# Everyday Actions Guide

STEP UP

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# EVERYDAY ACTIONS GUIDE

# Teacher self-reflection

*On a scale of 1-5, rate the extent to which you do the following actions.*

| **Supporting students individually** | **NOT AT ALL** | | | | | **VERY MUCH** |
|---|---|---|---|---|---|---|
| Discuss with students why they would be a good fit for physics | 0 | 1 | 2 | 3 | 4 | 5 |
| Direct students to willing but less-recognized 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 |
| **Facilitating group work/labs** | **NOT AT ALL** | | | | | **VERY MUCH** |
| Avoid isolating students in groups in which they cannot engage fully | 0 | 1 | 2 | 3 | 4 | 5 |
| Ensure less-recognized students are taking active roles | 0 | 1 | 2 | 3 | 4 | 5 |
| Bolster confidence around lab equipment | 0 | 1 | 2 | 3 | 4 | 5 |
| Allow side conversations that let students connect as individuals | 0 | 1 | 2 | 3 | 4 | 5 |
| **Addressing the whole class** | **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 |
| Encourage 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 |
| **Planning and assessing** | **NOT AT ALL** | | | | | **VERY MUCH** |
| Incorporate examples that students personally connect with | 0 | 1 | 2 | 3 | 4 | 5 |
| Connect physics to other disciplines | 0 | 1 | 2 | 3 | 4 | 5 |
| Establish and share clear grading criteria with students | 0 | 1 | 2 | 3 | 4 | 5 |
| Allow students multiple chances for high stakes assignments/tests | 0 | 1 | 2 | 3 | 4 | 5 |
| **Engaging broader community** | **NOT AT ALL** | | | | | **VERY MUCH** |
| Encourage teachers in other disciplines to recommend physics to students | 0 | 1 | 2 | 3 | 4 | 5 |
| Talk to school counselors | 0 | 1 | 2 | 3 | 4 | 5 |
| Reach out to parents to recognize students and communicate achievement | 0 | 1 | 2 | 3 | 4 | 5 |
| Create opportunities outside of the classroom (e.g.,field trips, club, family night, etc.) | 0 | 1 | 2 | 3 | 4 | 5 |
| Engage students with outreach and community activities | 0 | 1 | 2 | 3 | 4 | 5 |

# Introduction

This document includes suggestions and pedagogical tools for positive changes that teachers can make in their classroom, ways to work with other school staff, strategies for organizing groups of students, and more. The guide is organized into five sections, which include actions and strategies for reducing the exclusion of students in the classroom and recognizing all students as physics people. These strategies draw from both research literature (with citations included) and the experiences of teachers in the STEP UP community who had established communal culture in their classroom and had a high level of student persistence.

Each section starts with a brief overview and then divides into subsets of pedagogical actions and strategies teachers are encouraged to use with students or consider while planning or interacting with parents or school administrators. Examples are included for each set of strategies to give teachers some ideas about how enacting these strategies may look or sound. These examples are under ***"You might say..."*** or ***"You might try..."*** headings.

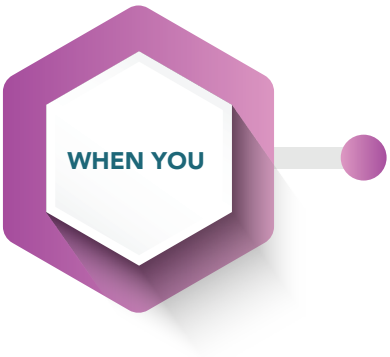
Additionally, several ***Teacher stories, Student stories,*** *and* ***Researcher stories*** are included. These are collected from various sources, including anecdotes from teachers in the STEP UP community, focus group interviews with teachers and/or students conducted by the STEP UP research team over the years, and excerpts from existing research literature. The examples are included to help the reader learn about two things: the impact of these actions on students' feeling of belonging and recognition, and possible challenges that teachers may have faced and ways of addressing them.

# Suggestions for using this document

Each classroom is a unique space, and creating a learning environment depends on various conditions that teachers must consider and adapt to. Therefore, it might not be possible to implement all these actions in every classroom. Moreover, if one is new to teaching or finds some (or all of these actions) different from their usual pedagogical practices, it might be overwhelming to consider them all at the same time.

Thus, we suggest ***starting small by focusing on one or two strategies*** and trying them out. Reflect on how they went, adjust accordingly, and try again. Gradually expand and try another strategy when you can.

To assist you in orienting yourself we added a space at the end of each section to write what strategies or actions you want to try. We recommend printing it and having it handy during your teaching.




# Support students individually

Encourage students individually, promoting self-confidence through explicit reinforcement of their abilities. Some students tend to have less self-confidence in physics [1-4].

## Recognize students

- Discuss with students (e.g., women) why they should consider physics as a path for themselves. Remind students of these messages regularly as students are unlikely to internalize it the first time.
- Direct students to less-recognized students for help. Position students as local experts both in small groups and the class as a whole.
- Encourage and acknowledge students' understanding/explanations even when they do not use technical language [5-6].
- Privately and publicly thank students who help create an environment for everyone to learn physics. Do this by recognizing students' efforts in creating a welcoming space (being supportive, friendly, engaging, and collaborative).

## Examples of recognizing 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 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."
- "Thank you for caring about your classmates and how they are doing in this class."
- "Thanks for celebrating others' accomplishments both inside and outside of class. It really makes this class gel."
- "I know you worked really hard this year. You may not have the grade you wanted, but I can tell you learned a lot of physics. I encourage you to take another physics class in college, and you'll start to see the ideas come together."
- "I know your lab group had results that didn't match the others, but as a data set they were very consistent with each other. That shows really good lab skills!"
- "I'd love to write a letter of recommendation for you; I think you're a strong student and would support you going forward in physics." [Refer to Resources for some suggestions about writing a letter of reference.]

**Student Stories**

"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."

***Note:*** *By sharing their thinking with others, this student was able to see more clearly how much they had actually learned.*

"I think I grew a lot as a problem solver in this class. You taught me to look at problems in a different way using more intuition rather than brute memorizing the steps to solve the problem. Because of the way you taught me, I believe I can look at problems differently and not just understand the math but understand the real life applications and how a system really works."

"Thank you for everything you've shown me over the past two years, and thank you for writing a letter of recommendation for my college applications. Your words got me into several colleges. I hope we can keep in touch! I will look for physics every day."

## Support new opportunities

- Direct students (particularly those with fewer opportunities) to clubs, camps, internships, or other programs not solely physics-oriented that would benefit them. These activities should not have significant barriers (e.g. cost, transportation, time requirement).
- Consider starting a STEP UP club at your school to give students a space to support each other and others in physics.
- Offer opportunities for less-recognized students to help/counsel other students outside of class about the opportunities available in physics. Peer-to-peer conversations can be very informative but may need assistance with logistics like advertisement, space, etc.

## Examples of supporting new opportunities

**You might say...**

- "I heard about a new summer program at a local university for students interested in quantum physics. Based on the questions you've asked in class, I think you might really love it. I'm happy to be your recommender if you choose to apply."
- "I loved the questions you were asking to connect our energy unit to climate change. Here are some books and articles you might enjoy, which push the conversation further."

**Teacher Stories**

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

> As the only physics teacher at my high school, my classroom after school would always be filled with students that needed extra assistance. After a few of these long sessions, I began to invite the students who were excelling in the class to come by after school and to help me tutor their classmates. The tutoring sessions grew and the students began enjoying coming to work on the problems together.

> I had just started at a new school, and it was clear that many (high-income) first-year students were starting to hire physics tutors. I asked the AP physics teachers to recommend students to become tutors, and I paired up first-year students with AP students.

**Student Stories**

> 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.

***Note:*** *Students may not be aware of programs they may qualify for, but if they are aware, they also may not apply if their chances to be accepted are low. Like practicing for job interviews and refining resumes, even unsuccessful program applications are beneficial for students to experience.*

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

***Note:*** *Introducing students to career options and modern research topics that relate to classroom content can help them see paths to physics they may not have considered to open more opportunities for their futures.*

## Strengthen student-teacher relationships

- Connect with students about what they value and are interested in.
- Get to know their culture and background. Context about your students will help to build trust and will inform your teaching as you customize content for your students' interests and life experiences.
- Provide students with academic feedback, reassurance that everyone can learn physics, and your own personal stories of struggle.
- Model perseverance after mistake-making and praise multiple versions of "success."
- Regularly solicit feedback from students on your teaching practice, and explicitly show students how you are reflecting on and incorporating their feedback into your practice moving forward.

### Examples of student-teacher relationship

**You might say...**

- "What kind of things are you interested in? What do you like to do for fun?"
- "Tell me something special about you."
- "What do other teachers or peers usually get wrong about you?"
- After introducing a new concept or example "What else does this make you think of?"
- "I'm glad you noticed I made a mistake on that assignment key! I've corrected it and made a note so I remember next time."

## Teacher Stories

> When I survey students at the beginning of the school year, I always ask if there's something they want me to know about who they are, which isn't obvious from a first encounter. Then I go back and revisit the survey after a month or so and make sure I encourage each student in a way that is reflective of what they've shared.

> I've begun attending my students' sports events. It's wonderful to see them thrive in a context outside of my class.

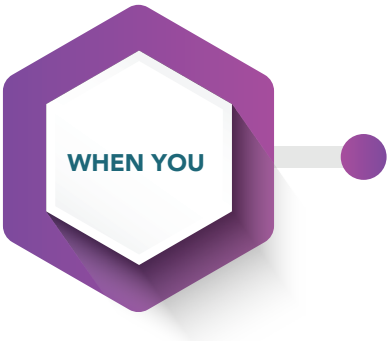
## Student Stories

> 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.

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

> I do feel [my teacher] understands that we have our own schedules. So sometimes we need that extra tutoring or question-answering just from her. So, I'm extremely thankful that she does have that demeanor. It honestly sparked my interest more in physics and also just gives me confidence in what I do.
>
> ***Note:*** *The student was referring to her teacher's availability during lunch hour to walk in and ask their questions.*

## Reflections & Plans




# Facilitate group work/labs

In group activities, all students should have an equal opportunity to assume active roles and contribute to group discussions. Students can be less engaged in group work due to unsupportive group dynamics and less prior experience with physics experimentation [7-13].

## Choose group members

- Ensure less-recognized students are taking active roles within small groups.
- Avoid isolating students in groups in which they cannot engage fully because of unsupportive or dominating classmates.

### Examples of choosing group members

**You might try...**

- Having randomized groups.
- Having assigned roles.
- Having guidelines for how to divide the work among the group members.
- With any grouping strategy, be clear with your students about your rationale and your expectations in order to increase student buy-in.

## Teacher Stories

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

> There was a difficult group dynamic. Just based on the student's personality, we've known each other now since her sophomore year, that was probably not a good fit for her. And she did not feel heard in that group. We talked afterward, and I apologized to her for the way the grouping went that day. We also had a conversation about her being able to use her voice in a respectful manner with them as well. So it was kind of a learning scenario for all involved.
>
> ***Note:*** *In the conversation with the researcher, a teacher reflected on how the grouping went in one of her classes where one of the students did not end up with the partners that the student could work successfully with and the teacher did not notice it in time to change her group. Later the teacher talked with the student acknowledging her difficulty in working with the group and how to change that for future activities.*

## Researcher Stories

> 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. [7]

> Groups composed 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. [10,16]

> [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. [11]

## Scaffold group collaboration

- Consider using group role descriptions and assigning group roles to facilitate involvement from all students. Ensure that roles are shared or rotated to encourage interdependence among students [14].
- Bolster confidence around lab equipment to ensure that all students can use the equipment regardless of their previous experience.
- Teach collaboration skills during or before initial group activities. By explicitly teaching such interpersonal skills, you are showing their value as equal to those of content based skills.
- Allow side conversations that let students connect as individuals [15].

## Examples of scaffolding group collaboration

**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."
- "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."
- "As a reminder, your best assets are the people sitting next to you."
- "When I was confused as a physics student, my classmates were also confused - and we figured it out together. That's what this is all about."
- "If you have a group member who hasn't yet [held the whiteboard marker, taken a photogate measurement, etc.] then it's now their turn to do it."

**Teacher Stories**

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

"I assess students on collaboration skills like communication and splitting the tasks because it shows that it matters as much as the content."

> I find that one way to keep a small number of students from dominating group discussion is to ask groups to create intermediate goals to meet as they progress toward the larger goal that I have set. This provides an opportunity for all group members to consider what needs to be done and how each member might participate. It is helpful to be able to pause an off-track discussion and ask the group for an update on the goals they have set for themselves.

> A lot of my labs are inquiry-based, so there may not actually be a lab write up. One way I keep track of collaboration in these labs is giving individual students different color markers for writing on the whiteboards. I know Gabby's purple and I know Patrick is red and then I can tell who's contributed when they'll write on the same whiteboard. I have evidence of who collected what data, who, you know, sketched out the scatter plot for this and applied some kind of best fit.

**Student Stories**

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

> For most of our labs are on a computer, like using a physics system like logger pro. And what usually ends up happening is someone's writing it down on a OneNote. Someone's writing it down on paper. Someone's doing the logger pro figuring that stuff out. So it's more of a collaborative effort in that you don't have to do all the writing, but you conceptually understand what's going on.

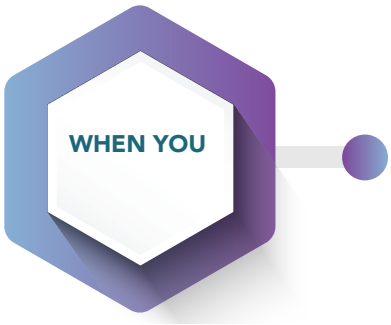
**Researcher Stories**

> Yet classrooms where side-talk is completely prohibited may fail to encourage feelings of group membership associated "with science." [15]

> Ask groups to set goals and evaluate progress toward their goals at multiple points within their collaboration [17].

***Note:*** *The example rubric (available in [18]) can be used to provide students with an outline of the behaviors needed for productive collaboration.*

## Reflections & Plans




# Address the whole class

Frame the expectations and environment to create a supportive community that is a safe space for engaging in learning physics. Together, the teacher, peers, resources, and others become supports for learning, rather than the teacher being the sole support.

## 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 [19].
- Allow students access to materials (lab equipment, office supplies, etc.) as the classroom is their shared learning space.
- Promote a growth mindset [20-22]. 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 such as the different Laser Interferometer Gravitational-wave Observatory (LIGO) facilities working together or the multinational efforts of the Large Hadron Collider (LHC).

## Examples of setting the tone

**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."
- "While the units in physics are all connected, the concepts often feel very different from each other when you're first learning them. If this unit seems a bit difficult now, it may make more sense when we get to the next unit. We'll keep reviewing and reflecting as we go along to see how it all fits together."
- "I like how you used that in everyday terms. Will you share it with the class?"

**Teacher Stories**

"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."

"When I had to change classrooms I had to change where materials were kept. There was such a positive change in student independence when the new locations for commonly used materials and lab equipment were more readily accessible!

"A student brought cupcakes to class once that came with cheap plastic rings. The whole class wore them together for about a week, me included. Over a year later one of those students came to visit and found that ring on my desk and was so excited I had kept it. Such a little, spontaneous thing brought them together.

"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.

**Student Stories**

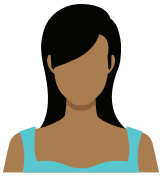
> .....he says that we're all capable of doing physics, but we've just got to put our mind to it...like he'll see us as a physics person.

> My teacher thinks that everyone in his class is a physics person and he's stated it multiple times. He doesn't like to say it just to make us feel good, I think he really does believe that everyone can use physics like in their daily lives."

## Distribute attention

- Ask less-recognized students questions in front of others when you know they have the right answer.
- Distribute your attention to all students during class discussions. Make sure all students can participate and that certain students don't dominate the discussion.
- Consider asking questions of a small group rather than an individual. Solicit a communal response from the group. This allows students who feel unsure to gain confidence in hearing similar responses from others [23].

### Examples of distributing attention



**Teacher Stories**

> 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."

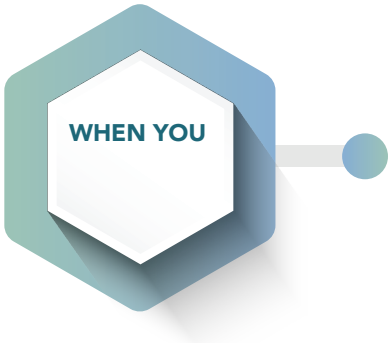
> I asked each table group to share something from their discussion that hadn't been shared yet. When they started to run out of new discussion points I switched to asking them for questions they might pose to the other groups based on what was shared. Each group was able to contribute that way."

**Researcher Stories**

> Research has shown that addressing groups of students (e.g., an entire table, 'think-pair-share', 'elbow partners' [24]), rather than individual students, increases engagement, builds a collaborative environment, and creates a greater perception of comfort and safety.

***Note:*** *You can refer students to the STEP UP Guidelines for Conduct During Discussions with reminders such as "Share air time equitably."*

## Reflections & Plans




# Plan and assess

Connect lessons to topics that resonate with students' values and experiences, and lower the anxiety related to grades. Certain students' interests are less likely to be incorporated in physics classes and they are more likely to feel anxious about good grades [1, 25-27].

## Plan lessons with context

- Incorporate physics examples from your students' lived experiences, particularly those related to helping people and society (e.g., medical/health, alternate energy, climate science).
- Connect physics to other disciplines (i.e. art, literature, math).
- Integrate students' interests into physics questions on assignments or assessments.
- Include opportunities for students to make decisions about the lesson/assessment.
- Provide academic feedback that can be immediately responsive to students' needs.
- Leverage local/community problems that need to be addressed within class activities/ projects.[28] (e.g., ending an energy unit with students writing letters to local policymakers about the effects of building a new proposed power plant).
- Consider these suggestions for community issues to address in class
    - Energy audits of the campus
    - Analyzing traffic patterns of school and surrounding area
    - Environmental audits (e.g., noise pollution, garbage run-off into drains)

***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 a job, or locally known physicists that you would like to highlight to your students.

## Examples of planning lessons with context

### Teacher Stories

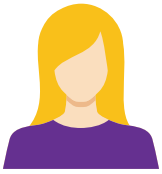
> I highlighted the existing examples in the textbooks that connect physics to other disciplines like medicine, climate change, communication, and music.

> 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.

> 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.

> Whenever I created a test for my physics class I would refer back to previous conversations in the class about student interests. My students would always laugh when they would find Squidward or Peppa Pig in the test problems. The students often told me they enjoyed the references, as they found it reduced their stress.

> In my beginning-of-year survey, I ask each student whether they're ok with showing up in a physics problem later in the year. Then, I use something about the students when they show up in physics problems. For example, a student who loves soccer was kicking a soccer ball in one problem. When the class started an inside joke about one student's struggle to unscrew the lid of a jar, I turned it into a torque problem.



### Student Stories

> 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 which were interesting for us.

> One day I was playing ultimate frisbee and it was very windy. Many people put a frisbee on their palm and then tilted it at an angle and it didn't fall, even when it was completely horizontal. I realized that it was the force of friction that was holding the frisbee up, and the wind increased the normal force, which made the force of friction increase and be able to counter the force of gravity.

> As a cellist, I knew sound was produced by pulling horse hair over a metal string, causing the string to vibrate. However, I didn't fully understand how or why this vibration created sound until your explanation. While I knew sound waves were tied to vibrations, your lecture helped me grasp the underlying physics in a much clearer way.

> A little something that physics brought back into my life that has recently brought me so much joy is figure skating. Learning the physics behind tucking arms in during spins (because as angular momentum remains constant and moment of inertia decreases, angular velocity increases by L = Iw) sent me and my cousin to the ice skating rink the following weekend, and we have been rather successfully practicing our spins every now and then as a newfound super fun and relaxing hobby.

> Through physics, I was able to learn how forces are distributed while skiing down a hill, and the initial velocity required to score a basketball shot. All of my favorite activities exist due to physics.

> In fact, just the other day I was wondering why it is easier to hold a standing position when compared to a squatting position. Through my understanding of physics and my research, I learned that in a standing position, the human body's center of gravity is aligned with out feet which means our muscles do not have to be as engaged to maintain this position. However, in a squatting position, humans' center of gravity shifts which forces your quadriceps and glutes to produce more force to keep you from falling down.

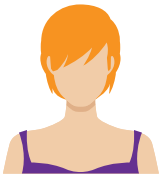
## Grade equitably

- Establish and share clear grading criteria with students that are consistent across units and the term.
- Publish the assessment/grading criteria and frequently refer to it for larger projects or assignments.
- Allow students multiple opportunities for high stakes assignments/tests.
- Consider carefully what assessments are most meaningful representations of students' understanding and adjust grades accordingly so that the majority of the grade is reflective of their physics knowledge.
- Incorporate opportunities for students to make decisions about assessments.

## Examples of grading equitably

**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."



## Teacher Stories

> 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."

> I'm careful grading student participation because I've realized there are many ways to participate and reasons why certain students may not participate like I am accustomed to seeing or doing myself. It is more important to find ways to engage them that they are comfortable with."

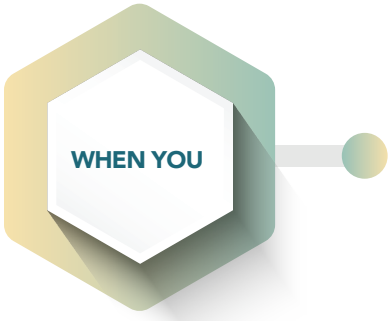
> I have used the mode or 'high-water mark' as a unit/quarter grade as a better representation of students' understanding rather than the average."

## Student Stories

> If we don't get it after a test, we'll go back and, like, 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.

> I am very very grateful for the extra time you spent after class, offering retakes and corrections. I can tell you put a lot of effort into teaching, doing more than you have to, and I (and the rest of your students probably) truly appreciate it.

## Reflections & Plans




# Engage broader community

Engage with colleagues, potential future students, student families and your school community to share more about your physics program and students. Reach out to local programs that provide less-recognized students (e.g., women) opportunities outside of the classroom related to physics. Some students who persist in physics often have fewer physics-related experiences and relationships [29-31].

## Other teachers

- Encourage teachers in other disciplines (math, biology, etc.) to recommend physics to students who have had less opportunities to consider physics (e.g., women).
- Offer to go to classes that often precede your physics class to give a short introduction to physics before registration for the next school year.

## Examples of interacting with other teachers

**You might say...**

- "Do you have a student who isn't taking physics next year, but you think they should be?"
- "Which student was it that took apart and fixed your hot plate? I wanted to make sure you suggested she take physics next year."
- "Can I come into your class during my prep period and give a quick talk about physics? From what you told me about that class they sound like they would love it next year!"
- "Would you mind sharing this slide about the Physics Club information event? They are helping to answer questions about what to expect for our different physics classes ahead of scheduling."

**Teacher Stories**

"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."

"The physics teachers at my school decided to personally go to all the chemistry classes to make sure students hear directly from us about how welcoming and supportive the physics team is, so that students, particularly those from backgrounds not typically seen in the field of physics, don't just assume physics isn't for them and decide not to take it at all.

## Talking with counselors

- Talk to school counselors to ensure they encourage less-recognized students (e.g., women) to take physics and consider physics careers. Share with them the skills that successful physics students have (e.g., good critical thinkers, strong collaboration skills, persistence, etc.) so that they can suggest good candidates.
- Provide school counselors with information about the breadth of jobs in physics, available from a variety of sources including Physicists Career Profiles and careers.aps.org.
- Analyze the demographics of your physics class and compare them to the rest of the school. Use the results to talk to your counselors about who is missing from your classes.

## Examples of talking with counselors

**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." [32]
- "Many students have to take physics in college and they do better in college physics if they have taken physics in high school." [33]

**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."

## Interacting with parents and family

- Share less-recognized students' successes and capabilities with their families. Showcase these successes/capabilities formally and informally (e.g., during family nights).
- Provide parents with information about job opportunities in physics, available from a variety of sources including careers.aps.org.
- Send updates to families about labs or projects from class and encourage them to talk to their children about what they learned.
- Go to family scheduling nights to answer questions about physics.
- Invite former students from less-recognized groups to share their experiences learning physics with families/students who might be hesitant about taking physics.

## Examples of interacting with parents and family

**You might say...**

- "Your daughter is an amazing physics student and your support of her means so much for her success."
- "Your student has been an amazing collaborator in physics. They are working well with their lab group to solve problems and doesn't mind if they start off on the wrong method. They'll regroup, talk with their peers and get right back at it!"
- "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."

**Teacher Stories**

"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."

"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."

"I went to the family scheduling night and set up a table for Physics and AP Physics. I made informational flyers and had copies of the books on the table and helped answer questions from future students and parents. Many left looking much more optimistic than they arrived!

"On back-to-school night I would get index cards from the 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.

# Activities outside school

- Look for events or field trips for your classes or clubs to attend at local labs, universities or businesses that relate to physics or STEM that would interest your students and relate to your content.
- Find out about outreach and community activities for student engagement and find ways for your school or classes to engage.
- Look for opportunities for your family support structures (boosters, PTA, etc.) to make connections with local businesses and organizations that can help support the school and your classroom.

## Examples of activities outside school

**You might say...**

- "How could we help other students find out why physics is awesome?"
- "What are some ways we can show the community how useful learning physics is?"

**Teacher Stories**

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

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

> One year we were able to take the advanced physics students to a local lab and they got a tour from one of the acting scientists. They loved seeing applications of what they were studying, like lasers, reflection, magnetic fields, etc.

**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.

## Reflections & Plans

## RESOURCES

- Avoiding gender bias in reference writing by the Commission of Status of Women at the University of Arizona
- Avoiding racial bias in letter of reference writing by Lachowiec Lab at Montana State University
- "Gender and ethnic bias in letters of recommendation" by American School Counselor Association.
- "4 Amazing Recommendation Letter Samples for Students" by Rebecca Safier at Prepscholar

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