

How to Be Successful in a Physics Career: Preparing for Life After Your Physics Degree

Welcome – we'll get started soon

- Dial in or use your computer's microphone and speakers.
- Submit questions via the Questions panel on the right.
- **This session is being recorded.**
- **The recording will be sent to you via a follow up email.**

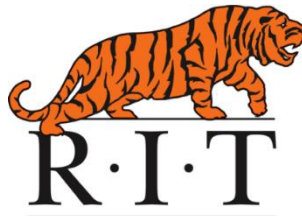
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How to Be Successful in a Physics Career: Preparing for Life After Your Physics Degree

March 21, 2018

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Physics as a forest



Audience input!



What would you see yourself (professionally) in 5 years?

Type your (short) answers into the “Questions” panel.

Where do physics majors go?

Status of Physics Bachelors One Year After Degree, Classes of 2013 & 2014 Combined

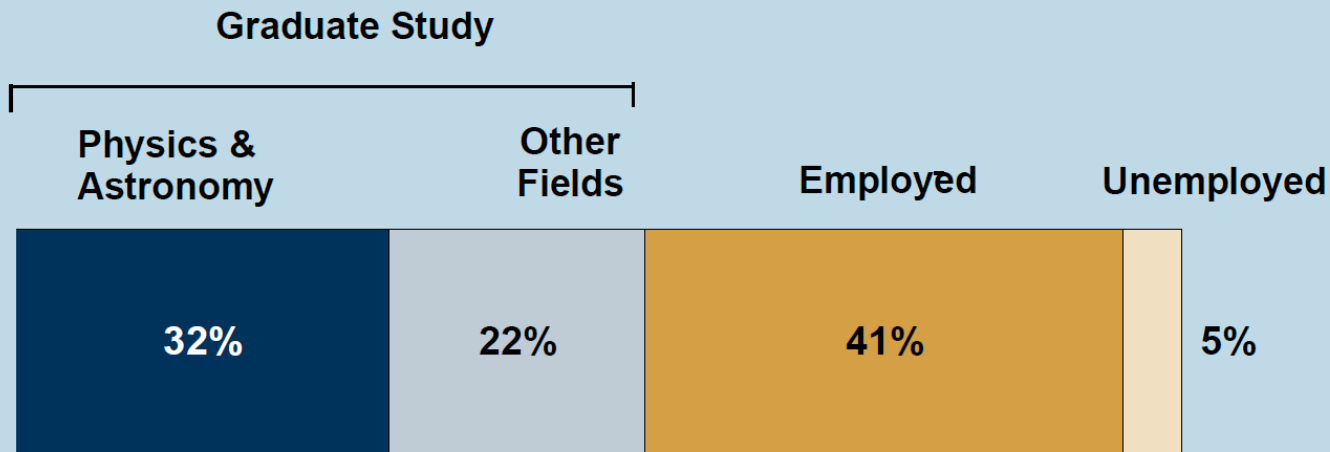
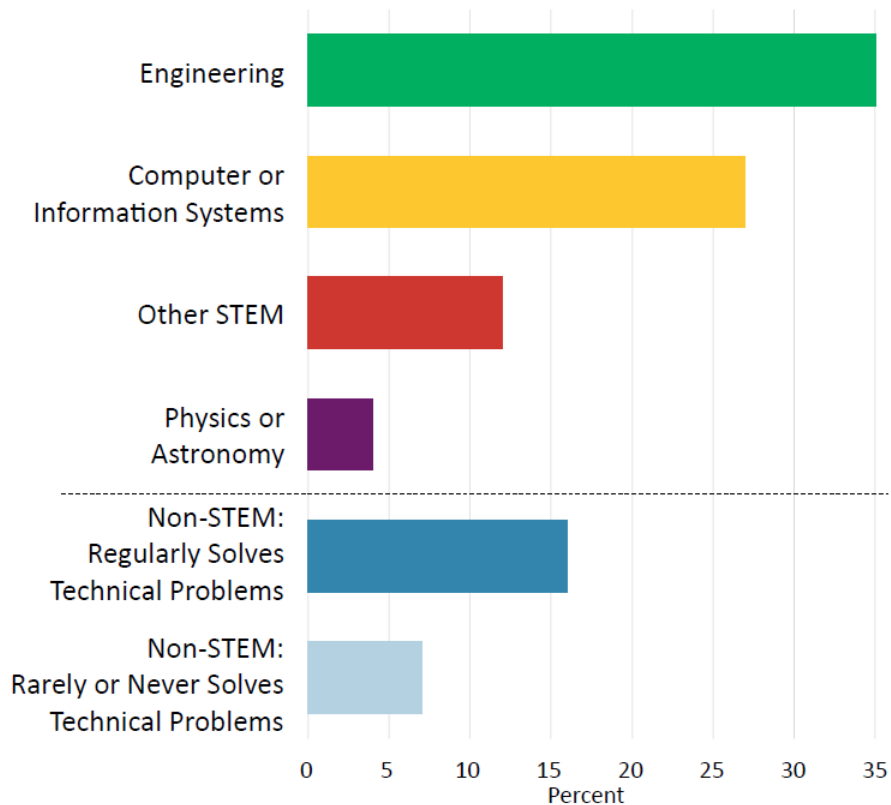


Figure based on 4,886 individuals.

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

Where do physics majors go in industry?

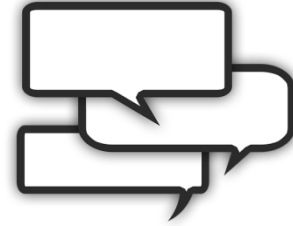
Field of Employment for New Physics Bachelors Employed in the Private Sector



Physics as a forest



Audience input!

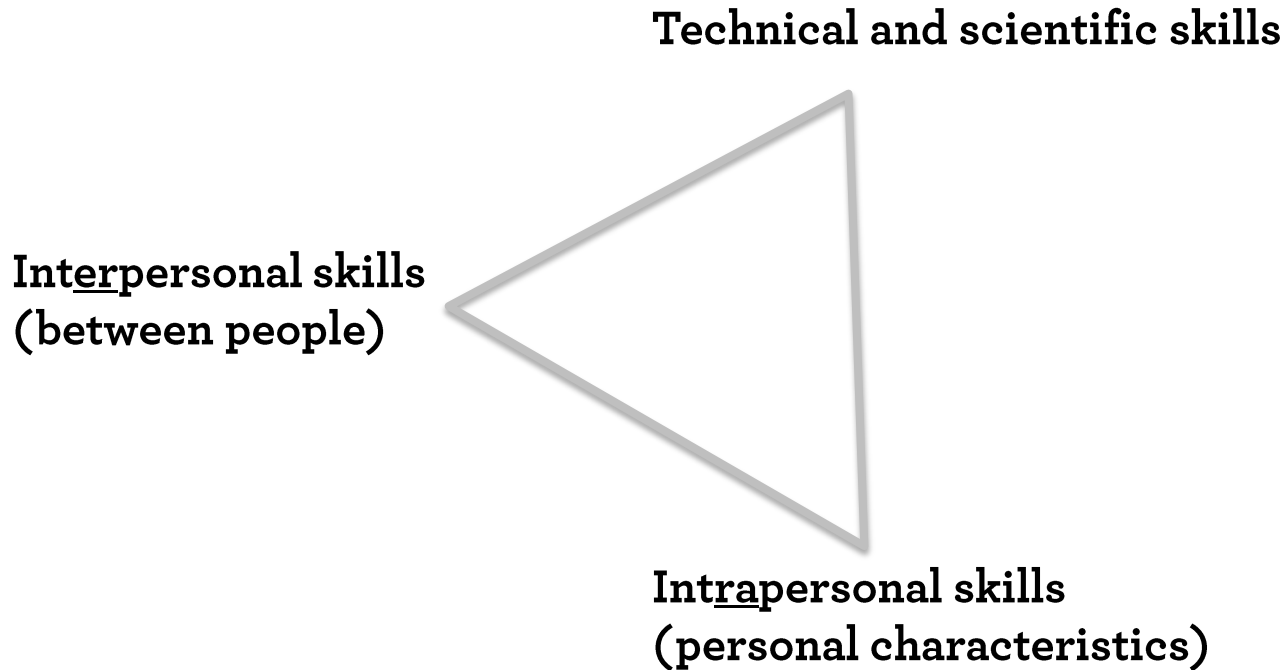


What are the top skills (top three) you would list on your resume or CV that you learned in physics?

Type your (short) answers into the “Questions” panel.

21st Century Skills

Broadly applicable as trends and technologies rapidly evolve.

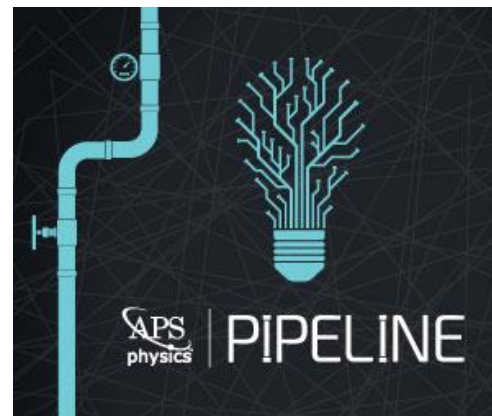


Our Research



Exploring Multiple Postsecondary Opportunities
through Workforce and Education Research

NSF DGE-1432578, DUE-1624887, DGE-1561493



Our Research

Data	Qualitative semi-structured interviews, surveys with multiple choice/select and open-ended questions
Participants	Over 60 industry managers, recent hires (<2years), HR, Over 50 faculty, graduate students, and undergrads interviewed
Analysis	Qualitative coding including thematic, semantic, structural and categorical approaches
Goals	Determining factors for success in careers and connecting these with education opportunities

Factors for

WORKPLACE SUCCESS

1. Question asking

Asks a lot of
questions



Does not ask
questions

Dependent



Independent

1. Question asking

Asks a lot of questions

Uses questions to
avoid taking initiative

Curious, eager learner, leads
new directions, solves new
problems, builds on team and
supporting resources

Dependent

Passive, waits for others
to give instruction

Loner, tries to solve
everything on their own
wasting time/money/effort

Independent

Does not ask questions

1. Asking questions at work...

*“When we’re working with people, you have the type of people that are going to **ask a million questions** and they’re **inquisitive** and they want to know all the minute details that go into the process...in the long run they tend to be some of the **best opticians that we’ve ever had.**”*

1. Asking questions at work...

“Definitely not being afraid to speak up.

A lot of people have the problem where if they speak up and they ask a question that identifies a gap in their knowledge, they feel that brings them down a rung in other people's eyes.

*But really, that's something that **we value** here is the **ability just to ask a question.**”*

2. Problem solving

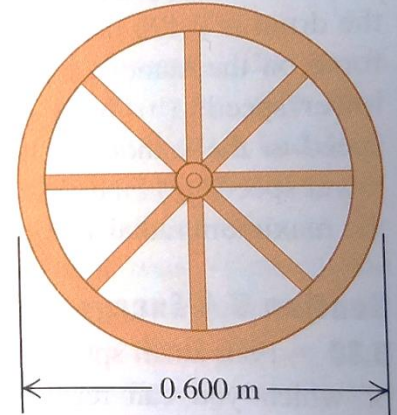
Problem 10.18 Suppose a point charge q is constrained to move along the x axis. Show that the fields at points on the axis to the *right* of the charge are given by

$$\mathbf{E} = \frac{q}{4\pi\epsilon_0} \frac{1}{r^2} \left(\frac{c+v}{c-v} \right) \hat{\mathbf{x}}, \quad \mathbf{B} = 0.$$

What are the fields on the axis to the *left* of the charge?

9.35 •• A wagon wheel is constructed as shown in Fig. E9.35. The radius of the wheel is 0.300 m, and the rim has mass 1.40 kg. Each of the eight spokes that lie along a diameter and are 0.300 m long has mass 0.280 kg. What is the moment of inertia of the wheel about an axis through its center and perpendicular to the plane of the wheel? (Use the formulas given in Table 9.2.)

Figure **E9.35**



What does problem solving look like in your physics classes?

What will problem solving be like on the job?

2. Problem solving beyond the textbook

“I guess in undergrad it's ...professor-defined ... and they kind of tell you this is the problem you need to solve, and this is kind of the solution you're looking for.

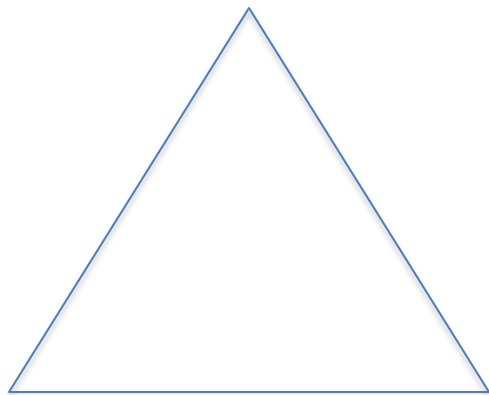
*Whereas, in graduate school ...you have to **figure out what you really want** to pull out of the data and where it's going and if what you got is actually **good or not.**”*

~Physics Graduate Student

2. Problem solving beyond the textbook

Analyzing data

Context



Interpreting results,
Assessing quality

Activity

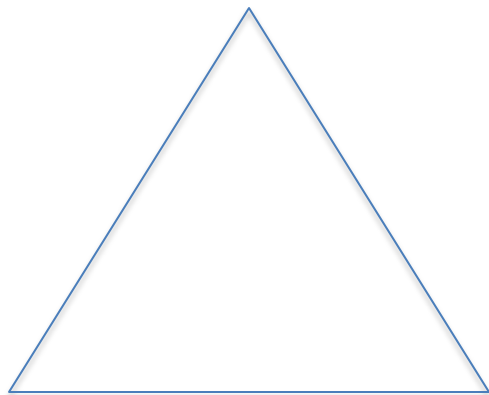
Feature

Unknown solution
or outcome

2. Problem solving beyond the textbook

Experimental physics lab

Context



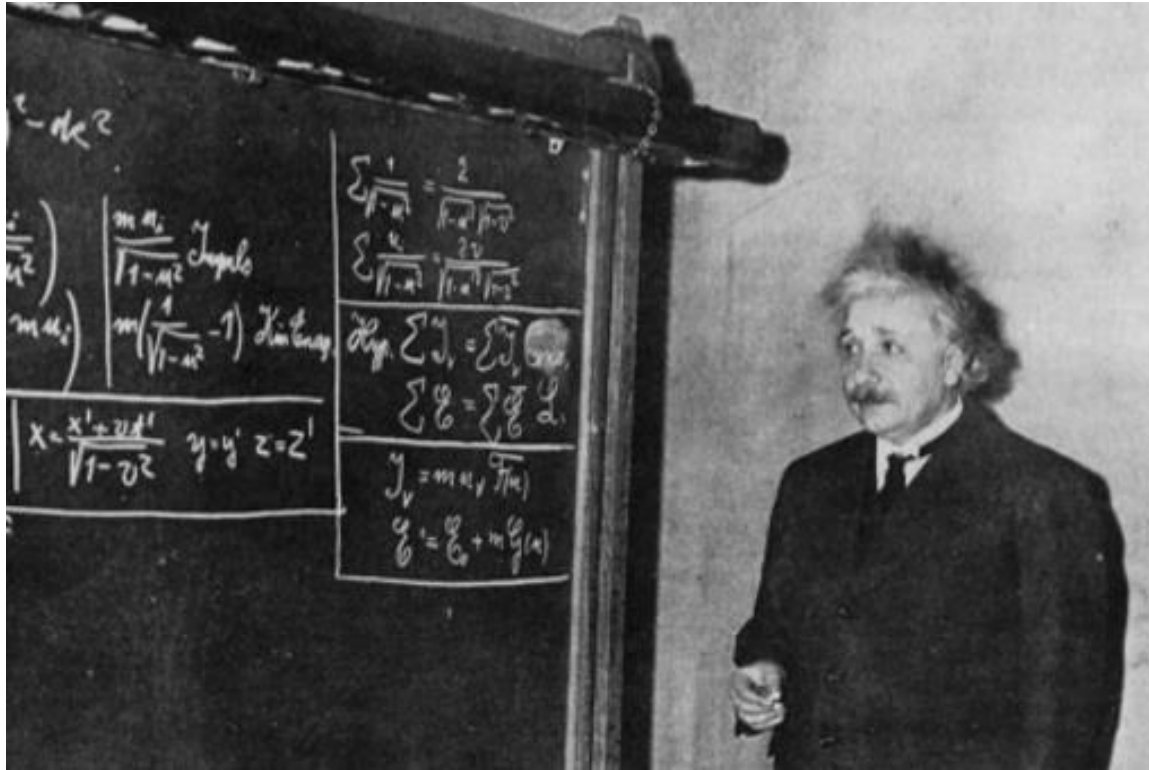
Troubleshooting

Activity

Feature

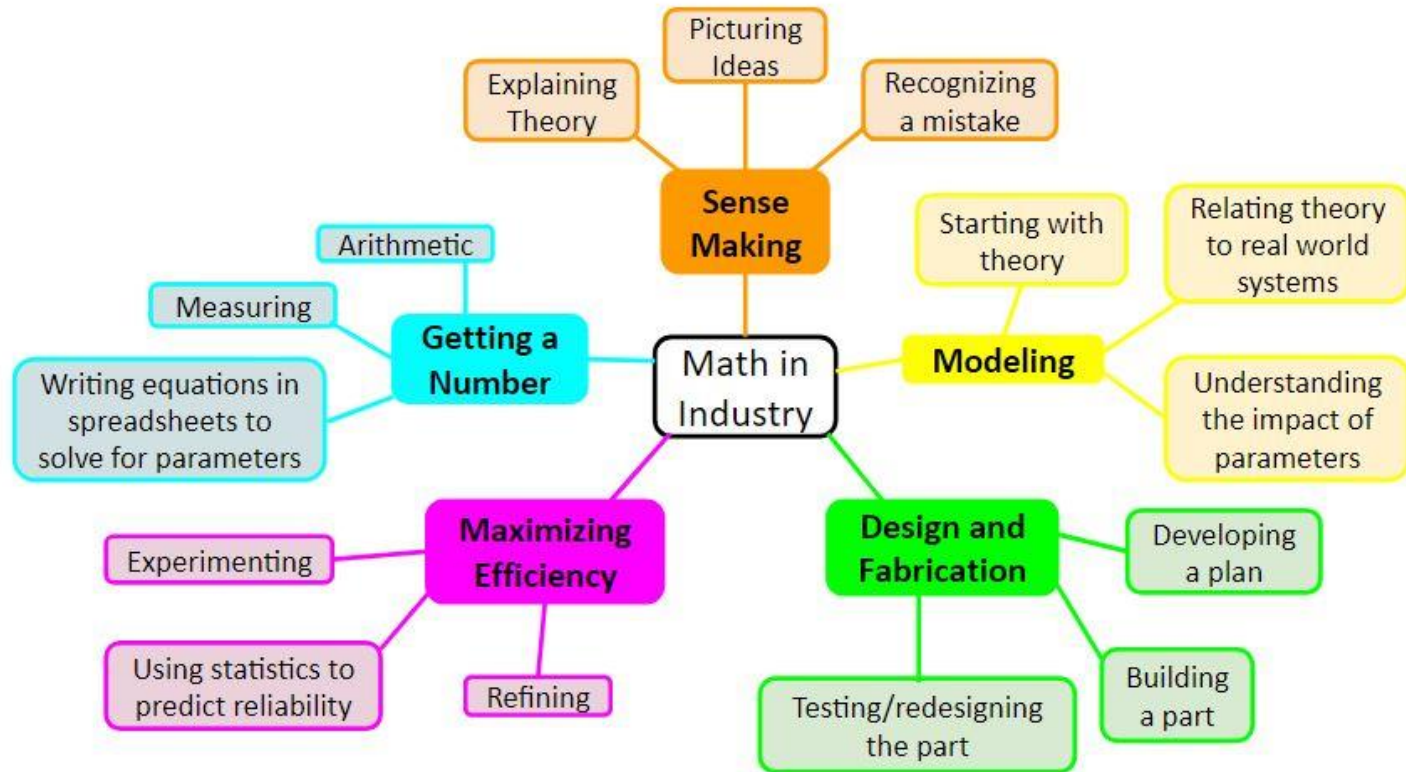
Lack of experience
or confidence

3. What does it look like to be good at Math?



Is this representative of math use on the job?

3. Mathematics use in industry



3. Mathematics and computation training

*“My biggest piece of advice is **learn the numerical and computational** methods. Do it because, otherwise, you can't contribute. Yes, you're great at physics and, yes, you have a good intuitive understanding, but without being able to actually model things in real life, it's going to be impossible to...it's not impossible to contribute, but you're going to be much more effective. I think that's something that has been my advice, and I've told many physics students.”*

~Recent Hire

3. Mathematics and computation training

Using computational tools is essential

- Excel, a spreadsheet tool
- General purpose modeling and data analysis – MATLAB, Mathematica, Python, R
- Specialized modeling tools – COMSOL multiphysics simulation, CodeV optics

Mathematical thinking and data analysis

“what we mostly do is related to analyzing images, but also fitting functions to spectra, for example. What I have to do is to write a code which fits these kinds of functions to my signal, and then I have to get some parameters out of the fit.”

~ Astronomy graduate student

Essential for jobs involving research, engineering, data science, etc.

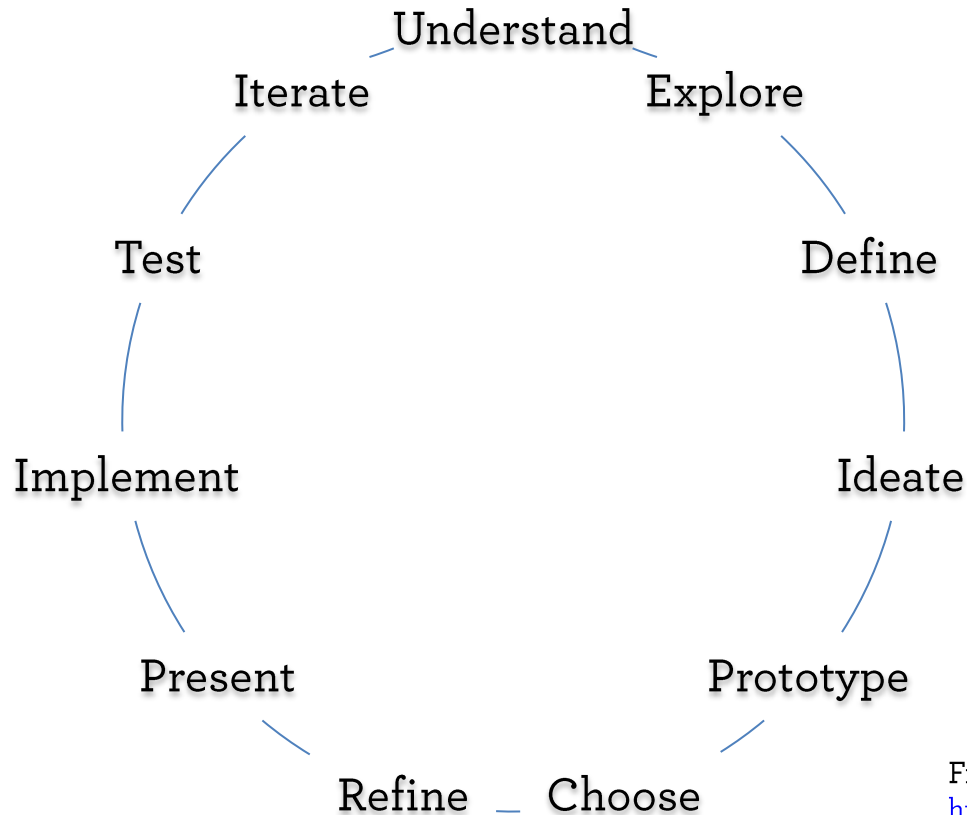
4. A quote from physics students...

“[Design] I guess that's more of an engineering thing.”

~Physics Undergraduate Students

What do you think?

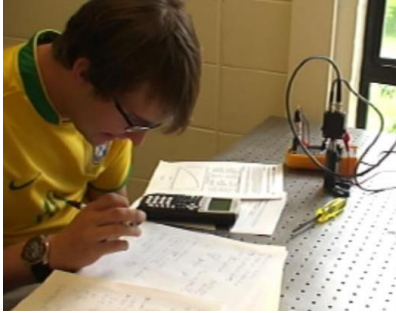
4. What is a design process?



From VEX Robotics EDR Curriculum
<https://curriculum.vexrobotics.com/curriculum/intro-to-engineering/what-is-the-engineering-design-process.html>

4. Design is part of physics and more!

Experiments



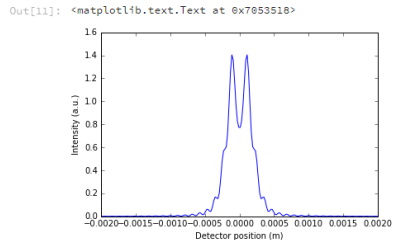
Clubs



Software and programs

```
In [11]: make_diffraction_plot("huygens")
         #make_diffraction_plot("kirchhoff")
         #make_diffraction_plot("fresnel")

         xlabel("Detector position (m)")
         ylabel("Intensity (a.u.)")
```



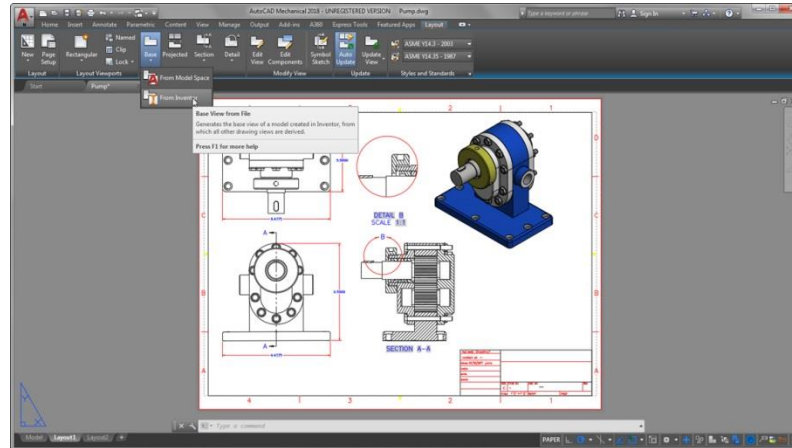
Your community & hobbies



4. Design in the workplace

*“Having a real good **hands-on type attitude and mind-set.** The type of people that are most successful here are the ones that don't want to just sit in the cubicle all day. They **want to design something, and get it built and touch it and fix because it may not work the first time, and understand the whole design process.**”*

~Manager

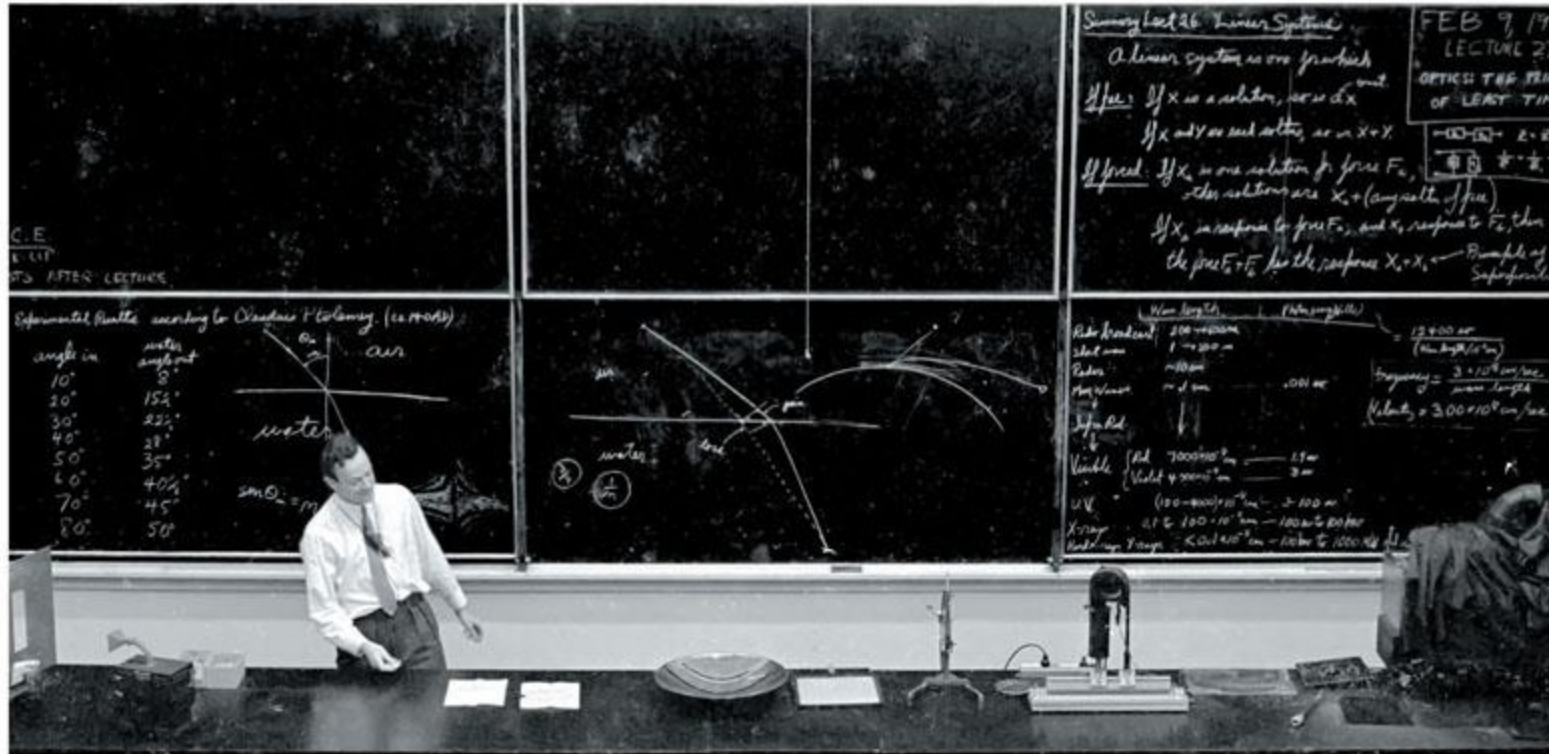


5. Communication

What makes a great communicator?

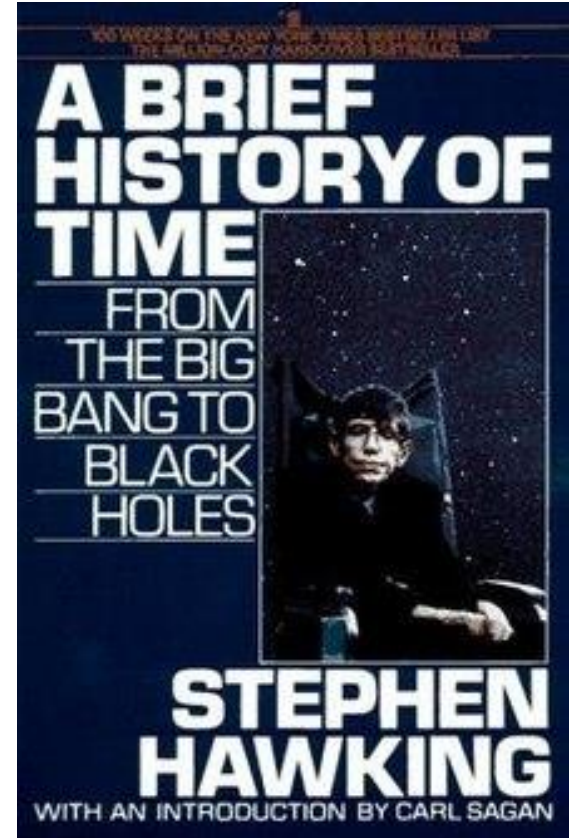
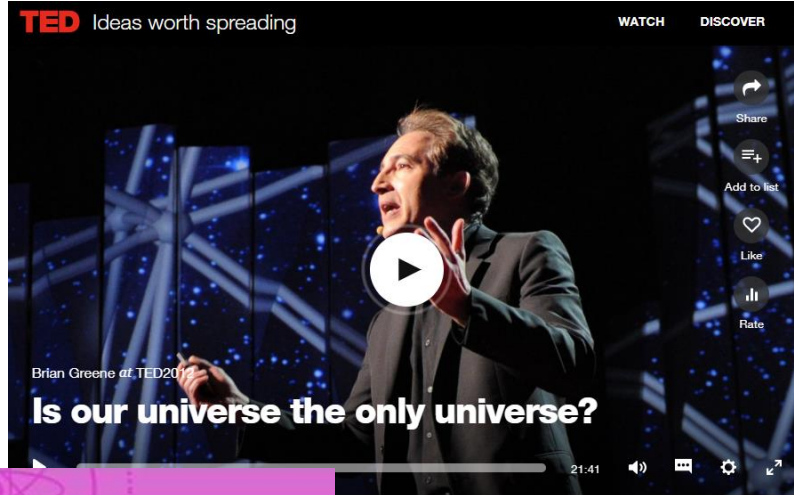
What examples come to mind?

5. Communication in the classroom



Richard Feynman lecturing in 1962 on optics and Pierre de Fermat's principle of least time.

5. Communication to the public



5. Multifaceted workplace communication

Interdisciplinary collaborator



Manager, advisor

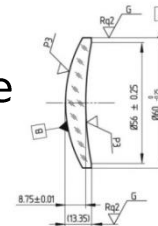


Clients, customers



You

Co-workers with different expertise



Other experts in similar field



General public



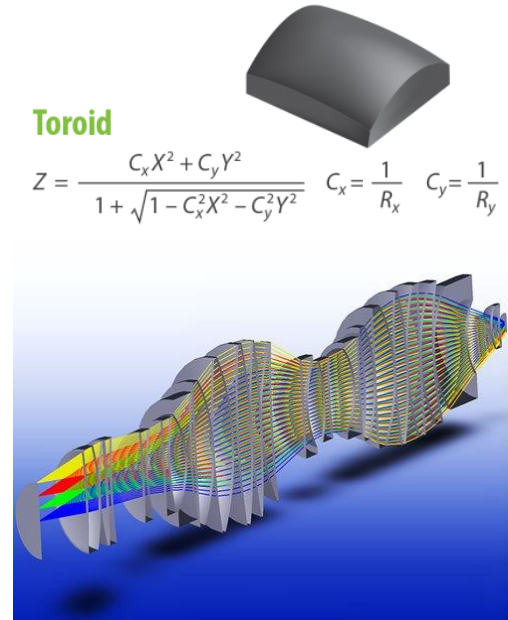
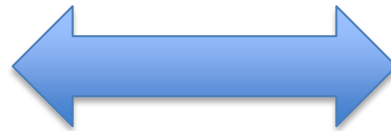
5. Communicating across occupations

With co-workers with different expertise

“One of the big things is ... to communicate with those who do not necessarily understand all of the physics behind what they're doing.”



Makers



Modelers and designer

5. Communicating with clients

“Presentation is huge. You can know all the right things, but if you don’t know how to read that information in a clear, easy to read and understandable way, you’re just going to confuse customers...”



6. Learning beyond the classroom

*“Then there [are] intangible things that we’re looking for. A lot of times it’s a person’s **drive** for their own personal development... ‘How do I better myself? What do I need to do?’ They’re actually **pushing their learning** instead of having someone have to pull it out of them, kind of thing. What books they read, why did they choose certain courses that they took? It says a lot about the individual and hobbies.”*

~Manager

6. Learning beyond the classroom

**Employer perceptions of
workplace training:**

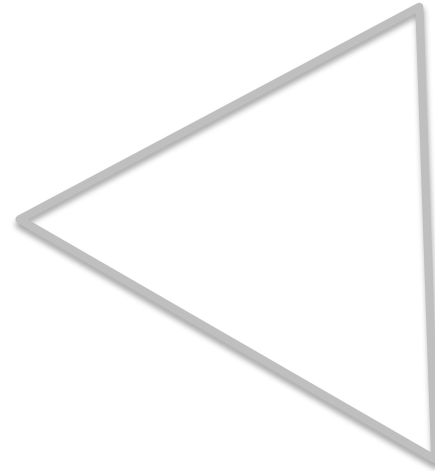
Most trainable



Least trainable

**Interpersonal skills
(between people)**

Technical and scientific skills

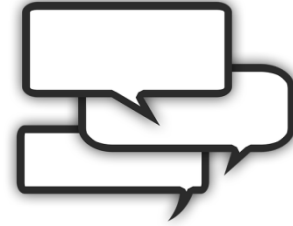


**Intrapersonal skills
(personal characteristics)**

6. Intersecting skills



Audience input!



What are some additional skills (three new ones) you could develop or repurpose to complement the ones you listed earlier?

Type your (short) answers into the chat window.

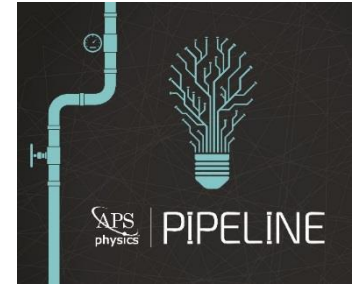
What can you do?

Adapt Physics Department Learning

- Think broadly about the contexts, activities, and features where you encounter problem-solving in physics.
- Use computation and programming (e.g., Python, Excel) for courses.
- Explore APS PIPELINE network for recommendations to integrate innovation and entrepreneurship in physics.
- Encourage professors to integrate and value skills relevant to your future career (e.g., communication).

APS PIPELINE Network

- **Six member institutions:** Loyola University Maryland, Rochester Institute of Technology, Wright State, UC Denver, and George Washington University.
- Advised by experts from established physics entrepreneurship programs (e.g. Carthage College, Case Western, Kettering University)
- Goals are:
 - to **deliver tested PIE curriculum** to a wider cohort of practitioners.
 - to **assess of effects of PIE implementation** on student and faculty attitudes towards innovation and entrepreneurship, and **examine barriers** to PIE implementation
 - to **build a community** of expert practitioners who can mentor other institutions.
- Activities are varied in scope and resources needed; institutions varied in culture and resources available.



www.aps.org/programs/education/innovation/index.cfm

Support for this work was provided by the National Science Foundation's Improving Undergraduate STEM Education (IUSE) program under Award No. 1624882



What can you do?

Pursue Additional Learning Opportunities

- Take classes in other departments to complement what you are learning in physics.
- Participate in informal learning experiences that involve design and communication (e.g., maker spaces, outreach, clubs, sports).
- Find internships or co-ops to start learning on the job before you graduate.
- Develop and highlight intersecting skills (technical and scientific, interpersonal, and intrapersonal) when applying to internships and jobs.
- Keep learning!

Resources

SPS Physics Careers Toolbox - <https://www.spsnational.org/sites/all/careerstoobox/>
Practical activities for identifying career options, writing resumes, etc.

AIP Statistics <https://www.aip.org/statistics>
Who's Hiring Physics Bachelors
<https://www.aip.org/statistics/reports/whos-hiring-physics-bachelors>

APS Careers <http://www.aps.org/careers/>

Phys 21 Report and Supplement <https://www.compadre.org/JTUPP/report.cfm>