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From the Editor

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There is one thing that puzzles me. In the past few months there have been many important (even drastically so) things happening at the interface between Physics and Society. I had expected to be flooded with articles and letters to the Editor, particularly in view of my unswerving policy of accepting controversial material. Yet, things have been quiet. I am informally told that some people (particularly those in government jobs, or those in positions that require a visa) are keeping quiet out of caution or fear. If this is so, this would be in itself a very serious Physics & Society issue. I hope the silence ceases.

Having said this, I will add that we do have three very interesting contributions in this issue. One, by Rachel Burley, is on a question near to my heart: where to publish our scientific work. Nearly all scientific papers I have ever published (you can easily look me up) have appeared in APS journals, and never in "magazine" format publications. The usual disclaimer that articles published do not necessarily reflect my opinion does not apply to this case.

The other two articles are by two of our recent Forum-sponsored APS Fellows. One is on mentorship in science at land grant universities, and the other is on organizing Physics instruction in a non-English speaking environment.

And also we have a book review. On this topic, let me invite you to review a pertinent book. It can be a book of your choice or one sent to you by our Book Reviews Editor, Quinn Campagna (qcampagn@go.olemiss.edu). He maintains a list of volunteers that make themselves available to review. Besides the pleasure of serving our community, you will get a free book that you can keep.

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This contents of this newsletter are largely reader-driven. All topics related to Physics and Society are welcome, excluding only undiluted politics and anything containing invective, particularly of the ad hominem variety. Strong opinionated language is of course quite all right. Manuscripts should be sent to me, preferably in .docx format, except Book Reviews which should be sent directly to book reviews editor Quinn Campagna qcampagn@go.olemiss.edu.

The contents are not peer reviewed (I do read them before acceptance of course)and opinions given are the author's only, not necessarily mine, nor the Forum's nor, a fortiori, the APS's either. But subject to the mild restrictions mentioned above no pertinent subject needs to be avoided on the grounds that it might be controversial. On the contrary, controversy is welcome.

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Physics and Society is the non-peer-reviewed quarterly newsletter of the Forum on Physics and Society, a division of the American Physical Society. It presents letters, commentary, book reviews and articles on the relations of physics and the physics community to government and society. It also carries news of the Forum and provides a medium for Forum members to exchange ideas. ***Opinions expressed are those of the authors alone and do not necessarily reflect the views of the APS or of the Forum. Articles are not peer reviewed.*** Contributed articles, letters (500 words), commentary, reviews and brief news articles are welcome. Send them to the relevant editor by e-mail (preferred) or regular mail.

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***Physics and Society* can be found on the web at** aps.org/units/fps.

Empowering Potential: Science, Mentorship, and Opportunity at 1890 Land Grant Universities

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A Mission Beyond Access

At the University of Maryland Eastern Shore (UMES), an HBCU and 1890 Land-Grant institution, our mission has always been clear: not just to provide access to education- but to cultivate excellence.

Access is only the starting point. It opens the door, but what lies beyond that threshold is the real work: the challenge - and the profound joy - of identifying untapped potential, nurturing brilliance, and building the intellectual and emotional resilience that students need to thrive.

At UMES, we see excellence as something that can be developed through intentional mentorship, transformative teaching, and sustained support. Many of our students come from communities that have been historically underserved by the education system. Our role is to ensure that, once they are here, they are not just included - they are empowered, challenged, and inspired.

We do more than deliver curriculum. We design ecosystems of growth - where students are encouraged to think critically, engage deeply, and lead with confidence. We want them to see themselves not only as learners, but as future scientists, innovators, and contributors to a better world.

This mission is not theoretical - it is deeply personal. It means walking with students through moments of doubt, failure, and discovery. It means equipping them with the tools to not only succeed academically, but to shape and lead the future of science.

Access is the promise. Excellence is the fulfillment. And at HBCUs like UMES, we are committed to making both a reality.

Diamonds in the Rough

Many of my students are first-generation college-goers. They come from under-resourced communities, often with untapped brilliance that hasn't been recognized or encouraged.

I see them as diamonds in the rough and my job is to help them shine. That process begins with belief - believing that every student has infinite potential and if given the right environment it can be expressed systematically.

These students often lack early exposure to scientific thinking, or creativity, but not because they lack the ability. They simply haven't been invited into those spaces yet. Our role is to create that invitation - and back it with resources, opportunities, and relentless encouragement.

With the right kind of attention and scaffolding, they transform. I've watched students who once hesitated to speak up in class go on to present at national conferences, win prestigious prizes, and publish in peer-reviewed journals. I've seen them tackle complex problems with the kind of insight that surprises even seasoned scientists.

We cannot afford to let this brilliance remain hidden. The future of our generation and the world depends on our ability to discover and develop these minds. And when we do, it benefits not just the students, but the entire scientific community.

Teaching for Critical Thought

I don't teach students what to think - I teach them how to think. Critical thinking is the engine that drives scientific innovation, and in the age of AI, this mission has become more important than ever. While artificial intelligence is rapidly advancing across sectors - from education and healthcare to finance and research - it cannot replace the uniquely human ability to reason deeply, ethically, empathetically, and contextually.

AI excels at solving numerical problems, generating text and code, and processing vast datasets. But it cannot nurture curiosity, adapt to the emotional needs of learners, or cultivate the intellectual independence that defines a true thinker. We still - and always will - need HI, Human Intelligence, to guide, interpret, and optimize the use of AI tools. That is why I believe learning assessment in this new era should prioritize students' critical thinking abilities over procedural problem-solving.

At UMES, our classrooms are designed to cultivate this mindset. Students are encouraged to ask questions, challenge assumptions, and explore the "why" behind every answer. One of the most effective tools we use is a series of conceptual cartoon-based critical thinking questions, developed in collaboration with renowned science cartoonist Larry Gonick (Fig. 1). These visual prompts depict everyday scenarios grounded in core physics concepts and are intentionally designed to expose misconceptions, spark dialogue, and deepen understanding.

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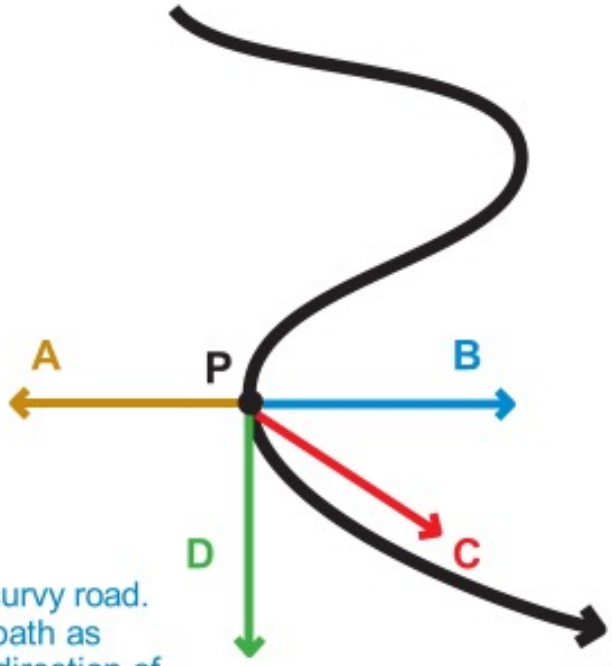
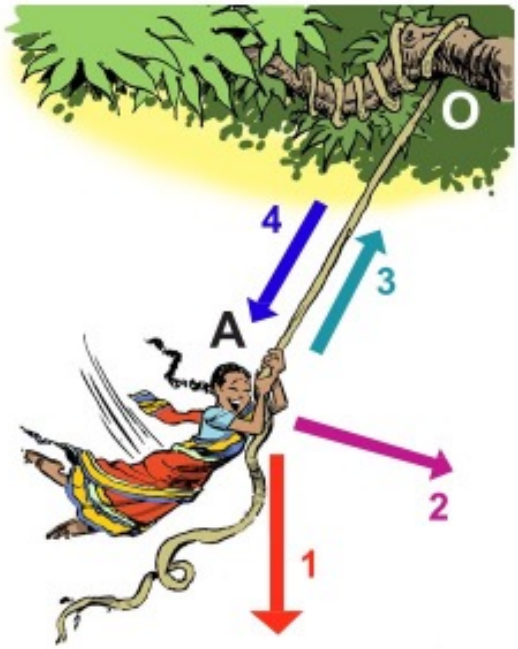


A truck is driving **at constant speed** along a curvy road. The heavy line on the right shows the truck's path as seen from above. Which arrow describes the direction of friction on the truck at point **P**?

Usha swings on a vine hanging from point **O**. As she swings through point **A**, consider four possible forces:



1. A downward force of gravity
2. A force in the direction of Usha's motion
3. A force exerted by the rope pointing from **A** to **O**
4. A force pointing from **O** to **A**

Which of those forces is (are) acting on Usha at point A?

A) **1** only
B) **1** and **2**
C) **1** and **3**
D) **1**, **2**, and **3**
E) **1**, **2**, and **4**

Fig. 1. Concept cartoon clicker questions developed by the author and science cartoonist Larry Gonick to spark curiosity, promote critical thinking, and enhance student engagement in the classroom.

This approach transforms passive learning into active inquiry. Students aren't just memorizing formulas - they're applying ideas, evaluating alternatives, and developing analytical skills that transcend disciplinary boundaries. When critical thinking becomes the norm, physics is no longer a set of abstract rules; it becomes a powerful lens for understanding the world.

That shift is not just valuable - it is essential. In a world increasingly shaped by AI, cultivating human thought, empathy, and reasoning must remain our highest educational priority. Only then can we prepare our students not merely to coexist with AI, but to lead in a future that demands both technological fluency and human insight.

Hands-On Learning and Authentic Research

I view the overall development of students as a holistic process. It starts by embedding critical thinking in the classroom, followed by hands-on, active learning strategies, and culminating in curiosity-driven, authentic research projects. Introducing research early in a student's academic journey is essential - not as an endpoint but as a catalyst. When students are exposed to real-world inquiry from the outset, they begin to see themselves as contributors to knowledge and solver of problems that could impact the broader society, rather than just consumers of it. This early engagement not only builds confidence but also helps students internalize the relevance of scientific thinking.

Constant mentoring throughout this journey is crucial to building student self-efficacy. As a result of these interventions, our undergraduate students have developed a table-top photolithography process to explore micro and nano technology [1], created plasma using a kitchen microwave [2], explored microfluidic mixing dynamics [3], built a payload to investigate solid body rotation in microgravity [4], designed microbial fuel cells [5], and created neuromorphic circuits [6,7], among other innovations.

Nature as a Laboratory

Physics is the study of quantitative laws that describe the natural world. While these laws apply equally to living and non-living systems, early physics education focuses mostly on the latter, neglecting rich connections with biology. It has been generally understood that physical processes and constraints influence biological structures and their resulting functions. However, these cross-discipline connections - and their importance to growing scientific disciplines such as biophysics - are rarely taught in introductory physics courses.

To bridge this gap, I have developed undergraduate curriculum that introduces how the laws of physics shape evolution of shape and form through concepts like surface area to volume ratio - an essential geometric measure of structure. We have also developed conceptual cartoon clicker questions to enhance students' understanding of these interdisciplinary ideas [8]. By connecting abstract physical laws with biological and technological applications, our approach helps students appreciate the deep interconnections between disciplines (Fig. 2), thereby enriching their learning experience and sparking deeper intellectual curiosity from the very beginning of their academic careers.

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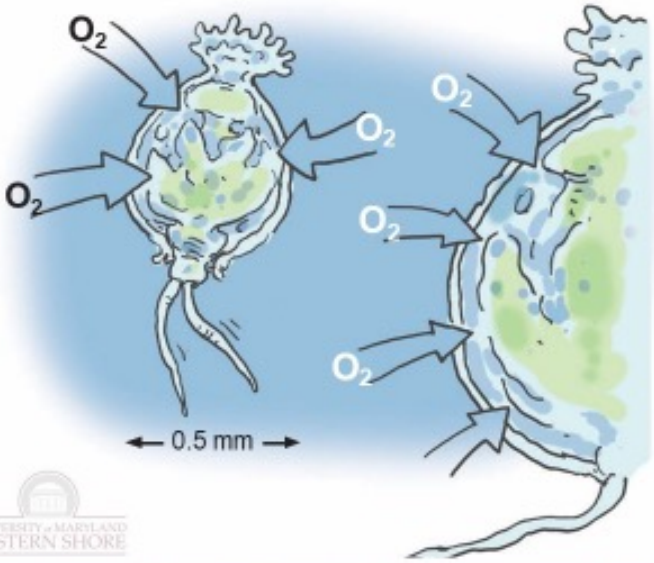
10. This tiny animal, a rotifer, "breathes" by absorbing oxygen directly through its skin and letting the gas diffuse throughout its body. The rotifer uses all the oxygen it takes in to survive. If the rotifer doubled in diameter, would it still be able to absorb enough oxygen to stay alive?



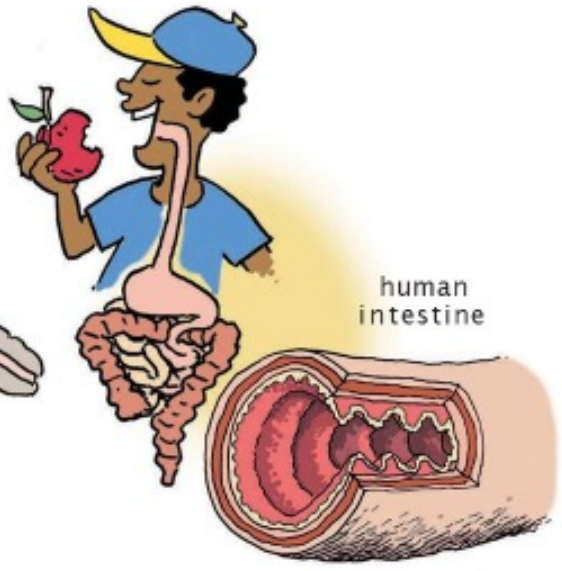
A. Yes, because the large and small rotifers have the same chemical make-up.

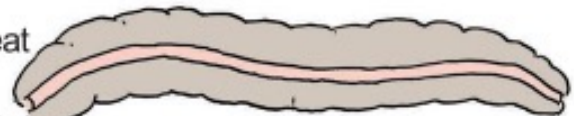
B. Yes, because the larger rotifer has a greater surface area through which oxygen can pass.

C. No, because the larger rotifer has to supply oxygen 8 times the body mass although the surface area increases only 4 times.

D. No, because the oxygen has to travel farther in the larger rotifer.

14. In an animal, nutrients reach the body by passing through the walls of the intestine. An earthworm has a straight intestine with smooth walls. Due to evolutionary adaptations a human has a long, coiled intestine, with highly reticulated, or folded, inner walls. What might account for the difference?





A. Earthworms only eat dirt.

B. Humans are much larger and need an intestine with extra surface area to supply nutrients to the large body mass. Straight intestine won't have enough surface area.

C. Humans have a lot of room in their abdomen and have to fill it with something.

D. Earthworms lack a mouth.

Fig. 2. These questions highlight the interdisciplinary nature of science by bringing concepts from evolutionary biology into the physics classroom, encouraging students to explore connections across disciplines [8].

Mentorship That Transforms and Cultivates Innovation

Mentorship is not a checkbox - it's a lifelong commitment to walking alongside students through uncertainty, self-doubt, and, eventually, to success. At UMES, this commitment is deeply woven into our academic and cultural fabric. I work closely with students to help them build belief in themselves. When they know someone truly sees their potential, everything begins to change. That belief is foundational - it shifts mindsets, breaks barriers, and opens doors many students never thought possible.

But mentorship must begin with listening. You have to be a good listener first - truly hearing students' stories, fears, dreams, and doubts. Only then can you guide them effectively. When students feel heard, they begin to trust not only you, but also themselves. That trust is the first step toward building self-efficacy.

Mentorship at its best is personal, persistent, and deeply human. I meet students where they are and walk with them as they grow, fail, try again, and ultimately triumph. It's not about correcting their path; it's about helping them find it. Every step of progress matters. Whether it's conquering a fear of public speaking, mastering a challenging concept, or presenting their first research project, these victories – both small and large - accumulate into self-confidence and a sense of purpose, and we celebrate it.

Once that self-efficacy is built, the next step is to challenge students to push beyond their comfort zones - the ceilings they've imposed on themselves. They must come to believe that not even the sky is the limit. I remind them that their potential is boundless, and that real growth happens when they take bold intellectual risks, stretch beyond comfort, and strive not for perfection, but for possibility.

This transformation doesn't end at graduation. I continue to mentor students as they enter Ph.D. programs, step into industry roles, or launch entrepreneurial ventures. These enduring relationships are not incidental; they reflect a commitment to their long-term success. Mentorship is not an extra - it is the work. And it is the most rewarding part of what I do.

This culture of support directly cultivates innovation and self-efficacy. Innovation doesn't happen in isolation - it flourishes within systems that empower students to trust their own capabilities. At UMES, we begin this early by creating classroom environments that value student voice, challenge assumptions, and reward curiosity and creativity.

The results speak for themselves. Our students who have gone through this holistic development process have defended Ph.D. theses at Ivy League institutions[9], earned the highest honor in the entire University System of Maryland - the Board of Regents Award for research and creativity [10] - received NSF Graduate Research Fellowships, founded start-ups [11], and secured positions at leading institutions such as Intel, Boeing, NASA and other national labs [12]. These are not outliers - they are the outcomes of a deliberate, structured approach that builds confidence and capability from the ground up.

Innovation grows when students are encouraged to take intellectual risks. That courage is born from knowing they are believed in from day one - and that belief is continually reinforced. With that foundation, students begin to see themselves not just as learners, but as creators of new knowledge - leaders who are limited only by the boundaries they choose to accept.

A Fellowship That Rewired a Mission

The Kavli Institute for Theoretical Physics (KITP) Fellowship served as a catalytic experience for me [13]. Not just because I engaged with brilliant, world renowned physicists, but because I found a space where my ideas were welcomed and my identity respected. I was pleasantly surprised and honored when after my Thursday lunch talk at KITP Nobel Laureate David Gross stood up and said, "I wish I had a teacher like you when I was a student!"

My time as a KITP Fellow showed me what psychological safety looks like in a research environment - a space where individuals are free to challenge ideas, engage in debate, and explore without fear. This experience was later reinforced through my involvement in the Pathways program at the Princeton Plasma Physics Laboratory [14], where open, intellectually vibrant settings encouraged bold thinking and authentic collaboration.

I brought that culture back to UMES. We have worked intentionally to create environments where both students and faculty feel secure enough to take intellectual risks, ask difficult questions, and grow. Science advances most effectively when people feel safe enough to be bold - and supported enough to persist.

That kind of environment is transformative - not only for research, but for human development.

I returned with more than notes. I came back with renewed momentum - and, more importantly, with collaborations that have expanded opportunities and changed the trajectory of my students' futures.

Research, Society, and the Responsibility of Engagement

Research is, at its core, an intellectual pursuit - a search for truth, understanding, and insight. For many of us, it is also a source of deep personal satisfaction, a space where curiosity is allowed to flourish. But we must be cautious not to treat research solely as a private intellectual pleasure that gives rise to disconnected elitism. Knowledge, no matter how abstract or fundamental, exists within a larger social ecosystem. There

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is - and must always be - a symbiotic relationship between research and society.

Whether we are probing the mysteries of the universe, seeking to unify the fundamental forces of nature, or applying physics to develop life-improving technologies, our work is ultimately sustained by and accountable to the public. This relationship is not one-directional. Society provides the support - through funding, trust, and infrastructure - that makes academic inquiry possible. In return, researchers have a responsibility to share knowledge, inspire curiosity, and ensure that discoveries contribute meaningfully to the common good.

When this relationship breaks down - when academia turns inward and society feels excluded or alienated - we risk what history has already shown us: the rise of mistrust and division. The "Town and Gown" conflicts of medieval Oxford [15] serve as a cautionary tale of what happens when academic institutions become disconnected from the communities around them. These conflicts weren't just about economics or jurisdiction - they reflected deeper tensions around relevance, access, and public trust.

We cannot afford to repeat those mistakes. In today's world, where information moves quickly and public understanding of science can vary widely, outreach and community engagement are not optional - they are essential. Scientists must step out of the lab and into public life, not to simplify their work, but to share its meaning and relevance. When communities see themselves reflected in scientific endeavors - when they are invited to participate, learn, and contribute - the bonds of trust grow stronger.

At UMES, we treat outreach not as a separate task, but as an integral part of our mission. We work with local schools, host public science events, and open our labs to the broader community. These efforts create a feedback loop where research informs society, and society, in turn, enriches our research with fresh perspectives, questions, and needs.

Academia and society must nourish one another. When that mutual support exists, science becomes not just a pursuit of knowledge, but a force for collective progress. That is how we ensure that research remains not only intellectually fulfilling, but socially meaningful.

Excellence as a Collective Outcome

The journey from access to excellence is not a solitary one. It is a collective effort supported by faculty, administrators, funding agencies, and peers.

When systems align around care, rigor, and opportunity, extraordinary things happen. We build a steady pipeline of critical thinkers ready to contribute to the innovation ecosystem of the nation and the world.

At UMES, we are proving that excellence doesn't depend on ZIP codes or legacy. It depends on belief, support, and the courage to reimagine what education can be.

Dr. Kausik S. Das is Professor of Physics and Director of the SANS Center for Student Excellence at the University of Maryland Eastern Shore. He is an editorial board member of the American Journal of Physics, a Fellow of the American Physical Society and Kavli Institute for Theoretical Physics Fellow.

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Choose Purpose-Led Publishers: Advancing Science Through APS Journals

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For most physicists, publishing research in peer-reviewed journals is not just important, it's essential. It's how they validate results, exchange ideas, fulfill grant and employment requirements, and build careers. But as publishing options multiply and the pressure to publish intensifies, the decision about where to submit your manuscript becomes more complex. Impact factors, publication times, journal reputation, and publishing costs are just a few of the factors to be weighed.

Researchers care not just about visibility of their research and rigor in the peer review process, but also transparency, equity, and whether their work supports a healthy scientific ecosystem. This is where Purpose-Led Publishing (PLP) offers an important set of promises, and choosing PLP journals is one way to align your publishing decisions with your values.

A Coalition with a Mission

PLP is a coalition of three nonprofit publishers: the American Physical Society (APS), AIP Publishing, and IOP Publishing. We are mission-driven, rooted in our scholarly communities, and deeply invested in advancing science, not maximizing shareholder returns.

What sets the coalition apart is the promises we make: we will always put purpose above profit, and have defined a set of industry standards that underpin high-quality, ethical scholarly communications.

Unlike many commercial publishers, APS and our PLP partners are deeply embedded in the communities we serve. Our staff and editorial boards are often physicists themselves. They understand the specific needs of our field because they are part of it.

Publishing for the Community, Not for Profit

PLP members promise to:

- Invest 100% of our funds back into science
- Publish only the content that genuinely adds to scientific knowledge
- Ensure our terms are reasonable
- Put research integrity ahead of profit
- Admit our errors and set them right

What does this mean in practice? When you publish in our journals, you're contributing to a system where publishing revenues are used to support physics education and outreach, fund advocacy for science at the federal level, convene and connect the physics community through scientific meetings and conferences and develop tools and resources for researchers.

This community orientation was a major motivator behind the creation of the PLP coalition. This year the PLP sponsored the *APS Global Physics Summit satellite* events that enabled more than 1000 scientists to meet in person and online at 17 satellite sites around the world. The PLP sponsorship helped to give people an opportunity to be involved in the APS Global Physics Summit without necessarily having to travel.

For FPS Members: A Values-Based Choice

The way science is communicated affects who can participate, what research gets amplified, and whether findings are accessible to policymakers and the public. Choosing where to publish is one way to shape that system.

So, the next time you're deciding where to publish your research, I encourage you to consider society publishers like the APS and the Physical Review family of journals, not just for our quality and reach but also because we reflect a broader commitment to purpose-led publishing. It's a small decision that contributes to a much bigger vision: a publishing ecosystem built around the needs of researchers and the advancement of science.

To learn more, visit www.purposeledpublishing.org or journals.aps.org.

Science in the Mother Tongue: The Bigyan Journey

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My efforts to promote science education in my mother tongue, Bengali, through the Bigyan initiative (bigyan.org) that I co-founded, contributed to my election as a Fellow of the American Physical Society (APS). Bigyan literally means "science" in Bengali, a language spoken by over 200 million people worldwide—most of them in the Indian state of West Bengal, where I was born, and in the neighboring country of Bangladesh. In this article, I aim to highlight our journey, the opportunities it created, and the challenges we encountered. Perhaps the key takeaway is that building grassroots networks, incorporating a sustainable organizational structure, and sustained effort by a critical mass of volunteers can make such a program viable.

The starting point was clear: there was a lack of modern science resources in Bengali. A handful of scientists have been consistently writing high-quality science articles in Bengali newspapers and books, and their contributions are deeply valuable. However, such efforts remain too few and far between. Most Bengali-language newspaper articles on science tend to be sensationalized or oversimplified. What was missing were mid-level explainer articles—substantial in content, yet accessible in language. We wanted to fill this gap, and we wanted the content to be in Bengali. Our belief is that a society cannot become scientifically literate unless science and technology can be discussed in the language people are most comfortable with. From a pedagogical perspective, introducing new scientific concepts in the mother tongue also removes the extra cognitive burden of simultaneously grappling with a second language—especially at an early stage when students may not be fluent in English.

An online platform seemed like the most feasible starting point. On India's National Science Day in 2014—commemorating C.V. Raman's discovery of the Raman effect—we launched our Bengali science article archive, bigyan.org.in. Initially, practicing scientists and science enthusiasts within our network began contributing articles on both technical topics and general science news, written in an accessible style.

To our delight, the platform soon attracted contributors we had never met. Scientists from around the world discovered Bigyan online and joined the effort, bringing fresh ideas, energy, and subject expertise—along with the inspiration to continue. We also received enthusiastic support from outside the Bengali-speaking community. For example, MacArthur fellow Prof. Manu Prakash of Stanford University generously shared several Foldscopes—origami-based microscopes he invented—before they were widely available. We distributed them across West Bengal, helping spark scientific curiosity in classrooms and workshops.

We never intended Bigyan to be a blog site featuring a few individual voices. A blog maintained by a small group is rarely sustainable—contributors eventually run out of ideas, and the lack of diversity in topics and perspectives becomes a limitation. Instead, we put in place the organizational structure of a peer-reviewed science magazine, albeit aimed at a general audience. This approach enabled broader participation and greater subject diversity. Our colleagues from various institutes around the world generously volunteered their time to review submissions for scientific accuracy and clarity. While this peer-review process significantly slowed down our publication workflow—taking several months from submission to final publication—it helped us build credibility and rigor.

The importance of fact checking became especially clear during the COVID-19 pandemic, when misinformation surged. One notable example was a widely circulated WhatsApp message that falsely claimed dozens of Nobel laureates and respected journals like The Lancet were speaking out against lockdowns and sanitization. The message even cited a specific issue of The Lancet, creating an illusion of authenticity. In reality, no such report existed—neither in the cited issue nor anywhere in the journal's archives. A Bigyan volunteer responded by creating an audio story in Bengali, told through a fictional conversation between two friends discussing whether to forward the message. This story illustrated how misinformation can be made to look credible and emphasized the value of independently verifying sources. Very few people, we pointed out in the audiostory as well as a series of follow-up articles, take the time to actually check a journal's website before forwarding such claims.

Our strategy of careful editing, peer review, and slow publishing—may not match the virality of social media, but it fosters trust and media literacy over the long term. Over time, our readership grew steadily. The Bigyan archive now has over 350 articles, receiving close to 2 million online pageviews. The articles span a wide range of topics—from classroom staples like Newton's laws and friction, to modern scientific developments such as machine learning, quantum computing, and antibiotic resistance, to Bengali translation of some classic articles, like Haldane's "On Being the Right Size" and Feynman's "The value of science".

As more volunteers joined, new segments gradually emerged—responding to reader questions, hosting live interviews on social media, and organizing online competitions such as nature photography and video contests. Analytics showed roughly equal readership from India and Bangladesh, reinforcing the cross-border relevance of our work. On average,

we have had about ten active volunteers - professors, postdocs, PhD students, and tech professionals - at any given time over the years. We also received support from unexpected quarters: a prominent radio personality and a nationally award-winning music composer in India volunteered their time and creativity, lending their voices and artistic talents to help increase our visibility. Their contributions not only broadened our reach but also underscored the cultural resonance of science communication in Bengali.

A pivotal moment came about four years into the initiative, when we were contacted by a group of educators from the Contai region of West Bengal. They had formed a science academy with dozens of high school and college teachers as members. Though they had been quietly following our work, they reached out with the suggestion that we expand our efforts beyond the digital realm. This was a milestone—our online platform now had a concrete connection to the grassroots. We collaborated with the Contai educators to publish two affordable printed collections of Bigyan articles, which they distributed across both local and remote high schools.

Following this initial success, our grassroots network began to expand organically to other regions across the Bengali-speaking world. Educators and volunteers reached out with interest in participating, distributing materials, and organizing local events. While these regions vary widely in resources and educational infrastructure, the shared language created a foundation for a unified effort. This distributed and decentralized model of engagement has since become one of Bigyan's defining strengths.

The COVID-19 pandemic disrupted these grassroots activities, but it also presented new opportunities. Internet infrastructure suddenly became more accessible, even in remote areas. Bigyan collaborated with grassroots educators to host online seminars, giving rural high school students the chance to directly interact with practicing scientists.

This connection to grassroots educators—and through them, thousands of students—opened new doors. To explore new methods in science pedagogy, Bigyan worked with teachers to incorporate real-time feedback techniques like the clicker method for formative assessment. We had a collection of high-quality clicker questions, and through an NSF-funded project led by a Bigyan volunteer as the principal investigator, many of these questions were converted into illustrated cartoons by Larry Gonick, known for The Cartoon Guide to Physics. Bigyan volunteers translated them into Bengali.

The main challenge was implementing the clicker method in classrooms lacking digital infrastructure. We adapted the method using colored cards: students would raise the card corresponding to their answer choice, and teachers would visually tally the responses. Several teachers adopted this method and shared reports after using it for about three months. The feedback was encouraging. One 8th-grade science teacher commented, "Some students who were not the most enthusiastic or academically advanced—usually 'back-benchers'—started sitting in the front and participating actively."

That said, common challenges emerged. Counting the cards in larger classrooms (more than 30 students) was difficult, and the pressure to complete the syllabus led many teachers to discontinue the method. Still, in an educational environment where innovation is rarely incentivized and rote

The author participating in a science workshop for high school students in Chakdwipa, West Bengal (India)

continued

memorization is the norm, even limited adoption of real-time feedback methods was culturally significant. Encouragingly, some teachers continued to use the card method on special occasions, such as workshops. In a recent in-person workshop I attended, around 200 students used colored cards to answer cartoon-based clicker questions. The discussion was lively, and as I anticipated, many students struggled with basic physics concepts—for example, the difference between velocity and acceleration, or the idea that a constant velocity does not require a continuous force.

More importantly, many teachers realized that some challenges could be overcome through collaboration. With the support of a local physics professor, high school teachers from various schools began developing worksheet-style teaching aids. These included explanations of both correct and incorrect answers, with an emphasis on addressing common misconceptions. I believe this collaborative work will have a lasting impact.

A science workshop in Contai, West Bengal using real time feedback with colored cards

As our grassroots momentum grew, it became clear that we needed additional resources to sustain the initiative. In 2022, we registered as a 501(c)(3) non-profit organization. Donations from well-wishers enabled us to hire freelancers and collaborate with professional graphic designers and video editors, allowing us to sustain ongoing activities and take on new projects. One notable initiative was a video interview series featuring renowned scientists, including Nobel laureates. To ensure accessibility and authenticity, English-language interviews were subtitled in Bengali—not using automated tools, but through careful human translation. The series included multi-part interviews on the current state of neutrino research, the global importance of semiconductors, and emerging directions in modern computer science. These conversations were designed to introduce complex topics in a way that resonated with students, educators, and curious viewers alike. In his interview, Nobel Laureate David Gross reflected on his childhood, the value of curiosity, and the process of scientific discovery. Beyond our usual online audience, these videos reached many teachers and students through our grassroots educator networks, helping to bring cutting-edge science into classrooms and community spaces.

One of our recent highlights has been the publication of posters on various scientific themes. This project was carried out in collaboration with a professional graphics agency, with careful attention to the needs of schools with limited resources. Each poster is designed in a modular format, consisting of approximately ten A4-sized pages, allowing schools to print and assemble them using standard printers rather than relying on large-format poster printers. Many schools have begun displaying these posters on their reading walls. One goal of the series is to reveal the interconnectedness of scientific ideas. For instance, one poster traces the story of light: from its generation in the Sun, through its journey across space and the atmosphere, reflecting off water droplets, reaching a child's eye, and finally being converted into neural signals reaching the brain—culminating in the experience of seeing a rainbow. Photos of students gazing at these posters in their school hallways continue to inspire us to keep the momentum going.

Looking ahead, we hope to sustain and expand our efforts with continued support—scientific, volunteer-based, and financial—from our growing community of well-wishers. The content developed in collaboration with grassroots educators

Students reading a poster made by Bigyan.org on climate change on the reading wall of their school in rural West Bengal, India

can be adapted for teacher training programs, extending its utility beyond the classroom. Existing initiatives by global scientific societies and popular science platforms—such as poster campaigns and outreach materials—could also be localized and disseminated through Bigyan to better reach the Bengali-speaking world.

Beyond content alone, Bigyan has helped build an unprecedented global network that connects practicing scientists in at least eight nations, spanning four continents, with grassroots educators and students. This model holds long-term potential to contribute meaningfully to the improvement of science education and the strengthening of scientific temperament in society.

Finally, we hope that our experience can serve as a template for similar initiatives in other regional languages—especially those where access to quality scientific content remains limited. The tools, practices, and community we have built may help seed efforts elsewhere, rooted in local languages and contexts but driven by the shared goal of making science accessible to all.

Children of a Modest Star: Planetary Thinking for an Age of Crises

Jonathan S. Blake and Nils Gilman (Stanford University Press, Stanford, 2024). 307p. ISBN 9781503637856. $28.

Children of a Modest Star is a book more about politics and sociology than physics, but it should be of interest to members of the Forum on Physics and Society, as well as anyone concerned about the fate of planet Earth. The book's thesis relies heavily on our current knowledge of the state of climate change and humankind's effects on that change, which derives in large part from physics-based sensors and research. Unfortunately, they conclude that the current nation-state structure of society, with it's various substructures and few supra-national structures, is wholly inadequate to address the planet-scale problems of climate change. They do, however, propose new local and planetary institutions for dealing with these planetary-size issues. In view of the recent wildfires in Los Angeles, these proposals are welcome.

A key principle put forth by the authors is Planetary Subsidiarity. According to this principle, "climate issues must be governed by the smallest (governing) scale that can provide an effective solution" to the problem. This first assumes that the whole planet has been organized into a hierarchical governing structure for dealing with climate change problems. Exactly how this structure would replace or interact with the existing nation-state governance system is not addressed in detail, though the whole book is an exposition of the authors' ideas of how governing structures for dealing with climate change should relate to each other. In the authors' words: "planetary institutions as we propose them here will determine the compass settings of where to go for planetary issues, whereas sub-planetary national and local institutions will have the authority to determine the detailed itineraries of how to get there in a way that works for their specific geographic and political circumstances."

As examples of planetary institutions, the authors describe a Planetary Atmospheric Steward to police greenhouse gas emissions, and a Planetary Pandemic Agency to "act against infectious diseases at the planetary scale." The authors admit that these institutions would need enforcement authorities beyond any that current UN or international climate agreements possess. To achieve these enforcement authorities, the authors discuss the need for planet-wide politics. They picture what this scale of politics would look like, but admit hardly anyone is thinking along these lines yet. They also note that key input to planet-level decision-making should come from scientific experts – a situation which seems to be out of favor with the MAGA public at present.

This book is far ahead of its time. With Republicans in control of Congress, and Donald Trump in the White House, the United States Government is denying the existence of climate change, much less doing anything to mitigate it. And the immediate need is to address the deadly and costly disasters that climate change brings. It will be a long time before people are ready to think about global governing institutions to manage responses to climate change. If the climate change deniers stay in control of our government for several more voting cycles, the U.S. will have been left behind in any efforts to save the planet. But people in other nations can read Children of a Modest Star and begin thinking of new governing structures at local and global scales to deal with climate change.

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