

## **Workshop on cool demos and other physics recruitment strategies.**

November 4, 2017 from 9am to 1pm in the Department of Physics at Arizona State University.  
Leaders: Zachary Kovach, La Joya High School; Melissa Girmscheid, Centennial High School

**Workshop overview:** Physics is the most important science course in high school for college and career readiness, according to research. Thus ACT recommends a core curriculum that includes physics. Yet only a minority of students take physics. The workshop focused on how physics teachers can increase their enrollment; i.e., ways to recruit physics students.

The 21 participating physics teachers practiced doing four enticing demonstrations (mystery tube, balancing nails, singing rods, and dropping strong magnets in vertical copper pipe). They discussed starting with WHY, confronting barriers (including addressing guidance counselors' naïve conceptions), many practical strategies, and making your physics program stand out (via projects, contests, and events).

The workshop schedule is at: <http://increasephysics.weebly.com/workshop-schedule.html>. Zachary 'Zak' Kovach built the website. He posted the leaders' three powerpoint presentations, demonstration materials list, pictures, and information on how teachers can increase their physics enrollment, at <http://increasephysics.weebly.com>. He included weblinks to articles by local expert Earl Barrett, retired physics teacher and invited author of "Increasing Physics Enrollment in Your School", *The Physics Teacher*, Vol. 47, Sept 2009. <http://www.aapt.org/Resources/>

**The need:** Three years of science are required in Arizona, but only biology and chemistry are "CORE". Physics should be, too. Students who take high school physics are **twice as likely** to be ready for any college science – and for workforce training programs, according to ACT research. Thus ACT recommends a minimum core curriculum that includes **physics**. Nationally, 40 percent of students take physics, compared with 20 percent in Greater Phoenix.

**WHY increase physics enrollment?** (from the workshop announcement):

Physics is the most important science course in high school: more than any other course, it teaches quantitative reasoning. it is the only course where students use math to solve problems and predict outcomes. Physics connects us to our world; it is everywhere. It is the foundation of all sciences and technology -- and is crucial in the STEM economy.

"We need many more students taking physics," said Steve Zylstra, CEO of the Arizona Technology Council.

So why aren't more kids taking it? Join us as we explore ways in which you can increase physics enrollment in your school.

### **Workshop details:**

Participants lauded the workshop! The hands-on, minds-on Saturday morning workshop was attended by 18 Greater Phoenix high school physics teachers and 3 teachers from Tucson. Half were women (even though 2/3 of local physics teachers are men). Seventeen use Modeling Instruction. Five teach at charter high schools, and the rest are at district public high schools.

The workshop empowered them to increase their physics enrollment by learning “cool” demonstrations to use when they must cover classes (when the school cannot get a sub) and other practical recruitment strategies, such as coordinating with CTE classes, social media to draw attention to physics, communicating with counselors, a common vision in the science department of what is best for most students, and sharing that vision with counselors and administrators.

Each teacher paid \$35 (or \$50 for two people in the same school: only 1 school used this option). Most teachers paid out of pocket. All revenue was used to pay the two leaders.

Each physics teacher got almost \$50 worth of demo supplies, thanks to the AAPT Bauder Fund. Melissa and Zak bought them and brought them. Jane supplied the funds, to be reimbursed to her from the AAPT Bauder Fund. Total cost: \$945.86.

Jane Jackson administered/coordinated the grant. She invited teachers (by calling & e-mailing them, and posting three times on TCHRS, the statewide listserv for physics & chemistry teachers). She handled finances, gave receipts to participants, & sent letters to participants for re-certification credit. She spread use of Zak and Melissa’s student recruitment strategies by posting them on the ASU modeling website (<http://modeling.asu.edu> in the section called “Arizona Community”), and announcing them to TCHRS, the listserv for physics and chemistry teachers & post-secondary faculty in Arizona. TCHRS has 1000 AZ subscribers.

In June 2018, she announced Zak and Melissa’s student recruitment strategies and Zak’s INCREASE PHYSICS website to 4 physics teacher listservs in the nation: physics modeling (3400), American Modeling Teachers Assn (AMTA) (4300), physhare, and AAPT Physics First.

#### **Evidence of short-term success:**

- \* Jae Chang spoke in chemistry classes and doubled his physics enrollment (from 17 to 35).
- \* Marissa Yap used Zak’s activity and increased her regular physics by 1 section (32 students).
- \* Red Mountain HS in Mesa **increased from 11 sections to 13 sections**. They used Twitter more, and talked about physics with a leading counselor who then transferred to administration.
- \* Scott Hogan used some ideas in January 2018. He is new to physics, and new to his school. **His enrollment increased from 1 section this year to 5 sections for next year**. He wrote in Jan. 2018, “I spent my own money making flyers, posters and a banner to promote physics. It is a strange situation that I have to promote the subject to get students to sign up. I visited 10 teachers classrooms last week promoting and presenting about physics and won’t know until mid February how the signups went. Is it any wonder physics is dying as a subject if as a science teacher for an elective class, I have to market the class. I was the only science teacher marketing and advertising. I even have a rap video I made.... The sad fact, one that can’t be denied, is that students in AF district can take Environmental Science, biology, anatomy and forensics and never touch chemistry or physics -- it is the get ‘em through, look good in numbers and put physics out to lunch in the process.” He reported on it at the AZ-AAPT meeting in April.
- \* Toni Gagliardi, a physics student in the ASU Barrett Honors College, included Zak and Melissa’s recruitment strategies in her senior thesis in May 2018, on high school physics teachers’ perceptions. It is at <http://modeling.asu.edu> .

### **Workshop leaders were:**

- \* Melissa Girmscheid, physics teacher at Centennial High School in Peoria Unified School District. Melissa tripled her physics enrollment in a few years by using Modeling Instruction with culminating projects, involving CTE teachers, & using Twitter to draw attention to physics.
- \* Zachary Kovach, a PhysTEC Teacher of the Year -- at La Joya HS, a Title I school in Tolleson Union HSD. Zak increased his physics enrollment tenfold -- from 2 sections (45 students) to 13 sections (~425 students) -- in 4 years. He uses 'cool demos' when he covers for classes (often!) when no sub is available. His first career was in marketing, and his expertise showed!

Workshop coordinator Jane Jackson has 24 years of expertise in directing the Modeling Instruction Program in the ASU Department of Physics, which has served 1200 teachers and reaches about 100,000 students each year. She manages a listserv for Arizona physics and chemistry teachers/faculty and a nationwide listserv for physics teachers who use Modeling Instruction. She manages the ASU Modeling website: <http://modeling.asu.edu>. It has many research-based resources for high school physics teachers, including how to increase enrollment in physics, on the home page (at the bottom, in the section called "Arizona Community") and also at <http://modeling.asu.edu/Projects-Resources.html>.

### **What didn't work:**

- 1) Guidance counselors, school and district-level science coordinators and curriculum coordinators were invited personally by Jane, the two workshop leaders, and some participating teachers. None came. After the workshop, Jane asked the leaders why. Melissa replied: *"The response I received was, to paraphrase, "Sounds good. Fill us in." Around our district I am finding that counselors and administration rely on teachers to pass along what they learn. Our curriculum dept has been meeting with counselors and admin, but it is separate from one another and from teacher input. I find this is very common."* Zak added: *"My district is the exact same way as Melissa's. They have almost a wait and see mentality instead of being proactive."*
- 2) Melissa initiated an Arizona Slack web-based discussion group and announced it at the workshop and later via TCHRS listserv. Low use. She thinks a listserv might work better.

### **Workshop components:**

- 1) Practice 'cool demos'. Teachers worked in groups, and were given demo materials for their classroom. (If materials were expensive, we would have given teachers a proposal for school administration or school district foundation for funding.)
- 2) Guided discussions of questions on recruiting students for your physics courses.
- 3) Work time, to create a plan to sell your physics course to counselors & your feeder chemistry classes. How can you best use 10 minutes with them?
- 4) Written resources. Each teacher was given handouts (7 Myths about High School Physics; Earl Barrett's TPT article & checklist; see [modeling.asu.edu](http://modeling.asu.edu) and [increasephysics.weebly.com](http://increasephysics.weebly.com)).

### **Timeline:**

- \* September & October 2017: Jane invited participants. Melissa made a pre-registration form on google docs. Zak and Melissa designed the workshop, with mentoring by Earl Barrett. Zak and Melissa bought lab equipment. Zak made a free website. Melissa set up "Arizona Slack".
- \* Saturday, November 4: workshop was held at ASU: 9 am to 1 pm.
- \* November: Jane and Melissa invited Arizona physics teachers to join Arizona Slack.

**Agenda** (on 3 Powerpoints at <http://increasephysics.weebly.com/workshop-schedule.html> )  
Powerpoint #1.

\* Introduction to Zak and Melissa.

\* *Cool demo #1: Mystery Tube* (promotes critical thinking and scientific reasoning)

\* Student recruitment basics: How can you quickly communicate to prospective students:

Why should they take your physics course?

How can physics help them?

First, clarify your philosophy as a physics teacher: What effect are you having on students and their learning? Then formulate an elevator speech. Start with WHY (Zak showed the TED talk of Simon Sinek.) Then HOW. Finally WHAT. Zak showed his elevator pitch, then each teacher wrote an elevator pitch. The group shared them orally.

\* *Cool demo #2: Balancing Nails*

\* GoDirect by Vernier: a demonstration of new probes, by Larry Dukerich and Ann Hammersly, retired Phoenix physics teachers who are consultants for Vernier Software & Technology.

\* BREAK, for snacks provided by Zak and Melissa (at their own expense).

Powerpoint #2.

\* Why aren't kids taking physics? Results of Earl Barrett and Larry Dukerich's survey in 2017 of 75 Arizona high school guidance counselors and 875 chemistry students. Read their letter to Arizona businesses, at <http://modeling.asu.edu/AZ/AzPhysicsCrisis-ForBusinesses.htm> .

\* What barriers exist in your classroom, school, district, and community? (Teachers wrote on 4 wall whiteboards. See pictures on Zak's INCREASE PHYSICS website.) Discussion.

\* *Cool demo #3: Singing Rods*

\* How Zak and Melissa recruit students for their physics courses. See

[http://modeling.asu.edu/AZ/Zak\\_Melissa-RecruitPhyStudents.htm](http://modeling.asu.edu/AZ/Zak_Melissa-RecruitPhyStudents.htm) or download in pdf.

\* BREAK

Powerpoint #3.

\* *Cool demo #4: Copper Pipe and Magnets*

\* Making physics programs stand out.

    Melissa's signature projects: Punkin' Chunkin', Cardboard Boat Regatta.

    Zak's signature projects: Physics Olympics, Cardboard Cars, Water Balloon Human Target.

    (Zak and Melissa gave details & told how projects attract students & inform counselors.)

**Behind the scenes** (i.e., not explicitly articulated during the workshop):

**Guiding principles** for the workshop:

\* A key to attract students is to connect physics with the physical world outside the classroom.

This makes science pertinent to students' lives. A bridge built between class and the outside world encourages students to use scientific principles and models on a daily basis, long after they leave school. Students learn that science is not magical but rather an integral part of their lives.

\* Every demonstration was based on a *prediction of performance* based on science/math.

\* Focus was on the *process*, because science is more a way of *thinking* than a specific content.

**Guiding questions** posed by Earl Barrett, resulting from his funded research in 2016-17:

\* Students value advice of counselors. Counselors think students are so weak in math they shouldn't take physics, but admit they have no contact with physics teachers. How much contact

do YOU have? Solution: Can a counselor meet with each science discipline and spend a day in class observing methodology? Then guide other counselors in questions about science selections.

\* Counselors provide inaccurate information to students about the need for physics in their major. Career guides like AzCIS ECAP give wrong information. How can that be fixed?

\* Most AZ physics teachers have less than a full schedule of physics, and math departments have a hard time filling the 4th year requirement. Any school district can declare that physics can count as that math class. Physics won't then meet the third science requirement, but who cares! Solution is to persist in talking up the idea, and get math department support.

\* Do your colleagues support physics? The biology teacher encourages students to take AP biology, the chemistry teacher AP chemistry -- but are they doing this so kids will take their class instead of physics? What is your take? Solution: do your own research online to see the AP college credit and scores needed for credit, and give the information to administrators, counselors, students and parents. [https://catalog.asu.edu/credit\\_exam](https://catalog.asu.edu/credit_exam)

\* Counselors support a physics class for average students that emphasizes developing math skills through practical applications and project-based experiences. Can this course be started?

\* Students say they have no clue what physics is. This is the linchpin for immediate growth. Where and how should they be getting this information? What works at your school? Social media? How can you coordinate with CTE teachers, to make physics pertinent to STEM careers?