The Joy and Challenge of Writing for a Broad Audience

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Our calling as educators:

To learn and to teach.

Pedagogical scholarship:

Broad engagement with our discipline beyond just the courses we teach and the specialized research we perform.

One key deliverable:

Writing pedagogical books, articles, columns, letters, and web documents.

1. Motivations for Writing Broadly

- It's enjoyable.
- It helps you better understand physics.
- Your article can generate interest in a topic.

David Mermin was once told that he writes about things in a way that makes people think those things are interesting even though they are not.

White papers on my website:

Mechanics | Electricity and Magnetism | Optics | Thermodynamics | Mathematical Physics | Physics Videos

- Phase and Group Velocity of Matter Waves
  A discussion of various calculations of the phase and group speeds for a monoenergetic beam of particles in free space.

- Uniqueness of Brachistochrone Solution
  A subtle but elegant proof that a cycloid is the unique analytic functional shape of track that has minimum descent time between given initial and final points along a frictionless track starting from rest.

- Fastest Descent along a Ramp and Horizontal Track
  A particle slides frictionlessly starting from rest down a ramp and then along a horizontal track. For fixed vertical and horizontal distances between the starting and ending points, what ramp angle minimizes the total travel time of the particle?

- Pressure Exerted by a Rotating Cylinder of Fluid
  A cylindrical can of water is rigidly rotating about its vertical axis of symmetry, such that water makes contact with the top surface of the can. What pressure does the water exert on that surface?

- Inertia Ball
  A weight is hung from a fixed support by a light string. An identical string hangs from the bottom of the weight. If you pull slowly on the lower string, the upper string breaks first. But if you jerk the lower string, it breaks first. I analyze this well-known demo both analytically and numerically using Hooke's law, Newton's second law, and kinematics.

- Polar Form of an Ellipse
  Algebra is used to derive the polar form of an ellipse, the relation between the semilatus rectum and angular momentum, and the construction of an ellipse by looping a string around two thumbtacks and a pencil moving in such a way as to keep the string taut. Other than definitions, the only needed ingredients are the rectangular form of an ellipse, and conservation of angular momentum and mechanical energy.

- Magic Newton's Cradle
  Three balls are arranged so they make 1D elastic collisions. If the balls have relative masses of 1, 0.236, and 1 in order, then sending the first ball in to impact the others at rest will eventually lead to the third ball coming out with all the initial momentum, after the middle ball has bounced back and forth making four collisions with the two end balls.

List of educational physics journals that I read regularly:

- The Physics Teacher
- American Journal of Physics
- Physics Education
- European Journal of Physics
- Resonance
- Journal of Chemical Education
- Physical Review Physics Education Research
- Physics Today
- Society Newsletters

2. Sources of Inspiration

- Read pedagogical journals regularly.
- Listen to your students.
- Listen to your colleagues.
- Simplify complicated topics.

Inspiration for my pedagogical articles and letters:

- face-to-face talking with colleagues = 8 articles
- email discussions = 24 articles
- response to articles read = 8 articles + 12 comments or letters
- response to letters or columns read = 5 articles + 12 letters
- textbook discussions = 9 articles
- standard demonstrations = 4 articles
- AAPT presentations = 2 articles
- class assignments = 3 articles
- my optics research = 2 articles
- I cannot remember = 6 articles

3. Nature of the Audience

- Assume your readers have a broad assortment of backgrounds and interests.
- Put yourself in your readers' shoes. It's not about how smart you are.
- What are you being paid to do when it really comes down to it?

4. Organizing a Paper along a Storyline

- You can either win or lose your readers on the first page.
- Physics is a voyage of discovery. The journey is at least as important as the destination.
- Sequence your article.

5. Contrast between Research and Pedagogical Articles

- Educational articles need to be simple, clear, and brief.
- Research may proceed by LPUs and self promotion, but those aren't the goals of education.
- What's the point?
- References are not there merely to show you know your field and to pad the impact factors of possible referees.
- Be on the alert for journals in which to publish educational articles.

Example citation in the first few lines of a research article:

Electron-doped and hole-doped $BaFe_2As_2$ compounds are among the most intensively studied systems of IBS families [3–12].

(from *Physical Review B*, July 2017)

Some unusual journals in which I have published pedagogy:

- Journal of the Washington Academy of Sciences
- Latin-American Journal of Physics Education
- APS Forum on Education Newsletter
- The Mathematical Gazette
- International Journal of Mathematical Engineering and Science

6. Use of Effective Diagrams, Applications, and Demonstrations

- Use figures that can tell a story at a glance.
- A creative application or demonstration can sell an entire paper.

7. Making Time and Energy to Write

- What are you waiting for?

  Peter de Vries said, “I write when I’m inspired, and I see to it that I’m inspired at nine o’clock every morning.”

- Don’t always go it alone.

My pedagogical co-authors:

- Trevor Lipscombe — editor of university press
- Chris Panuski & Sean Genis — students
- John Emery — military faculty at USNA
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- John Denker — prolific author of email physics listserver postings
- Jennifer Birriel — I contacted her by email about a column she wrote in TPT

QUESTIONS?

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