

Demographics of Astrophysical, Planetary & Space Sciences: 30 Year Perspective

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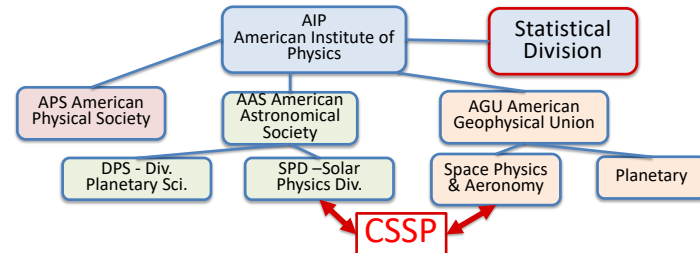


We've come
a long way,
but.....

Outline

- First, the numbers.....
 - International
 - National
- Where are the worst leaks?
- How to fix them?
 - Think globally, Act locally

*The acronym soup
of professional
organizations*

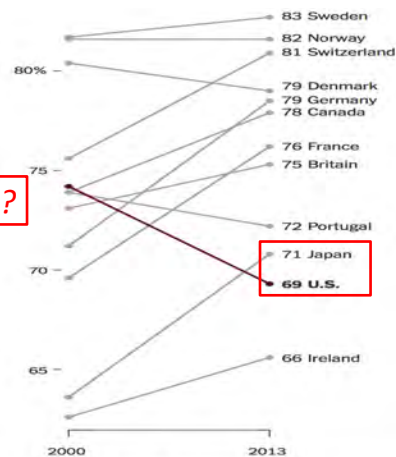


Statistics - buyer beware!

Percentage of women
ages 25-54 who are employed

- First, there's the numbers
- Then, there's the interpretation
- Statistics can often reveal interesting sociology... or politics... or....?
- or maybe it's just a change in the way they are gathering the numbers.....

What's going on here?



Source: Organization for Economic Cooperation and Development

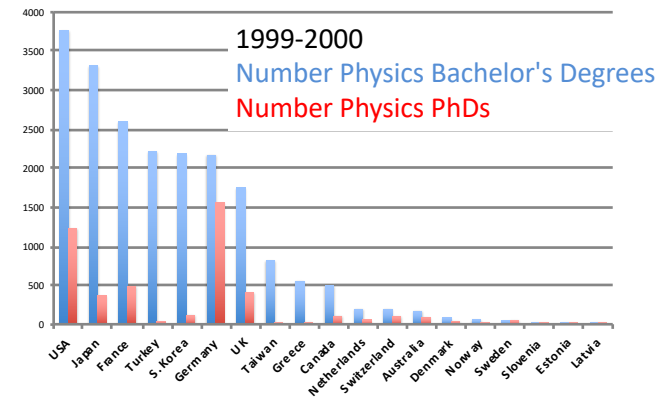
Reflections

- Why does it require an effort to bring more women into scientific careers?
- ... and for them to thrive there
- Women are "the canaries in the mine" – generally, addressing gender issues improves things for all

International View

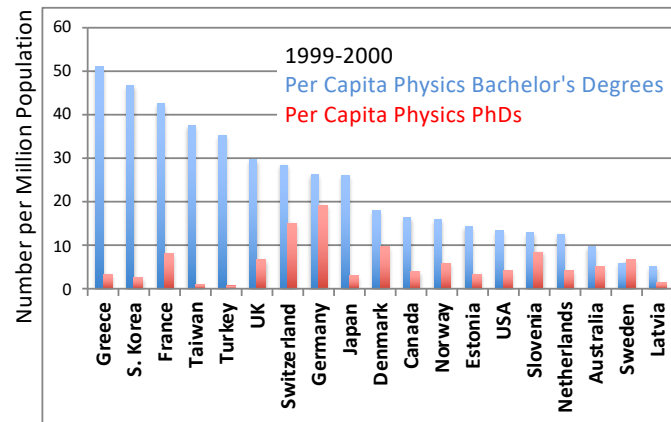
International

Compiled by the AIP Statistical Research Center



Many countries missing – India? China?

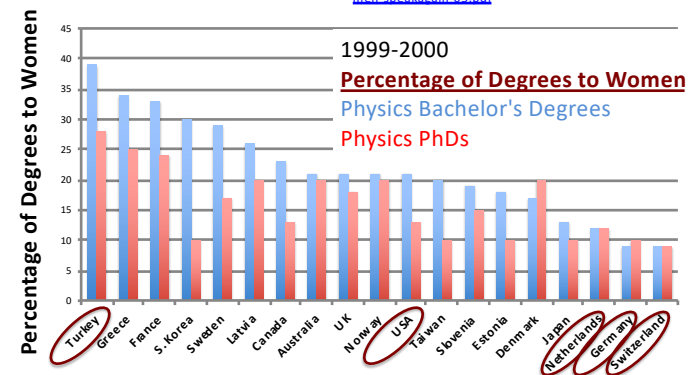
International



International

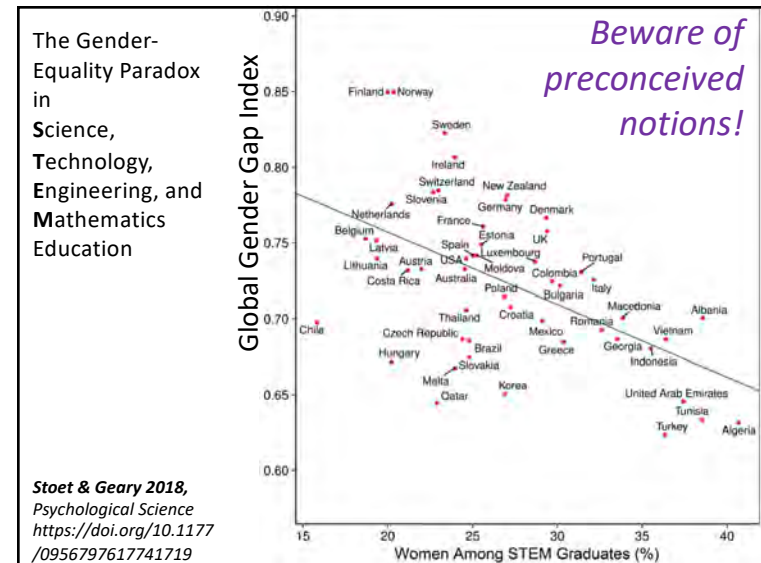
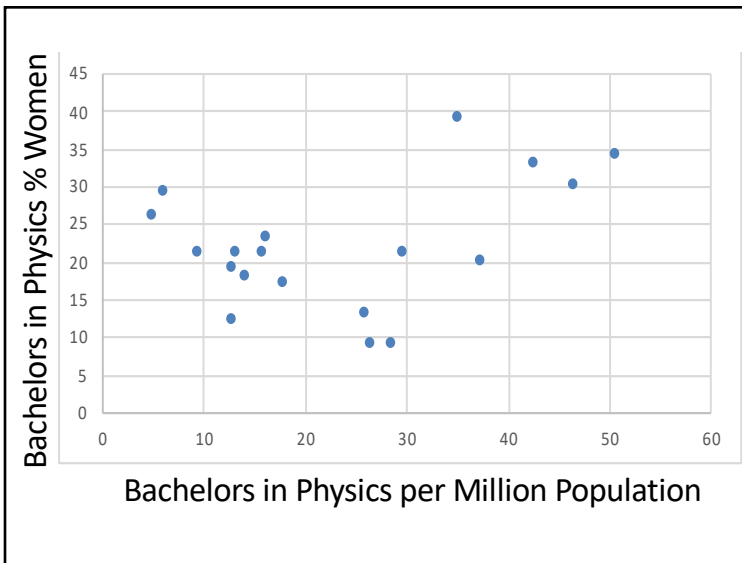
Compiled by the AIP Statistical Research Center

<http://www.aip.org/sites/default/files/statistics/women/women-speakagain-05.pdf>



Numbers sometimes test our pre-conceived notions

??????????????



National Surveys:

Astronomy
Planetary Science
Space Physics

National Surveys

Astrophysics: 2013 AAS Survey by AIP
63% response = 1583 Respondants

-> 2040 PhD astrophysicists in US

Solar & Space Physics: 2013 NRC Decadal Survey
AGU-SPA, AAS-SPD, Space Weather Week
51% response = 1305 Respondants

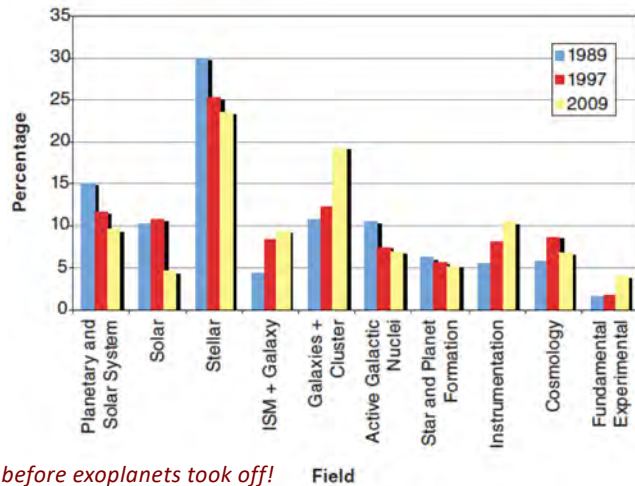
-> 2300 PhD solar, space & upper atmos. in US

Planetary: 2011 AIP Survey
62% Response = 2622 Respondants

-> 1200 PhD planetary scientists in US

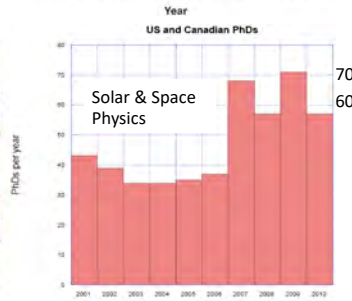
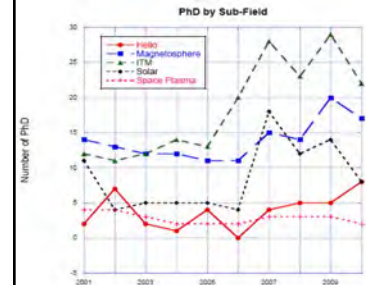
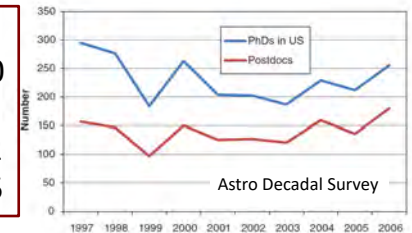
Attendees/Members of Planetary Conference/Section				
	LPSC	AGU	DPS	All Three
LPSC	1280	345	90	
AGU		264	124	
DPS			358	
All Three				161

AAS Membership

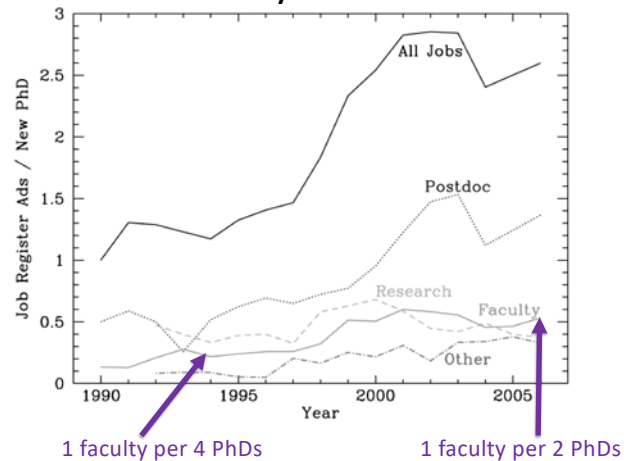


PhDs/year in US

Astro	250
Solar & Space	62
Physics	62
Planetary	65



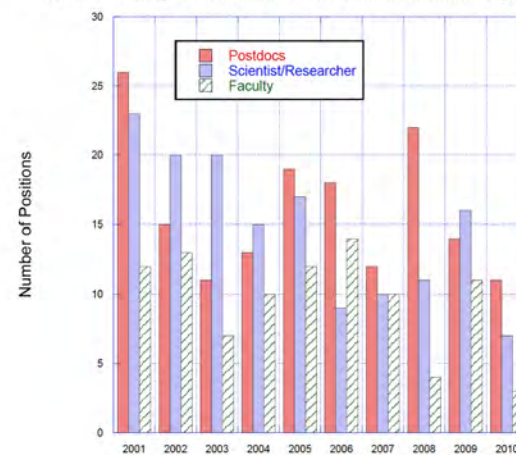
Astronomy: Jobs for PhDs



The Production Rate and Employment of Ph.D. Astronomers, Metcalfe (2008), ASP, 120, pp 229-234

SPA+SPD - Jobs for PhDs

Number of Unique Positions Advertised for US Institutions (SPD + SPA)

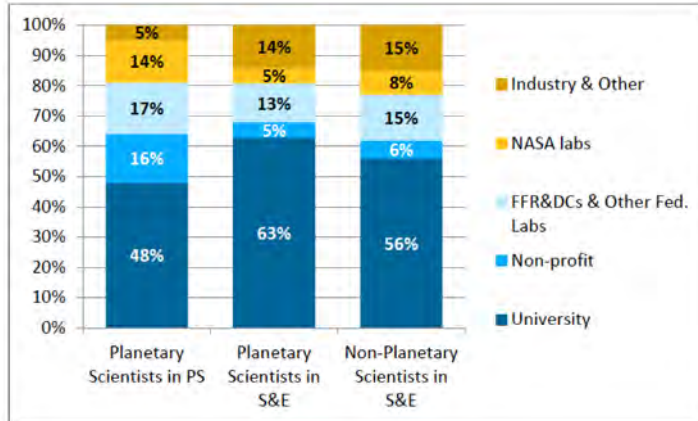


62 PhDs / year

1 faculty per 5-20 PhDs ??

Recent years??

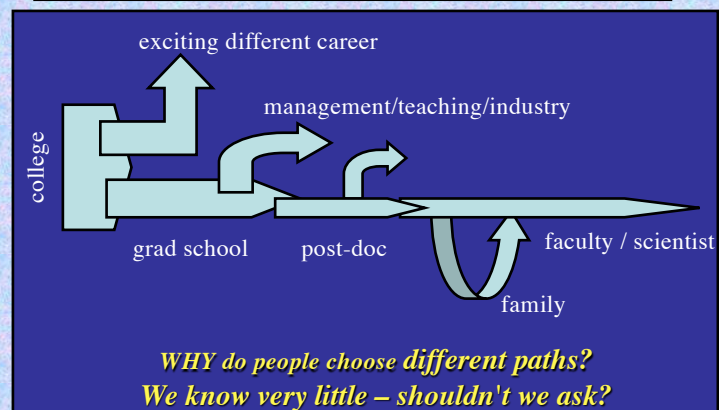
Planetary - Jobs for PhDs



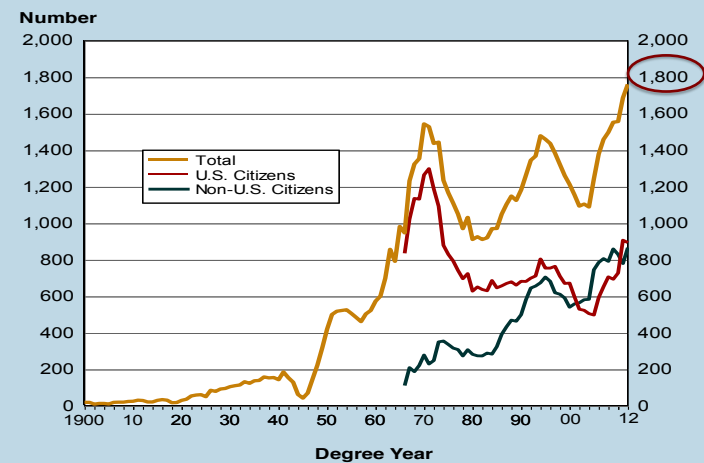
More varied? Less academic?

The Leaky Pipeline

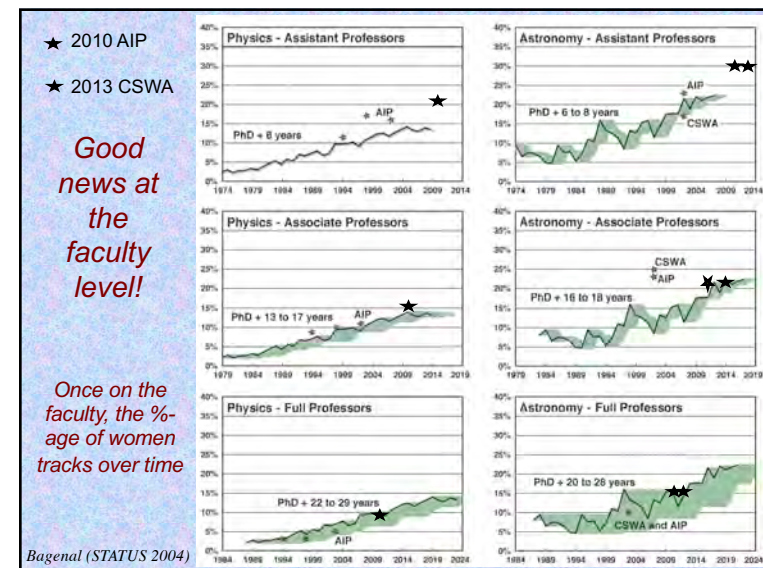
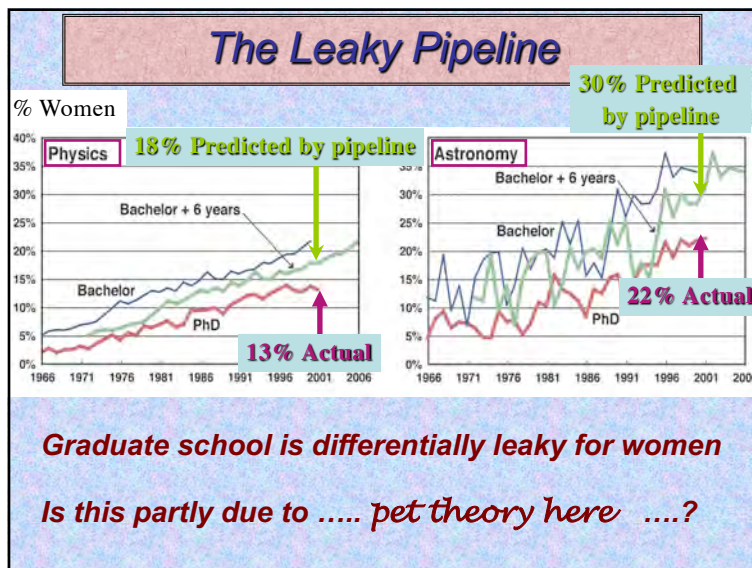
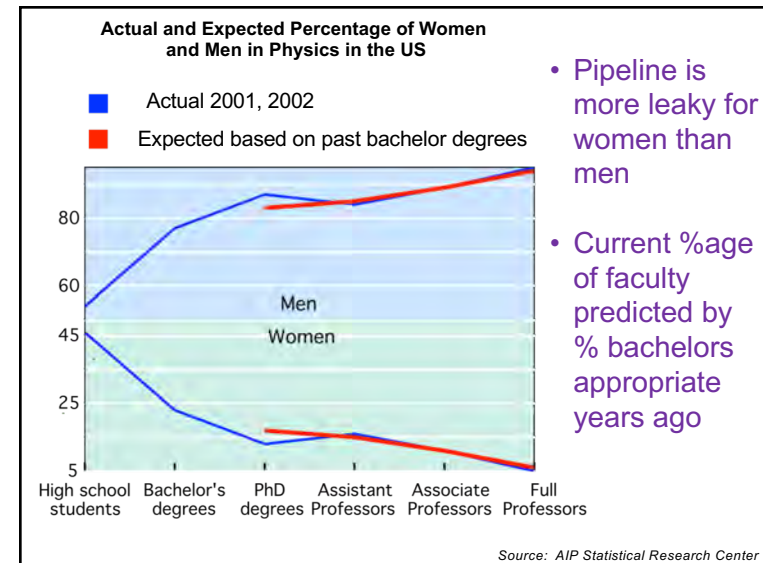
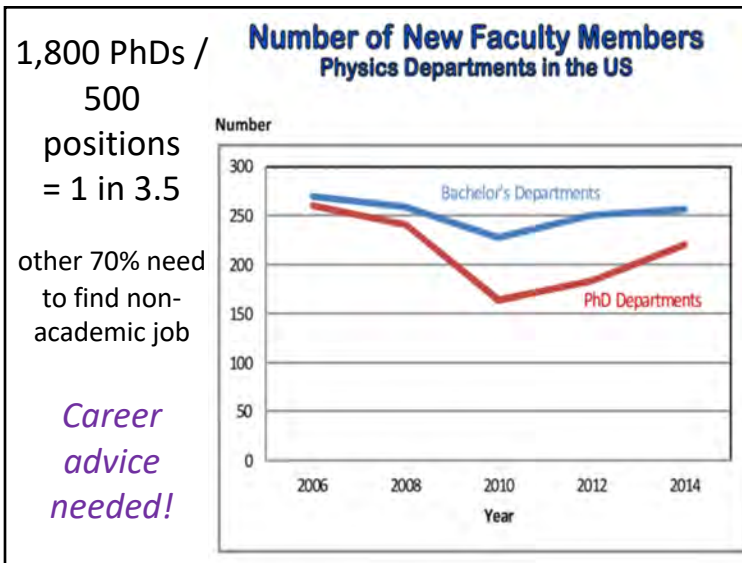
Pipeline?



Physics PhDs Conferred in the U.S., 1900 through 2012.



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



Still <50% women in STEM fields Reasons for Disparities?

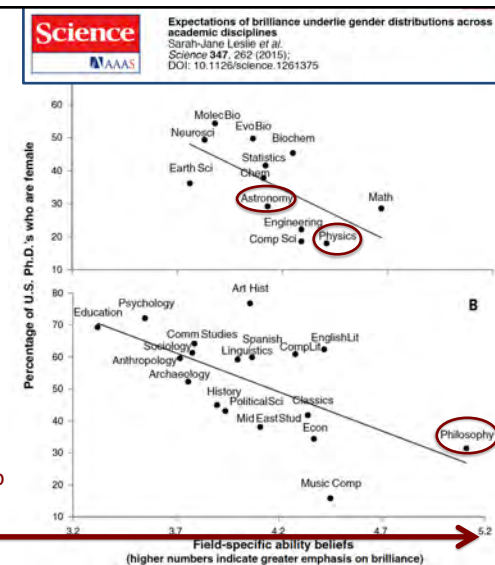
- **Not family**
 - Women w/o children not more successful
 - Many women in other demanding fields
 - Countries w/ strong support systems (e.g., Scandinavia) have few women in physics
 - Academic careers flexible: *become a professor, have a family!*
- **Culture?**
- **Earlier in Pipeline?**

Meg Urry, Yale Physics Dept.
AAS President

Innate vs. Learned

*Remember 2005 when
at Harvard Larry
Summers said there's
an "intrinsic
aptitude"?*

Means:
"I think you need to
be innately brilliant to
be in my field"



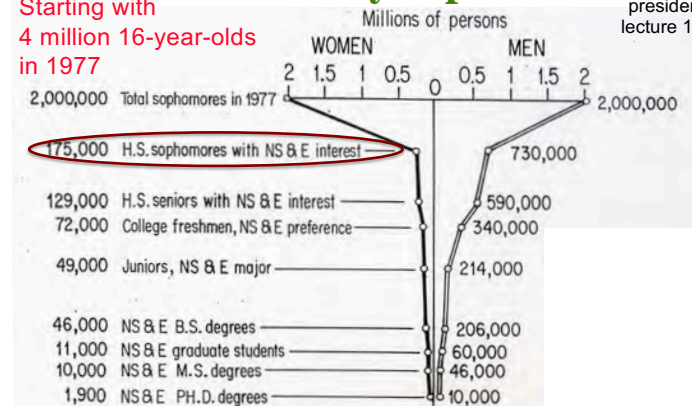
US Physics Undergraduate Education:

Workforce Supply
Total Numbers
Gender Issues
Other Minority Issues

"The Leaky Pipeline"

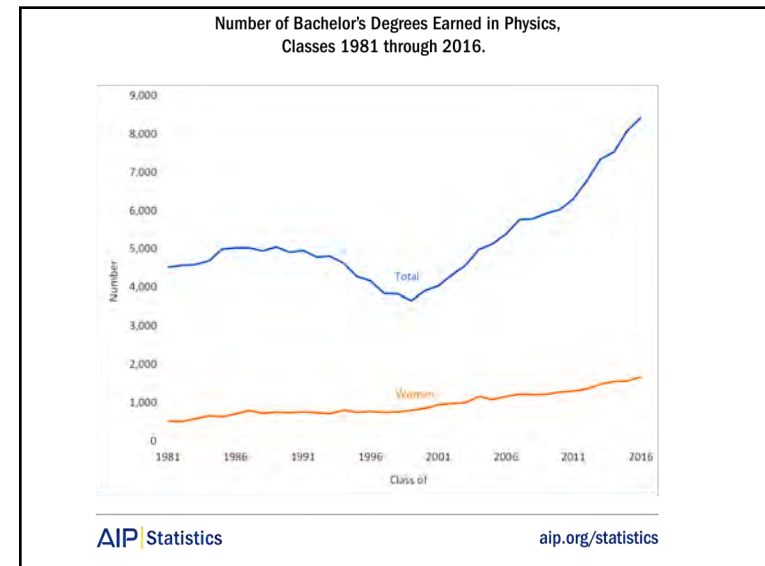
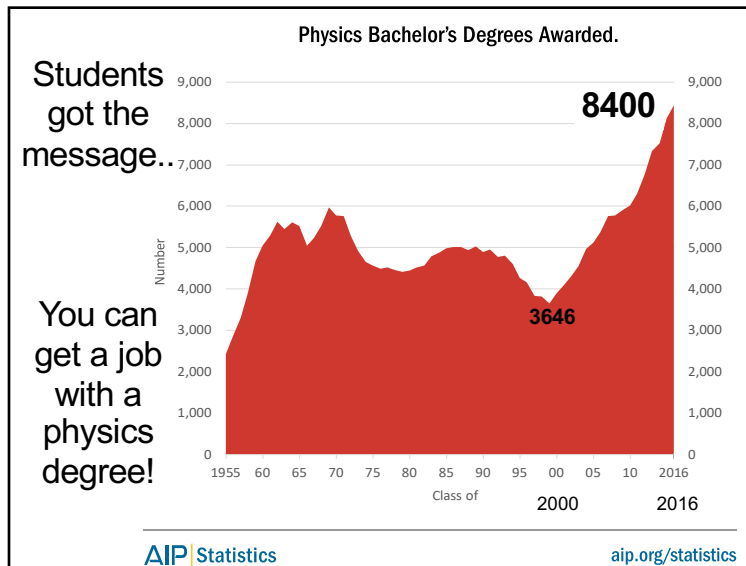
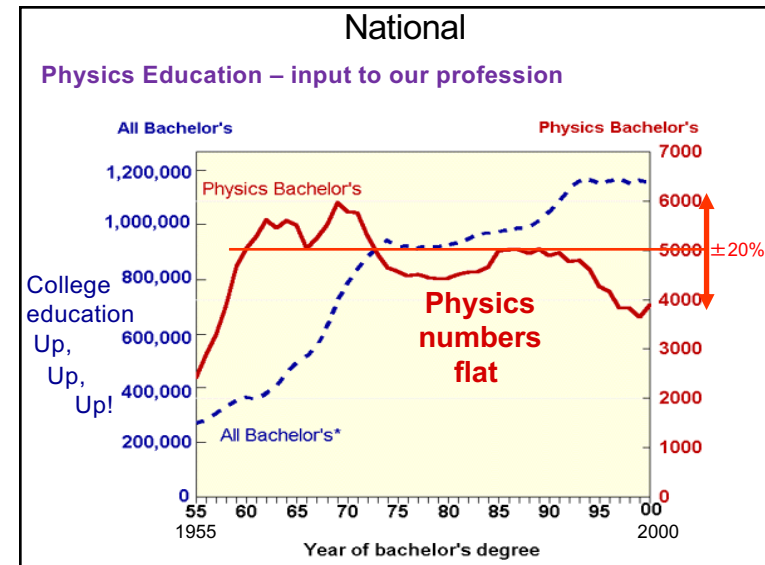
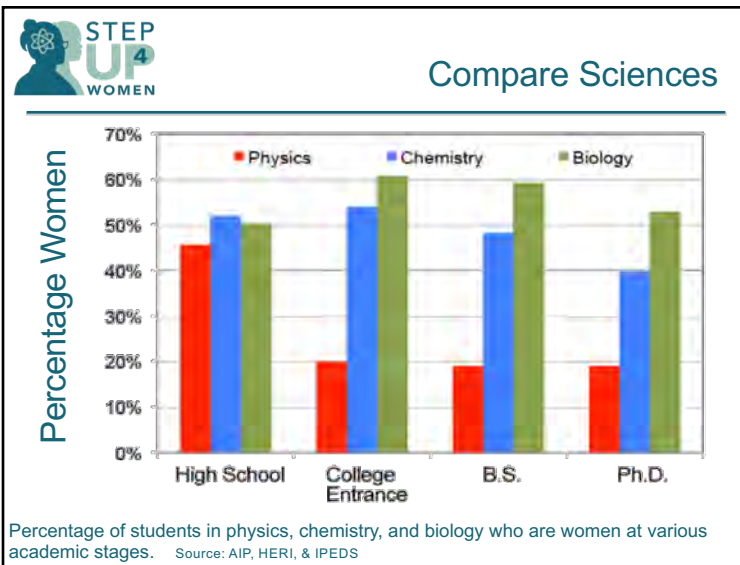
Shiela Widnall
AAAS
presidential
lecture 1988

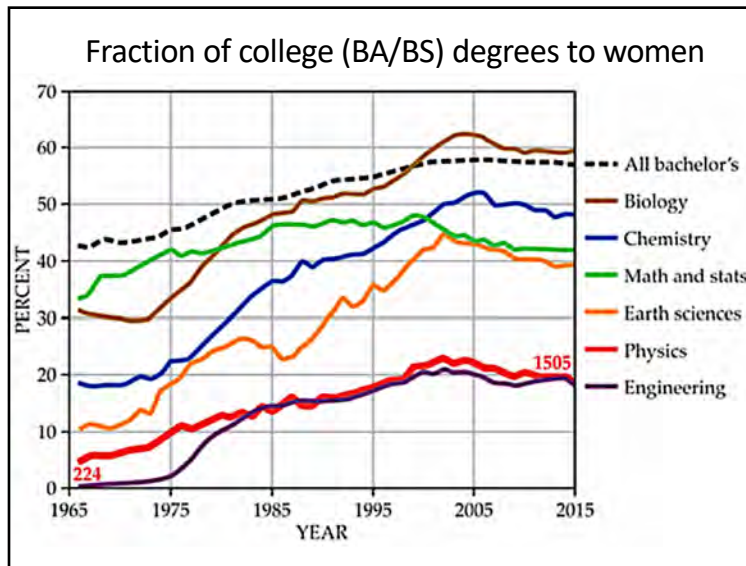
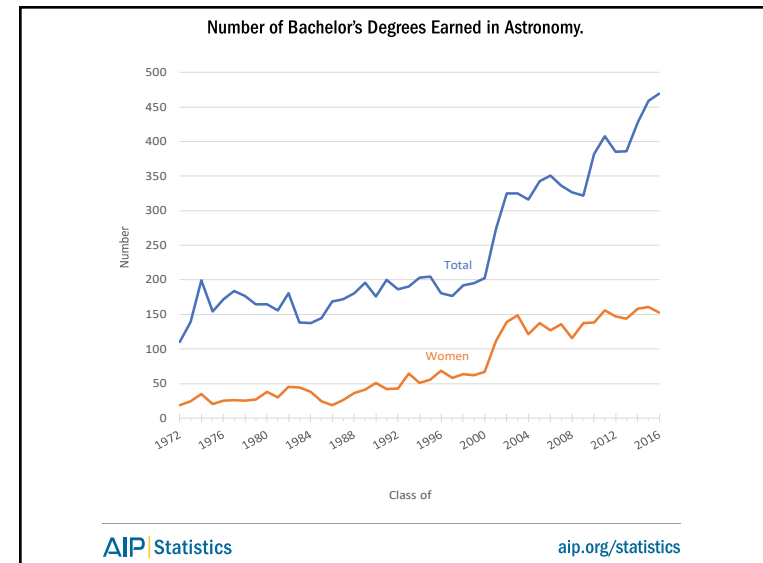
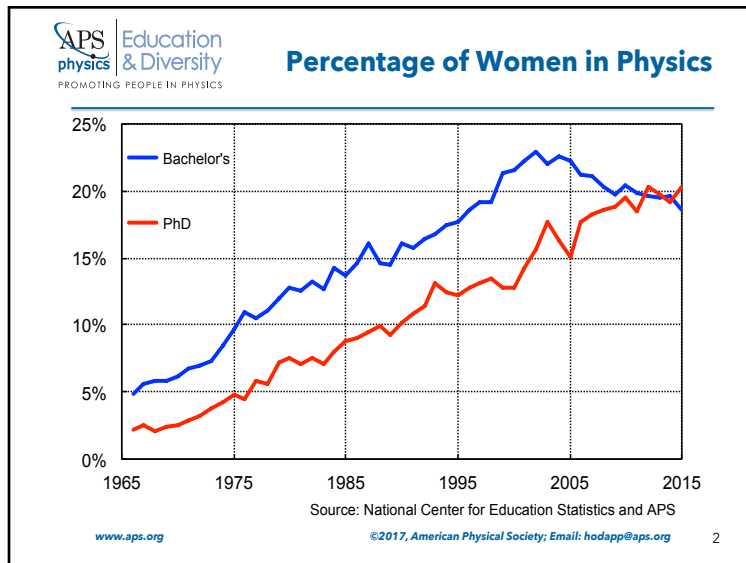
Starting with
4 million 16-year-olds
in 1977



**1 in 1000 women obtained
Ph.D.s in Nat. Sci. & Eng.**

**5 in 1000 men obtained
Ph.D.s in Nat. Sci. & Eng.**



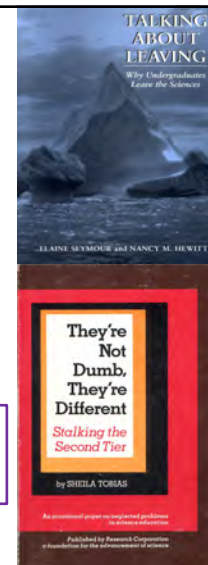


It's not just about grades....

- women and men equally likely to change their major in response to poor grades
- Women more likely to switch out of male-dominated STEM majors in response to poor performance compared to men

*Is this true at your institution?
Got the stats?*

NATIONAL BUREAU OF ECONOMIC RESEARCH
Kugler et al. 2017 <http://www.nber.org/papers/w23735>



The Proportion of Physics Bachelor's Degrees Awarded to African-Americans and Hispanic-Americans.



AIP Statistics

aip.org/statistics

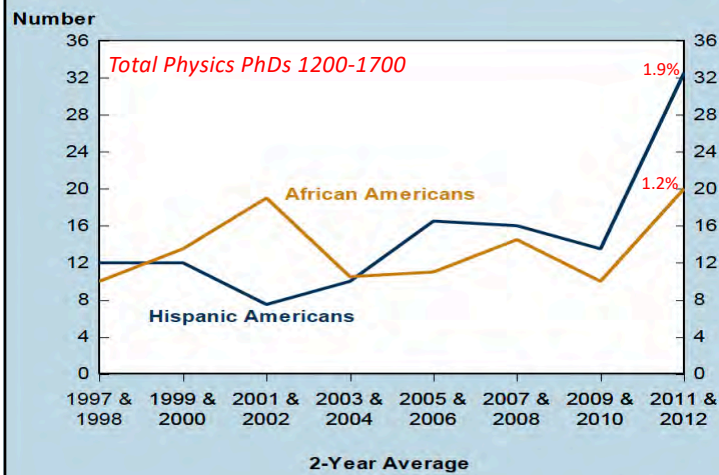
Top 10 Majors by Concentration of African-American Bachelor's Degrees

	Percent White	Percent African-American	Percent Hispanic	Percent Asian	Percent Other Races & Ethnicities
School Student Counseling	56	38	<0.5	6	<0.5
Human Services and Community Organization	65	21	11	1	2
Counseling Psychology	72	20	3	5	1
Health and Medical Administrative Services	71	18	6	5	1
Public Administration	67	18	10	4	2
Social Work	71	16	9	3	1
Miscellaneous Social Sciences	77	16	3	4	<0.5
General Medical and Health Services	71	15	7	6	1
Public Policy	72	15	6	7	1
Community and Public Health	73	14	4	7	1

Doing good things for society...
not the best paid



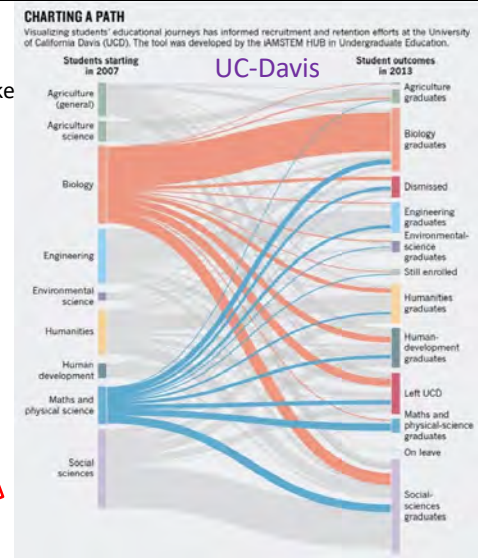
Number of Physics Doctorates Earned by African Americans and Hispanic Americans, Classes of 1997 through 2012.

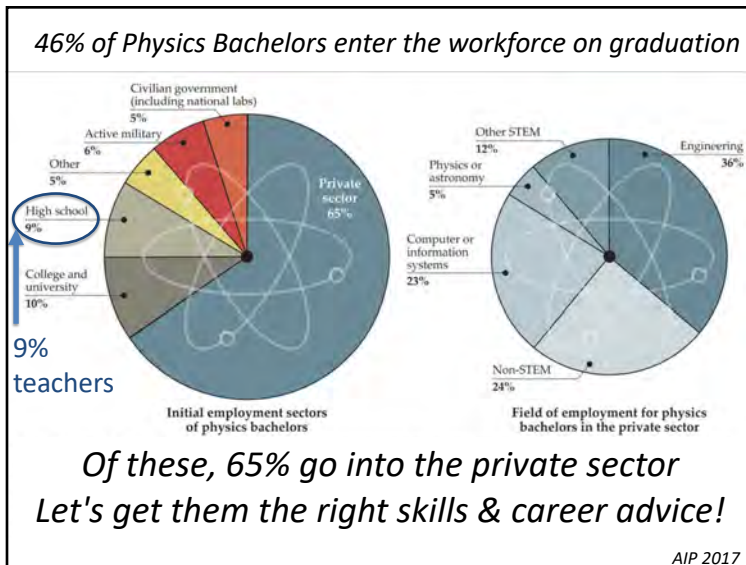


Where majors start-end

- What does this look like separated by years?
- When do students move? Why?
- Gender? Minorities?
- What does this look like at your institution?

Let's do the research





Thought Experiment:

What would it take to put a teacher with a physics bachelor in every high school in the US?

45,000 high schools

15 years "Typical career length" – survival span (optimistic)
= 3000 Physics bachelors going into teaching

Currently 9% of 8000 = 720

Crank up production another factor 4

Incentivize? Pay better?

Change "Physics" to "Natural Sciences"?

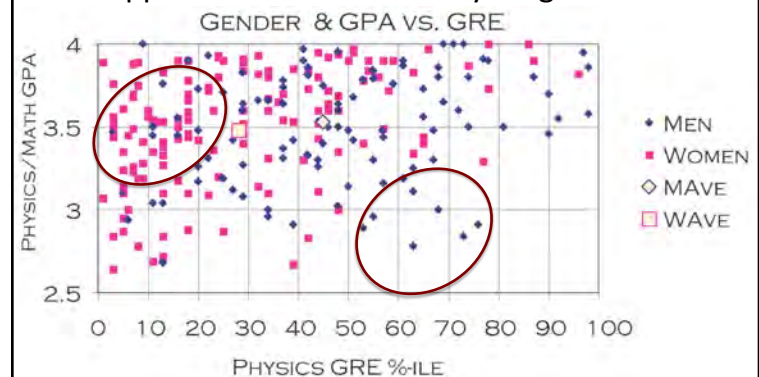
Placement at local schools?

Women lack math ability ...

- STEREOTYPE THREAT: performing below ability because of expectations
- Example: Given math test told "this will be hard"
 - Men: 25/100
 - Women: 10/100
 - Gender gap in math?
- "This test has been designed to be gender neutral"
 - Women: 20/100
 - Men: 20/100
- Important for minority students?

Costs Nothing!!

300+ Applicants to CU Astronomy Program 2003+4



Each of us can think of reasons why this happens –
but do we really know whether GRE or GPA or WHAT are good predictors of success for grad school? *We need to look at the numbers.*

Society, Culture....
All That Other Stuff.....

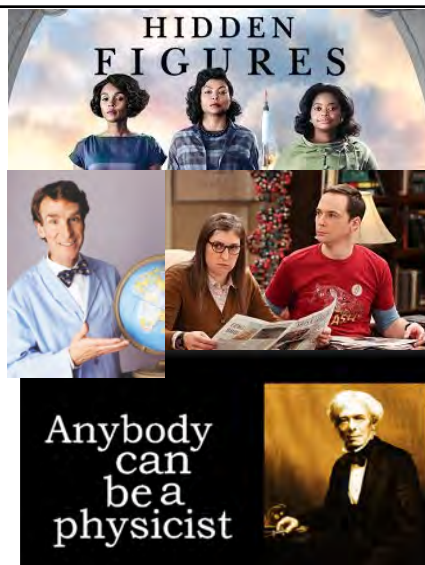
What does a
physicist look
like?

Ask Google
Images: 6 out of
140 women

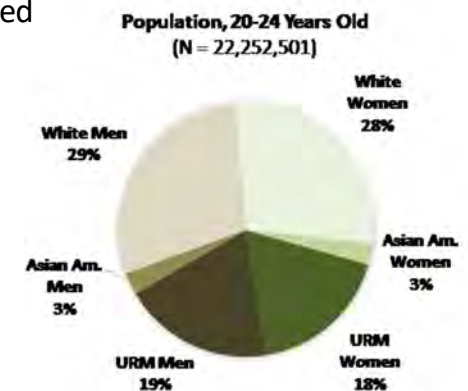
Hmm.... not much
we can easily do
about this

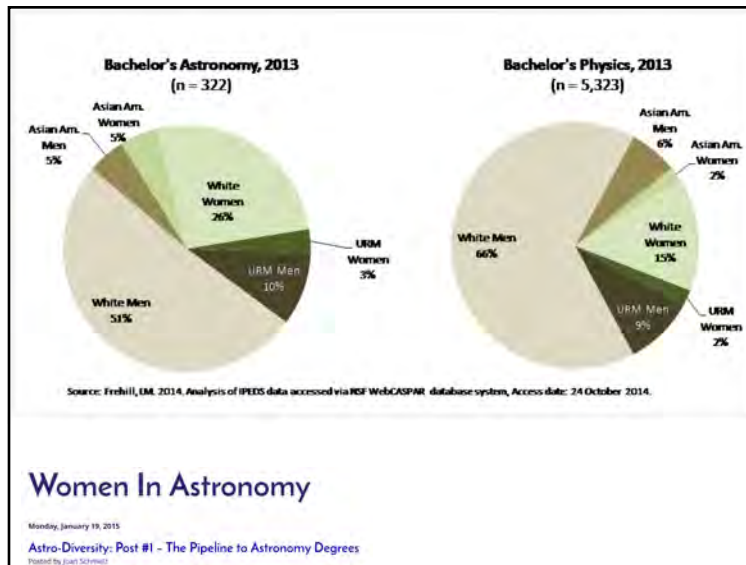


Yes, there's
Hidden Figures
but
there's also
*Big Bang
Theory*,
Bill Nye,
etc., etc., etc.,



Under-Represented
Minorities
& Gender





**Think Globally
Act Locally**

Solutions – 1 - Undergrads

- Get the numbers:
Where/When/Why are students dropping Physics?
- Department needs to work on getting more undergraduates through to graduation *with good GPA*
 - Major efforts in UG physics reform
 - Read "They're not dumb, they're different" and "Talking about leaving"
- Department needs to work on preparing its own undergraduates for grad school
 - Enough of the right courses?
 - GRE prep sessions? Involve the grad students
 - Research experience
- Dept/AGU/AAS/APS needs to provide more preparation and advice on non-academic careers

**Think Globally
Act Locally**

Solutions – 2 Grad School

Recruitment:

- what are the realistic predictors of success in grad school?
- cast a broad net – makes a better environment

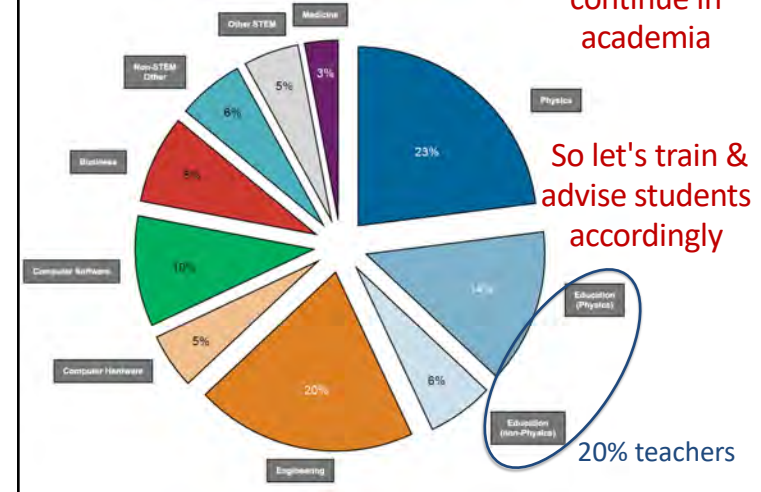
Program

- set fair, consistent, expectations
- design a program that supports and encourages a broad spectrum
- evaluate and articulate progress in a fair, consistent manner – so students know where they are early & often

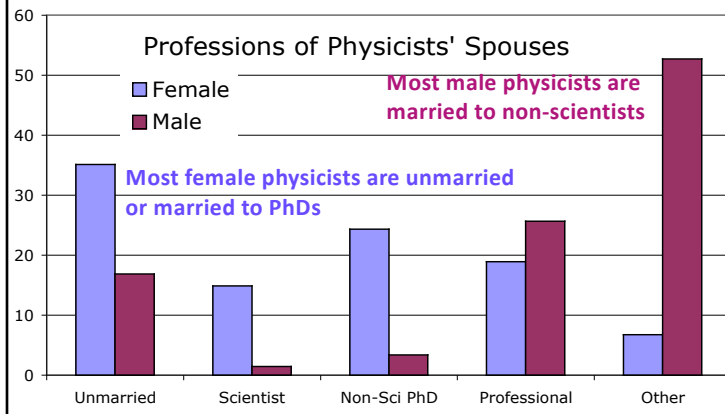
Non-academic career advice

– get people from the real world out there to come give advice on real-world careers

Jobs: New Physics PhDs 2009-2014



Two-Body Problem



Think Globally
Act Locally

Solutions – 3 - Family

- A society that puts generous resources into educating women - and should make a major effort to benefit from the investment on the long term
- Institutions need to develop policies, be flexible, adapt to specific cases/needs
- Think long-term – 2 years of supporting "re-entry stipend" pays off over 25-30 year career (e.g. to pay for post-doc to keep research going)


Think Globally
Act Locally

Solutions – 4 - Culture

- Don't blame the women.
Telling women to become more like men is not the solution.
- Change the institutional environment
BUT don't just ask women faculty/researchers to "fix" the problem
- Hire more women faculty/researchers - it's non-linear
- But it is as much CULTURE that drives women away
 - Women are less content with their work environment
 - 2-body problems, family issues
 - But also hostile environment - many subtle obstacles
- **Leadership - from the very top - is critical**

Solutions – 5 - CSSP

- Sponsor AIP to do the next Solar & Space Physics survey – in time for next Decadal Survey
 - How are numbers changing?
 - What fraction of researchers are non-US to meet needs of the field?
 - How is the field changing?
 - What workforce is needed for next decade?
- Urge APS/AGU/AAS to provide career advice



Thank You!

"Reserve your right to think,
for even to think wrongly is better than not to think at all."
Hypatia of Alexandria (370-415 BC)

Web Sites

www.aip.org/statistics/index.htm
American Institute of Physics Statistics Group

<https://www.awis.org>
Association of Women in Science

<https://www.aps.org/about/governance/committees/cswp/index.cfm>
Comm. on the Status of Women in Physics, American Physical Society

<https://cswa.aas.org>
Comm. on the Status of Women, American Astronomical Society

<http://www.portal.advance.vt.edu/index.php/tags/dual-career>
NSF Advance program has a really great website listing what many universities are doing to deal with dual careers

<http://adsabs.harvard.edu/abs/2008PASP..120..229M>
Metcalf – article on demographics & employment of astronomy PhDs – with references to data bases