

Everyday Actions

STEPUP 

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 STEP UP

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Use the self-reflection below to think about how well your everyday actions support an inclusive physics classroom community. Then, use the *Everyday Actions Guidelines* on the following pages to work to improve your practice as you support young women in physics. Try choosing one area to focus on each week.

EVERYDAY ACTIONS SELF-REFLECTION

On a scale of 1-5, how would you rate your use of the everyday actions?

When you talk to students individually, do you:	NOT AT ALL					VERY MUCH
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 students with feedback, reassurance, and personal stories of struggle	0	1	2	3	4	5
When you facilitate group work/labs, do you:	NOT AT ALL					VERY MUCH
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, do you:	NOT AT ALL					VERY MUCH
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, do you:	NOT AT ALL					VERY MUCH
Incorporate real world physics examples related to helping people/society	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
Allow second chances for high stakes assessments	0	1	2	3	4	5
When you are outside the classroom, do you:	NOT AT ALL					VERY MUCH
Encourage other teachers to recommend physics to their female students	0	1	2	3	4	5
Talk to school counselors to ensure they encourage female students to take physics and consider physics careers	0	1	2	3	4	5
Provide school counselors with information about the breadth of jobs in physics	0	1	2	3	4	5
Share female students' successes and capabilities with their families	0	1	2	3	4	5
Provide parents with information about job opportunities in physics	0	1	2	3	4	5
Support students who want to start a physics club or take part in physics activities and events	0	1	2	3	4	5
Find out about outreach and community activities for student engagement and encourage students to participate	0	1	2	3	4	5



Talk to Students Individually

Encourage students individually, especially young women. Promote self-confidence through explicit reinforcement of their abilities – female students tend to have less self-confidence in physics [1-4].

Recognize students

- Discuss with students why they would be a good fit for physics. Remind students of these messages regularly – students might not internalize the message the first time.
- Direct students to female students for help. Position them as local experts.

Support new opportunities

- Direct them towards clubs, camps, internships, or other programs, or even start a STEP UP Club.
- Encourage students to take advantage of academic opportunities in physics they may not have considered.

Learn what students value

- Connect with students about what they value and are interested in.
- Provide students with feedback, reassurance, and personal stories of struggle.

Recognize students

YOU MIGHT SAY:

- “You did a great job leading your lab group this week. This is such an important skill for a physicist. Have you considered majoring in physics?”
- “You’re a good communicator, and that would be helpful in a physics career.”
- “You have great creative ideas. Physicists need to be creative.”
- “You can explain physics very well – the fact that you can relate these concepts to everyday terms is very important.”
- “Emily did a great job with that; ask her how she approached the problem.”



Student Story



Other students asked me questions like how did you understand it this way, can you explain it to me in a simpler form? Exchanging ideas helped me realize how much I knew.”

Support new opportunities



Student Story



One year my teacher recommended that I apply for a summer internship at Yale. I didn’t get the internship, but it was encouraging to me that he thought I was good enough to be competitive.”



Teacher Story



I was a science fair coordinator, and kids will get selected [from the district fair], so they can go to regionals. They might be on the fence about it. You can encourage them to go. Like, “Yeah, you should do it! You have a great project!”

YOU MIGHT SAY:

- “I’d love to write a letter of recommendation for you; I think you’re a strong student and would support you going forward.”
- “I hope you might consider taking physics next year.” or “Tell me your thoughts about taking physics next year. I really hope you will go on in physics.”

Learn what students value



Student Story



I could see doing nuclear physics because I thought that was really interesting, like alternate energy. It’s pretty interesting.”



Student Story



One of the hardest classes that I’ve ever taken was physics. I was struggling and sought out my teacher for help. The teacher shared with me that he didn’t truly master the subject until he started teaching. This was encouraging for me to hear and affirmed that I was capable despite my self-doubt.”



NOTE: The STEP UP *Careers in Physics* lesson allows students to explore potential physics careers based on their interests.



Facilitate Group Work/Labs

In group activities, all students should have equal opportunity to assume active roles and contribute to group discussions. Female students are often marginalized in group work due to unsupportive group dynamics and having less prior experience with physics experimentation [5-9].

Choose group members

- Ensure women are taking active roles.
- Avoid isolating women in a group of mostly men.

Scaffold group collaboration

- Bolster confidence around lab equipment and trying things out.
- Teach collaboration skills during or before initial group activities.

Choose group members



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.”

YOU MIGHT SAY:

- “Make sure that no one is dominating the activity in your group and that everyone in the group is getting a chance to use the equipment, conduct the analysis, and contribute to the group discussions.”

Scaffold group collaboration



Teacher Story



I remind students that girls are often socialized to take fewer risks and try things out. I encourage them to not be afraid to experiment since that is how we all learn and grow.”

YOU MIGHT SAY:

- “This is challenging – I had a hard time learning to use lab equipment myself, but you will know this by the end, I promise.”
- “I expect there to be mistakes, since we are learning new things. As we examine what led to our mistakes, we can improve.”



Teacher Story



I assess students on collaboration because it shows that it matters.”



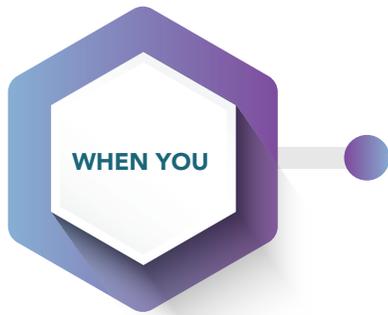
Student Story



Our team was recognized as team of the month on the board because we all worked together effectively to create and present a collaborative project.”



NOTE: The example rubric (available in reference [10]) can be used to provide students with an outline of the behaviors needed for productive collaboration.



Address the Whole Class

In classrooms that are effective in promoting positive attitudes towards physics, teachers do the following:

Set the tone

- Set expectations for success. Provide challenging tasks and problems and make it clear that you believe students are capable of meeting these challenges.
- Promote a sense of community – students are in it together (with each other and the teacher).
- Make the students aware of what resources are available in the classroom and repeat this clear message often.
- Promote a growth mindset [11-13]. Students can have a fixed mindset about their abilities in physics (i.e., you are good at physics or you are not). Provide encouragement and support so they learn that they can improve with effort and persistence.
- Value many different types of skills including communication, teamwork, and creativity. Talk about why these skills are essential to science.
- Emphasize that science is not done in isolation. Highlight examples of scientific achievements that were done collaboratively.

Distribute attention

- Ask a female student a question in front of others when you know she has the right answer.
- Distribute your attention to students during class discussions. Make sure all students can participate and that male students don't dominate the discussion.

Set the tone



Student Story

“...he says that we’re all capable of doing physics, but we’ve just got to put our mind to it...like he’ll see us as a physics person...”



Teacher Story

“Recognize students who improve even when it’s not an A. For example, I celebrate the “jumpers,” such as when a student goes from a D to a C/B.”

YOU MIGHT SAY:

- “If you’re ever struggling in this class, here are the resources available: me, your classmates, office hours, group study sessions, second-chances on work, etc.”
- “Every year students say they can’t do this, but every year they succeed. I know you’ll succeed too.”
- “This is a challenge but being able to do this means we’re all ready to move on to the next chapter. It’s hard, but I know you can all do it.”
- “This is a very challenging task. I want you to try, even if you think you won’t get it right. I’m not looking for right answers; I’m looking for risk-taking.”
- “Give it a try—we can always fix mistakes once I see where you are getting held up.”
- “I like how you used that in everyday terms. Will you share it with the class?”



Teacher Story



I assigned a vector scavenger hunt every year, where students had to figure out the end point of ten successive vectors. Every year the class would be surprised because the underachieving student would finish first—because they would look for an “easy way” to solve the problem without having to do much work. Then we all talked about that, as well as about algebraic vector addition.”

Distribute Attention



Teacher Story



I’ve seen teachers use popsicle sticks or index cards with every student’s name and go through the whole list of names every class period to ensure every voice is heard. I added that to my toolbox.”



NOTE: You can refer students to the STEP UP Classroom Guidelines poster with reminders such as “Share air time equitably.”



Plan and Assess

Connect lessons to topics that resonate with students' values and experiences, and lower the anxiety related to grades. Female students' interests are less likely to be incorporated in physics classes, and they are more likely to feel anxious about good grades [14-17].

Plan lessons with context

- Incorporate real world physics examples related to helping people (e.g. medical/health, alternate energy, climate science).
- Connect physics to other disciplines.

Grade equitably

- Establish clear grading rules.
- Allow second chances for high stakes assignments/tests.



NOTE: The *Careers in Physics* Lesson has profiles of physicists with varied careers that can give your students additional connections to physics. You can also add additional profiles to the lesson if you have a field or job that you would like to highlight to your students.

Plan lessons with context



Teacher Story

“ I highlighted the existing examples in the textbooks that connect physics to other disciplines like medicine, climate change, communication, and music.”



Teacher Story

“ I make it an assignment for students. They have to connect the physics we are learning to a topic they like. I give them an example of how to do it by connecting physics to something I love.”



Student Story

“ My teacher gave the class options for topics for the semester. We got to vote on what we wanted to focus on. I like that the teacher made an effort to find topics that were interesting for us.”



Teacher Story

“ When I taught about waves and sound, I had students who played violins bring their instruments to class and demonstrate some of the concepts we were learning.”

Grade equitably



Teacher Story



Rubrics are awesome for keeping the expectations clear, especially for labs and projects. I go over the rubrics so that everyone knows exactly what to expect, especially if it counts for a lot.”



Student Story



If we don't get it after a test, we'll go back and quiz again on it, learn more about it, and then move on. He tries to move fast but he doesn't want to leave anybody behind.”

YOU MIGHT SAY:

- “Remember that your assignment rubric includes your process and not just your content knowledge. I care about *how* you did it, not just your final results.”
- “I can tell you weren't really happy with that quiz grade. Do you want to study and then try another version of the quiz again? I know you can do this.”



Outside the Classroom

Communicate with other 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 in physics for building these relationships [18-20].

Other teachers

- Encourage teachers in other disciplines (math, biology, etc.) to recommend physics to their female students.

Counselors

- Talk to school counselors to ensure they encourage female students to take physics and consider physics careers.
- Provide school counselors with information about the breadth of jobs in physics, available from a variety of sources including careers.aps.org.

Parents and family

- Share female students' successes and capabilities with their families.
- Provide parents with information about job opportunities in physics, available from a variety of sources including careers.aps.org.

Activities outside school

- Support female students who want to start a physics club or take part in physics activities and events.
- Find out about outreach and community activities for student engagement and encourage students to participate.

Other teachers



Teacher Story



My colleagues, especially in math and science, know all the kids who have a lot of potential. I ask them about those kids and we encourage them to take physics.”

YOU MIGHT SAY:

- “Do you have a student who isn’t taking physics next year, but you think they should be?”

Counselors



Student Story



My counselor recognized that I excelled in math and science. She suggested I take physics and helped me get the process going. I will always be thankful to her for her support and recognition of my potential to excel.”

YOU MIGHT SAY:

- “A physics background is a really good way to prepare students for many careers. Scores on the LSATs or MCATs are much higher for students with a physics background.” [\[21\]](#)

Parents and family



Teacher Story



I make positive phone calls instead of just negative phone calls. Some parents have never heard from the teachers about positive comments, and it really makes a difference. I do this when students are getting better also.”



Teacher Story



I organize a Science Night with tables where students do experiments, and parents observe and circulate. The parents become proud of the students while they are doing the experiments, and it is a real sense of recognition for the students.”



Teacher Story



On back-to-school night I would get index cards from parents, so I could connect them with their child. I would ask them to tell me something important they wanted me to know about their child. Later in the year, I had their child write a card to their parent about what they love about learning physics.”

YOU MIGHT SAY:

- “Your daughter is an amazing physics student and your support of her means so much for her success.”
- “Did you know that students with a physics bachelor’s degree have higher employment and salaries than other degrees? They can pretty much do whatever they put their minds to.”

Activities outside school



Teacher Story

“ We have a big egg drop exhibition for the whole school, and women see other women who are taking physics and enjoying participating.”



Teacher Story

“ I started a Women in Physics club and the young women give presentations and demonstrations throughout the year during lunch periods.”

YOU MIGHT SAY:

- “How could we help other students find out why physics is awesome?”



Student Story

“ To help fulfill service hour requirements for graduation, our physics teacher helped arrange for us to tutor younger kids and do physics experiments with them.”



Student Story

“ [My teacher] was always there after school and early in the morning if we had questions, and he had many review sessions for us.”

REFERENCES

- [1] Carlone, H. B. (2004). The cultural production of science in reform-based physics: Girls' access, participation, and resistance. *Journal of Research in Science Teaching*, 41(4), 392-414.
- [2] Cavallo, A. M., Potter, W. H., & Rozman, M. (2004). Gender differences in learning constructs, shifts in learning constructs, and their relationship to course achievement in a structured inquiry, yearlong college physics course for life science majors. *School Science and Mathematics*, 104(6), 288-300.
- [3] Hazari, Z., Brewe, E., Goertzen, R. M., & Hodapp, T. (2017). The importance of high school physics teachers for female students' physics identity and persistence. *The Physics Teacher*, 55(2), 96-99.
- [4] Hazari, Z., Sadler, P., & Tai, R. (2008). Gender Differences in the High School and Affective Experiences of Introductory College Physics Students. *The Physics Teacher*, 46, 423-427.
- [5] Dasgupta, N., Scircle, M. M., & Hunsinger, M. (2015). Female peers in small work groups enhance women's motivation, verbal participation, and career aspirations in engineering. *Proceedings of the National Academy of Sciences*, 112(16), 4988-4993.
- [6] Chambers, S. K., & Andre, T. (1997). Gender, prior knowledge, interest, and experience in electricity and conceptual change text manipulations in learning about direct current. *Journal of Research in Science Teaching: The Official Journal of the National Association for Research in Science Teaching*, 34(2), 107-123.
- [7] Hazari, Z., Sadler, P., & Tai, R. (2008). Gender Differences in the High School and Affective Experiences of Introductory College Physics Students. *The Physics Teacher*, 46, 423-427.
- [8] Heller, P., & Hollabaugh, M. (1992). Teaching problem solving through cooperative grouping. Part 2: Designing problems and structuring groups. *American Journal of Physics*, 60(7), 637-644.
- [9] Laws, P. W., Rosborough, P. J., & Poodry, F. J. (1999). Women's responses to an activity-based introductory physics program. *American Journal of Physics*, 67(S1), S32-S37.
- [10] http://www.bie.org/object/document/6_12_collaboration_rubric_ccss_aligned
- [11] Dweck, C. (2006/2016). *Mindset: The new psychology of success*. Random House: New York, NY.
- [12] Framing tool from Mindset Works <https://s3-us-west-1.amazonaws.com/mindset-net-site/FileCenter/LVKMHI2ZNT4DLN5DU23.pdf>
- [13] Feedback tool from Mindset Works <https://s3-us-west-1.amazonaws.com/mindset-net-site/FileCenter/MM3J5IO126930FPPC4TD.pdf>
- [14] Carlone, H. B. (2004). The cultural production of science in reform-based physics: Girls' access, participation, and resistance. *Journal of Research in Science Teaching*, 41(4), 392-414.
- [15] Diekman, A.B., Brown, E.R., Johnston, A.M., & Clark, E.K. (2010). Seeking congruity between goals and roles a new look at why women opt out of science, technology, engineering, and mathematics careers. *Psychological Science*, 21(8), 1051-1057.
- [16] Hazari, Z., Cass, A.P., & Beattie, C. (2015). Obscuring Power Structures in the Physics Class: Linking Teacher Positioning, Student Engagement, and Physics Identity Development. *Journal of Research in Science Teaching*, 52, 735-762.
- [17] Stadler, H., Duit, R., & Benke, G. (2000). Do boys and girls understand physics differently? *Physics Education*, 35(6), 417-422.
- [18] Hazari, Z., & Cass, C. (2018). Towards Meaningful Physics Recognition: "What does this recognition actually look like?" *The Physics Teacher*, 56, 450-454.
- [19] Ivie, R., & Guo, S. (2006). Women Physicists Speak Again. American Institute of Physics Report, retrieved from: www.aip.org/sites/default/files/statistics/women/women-speakagain-05.pdf.
- [20] Lee, J. D. (2002). More than ability: Gender and personal relationships influence science and technology involvement. *Sociology of Education*, 349-373.
- [21] <https://www.aip.org/statistics/reports/mcat-lsat-and-physics-bachelors>