“If opportunity doesn’t knock, build a door.”

Milton Berle

My path to Active Dissemination of Active Learning
I will begin by briefly tracing the path that brought me here and thanking several very special people who have helped me along the way.

Then I will share some ideas on active dissemination of effective, research-validated active learning strategies.
In the beginning . . . 1971—Completed my PhD at MIT, joined Western Illinois University faculty—along with Dick Peterson (our distinguished Melba Phillips Medal winner who you will hear from soon).

1972—Became the second physicist in the Natural Science Department at University of Michigan, Dearborn.

As Physics Chair, started the physics program working with new faculty who I hired, including the late Paul Zitzewitz (former AAPT Treasurer).

There I met . . .
Orin Gelderloos
Professor of Biology
University of Michigan, Dearborn
Orin is a Field Biologist and Environmental Scientist

I thank him for three very important lessons:

1. Even students in a course for non-science majors can be scientists—learning from their observations.

2. Demand that your students work and think: don’t ever compromise on this.

3. Stick to your convictions about effective learning strategies, despite ridicule and attacks.
I tagged along with his Field Biology class one summer.

I noticed how he loved asking students to describe the special adaptations of plants in challenging habitats, like a campus parking lot . . .

Orin also has a great sense of humor.
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I tagged along with his Field Biology class one summer.

I noticed how he loved asking students to describe the special adaptations of plants in challenging habitats, like a campus parking lot . . .

Where he had placed them!
Orin invited me to become Director of the interdisciplinary, general education nonscience majors’ course, *Matter, Energy and Life (MEL).*
120, 121. Matter, Energy, and Life. Must be elected sequentially. (4 each).
These courses treat the cyclic energy mechanisms of life on the earth from chemical and physical points of view.
Imagine how cocky I felt at 29 years of age becoming

DIRECTOR OF MATTER,
ENERGY AND LIFE!
MEL was taken by every non-science major at UM-D with a total enrollment of 400+ each year. Developed and taught by an interdisciplinary team from the Natural Science Dept. It was hard work, and very challenging to a physicist who had studied K→PhD without a break.

It was also lots of fun!
1. Examining the adaptations of weeds in the UM-D Natural Area.
2. Exploring genetic selection in food plants, by cutting apart fruits and vegetables at the Detroit Eastern Produce Market.
3. Studying geologic features, on a drive between Detroit and Ann Arbor.
4. And many others . . .
I introduced labs on forms of energy and energy conversion, energy contents of foods, power and efficiency of electric devices and energy policy using a simulator developed by the U.S. Department of Energy.
I contributed my first physics education paper at Winter 1975 AAPT Meeting in Anaheim, CA:

“Physics in an Integrated, Interdisciplinary Science Course for Nonscience Majors”
The late Arnold Aarons was in the audience, neck and face turning redder and redder until—
The late Arnold Aarons was in the audience, neck and face turning redder and redder until—

“This is just another of these absurd courses that dumb-down the physics with no attention to effective pedagogy!!”

Needless to say, I learned:

1. To Pay more attention to learning strategies!
2. To be less cocky!!
MEL also resulted in my first papers in AJP:


... and in *The Physics Teacher*. 
Energy experiments for nonscience majors

David R. Sokoloff

In the last half-dozen years, a number of new introductory science courses have been offered for nonscience majors. Environmental problems have been popular topics for such courses, and most have included material on energy. A number of textbooks devoted entirely to energy have appeared recently, giving the instructor a wealth of lecture material. But, while several of these new courses have had a lab, there have been few new simple energy laboratory experiments reported in the literature. This paper describes four such experiments which have been developed as part of an interdisciplinary general science course. Since these experiments make use of common, inexpensive materials and equipment, they can easily be adopted as the core of an energy laboratory, even at a school with a limited budget.

The course

For the past six years, most of the freshman nonscience majors at the University of Michigan-Dearborn have met their science distribution requirement by taking the team-taught, interdisciplinary laboratory science course, Matter, Energy and Life (MEL). The philosophy, content and structure of this course have been described in detail. The teaching team of biologists, chemists, and physicists considers the main objective to be the development of scientific literacy among this group of students, most of whom will take no further science courses. They have agreed on a list of basic scientific principles with which a citizen should at least have some familiarity, and these principles are illustrated in MEL by applications to everyday problems.

Energy principles, and the applications of these, have been a very important part of MEL. Over the course of a year students are exposed to material on the various forms of energy, energy conversion, energy flow, efficiency and the laws of thermodynamics, energy resources of the earth, energy usage, energy conservation, and future energy technologies.

In addition to the three hours of lecture, the 400+ students meet each week in groups of 20 for a three-hour laboratory session. The laboratory has always been considered to be the most important and innovative part of MEL, because it provides hands-on applications of the concepts discussed in lecture, and because most of the laboratory exercises have been developed by the teaching staff. In keeping with the course philosophy, wherever possible, experiments make use of familiar items rather than esoteric apparatus and supplies. A complete annotated list of the 36 experiments developed for the course, as well as a list of lecture units, can be found elsewhere. The remainder of this paper will focus on four laboratory exercises designed to complement the lecture material on energy.
1978—Tenure and promotion at UM-D but . . .

I decided to head West and transitioned to Associate Professor and Associate Physics Department Head at the University of Oregon.

GO DUCKS!!!

Why???

That’s another story over beers sometime!
1986—I started working with . . .

Ron Thornton
Tufts University

Priscilla Laws
Dickinson College
I am very pleased that both Priscilla and Ron and here so that I can thank them publicly.

Like all successful trios . . .
Our skills complement each other remarkably well!

I couldn’t have asked for two more creative colleagues to work with over the last 33+ years!!

And let’s face it, I probably wouldn’t be here without them!!!

Thank you Ron and Priscilla!!!

And its been a fun and exciting adventure with them right from the beginning!!!
Here's how it all began: 1986-87 on sabbatical leave at Cal Poly.
Here's how it all began: 1986-87 on sabbatical leave at Cal Poly.

- I was working with Ron, using sensors originally developed for Apple II computers. (Remember???)
- I taught two lab sections, using borrowed computers wheeled in each week.
- Ron and I revised and greatly expanded lab activities in mechanics and heat and temperature originally developed at TERC.
- Each week I FedExed my labs to Ron for his comments. (No e-mail or internet back then! 😞)
- Each week his comments arrived back the afternoon before the lab meetings.
- Each week I ran to the printing department, apologized for the last-minute delivery, and promised it would never happen again!
But, right from the beginning, we were encouraged by the amazing conceptual learning gains we saw on the Force and Motion Conceptual Evaluation (FMCE) with these lab activities.
The rest is history . . . **RealTime Physics**

Co-authored with Priscilla and Ron

- Research-validated, guided inquiry, active learning laboratory curriculum.
- Adopted by over 200 departments (and many others have used pre-Wiley, open-source versions).
RealTime Physics (RTP)

1. Guides students to construct physical models based on observations of the physical world, often using computer-based tools.
2. Labs are sequenced and build upon previous knowledge.
3. Fits within the traditional structure of the introductory course.
4. Includes pre-lab preparation sheets and homework designed to reinforce concepts and skills.
5. Is compatible with most computer data acquisition systems.
6. Includes Instructor’s Guide for each module.
Interactive Lecture Demonstrations (ILDs)

1. First developed in 1991 to address traditional instruction in large lectures at Oregon and Tufts.

2. Eight-step process incorporating the same learning cycle used in RTP: prediction, observation, discussion and synthesis.

3. Research-validated: significant conceptual learning gains from the beginning.

I would be remiss if I did not thank Lillian McDermott (2001 Oersted and 2013 Melba Phillips Medalist), because I doubt that I would be here today without

1. The inspiring work that she and her Physics Education Group published beginning in the 1980’s, and

2. Her personal support in the advancement of my career on a number of occasions.
I didn’t really know the late Frank Collea that well, but (likely unbeknownst to him) he had a great influence on my life.

Project Officer on my first NSF science education grant (1984–86).

Later, Co-Director of NSF National Chautauqua short course program.

Frank was never shy bragging about his many accomplishments . . . and I learned to not be hesitant asking him for what I needed (or wanted).
1993 at NSF Project Directors’ Meeting:

Frank: “You, Ron and Priscilla should teach a Chautauqua course.”

Me: “When?”


1997 Frank: “I just sent a team to Hawaii for a Chautauqua course.”

Me: “When are you going to send us?”

June, 1998, Chautauqua at Kapiolani CC.
1998 Frank: “I sent Fred Goldberg, Jim Minstrel and Alan van Heuvelen to Australia.”

Me: “When are you going to send us?”

January, 1999 Ron, Priscilla and I presented short courses in Sydney and Melbourne.

More on this in a moment . . .

2020 will be the 27th consecutive year that we have offered at least one 2½ day Chautauqua course.

Now a pause for a shameless, self-serving ad:
An invitation to attend

Active Based Physics

ACTIVE LEARNING SHORT COURSE

Active Learning in Introductory Physics Courses: Research-Based Strategies that Improve Student Learning

July 12-14, 2020  Portland, Oregon

Presented by:
David Sokoloff, University of Oregon
Ronald Thornton, Tufts University
It was at the Chautauqua in Melbourne in January, 1999 that I first met our host . . .

Cherished colleague since then!

Alex Mazzolini  
Prof. of Physics

November, 2011  
Volcanoes Nat’l Park  
Rwanda
Alex is a gifted educator—committed to active engagement with his students, with a keen sense of the needs of educators in the developing world!
We discovered immediately that not only did we share a philosophy on the most effective strategies for student learning, but . . .
We both enjoyed shopping for "Rolex" watches at street markets...
we both enjoyed collecting musical instruments from around the world . . .
... and we have very compatible sarcastic senses of humor. 😊
I'm very pleased that Alex will receive the International Commission on Physics Education (ICPE) Medal (jointly with Pratibha Jolly) at the 3rd World Conference on Physics Education in Hanoi in July!

November, 2013
Addis Ababa, Ethiopia
Alex asked if we could extend short course in Melbourne for two extra days to work with 12 faculty flown in from SE Asia by the Asian Physics Education Network (ASPEN).

Two extra days in Melbourne? 🤔 That’s a no brainer! 😃

As a result:

- Our style of Active Learning adopted by ASPEN and UNESCO.
- November, 1999—I was invited to present at ASPEN active learning workshop in Hanoi.
- Summers 2000 and 2001—Ron, Priscilla and I were invited to present workshops in Chonju, South Korea.
- December, 2002—I was invited to present at ASPEN active learning workshop in Kandy, Sri Lanka.
Besides reinforcing my convictions about active learning, Alex

1. Modeled how to work effectively with educators from the developing world, and
2. Literally opened a world of opportunities for me to pursue this endeavor internationally!
May, 2004—Invited to UNESCO Paris to consult on a new faculty enhancement project in developing countries—Active Learning in Optics and Photonics (ALOP).

A week in Paris consulting with UNESCO? 😐
Another no brainer!!! 😄😄😄
And the rest is history . . .

Defence Institute of Advanced Technology (DIAT-DU) &
Faculty Development Centre
UGC-Human Resource Development Centre

“Active Learning in Optics and Photonics –
(ALOP)”, ALOP India 2019
(Under the framework of the UNESCO/ICTP International Program for Physics Education)

08 – 13 December, 2019

Organised by:
Department of Applied Physics, DIAT (DU), Pune

Sponsored by:
SPIE
ICTP
The Abdus Salam International Centre for Theoretical Physics
United Nations Educational, Scientific and Cultural Organisation
37 ALOPs to over 1100 university and secondary faculty since 2004

Thank you Alex!!!
Other members of the ALOP Facilitator Team

Alex Mazzolini
Australia

Vengu Lakshminarayanan
US/Canada

Ivan Culaba
Philippines

Joel Maquiling
Philippines

Souad Lahmar
Tunisia

Zohra Ben Lakhdar
Tunisia
Thank you also to my partner, Christine Chaillé.

• December 14, 2011—met for coffee at PDX—I was off to ALOP Nepal.
• We’ve been together ever since.
• Expert in early childhood science/math who studied with Piaget.
• NY Yankees fan!!!
• We share love of travel, among many other things!

June 29, 2019
London, England
Besides tolerating my workaholism (she’s also a workaholic) and my sarcasm, she’s taught me:

1. Even young children can be scientists, and
2. I should be more accepting and patient to all—yes, even Red Sox fans!!!
Active Learning Dissemination and Professional Development

Since 1987, my colleagues and I have presented nearly 300 extended active learning institutes, workshops, schools and short courses attended by over 8000 college/university and secondary faculty.
But first a word from our major sponsors:

These two also contributed significantly to our PER and curriculum development work!

Thank you!!!
Objectives of Active Learning Professional Development

• To introduce faculty to active learning strategies.
• To model active learning environments.
• (To introduce faculty to computer-based tools for data collection, display and analysis, modeling and video analysis.)
• To introduce faculty to active learning curricula.
• To give faculty opportunities to practice the use of active learning strategies, curricula (and tools).
• To provide faculty opportunities to “fill the gaps” in their understanding of physics.
• To introduce faculty to action research.
• To provide faculty support for implementation of the new strategies (and tools).
• To encourage faculty to disseminate active learning to colleagues.
In the beginning . . . the first professional development workshop Ron and I presented, Summers 1987, 1988
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National Microcomputer Based Laboratory (MBL) Institute for Teachers of Physics
Tufts University
In the beginning . . . the first professional development workshop Ron and I presented, Summers 1987, 1988

National Microcomputer Based Laboratory (MBL) Institute for Teachers of Physics
Tufts University

- 20 exemplary U.S. high school physics teachers.
- Sponsored by U.S. Department of Education.
- Pioneered many of the features that would be continued successfully in future workshops.
Model for Successful Professional Development in Active Learning

• Workshop begins with teachers taking conceptual evaluation tests.

• As part of the workshop, participants work through the actual student curricular materials.

• If time permits, participants are given a chance to practice active learning strategies with feedback, by presenting to the workshop group.

• Participants take all the curricula and one complete set of equipment home with them, and receive detailed information on procuring or constructing additional sets.

• Participants are encouraged to share their experiences with their colleagues back home.
Advantages of this Model

• Participants are introduced to conceptual testing and action research, and made aware of their students’ common conceptual problems . . . (And their own!)

• Participants are familiarized with the equipment and curricular materials, and, when necessary, have gaps in their understanding filled.

• Participants leave the workshop having practiced active learning strategies.

• Participants leave the workshop with the curricula and equipment they need for implementation.

• There are often incentives for “spreading the word.”

We were gratified to see members of the first National MBL Institute group time and time again at national AAPT meetings presenting workshops.
And the rest is history:

• 6 major, national summer institute programs over 22 years (1987-2008).

• Over 60 full or half-day workshops at almost every AAPT national meeting since 1987, enrolling over 1200 faculty.

• 37 Chautauqua short courses since 1994, enrolling over 1000 university and secondary faculty.

• 37 ALOP workshops since 2004, enrolling over 1100 university and secondary faculty from over 30 different countries.
In addition:

- ILD tutorial sessions at almost every AAPT national meeting since 1988, around 60 total, over 2500 attending. (Next one at 12:30 in Grand Sierra F.)
- Presentations at 21 AAPT/APS New Faculty Workshops since 2006 to an estimated 1500 university faculty.
- Two-week Fulbright Specialist faculty development projects in Argentina (2011) and in Japan (2018), including multiple workshops.
- And others . . .
Are Workshops of this Type Effective?

Summary of independent evaluator’s Final Report for the NSF-funded Activity Based Physics Faculty Institutes (2005-2008):

“... given the extremely positive feedback participants gave regarding the workshops and their post-ABPFI experiences with activity-based teaching, combined with the number of faculty trained over the course of four years, it would be hard to describe the ABPFI as anything but extremely successful overall. By the end of the grant period, 170 college instructors had attended an ABPFI workshop. As a result, nearly 20,000 students are now impacted by ABPFI-trained faculty each year, including over 5,000 minority students and nearly 9,000 women.
All the peer-reviewed quantitative research on the impact of activity-based learning in physics education corroborates the qualitative reports that ABPFI-trained faculty almost universally give: activity-based pedagogy leads to substantial gains in student learning.

... thousands of students, many of them members of traditionally underrepresented populations, are able to take advantage of these learning gains every year as a result of ABPFI ...”
Here’s what Active Learning looks like . . .
March, 2005
Monastir, Tunisia
July, 2007
Dar Es Salaam, Tanzania
Fortune cookie with my lunch at Oregon AAPT section meeting in October

Only those who dare, truly live.
Trans: “A little chutzpah never hurts along the way!”
Finally, I want to thank my children, Emily and Jonah.

September, 2019
Athens, Greece
for tolerating—and frequently sharing—my travels over the years.

July, 2012
Uluru, Australia
for constantly reminding me why our work in education remains so important,

August, 2014
Yokohama, Japan
for helping me to stay young and silly.

December, 2014
Kissimmee, Florida
for sharing many exciting adventures with me,

August 21, 2017
Corvallis, Oregon
and for always bringing me beautiful music!!
Thank you again for the honor and for your attention!