

زنان در علوم و مهندسی: روایتی از ایران و آمریکا



بهر روز پرهامی

دانشگاه کالیفرنیا در سنتا باربارا



About This Presentation

This slide show was first developed in 2021 for presentation at ASEE's Annual Conference & Exposition. It was updated and expanded for an IEEE Central Coast Section technical talk in January 2023 and subsequent venues. All rights reserved for the author. ©2021, 2023 Behrooz Parhami

Figure & table numbers come from BP's paper in ASEE 2021 Annual Conference

Edition	Released	Revised	Revised	Revised
First	July 2021	Jan. 2023	Feb. 2023	June 2023

File: http://www.ece.ucsb.edu/~parhami/pres_folder/parh23-women-in-sci-and-eng-slides-2.pdf

Title & Abstract in Conference Schedule

2021 ASEE Annual Conference & Exposition is now ALL VIRTUAL

Women in science and engineering: A tale of two countries

Presented at [Special Topics: Conscious Considerations](#)

Despite poor retention and advancement prospects, as well as female-unfriendly workplaces and corporate policies, women continue to flock to and excel in STEM (science, technology, engineering, mathematics) fields. In this paper, using data and narratives from the United States and Iran as examples, I analyze reasons for the low engagement of women in STEM careers. Using the two countries with which I am most familiar as examples is instructive, because this side-by-side comparison shows that undesirable outcomes in the domain of women in STEM fields can and do occur for vastly different reasons, which I discuss.

Authors

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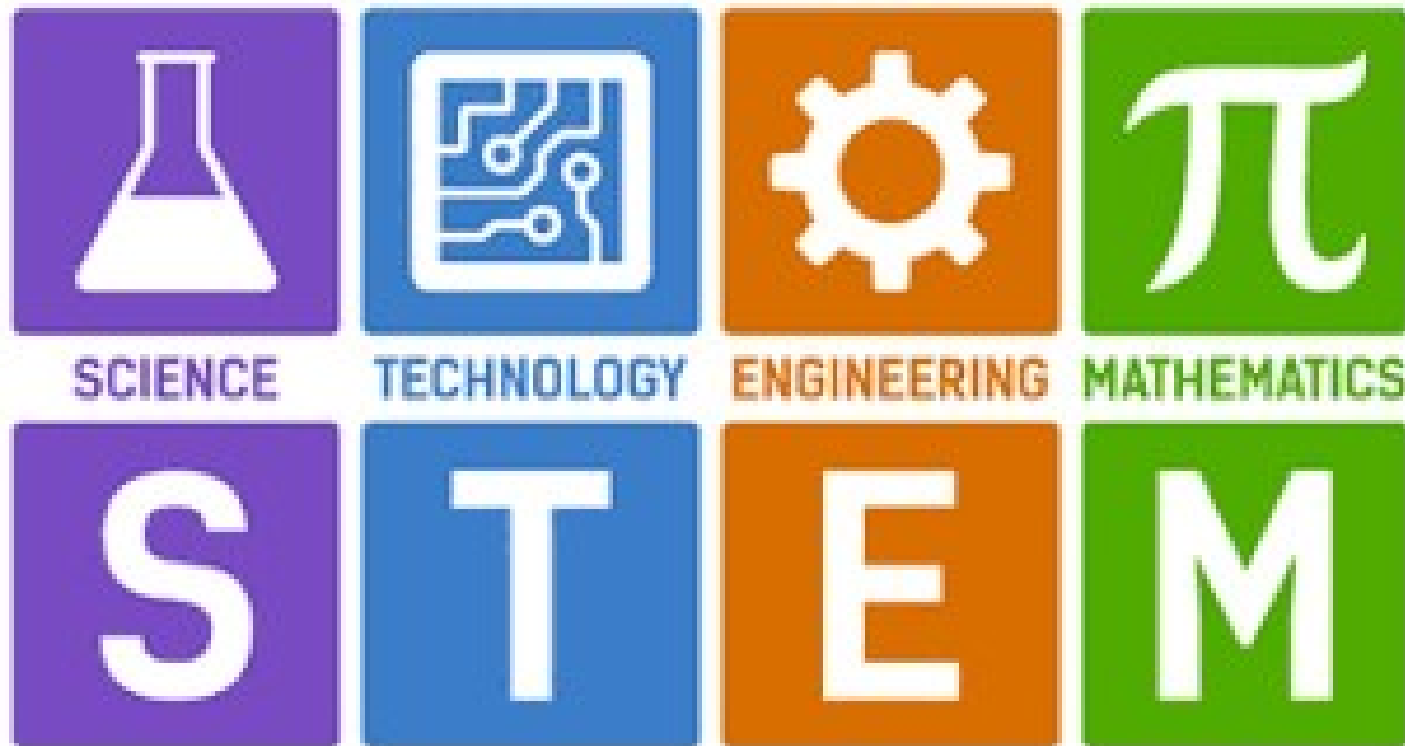
[« View session](#)

For those interested in:

- Broadening Participation in Engineering and Engineering Technology
- computer science
- gender
- information technology

STEM, STEMM, STEAM

STEM **Science, Tech, Engineering, Math**
STEMM **STEM + Medicine**
STEAM **STEM + Art**



Sex, Gender, and Related Terminology

I deal with male-identified and female-identified individuals, which is a vast simplification of a complex domain encompassing many inward identities and outward expressions

Cisgender

Gender expression

Gender identity

Gender non-conforming

Gender pronouns

Gender role

Intersex

LGBT

Non-binary

Queer

Transgender



A vast majority of people don't give much thought to their gender, whereas others might be consumed by it

Why Is This Any of My Business?

I criticize gray-haired male talking-heads discussing Iran's feminist/youth revolution!



Behrooz Parhami's Page:
"Men Advocating for Gender Equity"
A Group of UCSB Staff and Faculty Members



I have 3 sisters, all of them professional women
(2 PhDs; immunology; mechanical engineering)
My late wife was a software engineer
My daughter is a data scientist (neuroscience + CS)
Observed women colleagues and female students

UN Women Observance: February 11

<https://www.womeninscienceday.org/>



United Nations
Educational, Scientific and
Cultural Organization



International
Day of Women
and Girls in
Science



3D-Printed Statues of Women Scientists

Life-size statues of 120 STEMM women, created & displayed by the Smithsonian Institution for Women's History Month in 2022



A Tale of Two Cities



Countries

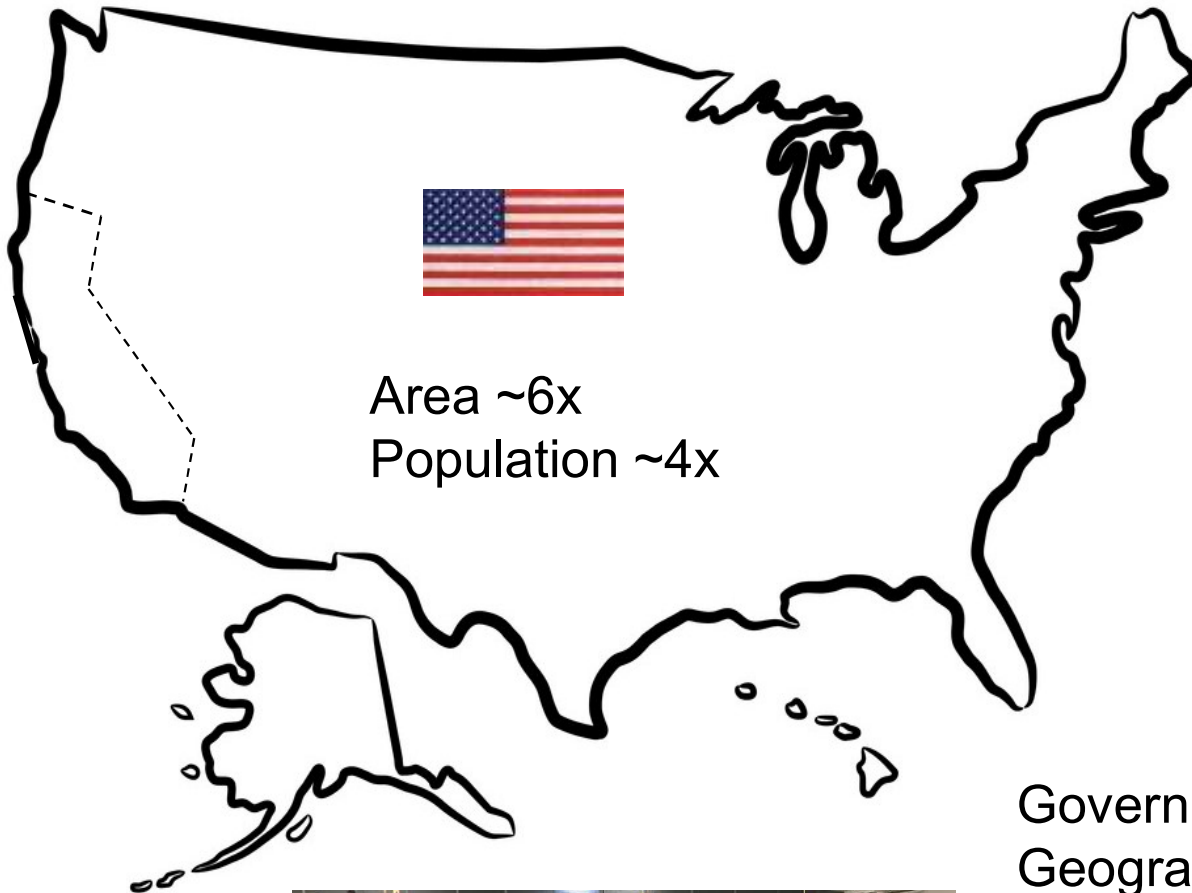
by Charles Dickens

IT WAS
THE **BEST**
OF TIMES.

IT WAS
THE **WORST**
OF TIMES.



The Two Countries of My Tale



Area ~4.1x CA
Area ~2.4x TX



Government: Democracy v. Theocracy
Geographic setting: Calm v. Turbulent
History: ~250 years v. ~2500 years
Language: English v. Persian (Farsi)
Anti-women laws: Few v. Prevalent
Curricula (up to HS): Local v. Centralized
Curricula (post-HS): Quite similar

Women's Movements in Iran

Constitutional
Revolution
1905-1911



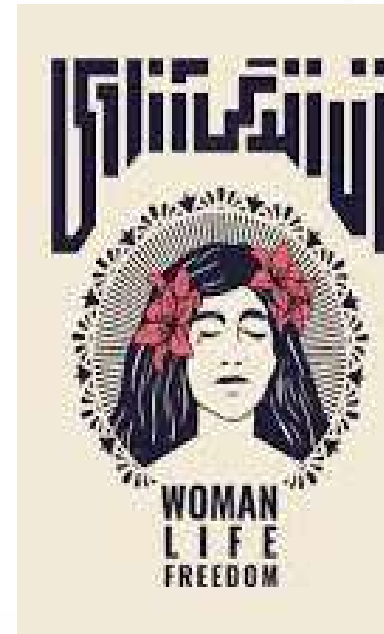
1920s

#WomanLifeFreedom
#MahsaAmini



1980s

2020s



#NoToHijab
#MeToo



Women's Movements in the US

#Suffrage, 1920



Roe v. Wade, 1973



#Feminism

#WomensMarch
#MeToo



Iranian Government's View of Women

Alternative facts from President Raisi's VP for women's affairs:

“We will publish data on Iranian women's better conditions compared with American women!”



انسیه خزعلی:

آمار وضعیت بهتر زنان ایران
نسبت به آمریکا را منتشر می‌کنیم



Image from an Iranian school textbook

“Expert” panelist, on Iran's state TV:
“In the West, women can't advance professionally, even at universities, without providing sexual favors.”

US Lawmakers' Views of Women

chalkbeat.org (Aug. 3, 2022):

“Early childhood aid stripped from federal spending bill.”

Washington Post (Sep. 13, 2022):

“[Sen.] Graham introduces bill to ban abortions nationwide after 15 weeks.”

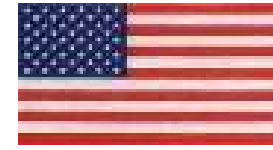
US Congresswomen show off their arms to protest sexist dress code (2017)



CNN (Jan. 14, 2023):

“Missouri House of Representatives lawmakers adopt a stricter women’s dress code in their rules package.”

Women's Participation in Society



Gained right to vote:	1920	1963
Admitted to universities:	1831	1937
Forced to wear the hijab:	----	1981
Percent of population:	50.5	49.5
Percent of college students:	37	55
Percent in parliament:	29/26	< 6
Percent of governors:	25	< 1
Percent of judges:	50	0
Percent of workforce:	56	16

Feminism



The radical idea that
women are human beings

The Feminist Test We Keep Failing

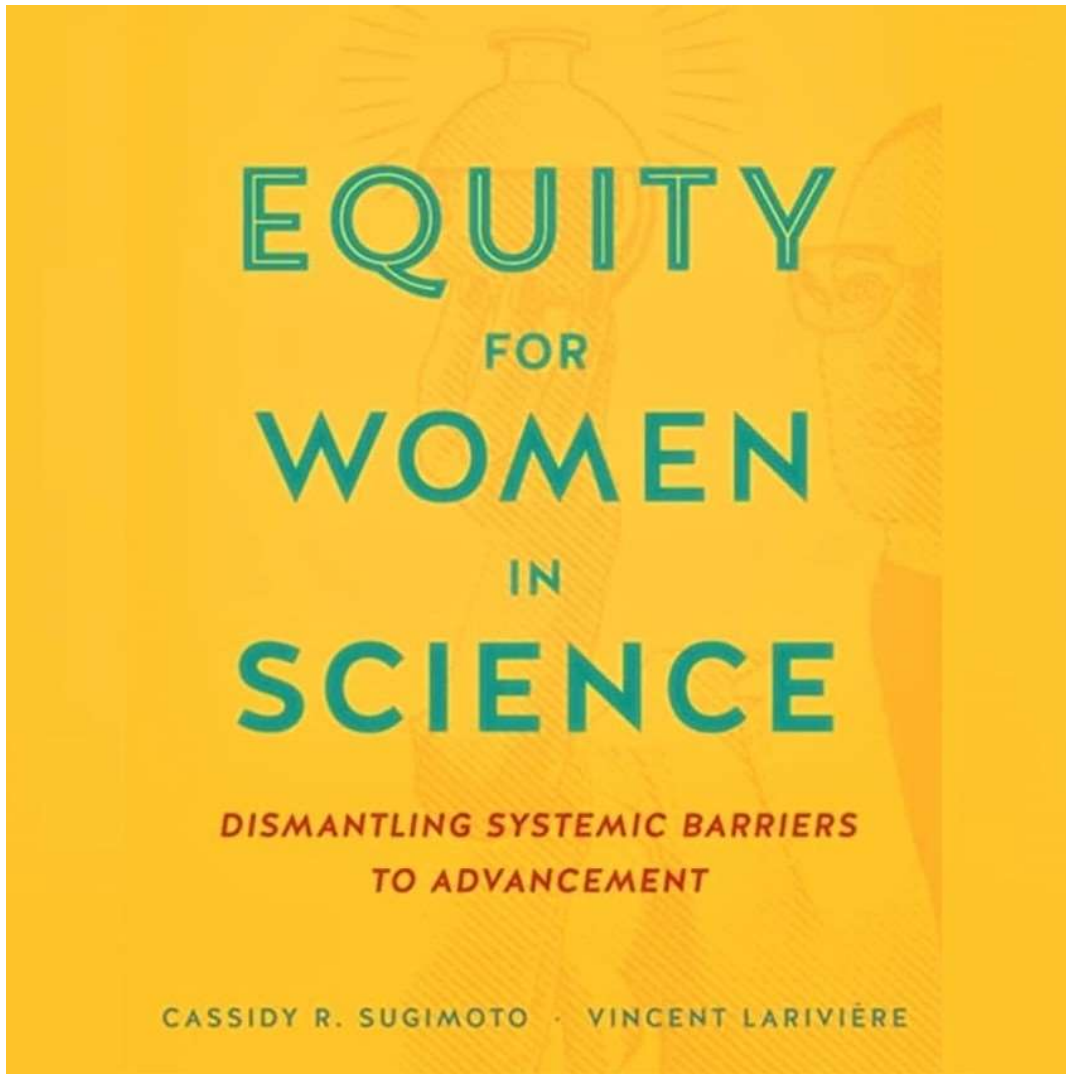
A 22-minute podcast in the "Lost Women of Science" series that discusses "the Finkbeiner Test," a checklist of what to avoid in writing the profile of a successful woman in the media. It includes not mentioning the husband's job, her childcare arrangements, or how she was the first woman to do or be 'X.'

My view: We should not over-emphasize a scientist's gender

But, instead of avoiding certain aspects of a woman scientist's life, we should make an effort to discuss those aspects for male scientists as well. In other words, we should present scientists of both sexes as human beings, whose profiles include scientific expertise & contributions, along with personal interests & relationships. This is already being done in other domains. An athlete's or actor's profile, for example, usually includes not just his/her career, but also personal interests & social connections

Podcast: <https://www.lostwomenofscience.org/season-3-episodes/bonus-the-feminist-test-we-keep-failing>

Women's Treatment in Science Production



Harvard University Press, 2023, 272 pp.

From a *Science* magazine review:

Compared with men, women are underrepresented in authorship lists

On average, women publish about one fewer article per year than men

When women appear in authorship lists, they tend to be underrepresented in first-author (primary writer) and last-author (senior conceptualizer and resource provider) positions

Articles with women in dominant authorship positions (first, last, or solo author) receive fewer citations than do articles with men in analogous roles

Science Team Composition Is Important

Gender-diverse teams produce more novel and higher-impact scientific ideas

Yang Yang^{1,2,3*}, Tanya Y. Tian², Teresa K. Woodruff⁴, Benjamin F. Jones^{1,4}, and Brian Uzzi^{1,2,3,4,5,†}

Edited by Susan Fiske, Princeton University, Princeton, NJ; received January 16, 2022; accepted July 24, 2022

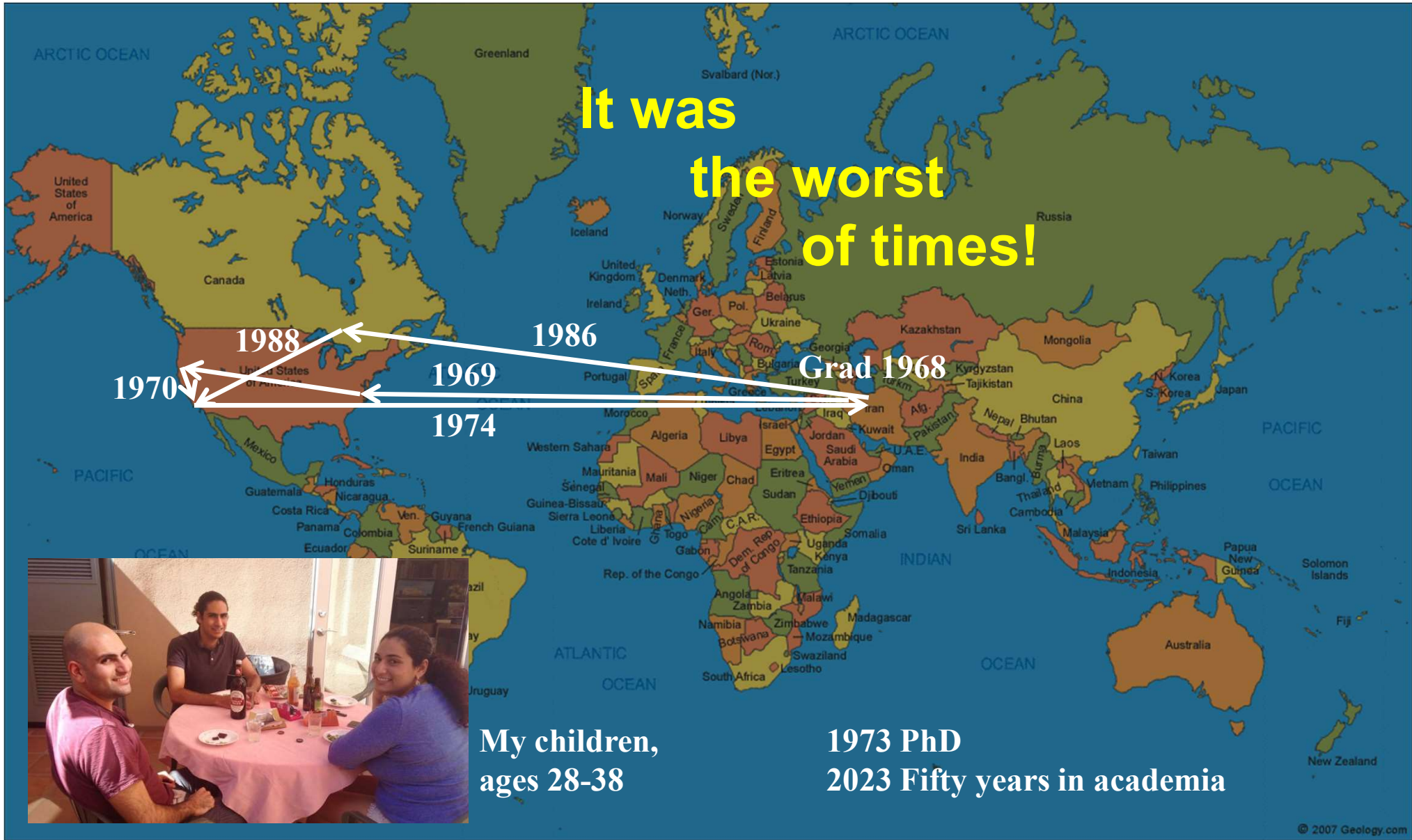
Science's changing demographics raise new questions about research team diversity and research outcomes. We study mixed-gender research teams, examining 6.6 million papers published across the medical sciences since 2000 and establishing several core findings. First, the fraction of publications by mixed-gender teams has grown rapidly, yet mixed-gender teams continue to be underrepresented compared to the expectations of a null model. Second, despite their underrepresentation, the publications of mixed-gender teams are substantially more novel and impactful than the publications of same-gender teams of equivalent size. Third, the greater the gender balance on a team, the better the team scores on these performance measures. Fourth, these patterns generalize across medical subfields. Finally, the novelty and impact advantages seen with mixed-gender teams persist when considering numerous controls and potential related features, including fixed effects for the individual researchers, team structures, and network positioning, suggesting that a team's gender balance is an underrecognized yet powerful correlate of novel and impactful scientific discoveries.

team science | gender inequality | innovation | computational social science

PNAS
paper
(2022)

Another paper by Uzzi *et al* (*Science*, 2007) showed that impactful science is usually produced by teams

My Personal Academic Journey



Women in STEM: The Mid 1980s View

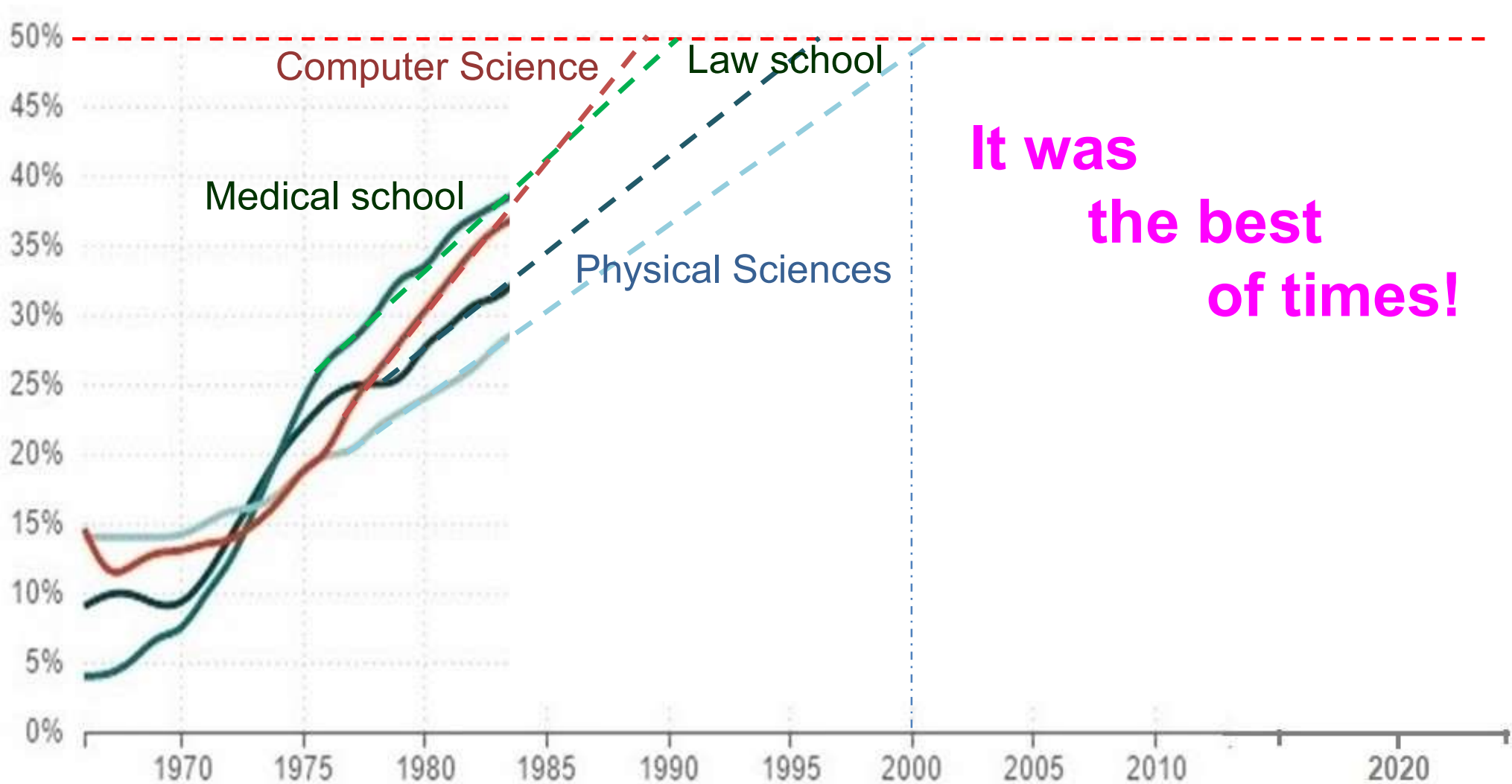


Figure 5. Percent of women majors, by field. [Source: Quoc Trung Bui, NPR, using data from NSF, Amer. Bar Assoc., & Amer. Assoc. Medical Colleges]

Women in STEM: Current Status

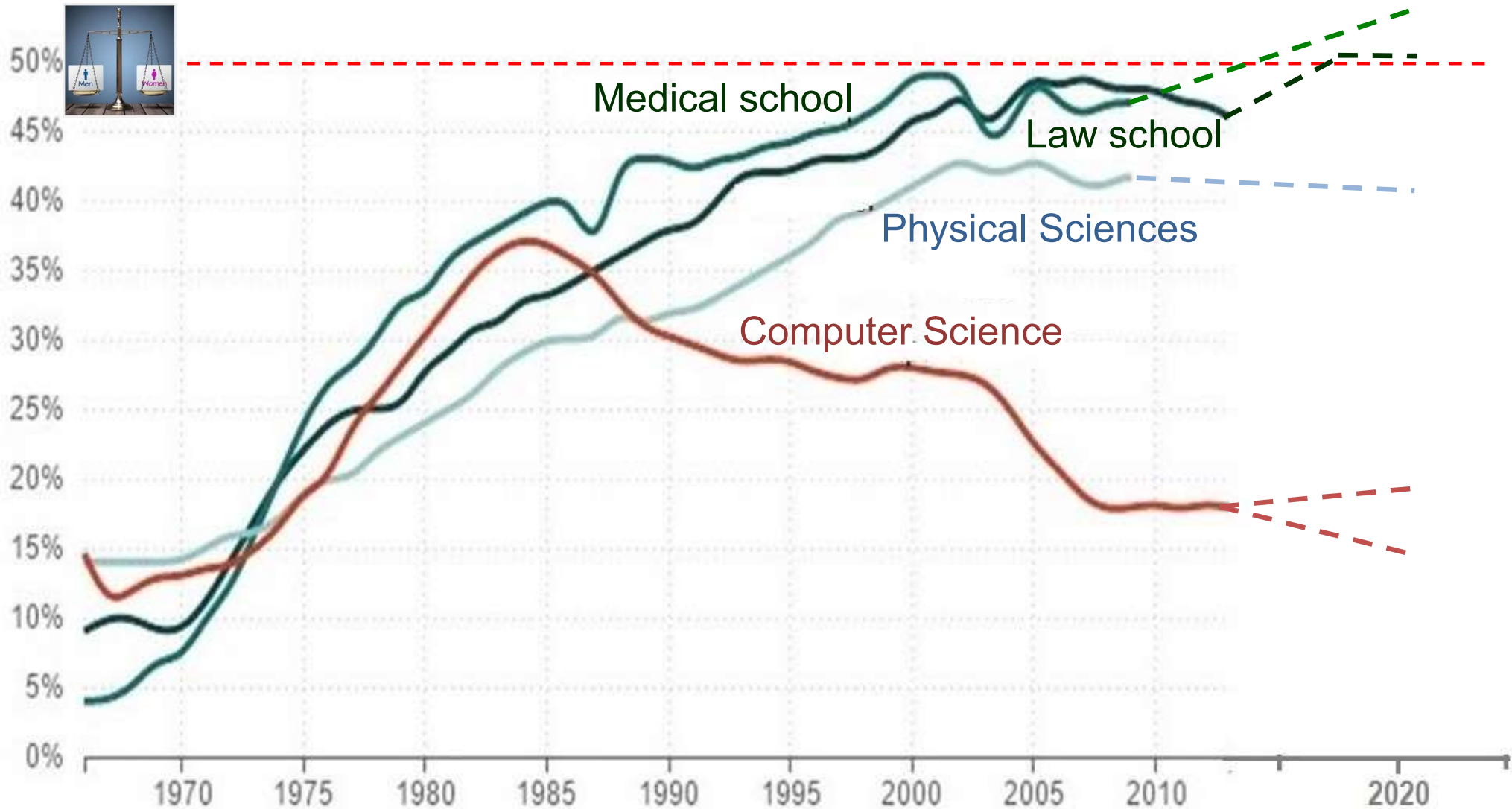
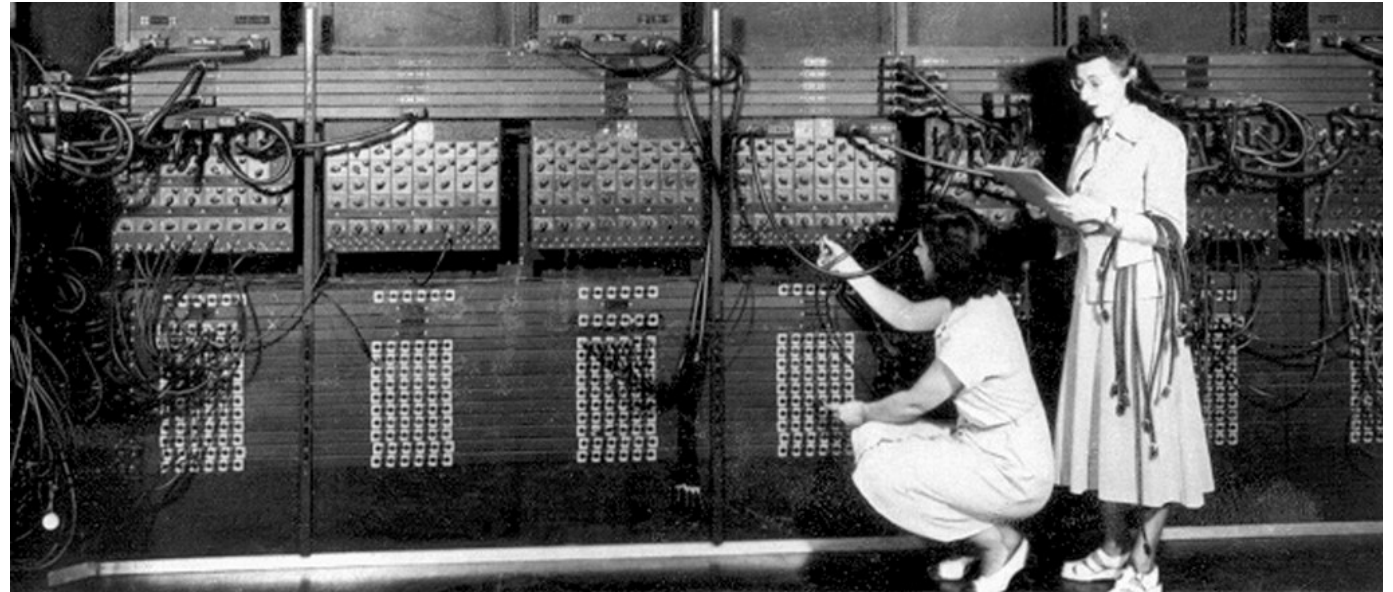
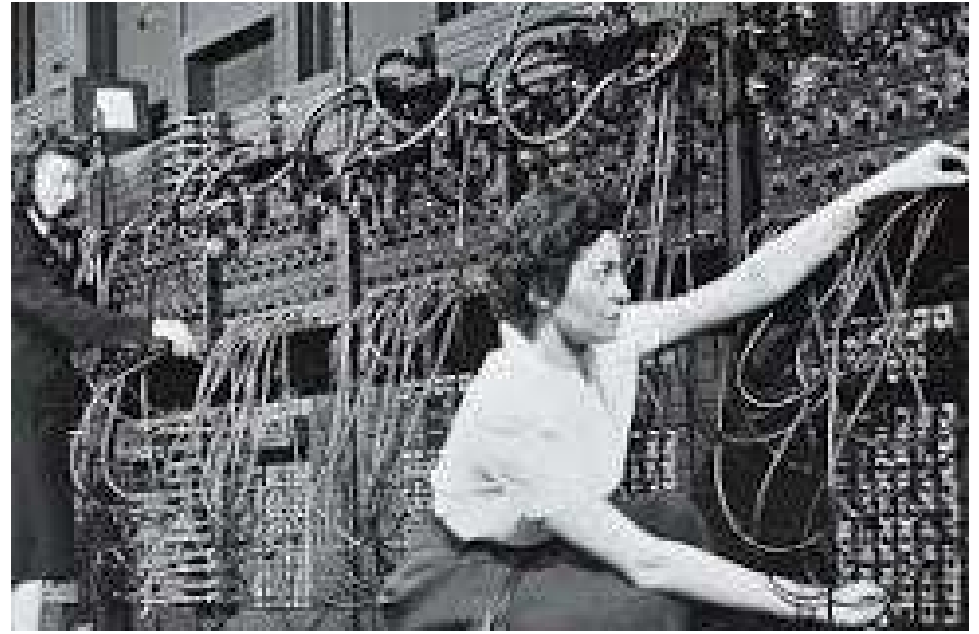
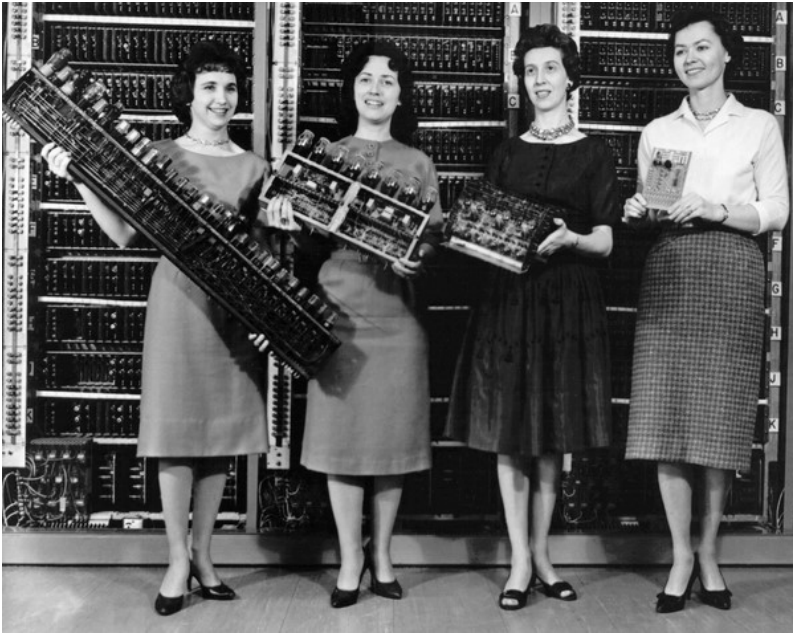


Figure 5. Percent of women majors, by field. [Source: Quoc Trung Bui, NPR, using data from NSF, Amer. Bar Assoc., & Amer. Assoc. Medical Colleges]

What Happened to All the Women?



Women Nobel Laurates



Solvay Conference (1927): 17 of 29 attendees had won or would win Nobel Prizes
<https://rarehistoricalphotos.com/solvay-conference-probably-intelligent-picture-ever-taken-1927/>

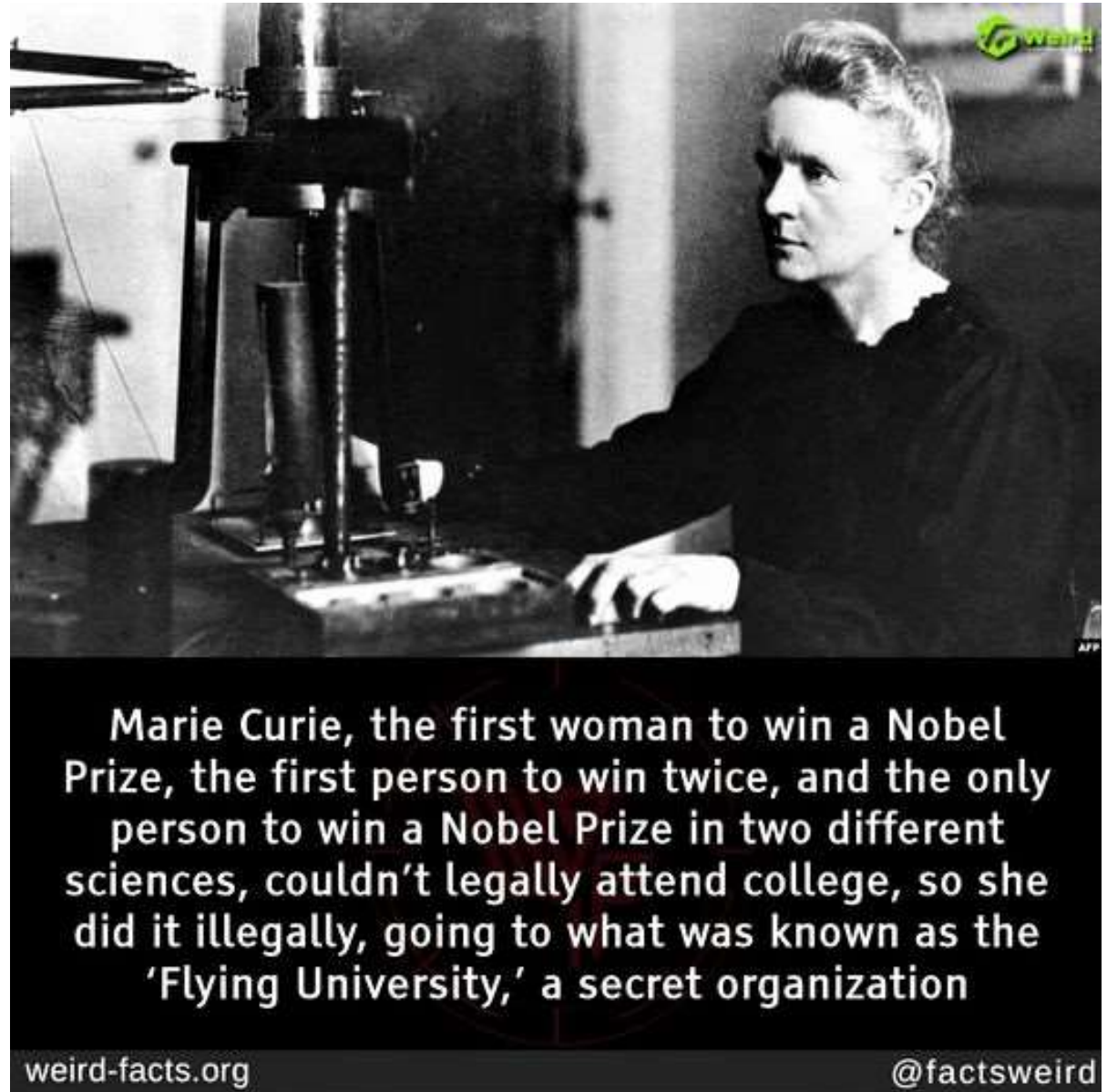
Areas	Men honored		Women honored	
	Number	Share	Number	Share
Chemistry	176	97%	5	3%
Physics	207	99%	3	1%
Physiology/Med	204	94%	12	6%
Literature	100	88%	14	12%
Peace	89	84%	17	16%
Economics	80	99%	1	1%
All areas	856	94%	52	6%

Decades	Men honored		Women honored	
	All	Science	All	Science
1901-1920	94	57	4	2
1921-1940	98	68	5	1
1941-1960	114	87	3	1
1961-1980	170	122	11	4
1981-2000	187	121	7	3
2001-2018	186	128	22	9
Total	856	587	52	20

Marie Curie Was Denied College Education

This is one reason why we must champion the cause of women in STEM

We've come a long way since Marie Curie was denied formal & open college education, but equity isn't a fait accompli.



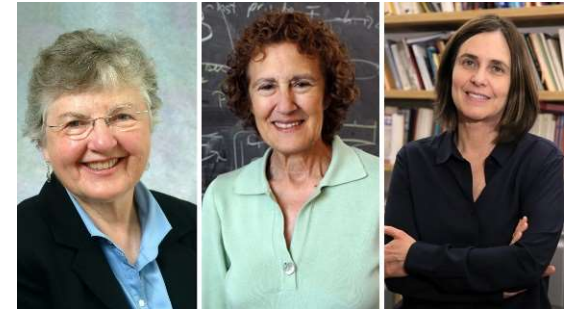
Other Prestigious Awards

STEM disciplines not represented by Nobel Prizes are mathematics, computer science, and engineering.

The most-prestigious prize in mathematics is the Fields Medal, awarded only once, out of the total of 60, to a woman (the late Maryam Mirzakhani, 2014)



The highest honor in Computer Science is the Turing Award, given to 3 women out of 70: Frances Allen, 2007; Barbara Liskov, 2008; Shafi Goldwasser, 2012.



In engineering, election to NAE is the ultimate recognition. Of the 2297 NAE members, 205 are women (~ 9%)

Prominent Women Scientists & Engineers

Ten notable scientists (left to right):

Top: Marie Curie, Jane Goodall, Maria Mayer, Rachel Carson, Rosalind Franklin.

Bottom: Barbara McClintock, Rita Levi-Montalcini, Gertrude Elion, Elizabeth Blackwell, Christiane Nusslein-Vorhard



Ten computer scientists & engineers (left to right):

Top: Susan Kare, Hedy Lamarr, Grace Hopper, Ada Lovelace, Mary Lou Jepsen,

Bottom: Roberta Williams, Radia Perlman, Erna Hoover, Marissa Mayer, Barbara Liskov

Women Scientists on Postage Stamps



Engineering Degrees & Faculty Positions

US engineering degrees awarded to women

High: 57.8% (environmental engineering)

2nd: 51.5% (biomedical engineering)

3rd: 39.1% (biological & agricultural engineering)

Low: 15.4% (computer engineering)



Engineering faculty at US universities

Full professors 14,328 (14.2% women)

Associate professors 7852 (21.4% women)

Assistant professors 7706 (26.5% women)

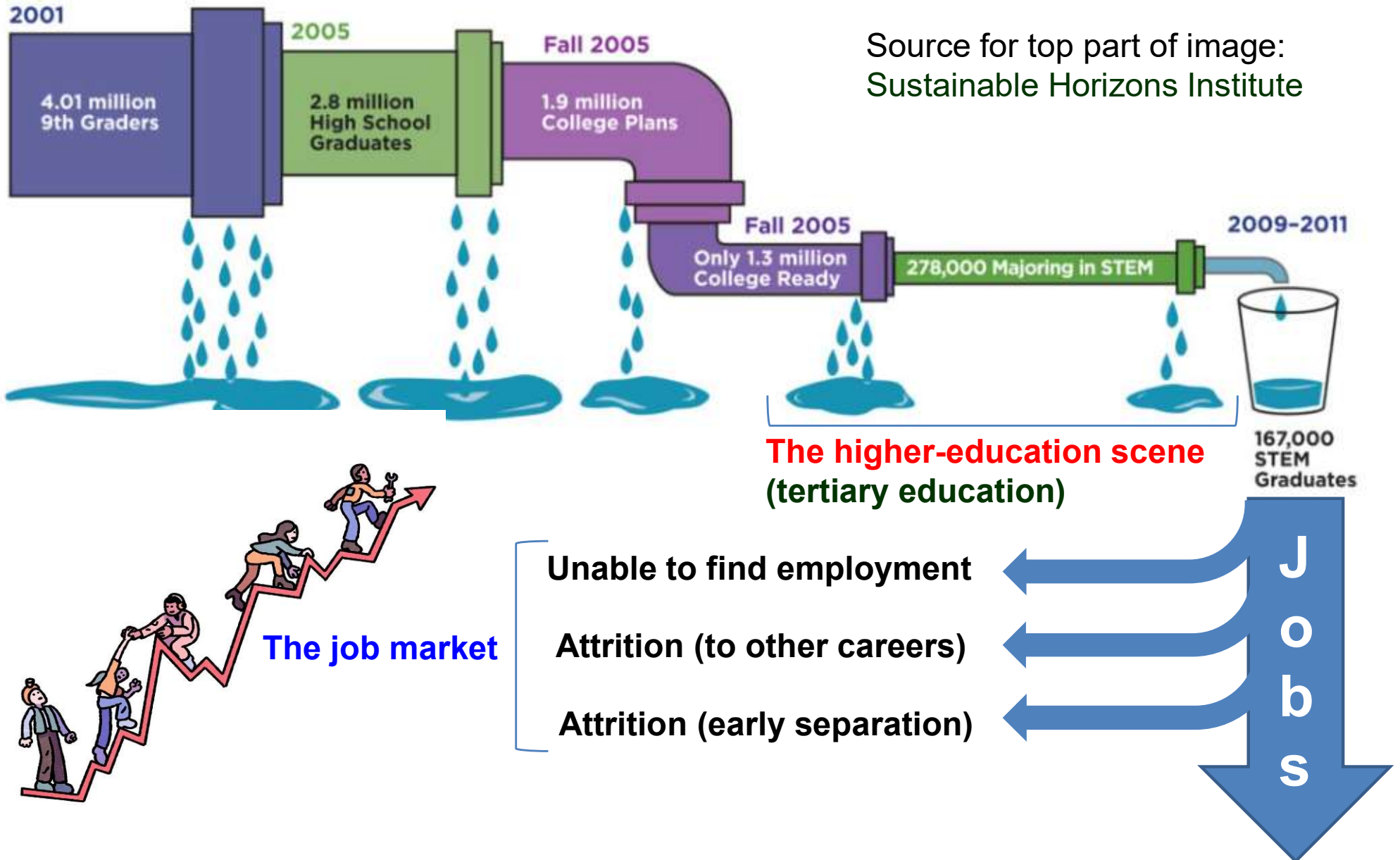
Non-tenure-track 5020

Part-time 4261



ASEE (2021 data): <https://ira.asee.org/wp-content/uploads/2022/11/Engineering-and-Engineering-Technology-by-the-Numbers-2021.pdf>

The Leaky STEM Pipeline



The Higher Education Scene in Iran



Figure 8. Women students in front of Tehran U.'s College of Engineering

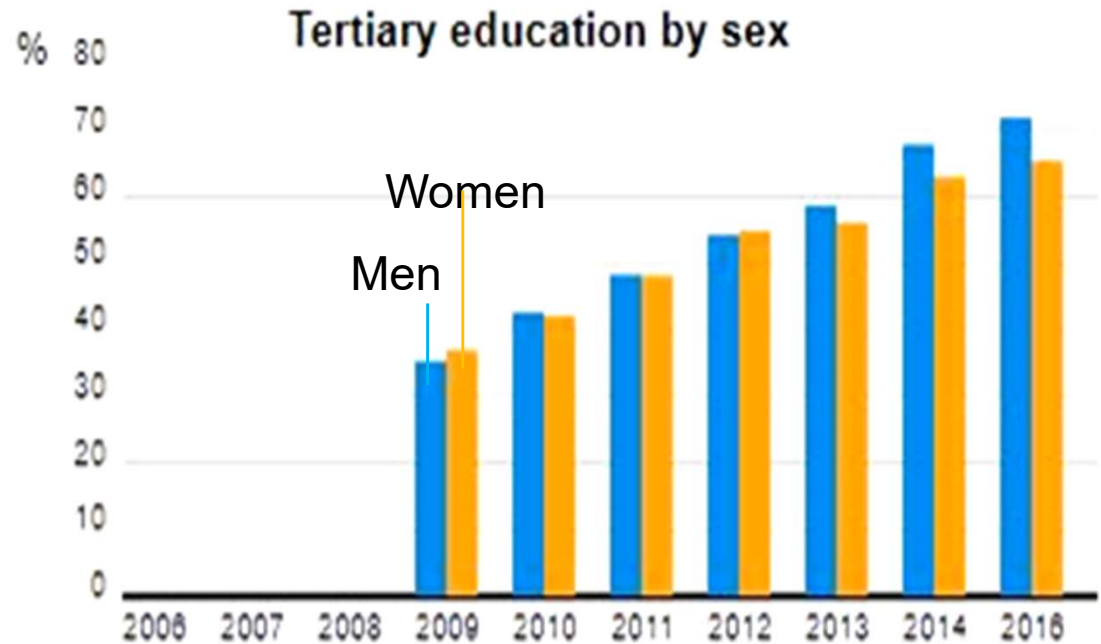


Figure 9. Iran enrollment ratio [Gross enrollment ratio: Fraction enrolled relative to those in the 5-year age group after typical high-school graduates]

Iran's universities:
Co-educational
Some all-women colleges
Segregation proposals
Women faculty are suspect
Some majors restricted

Women students face many challenges
Harassed/monitored by fundamentalist students and security personnel
Forbidden to study with men

The Higher Education Scene in the US

Field	BS	MS	PhD
Biology & Biomedicine	60	57	53
Math & Stat	43	42	29
Physical sciences	39	38	32
Engineering & Tech	20	25	24
Computer & info science	19	31	20
All STEM	36	33	34

Table 3.
US women in STEM

Figure 3.
Stanford's VMware Women's
Leadership Innovation Lab

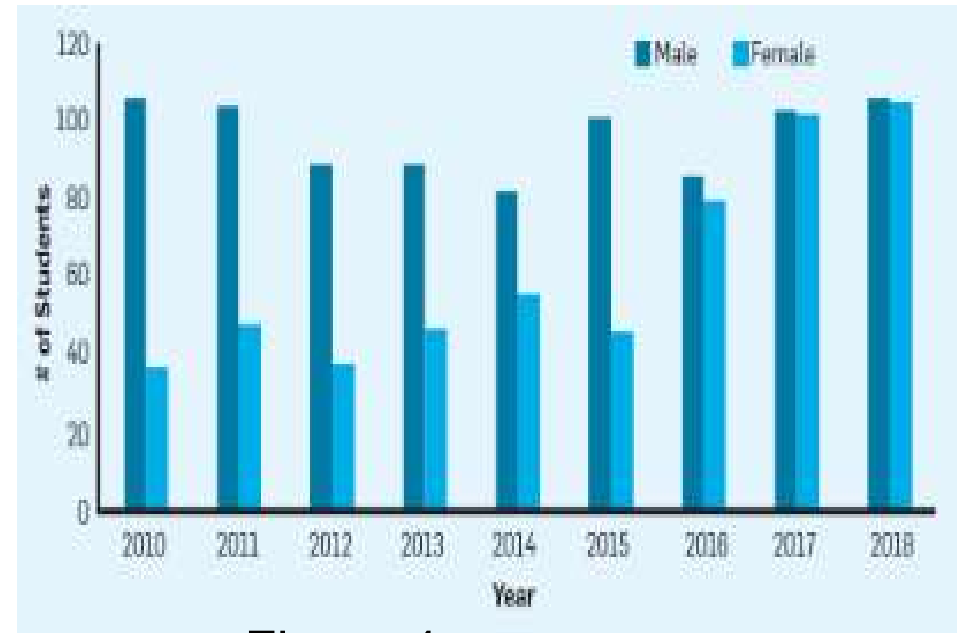
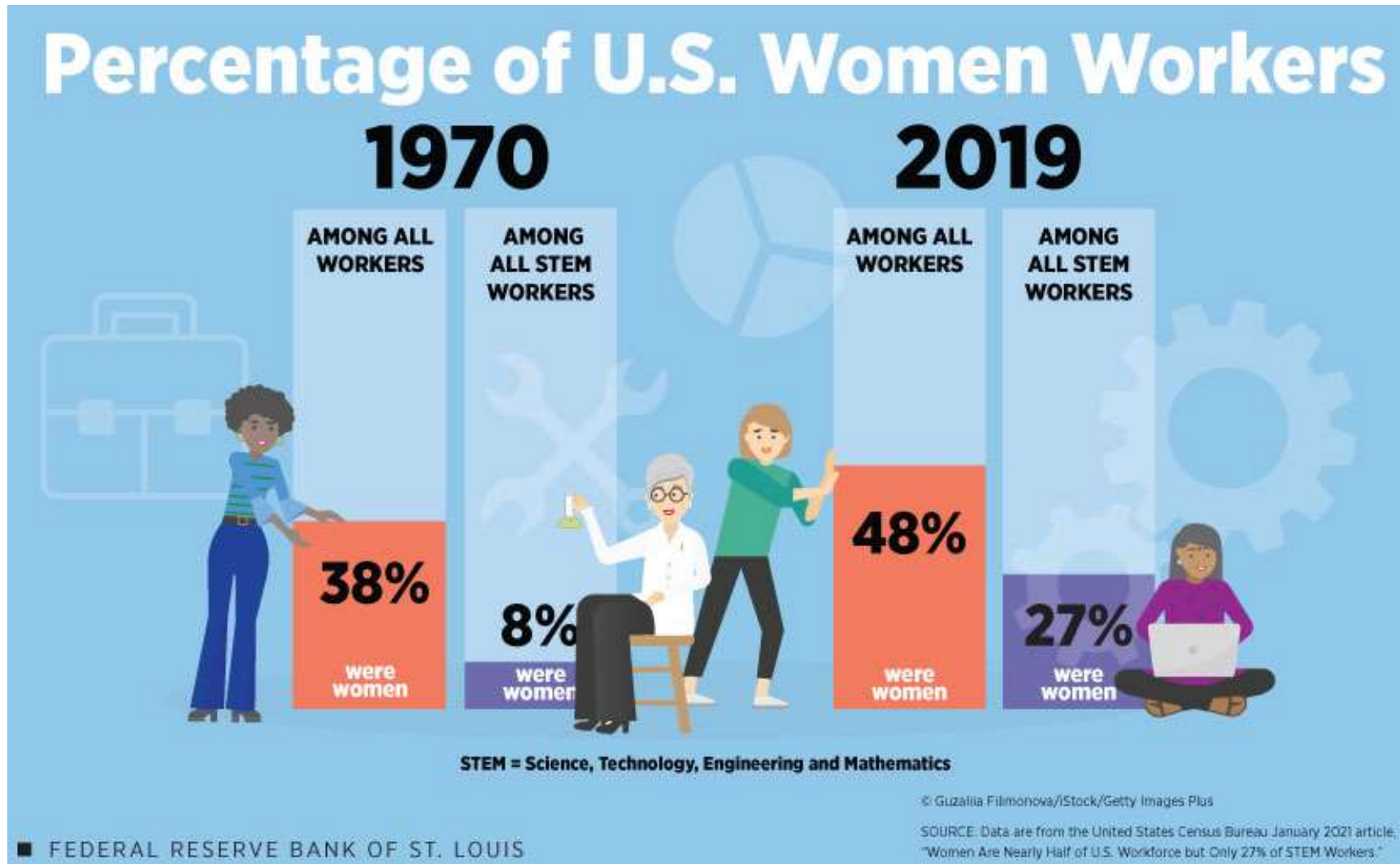


Figure 4.
CMU's CS gender mix

Harvard has also had some success
with its WiSTEM mentorship program

Efforts to Bridge the STEM Gender Gap



June 2023: NASA awards STEM grants to seven all-women colleges

The Job Market in Iran



Labor force participation* (2019)

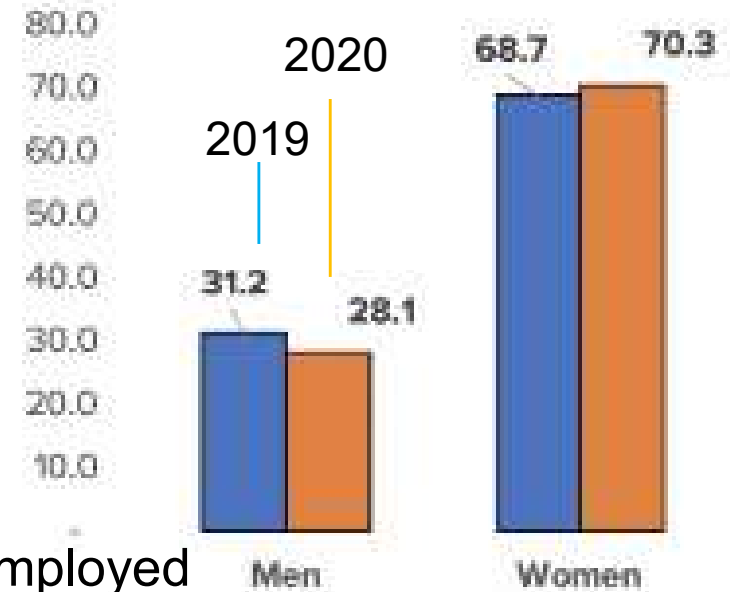
Men 72%

Women 18%**

(Source: Nadereh Chamlou, April 2021, "COVID-19 depressed women's unempl ...")

* COVID-19 impacted women more than men

** Ranked 175 out of 180 countries



Fractions of those unemployed

The Job Market in the US

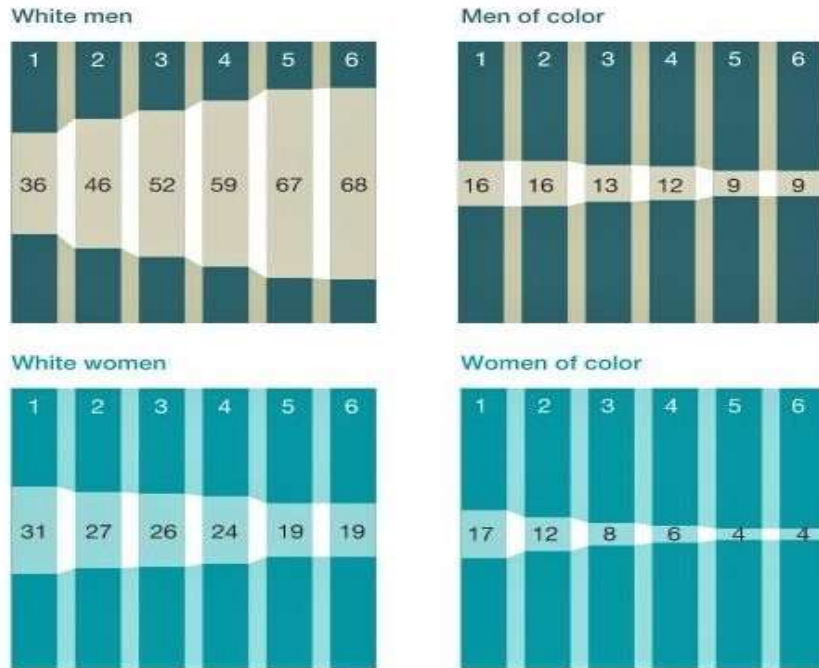


Figure 6. Women & minorities in US corporate ranks



Figure 7. International Women's Day 2019 discussion on women in STEM

Sexism in the workplace: "The Elephant in the Valley" survey, mid-2015
200+ responding senior tech women
Nearly all had experienced sexist interactions
84% had been told they were too aggressive
60% reported unwanted sexual advances (2/3 went unreported)

Few Tech Jobs for Iranian Women



Figure 10.
Start-up weekend event in Tehran

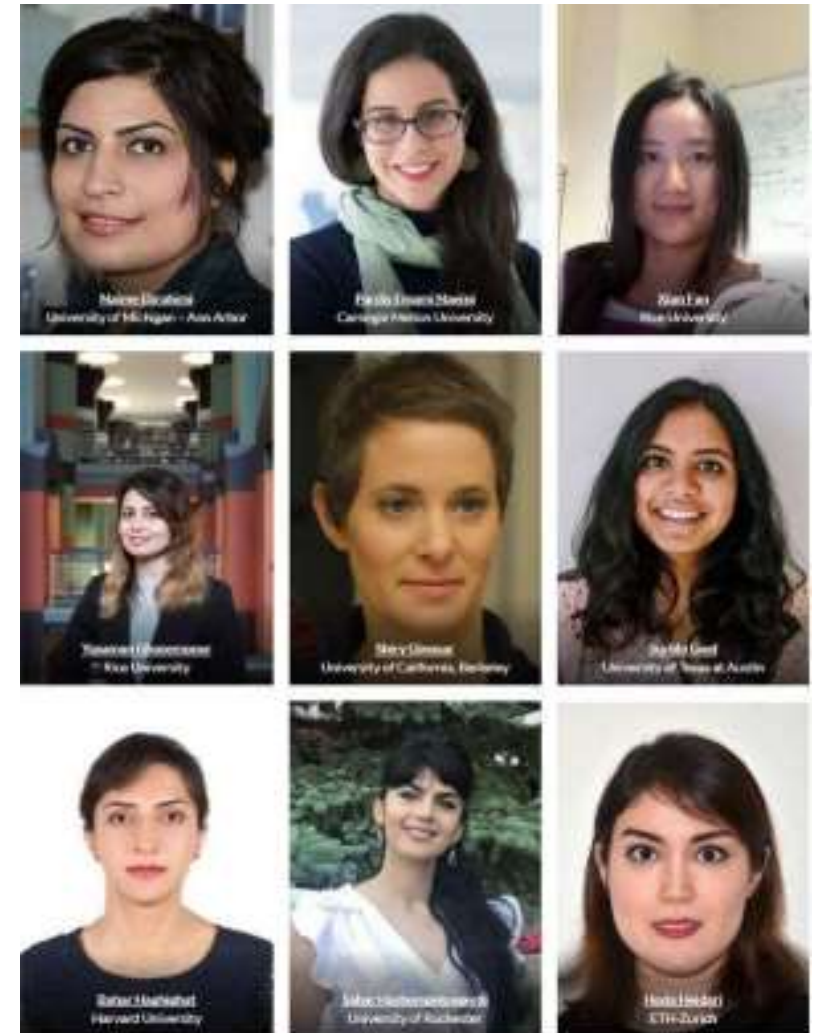




Figure 11.
Young women from Iran are over-represented in academic talent fairs

Roadblocks for Women in STEM

Table 4. Factors helping women’s participation/achievement in STEM educational programs and careers (on the subjective scale of 0-10).

Facilitating factor		
High school STEM preparation	2	8
Access to higher education	5	9
Motivation and family support	4	7
Cultural/Religious inducement	6	3
Gender-equitable family laws	9	2
Gender-neutral labor laws	9	3
Women-friendly workplaces	3	5
Social/Workplace safety	5	4
Overall facilitation score (out of 80)	43	41

Conclusion and Future Work

What we can learn from Iran

- Strong women's movement: No going back!
- Near-universal access to higher education
- Motivation to achieve; Family support

What we need to do going forward

- Understand changes and underlying reasons
- Expand STEM preparation in K-12 programs
- Assess impact of economic cycles, job market



Questions?



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