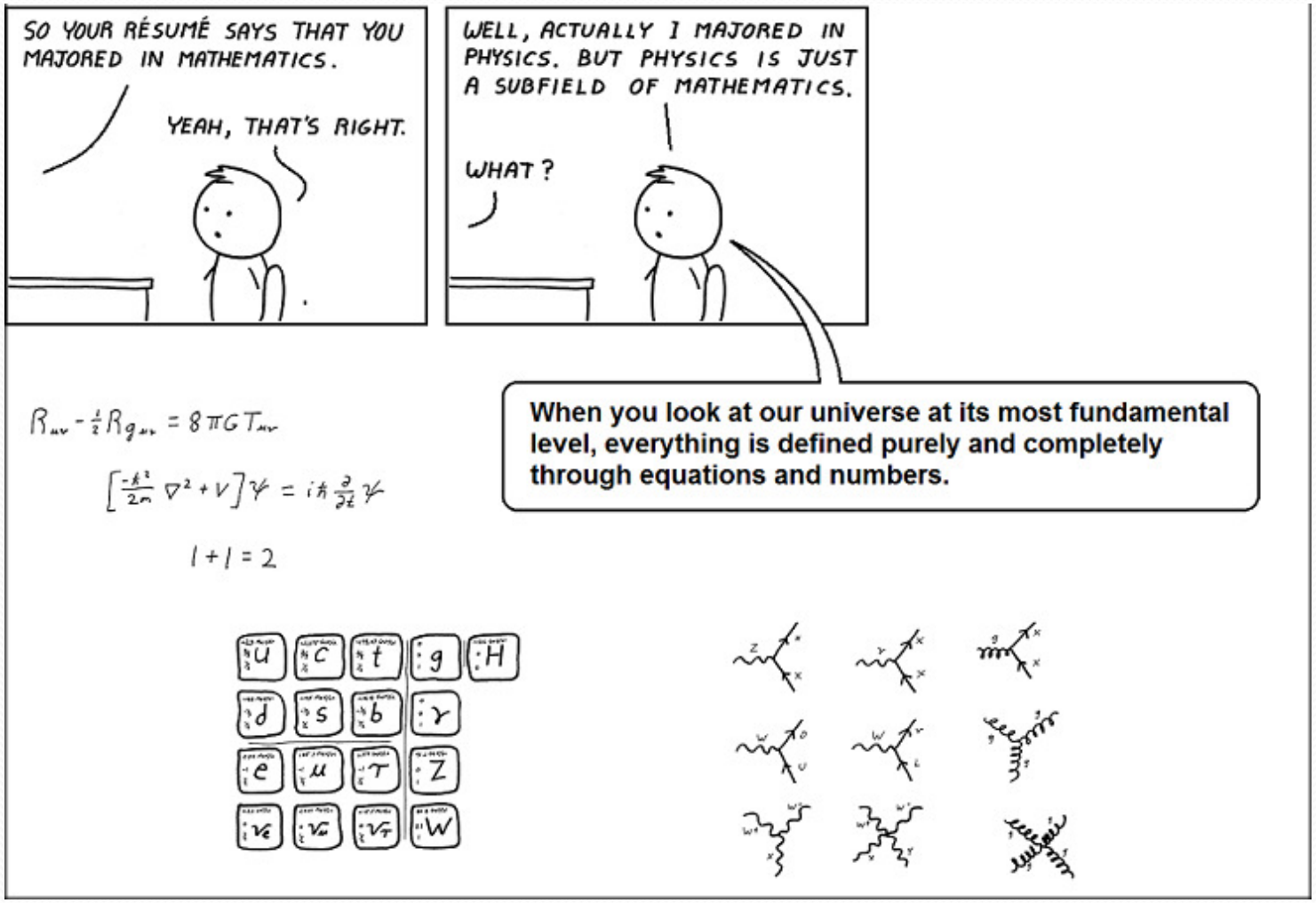
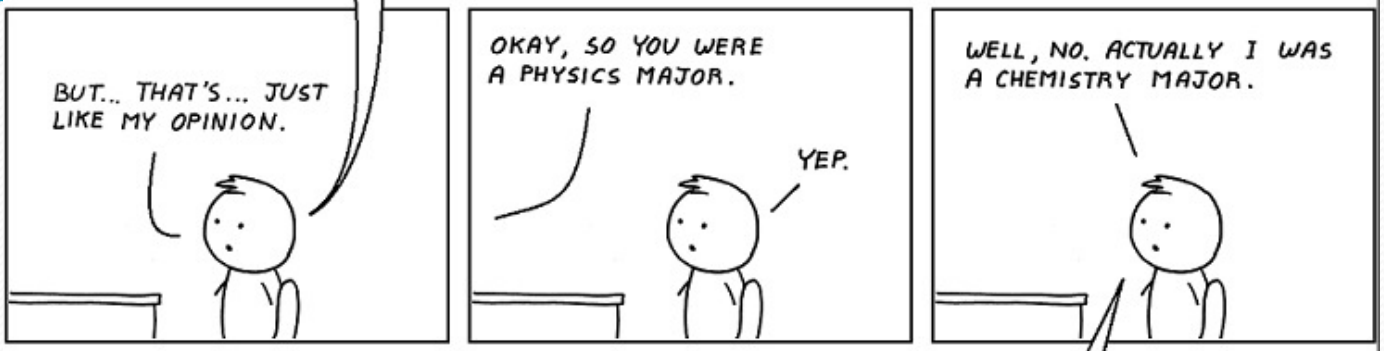
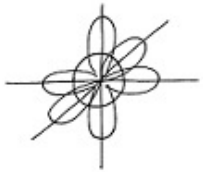


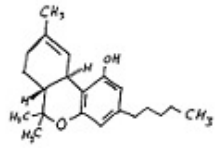
http://abstrusegoose.com/544

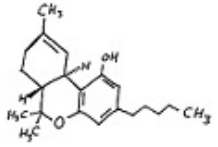
One can literally conceive of an infinite number of mathematical universes, but *our* universe just happens to be a particular solution to one.



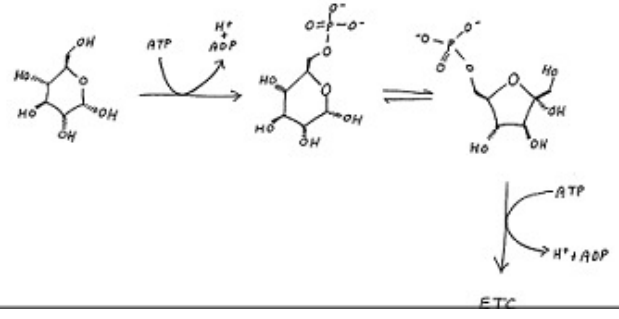
But when you think about it, chemistry is all about the physics of atoms and the interactions of molecules. It's really just a subfield of physics and hence a subfield of math.

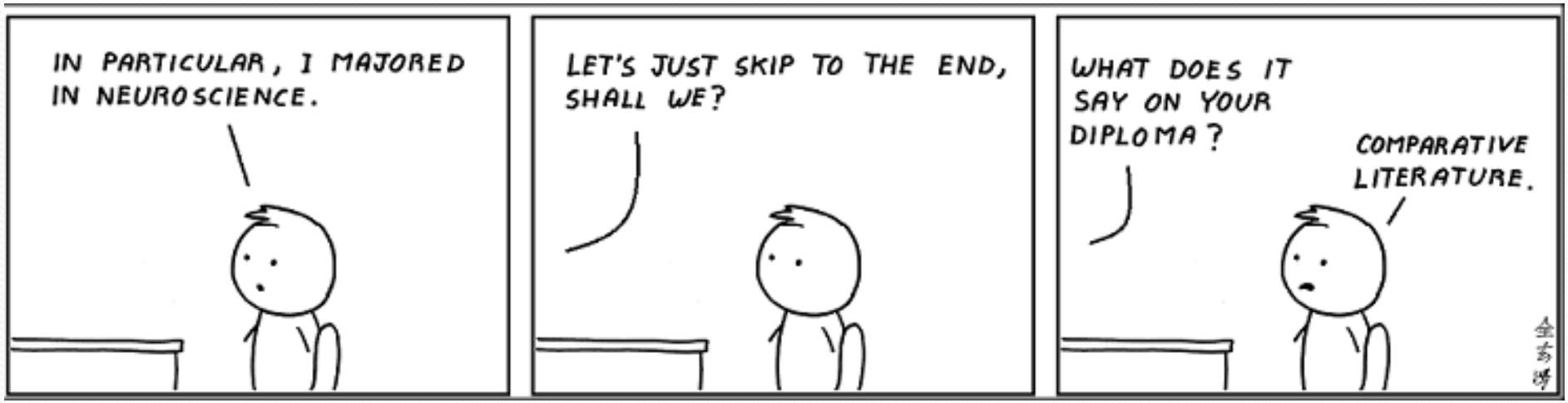






If you want to be really technical, I suppose I was a biology major. Since biology is really just the study of the chemical reactions and processes of living systems, I suppose you could say that it is a subfield of chemistry and hence a subfield of physics and hence a subfield of math.





Everything is a branch of physics.

Physics and Mathematics are different from other subjects

- Frontier physics and mathematics explore worlds that are very far removed from the human scale. This makes the news!
- Everything in the hierarchy, from chemistry on downwards, leans heavily on 'applied physics' from the past.
- There is a smaller gap between the *most theoretical* and the *most applied* in those other fields .
- The modern world is built on physics that is 50 yrs or hundreds of years old! This is a problem.

Hidden contributions of physics

- **Truth is, today physics is not really associated with modern technology by the public. It is more associated with the frontiers of knowledge. This is great! Yes?.. But it's bad for graduates of physics!**
- Besides the well-publicized nuclear era, physics has contributed to many vital areas, and there has been little 'direct' publicity.
  - The semiconductor , optics, space, communications, navigation and computing world is rife with major contributions from physics. Underpinning and driving these areas are: classical EM, relativity (GPS!), thermodynamics, and quantum physics (modern electronics, lasers etc.)

It's partly a cultural/marketing issue

- Physics as a discipline has a culture of not blowing its own trumpet. (No advertising dollars spent)
- As a result, the public has little understanding of what physicists bring to the table. (Incomprehensible nerd, Sheldon Cooper syndrome)
- Physicists have not reached out, at a social level, to the public and the media as physicists (We're not Carl Sagan syndrome).
- The priesthood mentality has drawn a closed circle around physicists. Seen as an academic degree only; it's not the "real" world.

Most physicists don't remain in academia

- In the USA in 2013: Out of 17,340 employed physicists (does not include self-employed, or bio-physicists), 3,050 were in academia.
- Intuitively we know this because we graduate more students than there are teaching staff.
- These students find jobs elsewhere in adjacent or unrelated fields.

Bureau of Labor Statistics http://www.bls.gov/oes/current/oes192012.htm

Good news! Physicists are employed

- Physicists outside academia tend to do well, generally, likely because they are flexible, smart and have **widely applicable** skills.
- Some don't wind up in jobs that would be directly associated with physics.
  - Instead they make use of innate skills or those learned from their physics years via osmosis.
- Most wind up either in R&D, new product development or perhaps a cross-disciplinary oversight role.

http://www.academics.com/science/you_rarely_see_an_unemployed_physicist_55358.html

Potential Job Opportunities

- Acoustic emissions technician
- Acoustical physics
- Aerospace engineer*
- Air traffic controller*
- Ariel survey flight supervisor
- Artificial intelligence developer
- Assistant research officer
- Astronomer*
- Astronaut*
- Astrophysicist
- Atmospheric scientist
- Avionics instrument mechanic
- Biomedical engineer*
- Biophysicist
- Chemical physicist
- Chemical technologist
- Chemist*
- Climate service specialist
- Climatologist
- Computer engineer
- Computer programmer*
- Computer software engineer*
- Condensed matter research
- Cosmologist
- Data analyst
- Database administrator
- Electrical equipment specialist
- Electrical engineer*
- Embedded software developer
- Engineering and natural sciences manager
- Environmental physicist
- Environmental scientist
- Equipment designer
- Exploration geophysicist
- Flight management analyst
- Geophysicist
- Health physicist
- Hydrologist*
- Information specialist
- Instrument designer
- Investment analyst
- Laboratory technician
- Logistics specialist*
- Market research analyst*
- Materials/metallurgical engineer*
- Mathematician*
- Meteorologist*
- Military engineer*
- Military officer*
- Molecular physicist
- Museum exhibits planner
- Nanotechnologist
- Natural and applied sciences consultant
- Navigation equipment specialist
- Nuclear medicine technologist*
- Nuclear physicist
- Operations research analyst*
- Optical physicist
- Optical technician
- Particle physicist
- Photodynamic therapist
- Photon scientist
- Physicist*
- Planetarium guide/lecturer
- Plasma deposition scientist
- Professor*
- Project manager*
- Public relations specialist for space agencies/manufacturers
- Quality controller*
- Radar indicator inspector
- Radiation monitor
- Radiation therapist*
- Radiographer
- Radiologist*
- Researcher*
- Robotics technician
- Sales representative*
- Science journalist
- Scientist*
- Scientific photographer
- Seismologist
- Space program manager
- Space vision technologist
- Software programmer
- Sound engineer
- Special librarian: science
- System support representative
- Systems analyst
- Teacher*
- Technical sales representative*
- Technical writer*
- Telescope engineer
- Ultrasound technician
- X-Ray technologist

Who employs them?

Aerospace industry, Airports
Colleges/universities/boards of education
Communications technology industry
Energy Development companies e.g. wind, fusion
Environmental and Pollution control
Governments
Hospitals and Medical Centres
Information Technology industry
Laboratories
Libraries
Manufacturing companies
Military
Museums
Observatories
Petrochemical companies
Planetariums, National/Provincial Parks
Newspapers and magazines
Research centres
Space industry

Skills

Ability to explain complex concepts and theories to others
High proficiency in written and oral communication
Effective communicator, present information clearly and effectively
Gathering/analyzing data
Conducting and clearly explaining scientific research
Quantitative skills
Reviewing scientific literature
Seeing relationships among factors
Attention to detail
Defining a research problem
Establishing hypotheses
Research & Laboratory experience
Apply and integrate fundamental scientific principles
Statistical analysis & complex problem-solving ability
Use of technical tools

http://www.utm.utoronto.ca/careers/careers-by-major-physics

"Hidden Physicists" – John Rigden, Sept 1997 – The Industrial Physicist

- Because physicists labour under various job titles (anything but 'physicist'!) the actual discipline of physics is seen, in industry and the commercial world, as a purely 'academic' degree.
- Not that there is anything wrong with that.
- But there is a problem for new graduates, especially with undergraduate degrees.
- How to get past the Human Resources department and get an interview? "*We only hire engineers*"

Skills for job seekers

- Communication!! – meaning, getting your ideas across to audiences who mostly do not understand physics.
- Time management!! – learn critical time management skills
- Understanding intellectual property (IP) and how it is managed and protected. Patents, non-disclosure agreements, trade-secrets.
- Know how companies work and what their goals and needs are. It's not about you.
- Entrepreneurship and even some accounting basics.
- "Engineering" design principles – if you are going into that type of industry, know a bit about standard operating procedures for the industry you are pursuing. Design gates, design reviews, ECNs, non-conformances, etc. Learn the lingo.

Secret skills for next generation job seekers

- Learn quantum mechanics.
  - QM information theory
  - QM in biological science
  - QM in materials science
  - QM in cryptography
  - QM in quantum electronics / photonics

http://uwaterloo.ca/institute-for-quantum-computing/

For upcoming/recent grads

- Pick the job/field/area in which you want to work first!
- Make sure you know everything about the history of the company, it's products and also the particular job. It's really impressive in an interview – trust me.
- Make sure you know about the company's competition! That's really impressive in an interview.
- If you can, try to have a brief chat with the hiring manager long before the position even becomes available!
  - Mind-reading magic? No. Networking.
- Do something (project) along the lines of what the company is trying to accomplish, even before you apply (see bullet #1)
- In your resume, use the same keywords that are in the job description, and then explain what you did.
- If all you've ever done is theory, emphasize your mathematical modeling / simulation / and analysis skills – best if you have some code to show for it.

Near term actions needed

- The words physicist and physics need to be made more prevalent in the media. In interviews, don't let journalists use a general term 'scientist say that'.
- More media exposure of industrial physics achievements in addition to the mainstream academic physics stories.
- Physicists need to self-identify, in the public, to employers, friends and on the dance floor.
- CAP, APS, etc. need to promote physicists proactively in the media. But I don't know how to do this, other than to promote industrial/applied physics.
- The world will need solutions for the future, for problems that we will face, on a timescale on the order of about 100 yrs. Don't be afraid to speak forcefully on climate, energy, and technology.

Long term actions for the physics community

- Add some changes to the curriculum, or strongly suggest elective courses that will be beneficial.
  - While against the principle of a well rounded education, most students pick the easiest courses anyway.
  - Engineering physics grads are more likely to get that job
- Encourage dialog between experimental staff (and maybe theory staff) with adjacent industries. Internships, seminars etc.
- Offer the use of any specialized lab facilities to industry for a fee, and vice versa.
- Funding from applied research can and should subsidize basic physics in university departments. *
- Appear more in the media to discuss not only the latest particle physics result, but also issues of immediate concern and interest to the public and identify yourself as a physicist.
- Reach the youngest students! High-school may be too late.