



# Forum on Education

American Physical Society

## Spring 2020 Newsletter

Jennifer Docktor, Editor

### In This Issue:

#### From the Chair

*Gerald Feldman* ..... 2

#### Honor the Deserving! Nominate Them for Fellowship and Awards

*Laurie McNeil* ..... 3

#### Updates from the APS November 2019 Council Meeting

*Noah Finkelstein* ..... 4

#### Systemic Changes to Increase African Americans with Bachelor's Degrees in Physics and Astronomy

*Edmund Bertschinger* ..... 5

#### Grrr ... the Textbook Screwed Up Again!

*Carl E. Mungan* ..... 6

#### A National Need for all High School Students to Enroll in Algebra-Based Physics and Chemistry

*Stewart E. Brekke* ..... 8

#### Section on Teacher Preparation

*Alma Robinson* ..... 9

#### Mentoring Brigham Young University's Pre-Service Physics Teachers

*Duane Merrell* ..... 10

#### Professional Learning with Teacher Communities the Knowles Way

*Katey Shirey and Andrew Wild* ..... 11

#### Browsing the Journals

*Carl Mungan* ..... 13

#### Web Watch

*Carl Mungan* ..... 14

Executive Committee of the FED ..... 15

*Disclaimer—The articles and opinion pieces found in this issue of the APS Forum on Education Newsletter are not peer refereed and represent solely the views of the authors and not necessarily the views of the APS.*

## From the Chair

*Gerald Feldman, George Washington University*

Greetings from the Forum on Education (FEEd) as we begin another year, and a new decade! First of all, let me thank the members of the Executive Committee who just finished their terms at the end of 2019. Larry Cain has completed his service as Past Chair of FEEd, and with that, his 4-year tenure as an officer comes to an end. We will miss his wisdom and wit. Charles Henderson has been the Secretary/Treasurer for FEEd over the past 6 years (yes, he served two consecutive terms!), and we are grateful for his dedicated work in keeping the finances of our unit in good order. Richard Steinberg has been our Newsletter Editor over the past 3 years, and we appreciate how well he has kept our community and the FEEd membership informed. Other departing members of the Executive Committee include Chuhee Kwon and Beth Lindsey as Members-at-Large, and we offer our heartfelt thanks for their participation and their contributions.

In the chair line, I am happy to welcome Eric Brewster (Drexel University) as our new Vice Chair, and that means that all of us advance by one step. I have the privilege of succeeding Laurie McNeil (now Past Chair) as the Chair of FEEd, and Catherine Crouch moves up to Chair-Elect. Eric will be leading our Nominating Committee for this year, and Catherine will be heading the Program Committee. We also welcome two new Members-at-Large to the Executive Committee – Brad Conrad (AIP) and Idaykis Rodriguez (Florida International University). In the important role of Secretary/Treasurer, we are glad to have Laura Rios (Cal Poly San Luis Obispo) to take over for Charles. And finally, we look forward to working with Jennifer Docktor (University of Wisconsin – La Crosse) who inherited the communication duties from Richard as our Newsletter Editor last summer.

At the upcoming March and April APS meetings, we will have the distinction of presenting our Forum on Education honors to this year's award winners. In March (this year in Denver), we are pleased to recognize Enrique Galvez (Colgate University) for the 2020 Jonathan F. Reichert and Barbara Wolff-Reichert Award for Excellence in Advanced Laboratory Instruction. The award will be presented in a special invited session, and Enrique will be joined by four other invited speakers (Patricia Allen, Nathan Powers, Nicole Ackerman and Randall Tagg) in the session. In April (this year in DC), the 2020 Excellence in Physics Education Award will be presented to the Open Source Physics (OSP) Team, a well-known group that has made significant contributions to advancing computational physics in the curriculum. The 18-person team will be represented in a special invited session by Wolfgang Christian, Harvey Gould and Bruce Mason. In addition, we have organized a dedicated session of contributed talks to be given by other members of OSP on the day after the invited session. To view the citations for these two FEEd awards, please take a look at the following links on the APS website:

**Reichert Award** – [aps.org/programs/honors/prizes/lab.cfm](https://aps.org/programs/honors/prizes/lab.cfm)

**Excellence in Physics Education** – [aps.org/programs/honors/prizes/education.cfm](https://aps.org/programs/honors/prizes/education.cfm)

As is our tradition, FEEd is also the co-sponsor (and co-host) of a special Education and Diversity Reception at both the March and April APS meetings. It is during this reception that we have the chance to honor the new APS Fellows who have been nominated by the Forum on Education. This year we are very happy to recognize Wendy Adams (Colorado School of Mines) and Idalia Ramos (University of Puerto Rico at Humacao). If you are at the APS meeting, please try to stop by at the reception – it is a very nice occasion to meet people, eat and drink, congratulate our awardees, and generally share our mutual interests.

For those of you considering attending the March or April meetings, as if the events outlined above were not enough, we have also arranged a broad array of invited talk sessions covering physics teacher preparation, biology and physics, data science, nuclear science education, computational physics, equity and inclusion, and physics education research. Overall, there will be 5 invited sessions (and one contributed session) at the March meeting in Denver, and there will be 7 invited sessions (and 4 contributed sessions) at the April meeting in DC. So we hope you can join us!

Since 2019, we have been redoubling our efforts to increase the membership of the Forum on Education. This past year, through the efforts of Laurie McNeil and members of the Executive Committee, we have designed a new recruiting flyer that will be widely distributed. We would remind all of you that membership in FEEd is free (as it is for all APS forums), and we encourage you to mention this to your colleagues. The level of funding and the allocation of invited talk sessions at APS meetings is tied to the membership of APS units, and so FEEd does actually benefit in several tangible ways by increasing our forum membership.

In closing, let me invite all of you to contact me, or any other members of the FEEd Executive Committee, with your thoughts or ideas about how we are doing with regard to promoting physics education or suggestions/recommendations for other initiatives that you think we should be pursuing. Your input is valuable, and it can help guide our efforts in the coming year. We also welcome your nominations for the two FEEd awards mentioned above, as well as names of folks who would be deserving of consideration for APS Fellowship. Our community has many amazing people, and if someone in particular stands out in your mind, please take the opportunity to support their candidacy as an award winner or as an APS Fellow. And of course, we also hope that you will be on the lookout for promising nominees for FEEd Executive Committee positions – you can even think about nominating yourself!

For now, let's get on with this year's exciting activities – best of luck to us all!

## Honor the Deserving! Nominate Them for Fellowship and Awards

*Laurie McNeil, University of North Carolina at Chapel Hill, Past Chair of FED*

Having stepped down as Chair of the Forum on Education, I now serve as Past Chair and therefore as the Chair of the FED Fellowship Committee. I want to encourage you to nominate APS members who have made exceptional contributions to physics education for selection as **Fellows of the APS** under the aegis of the Forum on Education. Fellowship is a distinct honor signifying recognition by one's professional peers. Each year, no more than one half of one percent of the Society's membership (excluding student members) is recognized by their peers for elevation to this status. Nomination instructions can be found at the APS Honors website: [aps.org/programs/honors/index.cfm](https://aps.org/programs/honors/index.cfm). The deadline for Fellowship nominations is 1 June 2020. Please consider a diverse set of people to nominate, including women, members of underrepresented minority groups, and people at smaller institutions.

The FED Fellowship Committee typically receives only a small number of nominations, so please consider taking the time to prepare one. Nominations typically include a suggested citation, a nomination letter, two to four letters of support, a CV, and copies of the candidate's most important publications and reprints. The time spent to prepare a nomination is very worthwhile to those nominated, to the Forum and to APS. You can find a listing of all Fellows selected by the Forum at [aps.org/units/fed/fellowship/index.cfm?year=](https://aps.org/units/fed/fellowship/index.cfm?year=). You may be surprised to see that some persons whom you would expect to see on this list are not there—that is probably because nobody took the time to nominate them!

In addition to APS Fellowship, I also want to encourage you to think about submitting nominations for the APS education-related awards that are under FED's care, and which also receive only a small number of nominations. Specifically, please consider preparing a nomination for the **Excellence in Physics Education Award**, which honors a team or group of individuals (such as a collaboration) or, exceptionally, a single individual, who

have exhibited a sustained commitment to excellence in physics education. You can find more information at [aps.org/programs/honors/prizes/education.cfm](https://aps.org/programs/honors/prizes/education.cfm). The second award for which FED has responsibility is the **Jonathan F. Reichert and Barbara Wolff-Reichert Award for Excellence in Advanced Laboratory Instruction**. This award honors outstanding achievement in teaching, sustaining, and enhancing an advanced undergraduate laboratory course or courses. Its nomination procedure and past winners can be found at [aps.org/programs/honors/prizes/education.cfm](https://aps.org/programs/honors/prizes/education.cfm). For both awards the nomination deadline is 1 June 2020, the same as the Fellowship deadline.

The final education award for which I encourage you to submit a nomination is the **Committee on Education Award for Improving Undergraduate Physics Education**. APS's Committee on Education (COE), upon which three of the FED's officers sit, seeks to recognize excellence in undergraduate physics education and support best practices in education at the undergraduate level. The Committee accepts applications (i.e. self-nominations) from physics departments and/or undergraduate-serving programs in physics that have a significant impact on undergraduate physics students. This award offers the opportunity for a department or program to receive national recognition for its efforts on behalf of undergraduate education, which can be valuable both internally and externally. (My own department was so recognized in 2019.) More information can be found at [aps.org/programs/education/undergrad/faculty/award.cfm](https://aps.org/programs/education/undergrad/faculty/award.cfm) and the deadline is 15 June 2020.

Surely you know of colleagues or professional contacts whose efforts on behalf of physics education deserve recognition in the form of APS Fellowship or one of these awards. They won't be honored unless they are nominated, so please consider submitting a nomination. It will benefit the recipient, the Forum, the Society, and physics education at large. It is worth the effort!

## Updates from the APS November 2019 Council Meeting

*Noah Finkelstein, University of Colorado Boulder, Forum on Education Councilor*

### APS is seeking to continue to enhance and expand its meetings...

Specifically as per our strategic plan, “we will improve APS meetings to better respond to the emerging needs of the various communities involved, especially students and early-career scientists, and to provide optimal experiences for all participants.” We are creating more synergies between APS meetings and *Physical Review Journals*; embracing new technologies; exploring nontraditional ways of meeting. To these ends, APS has a new Meetings Director: Hunter Clemens. And **there is plenty of opportunity to provide feedback** on/ suggestions for new meetings structures: Annual Leadership meeting (see below), April and Mar meetings forums, at our April, Sept and Nov council meetings... As your councilor please feel free to send suggestions my way.

You may note a new national meeting. From our strategic plan: In order for members and others to appreciate the exciting discoveries in physics, notable developments in the physics community, and the many successful APS programs, we will explore new and better ways to communicate and interact more effectively. Specific actions will include: **There was a new Leadership Meeting Jan 28-31, 2020 in DC**, coupled with Congressional Visit Days Jan 28-29, and a Keynote from Nobel Laureate Steven Chu. Jan 30.

### Organizational Updates have been made:

APS has a variety new staff and reorganized two key departments. The Careers, Diversity, Education and Public Engagement programs have been consolidated into one department, now known as the **APS Programs Department headed by Monica Plisch**. We have organized an APS Project Development unit that includes a variety of large-scale initiatives, such as : STEP-UP, EP3, IGEN, and a Graduate Student Network. **APS Project Development is headed by Ted Hodapp**.

**Work from the newly formed Ethics Committee** is underway – establishing tools, website, and conducting survey(s).

**A Working group on Climate (of departments)** is underway. The traditional (and successful program of site visits hosted by CSWP and COM, running since 1990), is being updated include more voice and clearer expectations for visits. This committee welcomes input.

**A new Forum of Diversity and Inclusion** was discussed and voted on.

### Policy work continues:

Relevant updates to **POPA statements focus on education** (supporting physics teaching (k12), undergraduate research, and phys-

ics education research), and **ethics and values**. All of these are focused on updating wording and modernizing language.

**The Office of Government affairs** has been assessing and addressing the challenges in international graduate student study in US institutions. Outside of the top tier, physics departments across the U.S. have suffered an average *2-year decline in international applications of -22%*. To that end, OGA is working on public campaign and legislation to support international graduate student engagement, including dual intent visa (a way to stay after graduate school) and a pathway to obtaining a Green Card.

### Finally APS hosts an Innovation fund.

In its first year, 4 projects were funded:

- More Humane APS Meetings through Machine Learning (Tim Atherton, APS IT): Using machine learning and natural language processing to improve the meeting experience by identifying talks on subjects the attendee wants to see
- APS Network of Diversity Leaders (Ed Bertschinger, Geoff Potvin, *Monica Plisch*): Convene representatives from 30 physics departments to form a national network that develops and shares equity/diversity/inclusion practices and strategic plans
- Informing and Activating the U.S. Physics Community in Nuclear Threat Reduction (Stewart Prager, Steven Fetter, APS OGA): Build a team of individuals to travel and engage the physics community (information and advocacy) on nuclear threat reduction
- U.S.–Africa Initiative in Electronic Structure (Omololu Akin-Ojo, Richard Martin, Renata Wentzcovitch, *APS Int'l Affairs*): Organize two week-long workshops (Rwanda, Africa / Columbia Univ., New York) on electronic structure simulations – an area of research that is readily available to anyone with internet connectivity

Next years competition will be announced soon (or has been announced – keep an eye out) .. likely Mar 15 submission of ~1 page summary followed by invited proposals.

If you have items you wish to communicate to Council, please contact me.

Noah Finkelstein  
Council of Representatives  
FED, FOEP, GPER  
[noah.finkelstein@colorado.edu](mailto:noah.finkelstein@colorado.edu)

## Systemic Changes to Increase African Americans with Bachelor's Degrees in Physics and Astronomy

*Edmund Bertschinger, Massachusetts Institute of Technology*

Why have physics bachelor's degrees to African Americans not increased over the last 25 years like they have for other racial and ethnic groups? Why is physics lagging compared with nearly every other field of science and engineering? What steps can and should individual faculty, departments, and professional societies take to redress this inequity?

These questions are answered in a [major report](#) released in January, 2020 by the American Institute of Physics (AIP). The AIP National Task Force to Elevate African American Representation in Undergraduate Physics and Astronomy (TEAM-UP), a group of physicists, astronomers, and social scientists, supported by AIP Staff and other researchers, conducted a two-year research study. Using a national student survey, interviews conducted at a meeting of the National Society of Black Physicists, a survey of departments, site visits to five high-performing departments, and the physics education and relevant sociology research literatures, TEAM-UP prepared a comprehensive report with guidance to the physics and astronomy communities.

Almost twenty years ago, the [SPIN-UP report](#) helped reverse the decline in undergraduate physics degrees leading to a more than doubling of bachelor's degrees in the 2000s and beyond. Unfortunately, African Americans did not benefit from that rebound. The TEAM-UP report explains why. TEAM-UP gives a prescription for doubling the number of bachelor's degrees awarded to African Americans in the 2020s.

### The TEAM-UP report makes three simple points.

- First, African American undergraduates have the same drive, motivation, intellect, and capability to obtain physics and astronomy degrees as students of other races and ethnicities. Many African Americans who might otherwise pursue these fields are choosing majors that are perceived as being more supportive and/or rewarding, resulting in a loss of talent to physics and astronomy.
- Second, the degree gap is due to the lack of a supportive environment for African American students in many departments, and to the enormous financial challenges facing them. The financial challenges affect not only individual students, but also the programs that have consistently demonstrated the best practices in supporting their success.
- Third, solving these problems requires changing not only the way physicists train students, but how they *think* about training students. Specifically, we must be willing to learn from social scientists how to recognize and redress the systemic inequity that pervades physics and astronomy. The highest priority recommendations of the report are related to sense-

making and cultural change. Educational psychologist Seymour Sarason's warning to K-12 teachers and administrators<sup>1</sup> applies here: "To put it as succinctly as possible, if you want to change and improve the climate and outcomes of schooling both for students and teachers, there are features of the school culture that have to be changed, and if they are not changed, your well-intentioned efforts will be defeated."

TEAM-UP focused on the experience of physics and astronomy majors in college and took a strengths-based, rather than a deficit-based, approach to their experience. The report centers the experience of African American students because students themselves are the best experts on their experiences. The project team sought to determine the keys to successful completion of physics and astronomy bachelor's degrees, by focusing on African American students and the departments that are the most successful in graduating them.

Analysis of student surveys, interviews, site visits, the research literature, and expertise of task force members led to five key factors responsible for African American physics and astronomy student outcomes:

- Belonging
- Physics Identity
- Academic Support
- Personal Support
- Leadership and Structures

The report provides detailed support for the salience of each factor including student quotes. For example, the importance of physics identity (defined as how one sees oneself with respect to physics as a profession) is highlighted by a student who found their identity challenged:

"I've had two professors ask me why I'm in physics. They see how much I'm struggling. Like, 'Why are you still a physics major? Why do you want to do this?' Multiple times. It's like, 'Well, I'm here because this is what I want to do.' They're like, 'You're making your life difficult doing all this.' It's very discouraging when you hear [this]."

Another student gave a more positive account of how a professor provided academic support:

"There was one teacher that—really, honestly, I was going to give up on physics and she changed everything. I mean, she was so passionate about teaching, she knew a lot about

<sup>1</sup> Sarason, S. B. (1996). Revisiting the Culture of the School and the Problem of Change. *New York: Teachers College Press* (p. 340).



physics education and research... She just kept checking in on me, and she would make comments on my test like ‘This is not so good. Come see me.’ Then she would email me like, ‘Did you see my comment? Come see me.’”

An entire chapter of the report is devoted to a call to action with two urgent requests of the profession. One request is that the physics and astronomy communities address the enormous financial challenges facing African American students and the most successful departments in graduating them. Nationally, the median wealth of black families is one-tenth that of white families. Moreover, HBCUs have been particularly hard hit, as emphasized in a recent Issue Brief of the American Council on Education.<sup>2</sup> The TEAM-UP report calls for professional societies to raise a \$50 million fund whose investment income would go to support African American (and other minoritized) students with unmet financial need as well as departments needing help to implement the report’s recommendations.

The second urgent request is for physicists and astronomers to transform the norms, values, and culture of their fields. The authors have no illusions about the difficulty of this given the systemic ways in which exclusive cultures reproduce themselves. That is why so much of the report, along with its highest prior-

<sup>2</sup> Williams, K. L., & Davis, B. L. (2019). Public and Private Investments and Divestments in Historically Black Colleges and Universities. *Washington, DC: American Council on Education. (Issue Brief, [acenet.edu/news-room/Documents/public-and-private-investments-and-divestments-in-hbcus.pdf](https://acenet.edu/news-room/Documents/public-and-private-investments-and-divestments-in-hbcus.pdf))*

## Grrr ... the Textbook Screwed Up Again!

*Carl E. Mungan, United States Naval Academy, Annapolis MD*

No textbook is perfect.<sup>1</sup> Each one contains a range of errors, from minor printing typos all the way up to major conceptual mistakes.<sup>2-3</sup> In my experience, instructors respond to the presence of errors in books in different ways.

Some teachers feel strongly that the existence of errors is a big deal and that they are ethically bound to alert students to every one of them that occurs in the sections of the textbook they assign to students. Such instructors are also likely to grouse loudly about the errors to department textbook selection committees, either in reference to a particular title or more generally that “all books in the field are hopeless” and so they cannot support any of the books under consideration.<sup>4</sup> Personally I find this attitude to be unhelpful. There’s no need to throw the baby out with the bathwater and condemn the entirety of a text just because it has errors in it (unless the kind and number of errors is *really* egregious). Furthermore, while it can be helpful to selectively point out *some* errors to students to prevent them from succumbing to confusion or misconceptions, it takes a great deal of class time to do so. The

ity recommendations, are dedicated to sensemaking—a learning process of creating meaning around concepts and ideas through a variety of social inputs including dialogue with others—and to theories of change in higher education. Systemic change in higher education involves individuals, departments, and professional societies. The report lays out a multi-level map for change.

Can physicists change their thinking and learn to embrace culture? Yes! The five successful departments visited by TEAM-UP (Chicago State University, Georgia State University, Henderson State University, Morehouse College, and the University of Maryland College Park) each have multiple faculty who have done so and they are already practicing most of the report’s recommendations.

Moreover, physicists, more than most other professionals, relish the challenge of learning powerful new descriptions of nature. They did so a century ago with the development of quantum mechanics and more recently with the audacity to build LIGO. If physicists can conceptualize the electron as both wave and particle, they should be able to conceptualize their field as both producer of knowledge and product of culture. The TEAM-UP report provides guidance in developing this new vision. Insofar as it is an experimental report on the role of culture and society in physics, and it calls for a new way of thinking, the report may become the Davisson-Germer experiment of its time.

*Edmund Bertschinger is Professor of Physics and a faculty affiliate in the Program in Women’s and Gender Studies at MIT. With Mary James of Reed College, he was co-chair of the TEAM-UP task force.*

students first have to find the page and line in the book that the professor is objecting to; then an explanation has to be elaborated about exactly what’s wrong<sup>5</sup> and why; and finally a correction has to be provided and perhaps inserted into the text by all the students. If instructors do that often, they should not be surprised if students complain in their end-of-course evaluations that “the professor knowingly adopted a textbook riddled with errors.” Students are also likely to conclude that “if the book has these many issues then probably I cannot trust anything in it” and leave the course with the impression that physics is a confused and error-prone subject where even expert authors cannot figure things out.

Partly in reaction to these issues, some faculty respond by not adopting any course textbook at all (or ignoring the one the department may require all students in a given course to purchase). They instead develop and use only their own notes and slides. Now, there are many good reasons for writing one’s own material, but it would be the height of arrogance to assert that such self-prepared items are less error-prone<sup>6</sup> than a textbook from a reputable pub-

lisher that has been illustrated professionally and peer-reviewed<sup>7</sup> by a large number of proofreaders and class testers. In addition, I would strongly discourage most faculty from investing the substantial time it would take to prepare all of their own materials from scratch. Yes, by all means, develop some of your own supplements such as worksheets, and edit slides obtained from others to suit your classroom needs. But I do not recommend attempting to write a whole course worth of stuff entirely on your own!

I advocate for a middle ground—that of adopting a textbook, orienting one’s course syllabus around that book, and not getting bent out of shape by the errors in it. Fortunately this approach remains a common way that physics courses are taught today, and I believe most instructors are making a good choice in doing so. I have a few additional thoughts. Recommending (or worse, requiring) other textbooks beyond a single primary one is seldom fruitful. Books are expensive and it already is asking a lot of students to read one carefully. Perhaps in an upper-level honors seminar it might be appropriate to recommend some books that motivated students might want to add to their library, but not in every course. I also suggest the book should be an officially published one (self-publishing is probably okay) rather than a photocopied set of notes which lacks an index and cannot be cited. I occasionally had professors use such bound notes in classes when I was a student, and I must say I remember little from those notes and never find it easy to look back at them to find things. At the same time, while sticking to one text per course, I usually like to change books when I teach a course the next time. I understand that many instructors object that there is a substantial preparation time invested in reading a book, understanding its electronic homework system, preparing notes and slides that tie directly to the text, and the like. But on the other hand, there are many benefits to changing textbook. You become exposed to alternative ways of presenting a topic. You remember what it’s like for students who are trying to keep up with new text readings and homework assignments. But maybe most importantly, I think it’s less boring as a teacher to dive into a new book rather than rehashing all the stuff you did last time. Plus it models an approach of lifelong learning for students, demonstrating that we instructors humbly admit we need to keep fresh in a subject. Unless we teachers are reading a textbook daily, why should we expect students<sup>8</sup> to do so?

Finally, what can we educators do about textbook errors? First, as we read texts, we can make notes and corrections in the margins. Encourage students to do likewise. We can gradually improve our teaching, they can improve their learning, and we can all grow in our understanding. Such marginal notes need not be shared with anyone else to be beneficial. Second, one could develop activities and discussions specifically geared toward analyzing and correcting selected textbook errors in class.<sup>9</sup> Although I have not tried to make some kind of class game or competition out of it, that does seem a potentially fun way to teach students to maintain a discerning attitude toward texts. Third, faculty can write articles in educational journals that encourage alternative ways to think about and explore a topic. Disparaging letters to authors and publishers about errors in their books are less effective than positively

presenting new and better ways to teach things. Fourth, if a homework or example problem that is *directly* relevant to the course has a *significant* error in it, by all means it should be pointed out to students. I suggest doing so in an email (rather than wasting class time in oral remarks that will probably go in one ear and out the other) or, better yet, directly in the homework instructions. But do so concisely, clearly, and unapologetically. Avoid criticizing textbooks by name around students or colleagues—it just makes one look like an irascible complainer. Fifth, don’t become obsessed by a vain attempt to never say anything wrong in class. It leads to a cautious and boring teaching style in which every statement is qualified. Enjoy your chance to make bold pronouncements now and then! Remember that learning is a spiral process and that students are not going to be damaged by a few mistakes. They are unlikely to remember any of those details you belabored to get “just right.” In the end, just as you can identify errors by thoughtful reading, so students are not doomed to permanent ignorance by them, provided we don’t just hand them fish but instead teach them to fish.

*Carl Mungan is completing his 24th consecutive year of teaching undergraduate physics courses. Although he enjoys thinking about, reading, and writing (short) pieces related to physics education, he has not to date seriously entertained the notion of writing a textbook. He believes that that job is reserved for educators who are specially gifted and dedicated to doing so and it should not be the ambition of most physics faculty.*

- [1] Textbooks are not going away any time soon, for reasons discussed at [theconversation.com/despite-predictions-of-their-demise-college-textbooks-arent-going-away-99931](http://theconversation.com/despite-predictions-of-their-demise-college-textbooks-arent-going-away-99931).
- [2] J.W. Warren, “Textbook errors,” *Phys. Educ.* **1**, 207 (1966).
- [3] J Slisko, “Repeated errors in physics textbooks: What do they say about the culture of teaching?” in *Physics Community & Cooperation: Selected Contributions from the GIREP-EPEC & PHEC 2009 International Conference*, edited by D. Raine, C. Hurkett, and L. Rogers (Lulu, 2011), Vol. 2, p. 31. Online at [academia.edu/2984508/REPEATED\\_ERRORS\\_IN\\_PHYSICS\\_TEXTBOOKS\\_WHAT\\_DO THEY SAY ABOUT THE CULTURE OF TEACHING](http://academia.edu/2984508/REPEATED_ERRORS_IN_PHYSICS_TEXTBOOKS_WHAT_DO THEY SAY ABOUT THE CULTURE OF TEACHING).
- [4] “That’s the way all the books were: They said things that were useless, mixed-up, ambiguous, confusing, and partially incorrect. How anybody can learn science from these books, I don’t know, because it’s not science.” R.P. Feynman, “Judging Books by Their Covers” in *Surely You’re Joking, My Feynman!* (Bantam Books, NY, 1985), p. 271.
- [5] I am reminded of the story that one does not learn to identify counterfeit money by studying forgeries. After all, there is an infinite variety of possible errors and weaknesses in fake bills. Instead, one should become so familiar with real money that one begins to intuitively sense an error because of its *contrast*. In the classroom, it is better to

spend student's time in learning what is helpful and correct than to wallow unduly in the mud of misconceptions and errors, as suggested at [phys-1.org/archives/2011/9\\_2011/msg00232.html](http://phys-1.org/archives/2011/9_2011/msg00232.html).

- [6] B. Chapman, "Causes for concern," *Phys. World* **4**, 21 (1991).
- [7] Some faculty argue that such peer review makes textbooks worse not better, because it forces them to hew to conventional explanations and commonly accepted viewpoints. I do not fully agree. Without a common corpus we would eventually descend into chaos in the curriculum, where what one teacher asserts in a course might be explicitly contradicted by what another instructor professes in a follow-on course. I grant that textbooks copy ideas and figures from each other, and thus some weak styles of presentation and even flat-out misconceptions get propagated. Yet I maintain faith that the community of physics educators

will eventually iron out these points in future books. The evolution in textbook writing may be slow and even exhibit occasional regressions, but on the whole I think we can all learn a lot by reading books and pedagogical articles rather than dismissing them as "same old, same old." For other points of view, read C. Bohren, "Physics textbook writing: Medieval, monastic mimicry," *APS Forum on Education Newsletter* (Summer 2008), p. 5 and two more letters entitled "Textbook errors" in *Phys. Educ.* **2**, 171 (1967) and **4**, 60 (1969).

- [8] See [wired.com/story/why-you-should-read-that-whole-text-book-right-now](http://wired.com/story/why-you-should-read-that-whole-text-book-right-now) for some student pointers about reading a physics textbook.
- [9] J.M. Campanario, "Using textbook errors to teach physics: Examples of specific activities," *Eur. J. Phys.* **27**, 975 (2006).

## A National Need for all High School Students to Enroll in Algebra-Based Physics and Chemistry

*Stewart E. Brekke, retired high school teacher from Chicago Public Schools*

I taught algebra-based physics and chemistry for numerous years at Paul Robeson High School on the South Side of Chicago. Unfortunately, many high schools in America only allow the upper 30-40% of students take mathematically based physics. I have found in retirement in Du Page county that all kinds of college graduates, many psychology, business, and especially humanities and social studies majors as well as accounting majors, working as baristas and cashiers at McDonalds and Starbucks for about \$10.00/hr. As some are aware there are immediate openings for teachers everywhere in America, especially those certified mathematics, physics, chemistry, and special education. Also, there are immediate employment opportunities for medical personnel such as registered nurses, surgical technicians and laboratory techs. All of these STEM and medical type jobs require a strong background in science and mathematics. These jobs pay a starting salary about \$50,000/yr, and registered nurses can make as much as \$100,000/yr after a few years.

It is essential that every high school student take algebra-based physics and chemistry and at least three years of high school mathematics to provide the sound foundations for STEM and medical type career programs in higher education. For those high school students weak in mathematics, some kind of algebra remediation can be employed as the physics and chemistry formulas are taught. There are virtually no living wage jobs for those students in fields other than STEM or medicine, all of which require the problem solving skills foundations learned in high school mathematics based physics and chemistry. In the Chicago Public Schools, it was required that every student take at least 4 years

of science including physics and chemistry. However, often the Chicago students were not given the algebra-based physics and chemistry. This type of physics and chemistry is worthless to prepare any student for success in a STEM or medical type career program in higher education and almost any other type of college career training will result in a lifetime low income situation. Algebra-based physics and chemistry, with mathematics remediation if needed, always must be given to all of our students, average level or higher.

Also, I was especially fortunate to have taught physics and chemistry at Robeson High School. The school was required to give four years of mathematics and science to all students to comply with an integration consent decree with the Federal government, because Robeson could not be properly integrated due to its location in the city. I gave my physics students, Black inner city students often weak in mathematics, the standard algebra based physics course, with mathematics help if needed, and was very successful often passing about 80% of my students. I gave a lot of help to the students to help them solve the mathematics type problems. When I later found out that most students in America are not allowed to take a mathematically based high school physics or chemistry course, I wrote articles on how our Chicago students often passed a standard algebra based physics and chemistry course [1,2]. Essentially, our Black students at Robeson HS and at Carver HS, average students and above average students, many with weakness in elementary arithmetic and basic algebra, were successful in passing high school algebra based physics and chemistry. This shows all of America that all kinds of average and



above average level can do an algebra based physics and chemistry course, with help if needed. These often under-estimated students went on to receive bachelor's degrees in Chemical Science from Chicago State University, possibly as many as 20 Black Carver HS students. There were other Carver HS students that received degrees in other subjects.

Therefore, it is essential that every American student, of average or higher ability, be allowed and even encouraged to enroll in algebra-based high school physics and chemistry and at least third year advanced mathematics, simply to provide every American student with an equal opportunity to obtain the problem solving foundations for a living wage career in STEM or medical fields. For capable, but mathematically deficient students, extra help involving mathematics remediation such as extra drills and practices, for example, must be provided to ensure competency in physics and chemistry problem solving, scientific notation, trigonometry etc. In America today often only the upper 30-40% of a high school are allowed to take algebra based physics and often algebra based chemistry. This unnecessary exclusion of many otherwise capable students may result in a lifetime of low wage jobs for a student and his or her future family. We educators must try to include as many capable students as possible, offering extra help if needed, in algebra based high school physics and chemistry as

well as third and even fourth year high school advanced mathematics to provide a foundation for the many American capable students to be successful in higher education STEM and medical type career programs and a probable good life for him/her and his possible future family. To do otherwise is blatant discrimination against many capable American students often happening right now in many public high schools across the country.

*Stewart E Brekke ([Stewabruk@aol.com](mailto:Stewabruk@aol.com)) is a retired Chicago Public Schools teacher certified in high school physics, chemistry, and mathematics. He holds a PhD from the International University for Graduate Studies in Arts and Sciences and is nationally and locally published.*

- [1] Brekke, Stewart E. (2002). Achieving Mathematical Physics for All High School Students. *APS News ViewPoint*, 11(6). [aps.org/publications/apsnews/200206/viewpoinr.cfm](http://aps.org/publications/apsnews/200206/viewpoinr.cfm)
- [2] Brekke, Stewart E. (2010). How to increase the number of physics majors. *APS Forum on Education Newsletter*, Spring 2010 pp. 6-7. [aps.org/units/fed/newsletters/spring2010/brekke.cfm](http://aps.org/units/fed/newsletters/spring2010/brekke.cfm)



### *Alma Robinson, Virginia Tech*

Because new physics teachers can often feel isolated and unsupported, PhysTEC highlights new teacher induction and mentoring as one of its [key components](#) of successful physics teacher preparation programs. I hope this issue of the Teacher Preparation Section will help you reflect on your own mentoring practices and provide new ideas on how you can support your students and connect them to professional learning communities.

The Knowles Teaching Fellows Program supports new high school science and math teachers across the United States. Co-authors Andrew Wild and Katey Shirey became Knowles Teaching

Fellows when they began teaching high school physics in 2006. Here, they reflect on the Knowles' scaffolded inquiry methods for improving instruction, growing community, and developing leadership skills as new teachers.

Brigham Young University is one of the most prolific physics teacher preparation programs in the nation. Despite their large numbers, they have been able to provide mentoring support to both their current students and their local alumni. Through highlighting one of their current students, Liz Finlayson, Duane Merrill describes how.

## Mentoring Brigham Young University's Pre-Service Physics Teachers

*Duane Merrell, Brigham Young University*

### Liz Finlayson

It was in Ms. Heather Riet's physics class at Lone Peak High School in Utah that Elizabeth "Liz" Finlayson decided to become a physics teacher. In the following year, Liz solidified her passion for teaching when she served as a teaching assistant in Ms. Riet's physics class. When Liz applied for colleges, she actively sought out physics teaching programs and soon followed in her teacher's footsteps – like Ms. Riet, she will be graduating from Brigham Young University's (BYU) physics teaching program, and she will start her student teaching during the 2020 Winter Semester. In this article, I will highlight the mentoring and support available to Liz as part of our physics teaching program.



*Liz Finlayson*

Liz entered BYU with ideas of how she wanted to teach physics, and as she's gone through her own courses, she has actively reflected on the teaching methods that she's experienced. To help her turn her desire to teach into a reality, our program has given her consistent mentoring and support, including the use of the physical science teaching labs. Whether she needed a lab for studying, equipment use, peer support, course work, or just to receive guidance from a physics professor, Liz has always known that she could find support in the lab space that was created for physics teaching students. Now, as senior, she has been able to use this space to also support others. Lauren, a nervous young freshman student who fell in love with physics in high school and wanted to become a physics teacher, was having some concerns about pursuing the physics teaching degree. She found Liz in the lab, and with Liz's help, Lauren was able to regain her footing and love of teaching physics.

The big question and challenge that we give all of our preservice teachers is: *When you teach physics, will your students want to take more physics?* The mentoring that Liz receives is geared toward this question. When she teaches physics, will the efforts she makes excite students to want to learn more physics, or will they swear to never take another physics class? Is there a method of teaching a high school physics class that will encourage the students to pursue more physics?

We think the key to this is to prepare our preservice teachers with labs and activities that will engage students in physics at a level that is not just computational, but also conceptual. In order to do this, our undergraduate courses for our physics teaching students include Introduction to teaching physical science, Methods of teaching physical science, Physics by Inquiry—Motion through Energy, and Physics by Inquiry—Electricity. In all, the students

take 14 semester hours that specifically focus on methods for teaching physics concepts in a way that helps students develop a conceptual understanding of physics alongside their computational problem solving skills. In addition, we prepare boxes of labs and activities that align with these curricula so that when our preservice teachers begin their student teaching, they have access to classroom sets of materials and the ability to use them. You can see the list of activities that are available to the students using this link: [tinyurl.com/yfrfm8c](https://tinyurl.com/yfrfm8c)

During Liz's upcoming student teaching, she will be supported with weekly mentoring from two university mentors, adding up to over 20 visits during the semester. We also use these visits to deliver and pick up the aforementioned lab and activity materials.

When Liz leaves BYU, we hope that she feels welcome to contact us for support at any time. We try to keep track of all of our graduates and support them when needed, but our real goal is to prepare them with a fully stocked quiver of knowledge about physics teaching. Often times, it seems that teacher preparation only provides a teacher with the quiver, the philosophy of teaching, and while we hope to do that well, we also want our young teachers to be able to reach back into their quiver and find an arrow – a lab, an activity, or a lesson – that will keep the students immersed in learning physics in an engaging and exciting environment of conceptual understanding and problem solving.

Come April 2020, Liz will be looking for her first classroom of physics students. We don't know where that will be, but we are hopeful that she will find a district that values physics teaching and has a vibrant physics teaching community. If she stays in the Provo, Utah area, we will continue to support her, not because we are tasked with the induction of new teachers, but because we believe in these students and want them to succeed. In fact, Liz will still have access to the lab kits and equipment when our current students don't need them. Our local alumni can also become members of a professional learning community supported by the Center for the Improvement of Teacher Education & Schooling (CITIES), a BYU-public school partnership. Of course, there are also other local and national organizations that can support new teachers. Liz has already attended a Utah Science Teachers Association (UtSTA) conference, and she can continue to grow her physics teacher community through the American Association of Physics Teachers (AAPT) and the Physics Teaching Resource Agents (PTRA).

*Duane Merrell is a faculty member in the Department of Physics at Brigham Young University, responsible for physical science teaching students at BYU who are earning Earth Space Science, Chemistry, Physics, and Physical Science degrees.*

## Professional Learning with Teacher Communities the Knowles Way

*Katey Shirey, Knowles Teacher Initiative*

*Andrew Wild, Winooski Middle High School and Woodrow Wilson Graduate School of Teaching and Learning*

If teaching were like sports, then team practice would be crucial, even if the teaching event was individual. Research shows that like athletics, teacher community activity leads to teacher learning,<sup>1</sup> and yet, some studies have found that teacher learning-community time often focuses on social community building rather than on improving practice.<sup>2</sup> Nationally, new teachers (zero to five years) are more likely to agree that other teachers contribute to their classroom success,<sup>3</sup> yet typical school structures limit teacher-to-teacher access.<sup>4</sup> The [Knowles Teaching Fellows Program](#) helps new teachers build community and advance instructional practices.<sup>5</sup> After practicing cycles of instructional inquiry with other Fellows, we were encouraged to start inquiry groups back home to further our local instructional development and grow our professional communities and leadership capacities.

Expert teacher educators at Knowles (Program Officers for Teacher Development, or “TDs”) taught us a method of instructional inquiry that harkens back to a legacy of examining student work.<sup>6</sup> We focused on deep questions about our teaching, such as, “What is the relationship between tasks and talk in my classroom?” In year-long inquiry cycles, we investigated these questions by collecting student data (verbal comments, written work, etc.) and analyzed it using prescribed discussion protocols. Working in teams meant that we had to expose our teaching methods and student outcomes in vulnerable ways. Leaning on the protocols to stimulate conversation, the TDs created an environment where we felt happily obligated to bring in our work and receive feedback. Taking risks together relied on us having built some trust, and in turn, taking risks helped increase our interpersonal confidence, ensuring that it would become easier for us to share in the future.

During this work, we were encouraged to seek evidence of student thinking and to try to reframe whatever deficit we might see

<sup>1</sup> Grossman, P., Wineburg, S., & Woolworth, S. (2001). *Toward a theory of teacher community*. *The Teachers College Record*, **103**, 942-1012. ([PDF](#))

<sup>2</sup> Wood, Diane. (2007). *Teachers' learning communities: Catalyst for change or a new infrastructure for the status quo?*. *The Teachers College Record*. **109**. 699-739

<sup>3</sup> Metropolitan Life Insurance Company. (2010). *The MetLife survey of the American teacher: Collaborating for student success. Place of publication not identified: Distributed by ERIC Clearinghouse. (2010). Retrieved December 19, 2019, from ERIC. (PDF)*

<sup>4</sup> Little, Judith Warren. “*Inside teacher community: Representations of classroom practice.*” *The Teachers College Record* **105.6** (2003): 913-945. ([PDF](#))

<sup>5</sup> Galosy, J. A., Gillespie, N. M., & Banilower, E. R. (2018). *Sowing the Seeds of Change: Supporting Teachers to Be Agents of Social Capital Development. In Networked By Design (pp. 111-130). Routledge.*

<sup>6</sup> Little, J. W., Gearhart, M., Curry, M., & Kafka, J. (2003). *Looking at student work for teacher learning, teacher community, and school reform*. *Phi delta kappan*, **85**(3), 184-192. ([PDF](#))

on the surface in asset terms. Were students struggling with solving kinematics problems because of algebra issues? Or was the math fine, but the frame of reference confused? How could we tell the difference? As beginning teachers who were sometimes self-conscious, the focus on student data helped us get out of our heads and focus on what matters most—impacting student learning. We turned the student work over and over, looking at it as if it were physical data, seeking patterns or anomalies. The protocols slowed us down and helped us see what others were seeing as well. Valuing multiple interpretations of student data became a habit, and it helped us develop a deeper curiosity for our peers’ input. In turn, this work refined our feedback to teachers and students, helped us reconsider our assessments, and refined our expectations for our students.

In a way, it was the same thing we Knowles Fellows were doing with one another. Whatever we internally thought about these other new Fellows, that they might not have useful subject expertise, or might not understand our unique contexts, the protocols helped us set aside our initial judgments and see our peers’ strengths. Listening and sharing, we heard ambitious goals and novel ideas. Working in this way, we realized that these Fellows, though novice, could offer us a lot, and we found ourselves pushing them as well! The work helped us understand one another’s assets and contributed to our feelings of community strength and connection. Plus, we were making real instructional realizations and changes.

Knowles TDs not only led this process for us, but they meta-cognitively broke it down; they taught us how to describe and structure the process and encouraged us to suggest it to our peers. Comfortable in the inquiry, if we invited colleagues to do this work with us, then we would simultaneously develop our teacher-leader stances. Because of my confidence in the process, I (Katey) led a group of local physics teachers to investigate student sense-making which is explanation based on experimental evidence.<sup>7</sup>

Through Knowles, I learned that engaging in inquiry work with peers was useful in helping me tackle difficult instructional questions. Back home, I had a dilemma about student sense-making from experimental evidence. I noticed students speeding through the post-lab work I assigned them and making incorrect or incomplete conclusions. It was hard for me to tell if they had really understood the lab but just made simple errors, or if they didn’t know how to make sense of the phenomenon and so couldn’t

<sup>7</sup> Zangori, L., Forbes, C., & Biggers, M. (2013). *Fostering student sense making in elementary science learning environments: Elementary teachers' use of science curriculum materials to promote explanation construction*. *Journal of Research in Science Teaching*, **50**(8), 989-1017. doi:10.1002/tea.21104 ([PDF](#))

make an appropriate claim from the evidence they collected in the lab.

I wrote a PTA grant for substitutes so I could observe and meet with other local physics teachers to investigate student reasoning. We used discussion protocols to focus on student data and looked for turning points in sense-making, such as where inference moved toward defensible conclusions. We shared strategies for cultivating conclusions from data (Five Practices,<sup>8</sup> whiteboard meetings, etc.) and agreed that we needed to recognize well-reasoned arguments more explicitly. We decided to make a big, public celebration of these moments of clarity. Through this work, I got to know my district colleagues better, but I was more excited to have articulated a collective need and to have explored strategies that could help us all.

The purpose of Knowles helping Fellows learn instructional inquiry is to provide time and space for Fellows to work together to improve their instruction and to create community among colleagues. Fellows learn the practices of collective inquiry explicitly and receive support to bring inquiry to their local contexts. Fellows are empowered to act concretely to develop their leadership capacity and more deeply incorporate themselves in their local networks as well as utilizing peer collaboration to improve practice. Four hundred Knowles Fellows are building communi-

---

<sup>8</sup> Cartier, J., Smith, M., Stein, M., & Ross, D. (2013). 5 practices for orchestrating productive task-based discussions in science. Reston, Va.: National Council of Teachers of Mathematics.

ties with each other and in their schools by using learning-focused collaborative inquiry and sending ripples through the educational system.

Physics graduates who will be either first or second year teachers in the Fall of 2021 are encouraged to apply for the Fellowship. Applications for the 2021 cohort will open in May 2020. More information about the Fellowship and its application can be found [here](#).

*Andrew Wild taught high school conceptual physics and chemistry in the San Francisco Bay Area prior to earning his PhD in science education at Stanford. Currently he is the Community-Based Learning Coordinator for Winooski Middle High School in Vermont and the Chair of the Graduate Learning Community for the Woodrow Wilson Graduate School of Teaching and Learning, developed in collaboration with MIT.*

*Katey Shirey's work focuses on the intersection of art, science, and education. Katey earned Bachelor's degrees in sculpture and physics and her master's in science education at the University of Virginia before teaching high school physics in Arlington, VA. Since earning her PhD in science education at the University of Maryland, Katey has worked for the Knowles Teacher Initiative to support teachers in finding deeper connections among science, math, engineering, technology, and art to enrich and improve student learning.*



## Browsing the Journals

Carl Mungan, *United States Naval Academy*, [mungan@usna.edu](mailto:mungan@usna.edu)

- Ricardo Kam reviews four introductory explanations about why quantum mechanics requires complex numbers on page 39 of the January 2020 issue of the *American Journal of Physics* ([aapt.scitation.org/journal/ajp](http://aapt.scitation.org/journal/ajp)). An article on page 51 of the same issue explores different methods of deriving the relationship between the isobaric and isochoric heat capacities.
- Jean Farago analyzes an interesting calculus of variation problem from a science fiction story in article 065003 of the November 2019 issue of the *European Journal of Physics*. It involves traversing a set of parallel walkways moving at progressively increasing speeds. The Leidenfrost effect is studied by video analysis in article 065101 of the same issue. Article 065003 in the November 2019 issue of *Physics Education* presents three apparently paradoxical problems involving masses connected by springs. Articles 065008 and 065009 in the same issue respectively examine scissors cutting at superluminal speeds and road mirages. John Campbell presents some interesting historical commentary in article 066501 about Rutherford scattering. Articles 015006 and 015007 in the January 2020 issue discuss the evolution in the geometry of solar cells over time and the trapping of dye in a vortex above a magnetic stirrer in a liquid. Ivanov and Nikolov challenge the conventional atmospheric pressure explanation for the breaking of a struck stick projecting beyond the edge of a table when the portion on the table is covered with a sheet of newspaper in article 015014. Both journals can be accessed online starting at [iopscience.iop.org/journalList](http://iopscience.iop.org/journalList).
- Bhattacharyya and Dawlaty discuss the connection between the thermodynamic and statistical mechanics definitions of entropy on page 2208 of the October 2019 issue of the *Journal of Chemical Education*. In a letter on page 2352 of the same issue, Jerry Bell argues that heating a plastic cube filled with carbon dioxide by a sunlamp to demonstrate the atmospheric greenhouse effect is flawed. (Also see the follow-up reply and correction articles.) An article on page 2553 of the November issue discusses the formation of interference rings by heating when a laser is incident on a dye-doped liquid or polymer. The journal archives are at [pubs.acs.org/loi/jceda8](http://pubs.acs.org/loi/jceda8).
- Article 1305 in the March 2019 issue of the *Latin-American Journal of Physics Education* ([lajpe.org/](http://lajpe.org/)) analyzes the demo of two stacked balls dropped from a height when the two balls are initially obliquely aligned with each other.
- The November 2019 issue of *Resonance* has an article on page 1235 discussing Bertrand's theorem, which states that only the Kepler and simple harmonic oscillator potentials give rise to closed orbits for central forces. The December issue has articles on pages 1439 and 1445 that respectively consider how to experimentally measure Fermi energies and the math problem of burning ropes to measure time intervals. These articles can be freely accessed at [ias.ac.in/listing/issues/reso](http://ias.ac.in/listing/issues/reso).
- Article 1950014 in the Dec. 2019 issue of *The Physics Educator* presents logic gate circuits constructed using relays and light bulbs. Article 1920009 in the same issue explores deficiencies in typical explanations of why electric power is transmitted across long-distance cables at high voltages. The journal homepage is at [worldscientific.com/worldscinet/tpe](http://worldscientific.com/worldscinet/tpe).



## Web Watch

*Carl Mungan, United States Naval Academy, [mungan@usna.edu](mailto:mungan@usna.edu)*

- Simulations for teaching introductory physics at the high school level are available at [thephysicsaviary.com/](http://thephysicsaviary.com/).
- ClassPad is a versatile online algebraic and graphical calculator at [classpad.net/](http://classpad.net/).
- A beautiful photographic tour of seven rocket launch sites around the world is at [story-maps.esri.com/stories/2019/spaceports/](http://story-maps.esri.com/stories/2019/spaceports/).
- If you enjoy science fiction, you may wish to check out the list of recommended novels at [sfcenter.ku.edu/sfib.htm](http://sfcenter.ku.edu/sfib.htm).
- A webpage devoted to helping women in STEM is [edubirdie.com/blog/women-in-stem](http://edubirdie.com/blog/women-in-stem) including scholarships, job information, and other resources.
- Elementary school lessons from the American Chemical Society about everyday science are online at [acs.org/content/acs/en/education/resources/k-8/inquiryinaction.html](http://acs.org/content/acs/en/education/resources/k-8/inquiryinaction.html).
- A library of free, elegantly typeset e-books (mostly classic novels) can be perused at [standardebooks.org/ebooks/](http://standardebooks.org/ebooks/).
- A website devoted to geological education is [onegeology.org/extra/home.html](http://onegeology.org/extra/home.html).
- *Sea and Sky's Astronomy Reference Guide* is online at [seasky.org/astronomy/astronomy.html](http://seasky.org/astronomy/astronomy.html).
- On the slightly edgy end of the political spectrum, a provocative site about the role of algorithms in society is [interactive.aljazeera.com/aje/2019/hail-algorithms/index.html](http://interactive.aljazeera.com/aje/2019/hail-algorithms/index.html) by Al Jazeera.
- SUNY has an electronic textbook of algebra-based physics problems based on movies, comics, and video games at [textbooks.open-suny.org/physics-problems-for-nerds/](http://textbooks.open-suny.org/physics-problems-for-nerds/).
- UMD has a site devoted to data analytics for STEM teaching at [onlinebusiness.umd.edu/blog/data-analytics-tools-for-stem-teachers-students/](http://onlinebusiness.umd.edu/blog/data-analytics-tools-for-stem-teachers-students/).
- The link expander at [checkshorturl.com/](http://checkshorturl.com/) will retrieve the original URL from a shortened link so that you can verify it is safe before you click on it.
- *The Journal of Stories in Science* at [storiesinscience.org/](http://storiesinscience.org/) is devoted to using human stories to engage with science and technology.
- Navy researchers have demonstrated a laser power transmission system. Some of the details are at [gophotonics.com/news/details/1937-researchers-use-a-laser-beam-system-to-power-drones-remotely](http://gophotonics.com/news/details/1937-researchers-use-a-laser-beam-system-to-power-drones-remotely).
- A databank of physics problems and solutions is online at [physexams.com/exam](http://physexams.com/exam).



## Executive Committee of the FED

**Chair:**

Gerald Feldman  
(01/20 - 12/20)  
George Washington University

**Chair-Elect:**

Catherine Hirshfeld Crouch  
(01/20 - 12/20)  
Swarthmore College

**Vice-Chair:**

Eric Brewe  
(01/20 - 12/20)  
Drexel University

**Past-Chair:**

Laurie E McNeil  
(01/20 - 12/20)  
University of North Carolina - Chapel Hill

**Secretary/Treasurer:**

Laura Rios  
(01/20 - 12/22)

**Councillor:**

Noah Finkelstein  
(01/17 - 12/20)  
University of Colorado, Boulder

**Members-at-Large:**

Mackenzie Stetzer  
(04/18 - 12/20)  
University of Maine

Adrienne Traxler  
(01/19 - 12/21)  
Wright State University

Brad R. Conrad  
(01/20 - 12/22)  
American Institute of Physics

**APS-AAPT Members-at-Large:**

Eleanor Close  
(04/18 - 12/20)  
Texas State University, San Marcos

Benjamin Dreyfus  
(01/19-12/21)  
George Mason University

Idaykis Rodriguez  
(01/20 - 12/22)  
Florida International University

**Chair, Committee on Education:**

Marty Baylor  
Carleton College

**Graduate Student Member-at-Large:**

Julian Gifford  
(01/19 - 12/20)  
University of Colorado

---

## Non-voting Members

**APS Liaisons:**

Theodore Hodapp  
APS Director of Project Development

Monica Plisch  
APS Director of Programs  
American Physical Society

**AAPT Representative:**

Gordon Ramsey  
Loyola University, Chicago

**Newsletter Editor-in-Chief:**

Jennifer Docktor  
University of Wisconsin - La Crosse

**Upcoming newsletter deadlines:**

Summer 2020: June 1, 2020  
Fall 2020: October 1, 2020