

IGNITE THE FUTURE OF PHYSICS

Learn more at STEPUP4WOMEN.ORG

Program Introduction













Presenter Introduction

STEPUP4WOMEN.ORG

Justin Fournier

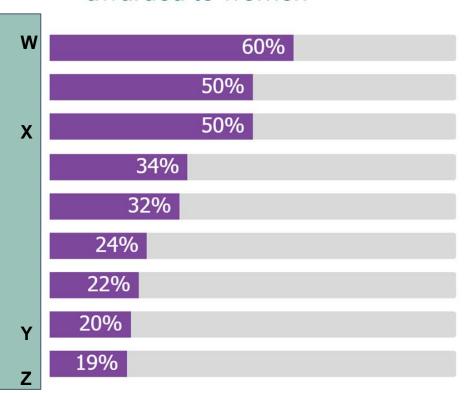
A Physics Teacher at Cypress High School



Comparing Across Countries

STEPUP4WOMEN.ORG

Percentage undergraduate physics degrees awarded to women



Talk to neighbor, then show of fingers:

- Which is country W?
 (highest percentage)
- Which is country Z? (lowest percentage)
- Which is country X?
- Which is country Y?







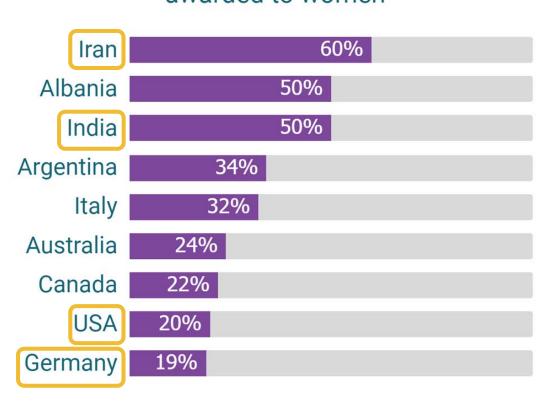




Comparing Across Countries

STEPUP4WOMEN.ORG

Percentage undergraduate physics degrees awarded to women



Check your predictions

Source: IUPAP International Conference on Women in Physics Proceedings









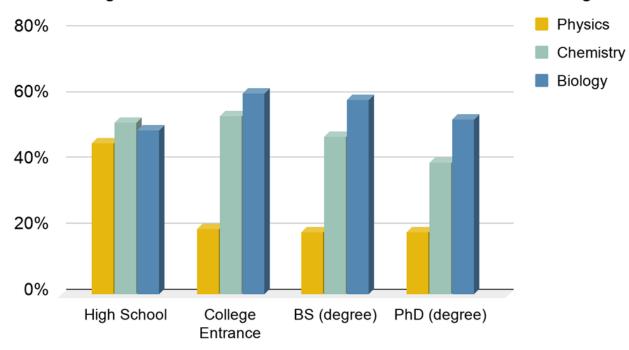


Why STEP UP 4 Women?

STEPUP4WOMEN.ORG

Examine: What trends do you see?





Source: AIP, HERI, IPEDS

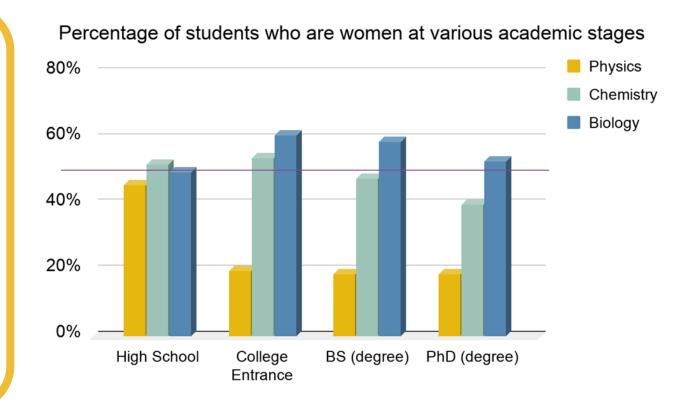


Why STEP UP 4 Women?

STEPUP4WOMEN.ORG

Examine: What trends do you see?

Although women make up nearly 50% of enrollments in high school physics, less than 20% of postsecondary physics majors are women.



Source: AIP, HERI, IPEDS



Why intervene in high school?

STEPUP4WOMEN.ORG

Most women physicists become interested at this time

Source: Hodapp & Hazari, 2015



Why intervene in high school?

STEPUP4WOMEN.ORG

- Most women physicists become interested at this time
- Compared to elementary school
 - teachers have greater content knowledge and are more vested in physics
 - students are closer to decision-making time for majors

Source: Hodapp & Hazari, 2015



Why intervene in high school?

STEPUP4WOMEN.ORG

- Most women physicists become interested at this time
- Compared to elementary school
 - teachers have greater content knowledge and are more vested in physics
 - students are closer to decision-making time for majors
- Compared to college
 - classes are smaller and there is more time to build relationships

Source: Hodapp & Hazari, 2015



STEPUP4WOMEN.ORG

<u>Supporting Teachers to Encourage the Pursuit of</u>
 <u>Undergraduate Physics for Women</u>



STEPUP4WOMEN.ORG

<u>Supporting Teachers to Encourage the Pursuit of</u>
 <u>Undergraduate Physics for Women</u>

Goals

- Dramatically increase number of young women pursuing a bachelor's degree in physics in the U.S.
- Shift deep-seated cultural views about who does physics



STEPUP4WOMEN.ORG

<u>Supporting Teachers to Encourage the Pursuit of</u>
 <u>Undergraduate Physics for Women</u>

Goals

- Dramatically increase number of young women pursuing a bachelor's degree in physics in the U.S.
- Shift deep-seated cultural views about who does physics
- Cooperative effort between multiple institutions













STEPUP4WOMEN.ORG

Guidelines and Lessons available for educators



STEPUP4WOMEN.ORG

Guidelines and Lessons available for educators

Everyday Actions Guide

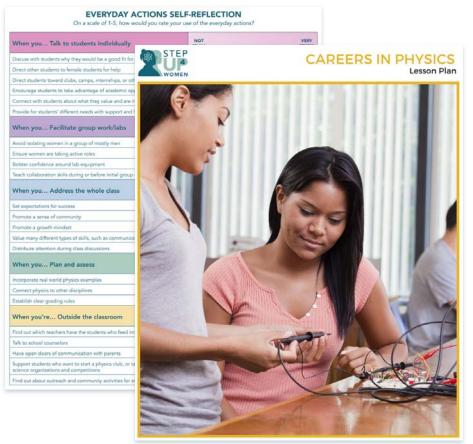
When you Talk to students individually	NOT AT ALL					VERY
Discuss with students why they would be a good fit for physics	0	1	2	3	4	5
Direct other students to female students for help	0	1	2	3	4	5
Direct students toward clubs, camps, internships, or other programs	0	1	2	3	4	5
Encourage students to take advantage of academic opportunities in physics	0	1	2	3	4	5
Connect with students about what they value and are interested in		1	2	3	:4	5
Provide for students' different needs with support and feedback	0	1	2	3	4	5
When you Facilitate group work/labs	NOT AT ALL					VERY
Avoid isolating women in a group of mostly men	0	1	2	3	4	5
Ensure women are taking active roles	0	1	2	3	4	5
Bolster confidence around lab equipment	0	1	2	3	4	5
Teach collaboration skills during or before initial group activities	0	1	2	3	- 4	5
When you Address the whole class	NOT AT ALL					VERY
Set expectations for success	0	1	2	3	4	5
Promote a sense of community	0	1	2	3	4	5
Promote a growth mindset	0	1	2	3	4	5
Value many different types of skills, such as communication and teamwork	0	1	2	3	.4	5
Distribute attention during class discussions	0	1	2.	3	4	5
When you Plan and assess	NOT AT ALL					VERY
Incorporate real world physics examples	0	1	2	3	4	5
Connect physics to other disciplines	0	1	2	3	4	5
Establish clear grading rules	0	11:	2	3	4	5
When you're Outside the classroom	NOT AT ALL				VERY	
Find out which teachers have the students who feed into physics	0	11	2	3	- 4	5
Talk to school counselors	0	1	2	3	-4	5
Have open doors of communication with parents	0	1	2	3	4	5
Support students who want to start a physics club, or take part in physics/ science organizations and competitions	0	13	2	3	4	5
Find out about outreach and community activities for student engagement	0	4	2	3	4	5



STEPUP4WOMEN.ORG

Guidelines and Lessons available for educators

- Everyday Actions Guide
- Careers in Physics Lesson

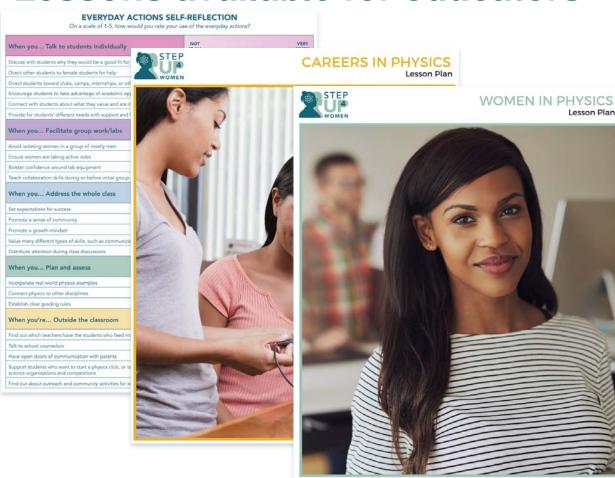




STEPUP4WOMEN.ORG

Guidelines and Lessons available for educators

- Everyday Actions Guide
- Careers in Physics Lesson
- Women in Physics Lesson





...to inspire future physicists

EVERYDAY ACTIONS SELF-REFLECTION

CTE	он н	3 A LA /	\sim N/I	ENI /	\cap D \cap
STE	гог	-4 VV		EIV.	

Guidelines and Lessons available for educators

Everyday Actions Guide

When you Talk to students individually		NOT AT ALL					
Discuss with students why they would be a good fit for physics	0 1		2	3	4	5	
Direct other students to female students for help	0	1	2	3	4	5	
Direct students toward clubs, camps, internships, or other programs	0	1	2	3	4	5	
Encourage students to take advantage of academic opportunities in physics	0	1	2	3	4	5	
Connect with students about what they value and are interested in	0	1	2	3	4	5	
Provide for students' different needs with support and feedback	0	1	2	3	4	5	
When you Facilitate group work/labs	NOT AT ALL					VERY	
Avoid isolating women in a group of mostly men	0	1	2	3	4	5	
Ensure women are taking active roles	0	1	2	3	4	5	
Bolster confidence around lab equipment	0	1	2	3	4	5	
Teach collaboration skills during or before initial group activities	0	1	2	3	4	5	
When you Address the whole class	NOT AT ALL					VERY	
Set expectations for success	0	1	2	3	4	5	
Promote a sense of community	0	1	2	3	4	5	
Promote a growth mindset	0	1	2	3	4	5	
Value many different types of skills, such as communication and teamwork	0	1	2	3	4	5	
Distribute attention during class discussions	0	1	2	3	4	5	
When you Plan and assess	NOT AT ALL				VERY		
Incorporate real world physics examples	0	1	2	3	4	5	
Connect physics to other disciplines	0	1	2	3	4	5	
Establish clear grading rules	0	1	2	3	4	5	
When you're Outside the classroom	NOT AT ALL				VERY		
Find out which teachers have the students who feed into physics	0	1	2	3	4	5	
Talk to school counselors	0	1	2	3	4	5	
Have open doors of communication with parents	0	1	2	3	4	5	
Support students who want to start a physics club, or take part in physics/ science organizations and competitions	0	1	2	3	4	5	
Find out about outreach and community activities for student engagement	0	1	2	3	4	5	



...to inspire future physicists

STEPUP4WOMEN.ORG

Classroom practices that promote the pursuit of physics

 Research-based and usable everyday in every classroom



...to inspire future physicists

STEPUP4WOMEN.ORG

Classroom practices that promote the pursuit of physics

- Research-based and usable everyday in every classroom
- Compiled into Everyday Actions Guide



...to inspire future physicists

STEPUP4WOMEN.ORG

Classroom practices that promote the pursuit of physics

- Research-based and usable everyday in every classroom
- Compiled into Everyday Actions Guide
- How to...
 - talk to students individually
 - facilitate group work/labs
 - address the whole class
 - plan and assess
 - promote physics outside the classroom



...to inspire future physicists

STEPUP4WOMEN.ORG

Everyday Actions to INSPIRE THE FUTURE OF PHYSICS



WHEN YOU Fac

Facilitate Group Work/Labs

Encourage students individually, especially young women. Promote self-confidence through explicit reinforcement of student abilities – female students tend to have less self-confidence in physics.

Ensure all students have equal opportunity to assume active roles and contribute to discussions. Female students are often marginalized in group work.



...to inspire future physicists

STEPUP4WOMEN.ORG



Promote a positive attitude towards physics. Set expectations for success, distribute attention during discussion, and encourage a growth mindset. Students often have a fixed mindset about their abilities in physics.



Connect lessons to topics that resonate with students' values and lower the anxiety related to grades. Female students' interests are less likely to be incorporated in physics classes



...to inspire future physicists

STEPUP4WOMEN.ORG



Outside the Classroom

Communicate with people who influence students outside of the classroom setting. Female students who persist in physics are strongly influenced by others but often have fewer experiences for building these relationships



...to inspire future physicists

STEPUP4WOMEN.ORG



Researcher Story



Creating small groups with high proportions of women in otherwise male-dominated fields is one way to keep women engaged and aspiring toward related careers." [5]



Researcher Story



Groups comprised of two males and one female tended to be dominated by the male students... even when the female member was articulate and the highest ability student in the group." [8]



Researcher Story



[Women in the physics laboratory] complained of domineering partners, clashes in temperament, being subjected to ridicule, fears that their partners didn't respect them, and feelings that their partners understood far more than they." [9]



Teacher Story



I hand out 'what's your favorite color?' cards; then noting that many of the girls have green, I say "Okay, green is going to operate the equipment" rather than letting them choose, for example, note taker."



STEPUP4WOMEN.ORG

Guidelines and Lessons available for educators

Careers in Physics Lesson





STEPUP4WOMEN.ORG

Student Prompt

Name a career you can have with a physics bachelor's degree.



STEPUP4WOMEN.ORG

Sample responses

Name a career you can have with a physics bachelor's degree.

```
rocket investigator accident physicst researcher professor teacher hotel-restaurant-bar teacher engineerscientist professor engineering by a nuclear anything astrocamp laser astrophysicist astronaut accident biomechanist movie fortnite fortnite physicist accident biomechanist movie fortnite physicist movie for
```



STEPUP4WOMEN.ORG

Students complete Career Goals Pre-Survey

2 questions



STEPUP4WOMEN.ORG

Students complete Career Goals Pre-Survey

2 questions

Refer to *Profile Matching Matrix* (Appendix 2)

- Find the name of at least one matching physicist profile
- Retrieve this physicist's card, read, and reflect



STEPUP4WOMEN.ORG

Students complete Career Goals Pre-Survey

2 questions

Refer to *Profile Matching Matrix* (Appendix 2)

- Find the name of at least one matching physicist profile
- Retrieve this physicist's card, read, and reflect

Share with nearest neighbors focusing on:

- What does your physicist personally value about their degree or career?
- Who benefits from their work?
- What did they gain from their physics degree?



STEPUP4WOMEN.ORG

Physicists Career Profiles

Christina Barrow - Medical Physicist



Christina Barrow was interested in math and science from an early age, entering her first science fair as a second grader. "I was always tinkering around the house as a child, trying to figure out how and why things worked the way they did," she says. After finishing her undergraduate degree, Christina worked in server development at Dell Computer Corporation for three years and then went on to accept a position in the biomedical engineering field. At this point in her career, Christina realized that she wanted to use her science background to make a contribution to the medical field and work in patient care. She pursued graduate school in Medical Physics, a field that combined her love for modern medicine, math, and physics.

https://www.aps.org/careers/physicists/profiles/barrow.cfm

Urszula Tajchman - Pediatric cardiologist



In her job, Urszula Tajchman treats children with heart disease, as well as conducts research in molecular biology. Urszula received her medical training at the Johns Hopkins University. She then did her residency in Pediatrics at the University of Colorado, and a fellowship in Pediatric Cardiology at the University of Iowa. She worked as a pediatric cardiologist at the University of South Dakota before becoming the first pediatric cardiologist in Central Oregon in 2002. Urszula is board certified in pediatrics and pediatric cardiology. She says that the best things about her job are caring for patients, teaching children and parents about their health, and studying therapies for disease.



STEPUP4WOMEN.ORG

Student Prompt-after discussion

What new careers emerged from researching the physicist's profiles?



STEPUP4WOMEN.ORG

Sample responses-after discussion

What new careers emerged from researching the physicist's profiles?

```
college dean physicist space doctor the writer film medical physicist actuary physical producer pilotengineer duster physical producer pilotengineer duster parachute-packer pediatric cardiologist rocket scientist
```



STEPUP4WOMEN.ORG

Students create their own Career

Profile: Identify/research a career that interests you.

Profile elements-Part I

- I want to pursue a career in ______
- In this career I will focus on
- What do you hope to accomplish or contribute by pursuing this career?
- How can a degree in physics lead you into this career or support your growth in this career?



STEPUP4WOMEN.ORG

Personal Profile (for display)

Profile elements-Part II

- Name | Career Title | Picture
- Who I am
- Why physics
- Using physics
- Advice for students

Share out of Personal Profiles



STEPUP4WOMEN.ORG

Bachelor's Degrees in Physics: What you didn't know



STEPUP4WOMEN.ORG

Bachelor's Degrees in Physics: What you didn't know

Based on National Surveys

- High employment rates (95%)
- High job satisfaction (71% to 93%)
- Multiple job opportunities



STEPUP4WOMEN.ORG

Physics majors get high scores on assessments for both medical and law school

Scores on MCAT by major		
Degree Field	Average	
Economics	10.5	
Physics	10.4	
Biomedical Engr	10.4	
Mathematics	10.1	
Electrical Engr	10.1	
Neuroscience	10.1	
English	10.0	
Biochemistry	9.8	
Chemistry	9.5	
Microbiology	9.4	
Psychology	9.3	
Biology	9.1	
Premedical	9.5	
All Majors	9.5	
Medical		

Scores on LSAT by major		
Degree Field	Average	
Mathematics	162.2	
Physics	162.1	
Economics	159.1	
Engineering	157.3	
Chemistry	156.7	
History	156.7	
English	155.8	
Biology	155.2	
Political Science	154.3	
Psychology	153.3	
Computer Sci	152.3	
Pre-Law	149.0	
Criminal Justice	145.6	
All Majors	153.6	
Law		

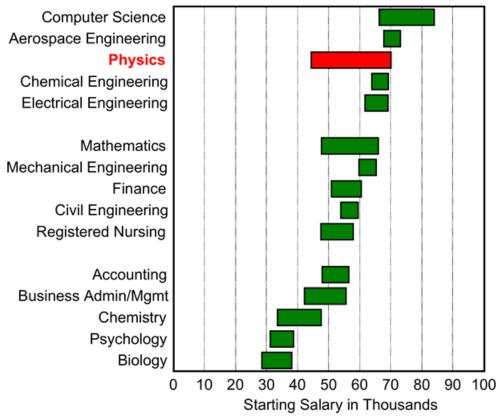
38



STEPUP4WOMEN.ORG

Physics majors earn comparatively higher salaries than other fields



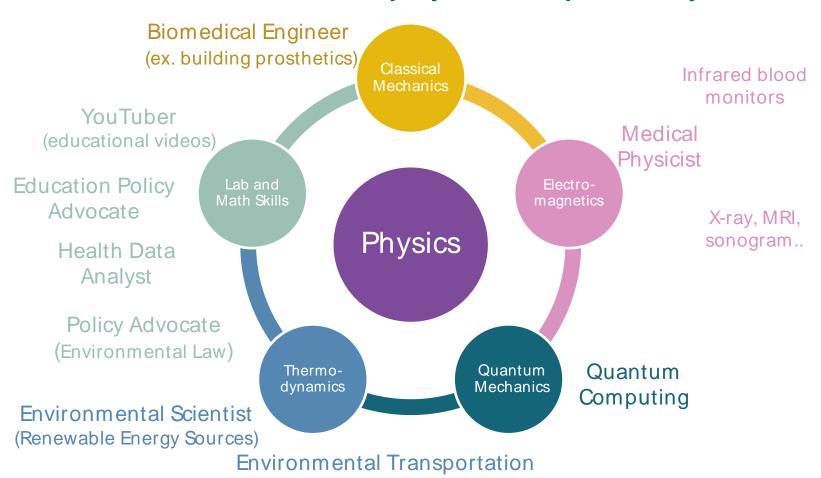


Source: AIP, 2016



STEPUP4WOMEN.ORG

Careers that use physics help society



Scientist



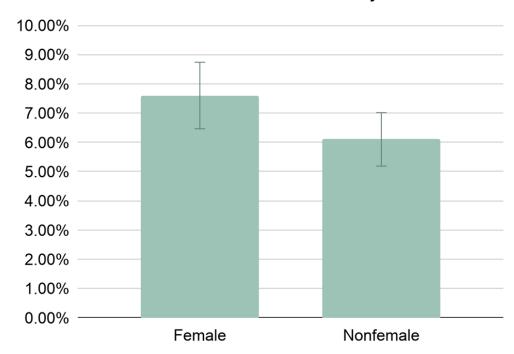
STEPUP4WOMEN.ORG

What is the effect of this lesson on students?

Shown to improve students' future physics intentions

- majoring in physics in college
- intention to pursue
 physics-related careers

Future Gains--Careers in Physics



N = 823

Source: Cheng et al., 2018



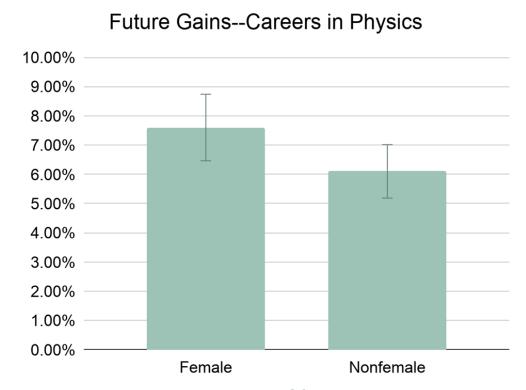
STEPUP4WOMEN.ORG

What is the effect of this lesson on students?

Shown to improve students' future physics intentions

- majoring in physics in college
- intention to pursue physics-related careers

Overall gains from the lesson across all students are positive



N = 823

Source: Cheng et al., 2018



Lesson Evidence

Careers in Physics

STEPUP4WOMEN.ORG

Quotes from teachers who used the lesson



Lesson Evidence

Careers in Physics

STEPUP4WOMEN.ORG

Quotes from teachers who used the lesson



"Students don't realize all the things they can do with a physics degree."



"It helps students see that physicists can help the world and work with others."



"The posters students make as part of the lesson help recognize students and who they are."



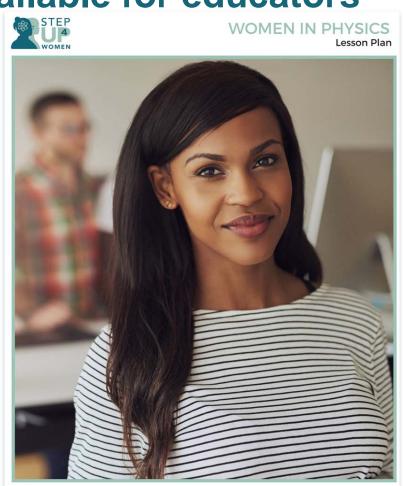
"As a student, I wish I had the opportunity of envisioning my future with physics."



STEPUP4WOMEN.ORG

Guidelines and Lessons available for educators

Women in Physics Lesson





STEPUP4WOMEN.ORG

Students examine the conditions for women in physics



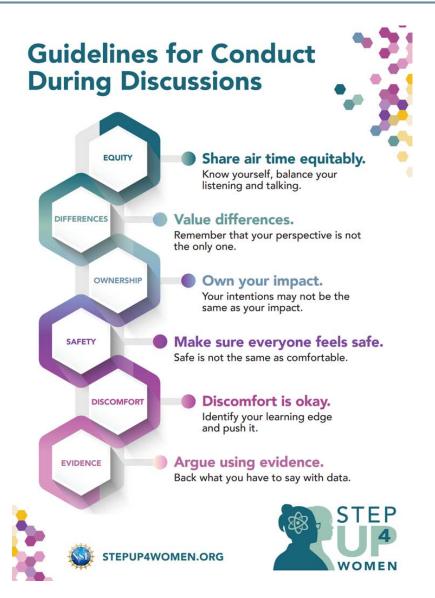
STEPUP4WOMEN.ORG

Students examine the conditions for women in physics

- Research famous physicists and analyze trends and stereotypes
- Discuss gender issues with respect to famous physicists
- See data about women in physics around the world and consider the role of culture and society
- Leverage personal experiences to neutralize the effect of stereotypes and bias



STEPUP4WOMEN.ORG





STEPUP4WOMEN.ORG

Guidelines for Conduct During Discussion

Share air time equitably

Value differences

Own your impact

Make sure everyone feels safe

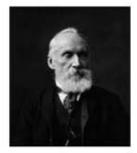
Discomfort is okay

Argue using evidence



STEPUP4WOMEN.ORG

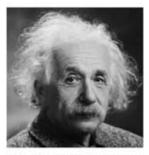
Googled: "famous physicist"



Most Famous Physicists - L... totallyhistory.com



Famous Physicists from Ar_ ranker.com



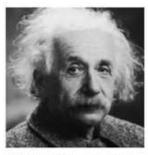
Famous Male Physicists | List o... ranker.com



famous physicists | famous physicists ... pinterest.com



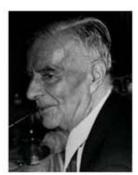
Famous Physicists - The Gr... famousphysicists.org



Most famous physicist ever? Re_ latimesblogs.latimes.com



Most Famous Physicists - List of_ totallyhistory.com



Famous Physicists from Pol.,



Famous physicist aims to ma., columbiaspectator.com



Most famous physicist ever? Readers _ latimesblogs latimes.com



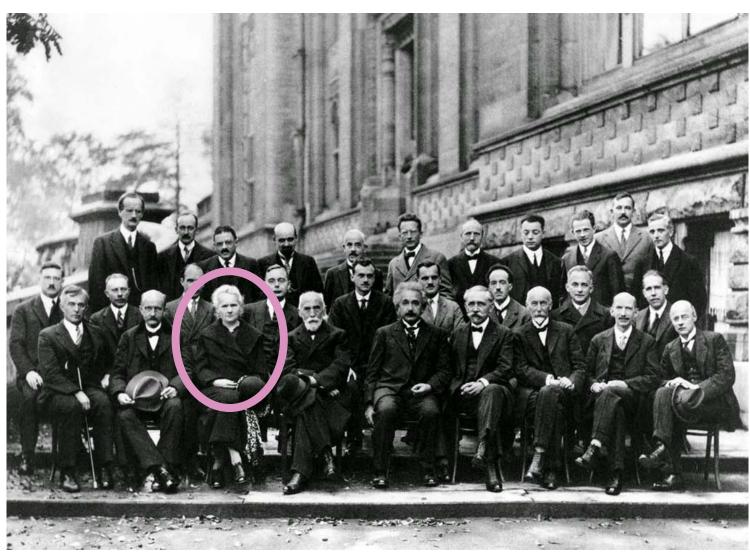
Most Famous Physicists - List of _ totallyhistory.com



FAMOUS PHYSICISTS: GJ Ston... ebephysics.wordpress.com



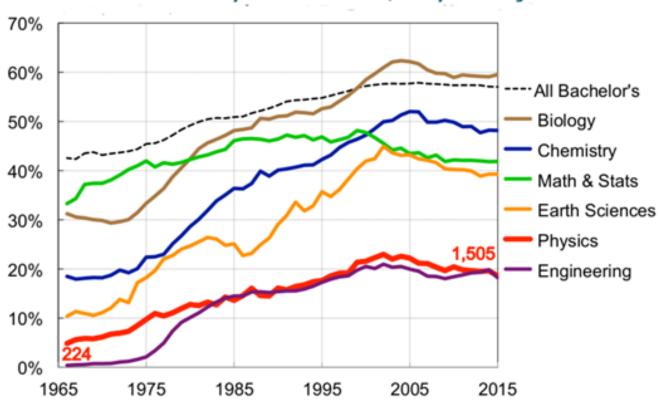
STEPUP4WOMEN.ORG





STEPUP4WOMEN.ORG

Percentage of Bachelor's Degrees Earned by Women, by Major





Resources available

STEPUP4WOMEN.ORG

- Everyday actions guide
- Careers in **Physics Lesson**
- Women in **Physics Lesson**
 - Includes Classroom Guidelines Poster





STEPUP4WOMEN.ORG





STEPUP4WOMEN.ORG

1. Register NOW at STEPUP4WOMEN.org



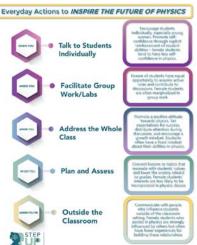


STEPUP4WOMEN.ORG

1. Register NOW at STEPUP4W OMEN.org

2. Learn about and implement effective strategies using the EVERYDAY ACTIONS guide.

Everyday Actions to INSPIRE THE FUTURE OF PHYSICS



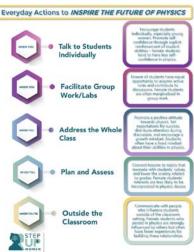




STEPUP4WOMEN.ORG

1. Register NOW at STEPUP4W OMEN.org

2. Learn about and implement effective strategies using the EVERYDAY ACTIONS guide.





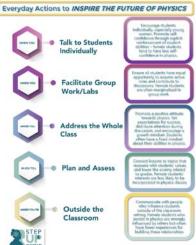
3. Inspire women! Teach lessons on careers and women in physics.



STEPUP4WOMEN.ORG

1. Register NOW at STEPUP4W OMEN.org

2. Learn about and implement effective strategies using the EVERYDAY ACTIONS guide.





- 3. Inspire women! Teach lessons on careers and women in physics.
- 4. Provide feedback. Tell us how it went!



STEPUP4WOMEN.ORG

You could apply to be a STEP UP 4 Women Ambassador!

 Attend the Ambassador Summit at the Summer 2019 AAPT meeting



STEPUP4WOMEN.ORG

- Attend the Ambassador Summit at the Summer 2019 AAPT meeting
- Recruit and prepare other teachers to use STEP UP 4 Women workshop materials



STEPUP4WOMEN.ORG

- Attend the Ambassador Summit at the Summer 2019 AAPT meeting
- Recruit and prepare other teachers to use STEP UP 4 Women workshop materials
- Maintain contact with those you've trained



STEPUP4WOMEN.ORG

- Attend the Ambassador Summit at the Summer 2019 AAPT meeting
- Recruit and prepare other teachers to use STEP UP 4 Women workshop materials
- Maintain contact with those you've trained
- Reflect, plan, etc. without Ambassadors across the country



STEPUP4WOMEN.ORG

- Attend the Ambassador Summit at the Summer 2019 AAPT meeting
- Recruit and prepare other teachers to use STEP UP 4 Women workshop materials
- Maintain contact with those you've trained
- Reflect, plan, etc. without Ambassadors across the country
- Receive compensation and recognition



STEPUP4WOMEN.ORG

You could apply to be a STEP UP 4 Women Ambassador!

 Applications released in December 2018 and due in February 2019



STEPUP4WOMEN.ORG

You could apply to be a STEP UP 4 Women Ambassador!

 Applications released in December 2018 and due in February 2019

Any questions? Ask Bree!

Bree Barnett Dreyfuss

Ambassador Lead

BreeBarnettDreyfuss@gmail.com



Thank you!

STEPUP4WOMEN.ORG

Please follow the appropriate link below to give feedback on this workshop. Your comments will help us to improve our program!



Participant Evaluation link bit.ly/su4wpdeval



Feedback from PD leaders bit.ly/su4wleadeval

Justin Fournier Fournier j@auhsd.us



Thank you!

STEPUP4WOMEN.ORG

Justin Fournier Fournier j@auhsd.us

stepup4women@aps.org

This material is based upon work supported by the National Science Foundation under Grant Nos. 1720810, 1720869, 1720917, and 1721021. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.









