AAPT
PHYSICS EDUCATION

2014 WINTER MEETING

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2014 AAPT Winter Meeting

Orlando, FL
January 4–7, 2014

Rosen Plaza Hotel, Orlando

American Association of Physics Teachers
One Physics Ellipse
College Park, MD 20740
301-209-3333
www.aapt.org

Welcome to Orlando!

Welcome to Orlando and the 2014 AAPT Winter Meeting: "The Magic of Physics"!

The 2014 Winter Meeting celebrates the wonder that is physics. The Orlando area is filled with excitement and magic—and the physics behind the magic, whether it's space flight or thrill rides. I hope that you've scheduled some time before or after the meeting to visit the Kennedy Space Center and some of the theme parks. The Rosen Plaza, the conference hotel, is across the street from Pointe Orlando, a major dining, entertainment, and shopping complex. Orlando's I-Ride Trolley stops outside the hotel and there is complimentary transportation to some of the theme parks.

At the meeting there are great plenary and award talks. Don Pettit, Sunday's plenary speaker, is a NASA astronaut who, while aboard the International Space Station, conducted out-of-this-world physics demos that appear as the 14-episode Science off the Sphere video series. Phillip Metzger, a NASA physicist and lab manager, will be speaking Monday on Preparing Physicists for the Industrial Revolution in Space. Monday will also feature the Richtmyer Memorial Award presented to Sir Michael Berry, noted for his communication of the beauty of quantum mechanics to broad audiences. Be sure to stay through Tuesday to see Dean Zollman receive the Oersted Medal and to attend the annual Symposium on Physics Education and Public Policy.

Special events begin Saturday with the evening Opening Reception. Sunday is the High School Teachers' Day and the schedule is packed with events and sessions of particular interest to high school teachers. Also on Sunday are the First Timers Gathering, Early Career Professionals Speed Networking, and SPS Awards Reception. The semi-annual Fun Run/Walk will be held Monday benefitting the Melba Phillips Medal.

With poster sessions, approximately 20 workshops and 60 paper sessions, there is something of interest for everyone. I encourage you to attend one or more of the 18 area committee meetings, which are open to all. Don't forget to stop by the exhibit hall to thank our exhibitors and view their wares—and for a "second breakfast."

Winter Meeting 2014 should be a great meeting. I hope that you experience the wonder, the excitement—and the magic—of Physics.

Enjoy!

Mary Mogge
Program Chair 2014 Winter Meeting–Orlando
Vice President, American Association of Physics Teachers

AAPT Sustaining Members

The American Association of Physics Teachers is extremely grateful to the following companies who have generously supported AAPT over the years:

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Special Thanks

— AAPT wishes to thank the following persons for their dedication as paper sorters for the Winter Meeting:

Daryl McPadden – Rep for the Committee on Research in Physics Education
Toni Sauncy – Director, Society of Physics Students
Adrienne Traxler – Rep for the Committee on Research in Physics Education
Connie Wells – Chair, the Committee on Teacher Preparation

— AAPT also wishes to thank *Becky Thompson-Flagg* of APS for her efforts in arranging Dr. Donald Pettit's keynote presentation.

— Thank you to Anne Murdaugh for organizing the workshops at Rollins College.

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College Park, MD

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Facebook/Twitter at Meeting

We will be posting updates to Facebook and Twitter prior to and during the meeting to keep you in the know! Participate in the conversation on Twitter by following us at **twitter.com/AAPTHQ** or search the hashtag **#aaptwm14**. We will also be posting any changes to the schedule, cancellations, and other announcements during the meeting via both Twitter and Facebook. Visit our Pinterest page for suggestions of places to go and things to do in Orlando. We look forward to connecting with you!

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Contacts:

Meeting Registration Desk: 407-996-2413
AAPT Programs & Conferences Dept: 301-209-3340; programs@aapt.org
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One Physics Ellipse
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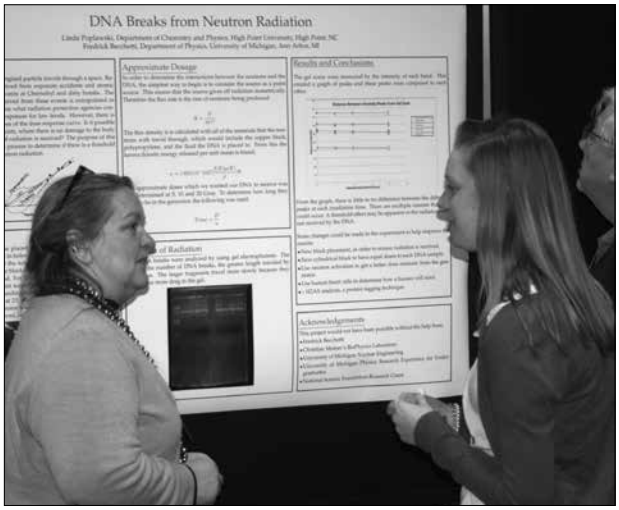
First time at an AAPT meeting?

Welcome to the 2014 AAPT Winter Meeting in Orlando! Everyone at AAPT hopes you fulfill all the goals you have for attending this meeting. To help you plan your meeting activities, the following information and suggestions have been developed.

- Being at your first National Meeting can be a lonely experience if you don't know anyone. AAPT members are friendly people, so do not hesitate to introduce yourself to others in sessions and in the hallways. It is fun and rewarding to establish a network of other physics teachers with whom you can talk and share experiences. This is especially true during lunch and dinner.
- Area Committee meetings are not only for members of the committee, but also for friends of the committee. You are welcome to attend any Area Committee meeting. You should be able to find one or two committees that match your interests. Their meeting times are listed on page 17 in this guide. Area Committee meetings are often relatively small and are a great place to meet other people with interests similar to yours.
- Be sure to attend the First Timers' Gathering from **12–1 p.m. Sunday in Salon 4**. It is a wonderful way to learn more about the meeting and about AAPT.
- Awards and other plenary sessions have distinguished speakers and are especially recommended. Invited speakers are experts in their fields and will have half an hour or more to discuss their subjects in some depth. Posters will be up all day and presenters will be available during the times indicated in the schedule. Contributed papers summarize work the presenters have been doing. You are encouraged to talk to presenters at the poster sessions or after the contributed paper sessions to gain more information about topics of interest to you. Informal discussion among those interested in the announced topic typically will follow a panel presentation, and crackerbarrels are entirely devoted to such discussions.
- Be sure to make time to visit the exhibits in the Exhibit Hall. This is a great place to learn what textbooks and equipment are available in physics education.



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Workshops at AAPT Winter Meeting 2014

PRESENTERS Dr. Damian Pope & Kevin Donkers

FOCUS Senior Physics, AP Physics, IB Physics

1 **PERIMETER INSTITUTE: HANDS-ON WAVE-PARTICLE DUALITY**

Sunday, January 5th, 2014 I 12:00PM – 1:00PM

The wave-particle duality is one of the deepest mysteries of quantum mechanics. Come explore a hands-on activity that introduces students to the concepts involved in the wave-particle duality.

2 **PERIMETER INSTITUTEUTE: SPICING UP CLASSICAL PHYISCS WITH MODERN EXAMPLES**

Sunday, January 5th, 2014 I 2:00PM – 3:00PM

Tired of using the same examples to illustrate concepts in classical physics every year? We will show you how to use dark matter in your lessons about circular motion, how to do nuclear physics using electric fields, and how to detect sub-atomic particles using conservation of momentum. Come and see how modern physics can be explored within classical curriculum in these easy-to-adapt examples for your classroom.

3 **PERIMETER INSTITUTE: CURVED SPACE-TIME IN THE CLASSROOM**

Monday, January 6th, 2014 I 12:00PM – 1:00PM

Bring Einstein's curved space-time model for gravity into your classroom using masking tape and balloons to explain free fall and predict time dilation, as observed in GPS calculations.

4 **PERIMETER INSTITUTE: MEASURING PLANCK'S CONSTANT**

Monday, January 6th, 2014 I 1:00PM – 2:00PM

Come explore Measuring Planck's Constant, using light emitting diodes (LED's), your students will accurately measure Planck's constant, the fundamental constant that defines the scale of quantum physics.

All workshops will be held in Salon 13

Visit the PI STORE at
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Orlando – The City Beautiful

Orlando, FL, the county seat of Orange County, FL, is nicknamed "The City Beautiful" and its symbol is the fountain at Lake Eola. Also called "The Theme Park Capital of the World" you will find Walt Disney World Resort (opened by the Walt Disney Co. in 1971), the Universal Orlando Resort (which consists of two parks, Universal Studios Florida and Islands of Adventure, as well as other attractions, including City Walk), SeaWorld, Gatorland, and Wet 'n Wild Water Park.

History

Before European settlers arrived in 1536, Orlando was sparsely populated by the Creek and other Native American tribes. The city's history dates back to 1838 and the height of the "Seminole Wars." The U.S. Army built Fort Gatlin south of present day Orlando to protect the area. By 1840, a small community had grown up around the fort. It was known as Jernigan, named after the Jernigan family, who had established the first permanent settlement in the area. Jernigan had a post office that was established by May 30, 1850. Six years later, the community officially changed its name to Orlando. The Town of Orlando was incorporated in 1875 with 85 inhabitants, 22 of whom were qualified voters.

The period from 1875 to 1895 is remembered as Orlando's "Gilded Era," when it became the hub of Florida's citrus industry. But a great freeze in 1894-1895 forced many owners to give up their independent groves, thus consolidating holdings in the hands of a few "citrus barons" who shifted operations to the south.

Orlando, as Florida's largest inland city, became a popular resort during the years between the Spanish-American War and World War I.

During World War II, a number of Army personnel were stationed at the Pine Castle AAF. Some of these servicemen stayed in Orlando to settle and raise families. In 1956 the aerospace/defense company Martin Marietta (now Lockheed Martin) established a plant in Orlando.

Orlando is close enough to Patrick Air Force Base, Cape Canaveral Air Force Station, and Kennedy Space Center for residents to commute to work from the city's suburbs. Because of its proximity to the "Space Coast" near the Kennedy Space Center, many high-tech companies have shifted to the Orlando area.

Perhaps the most critical event for Orlando's economy occurred in 1965, when Walt Disney announced plans to build Walt Disney World.

(compiled from http://www.exploreorlandoflorida.com/orlando_history.html)

Education

The following colleges and universities are located in and around Orlando:

University of Central Florida, Rollins College (in Winter Park), and *Valencia College.*

Things to do in Orlando:

◆ **Orange County Regional History Center:** Located in the heart of downtown Orlando, the History Center offers three floors of dynamic permanent exhibits exploring 12,000 years of Central Florida history. The fun continues with limited-run and nationally important exhibitions scheduled throughout the year. 65 East Central Blvd. • Orlando, FL 32801; *www.thehistorycenter.org.*

◆ **Orlando Science Center:** The Science Center encourages learning in a fun way. With four floors of exhibits, giant screen movies and engaging live programming, the Science Center is the perfect family destination.
777 E. Princeton St. • Orlando, FL 32803; *http://www.osc.org/*.

◆ **Bok Tower Gardens:** Nearly 50 acres of gardens designed by Frederick Law Olmsted Jr. surround Pinewood Estate, a 20-room, Mediterranean-style 1930s winter retreat, and the 205-foot art deco and neo-Gothic Singing Tower. The pink marble and coquina stone architectural treasure houses one of the world's finest carillons. Located about 30 minutes from Orlando, Bok Tower Gardens is one of Florida's first attractions and best kept secrets. Voted Florida's "Best Garden," it is a National Historic Landmark. (*http://boktowergardens.org/*)

◆ **Orlando Theme Parks:** You will find the world's top theme parks in Orlando. From the classic Magic Kingdom® Park at Walt Disney World® to The Wizarding World of Harry Potter™ at Universal Orlando® Resort, there's a world for everyone. Don't forget SeaWorld® Orlando or LEGOLAND® Florida, one of Orlando's newest theme parks. And with multiple new projects on the horizon, even the most die-hard visitors to Orlando theme parks will always find new ways to create lasting memories.

◆ **Golf:** With more than 170 golf courses, over 20 golf academies and some of the world's most prestigious tournaments, Orlando is a golfer's paradise. In addition to being home to more pro golfers than any other city in the world, Orlando was voted the "North American Golf Destination of the Year" by the International Association of Golf Tour Operators in 2010. And with stunning courses designed by the likes of Nicklaus, Dye, and Fazio, Orlando offers visitors an exclusive golfing experience not found anywhere else.

◆ **Kennedy Space Center at Cape Canaveral:** Only 45 minutes from Orlando, tours are offered of NASA's launch headquarters, located on a huge island wildlife refuge eight times the size of Manhattan. Includes the Shuttle Launch Experience, two IMAX films, all shows and exhibits, plus the Astronaut Hall of Fame.
http://www.kennedyspacecentertours.net

(Compiled from www.visitorlando.com)

Bus Schedule for AAPT Workshops, leave from Convention entrance near Registration

Saturday, January 4

Buses departing Rosen Plaza to Rollins College

- 7:15 a.m.
- 7:25 a.m.
- 12:20 p.m.

Buses departing Rollins College, returning to Rosen Plaza

- 12:15 p.m.
- 1:00 p.m.
- 5:15 p.m.
- 5:30 p.m.

Sunday, January 5

Buses departing Rosen Plaza to Rollins College

- 7:15 a.m.
- 7:25 a.m.

Buses departing Rollins College, returning to Rosen Plaza

- 12:15 p.m.
- 12:40 p.m.

Rosen Plaza Hotel
9700 International Drive
Orlando, FL 32819

Rollins College
1000 Holt Avenue
Winter Park, FL 32789

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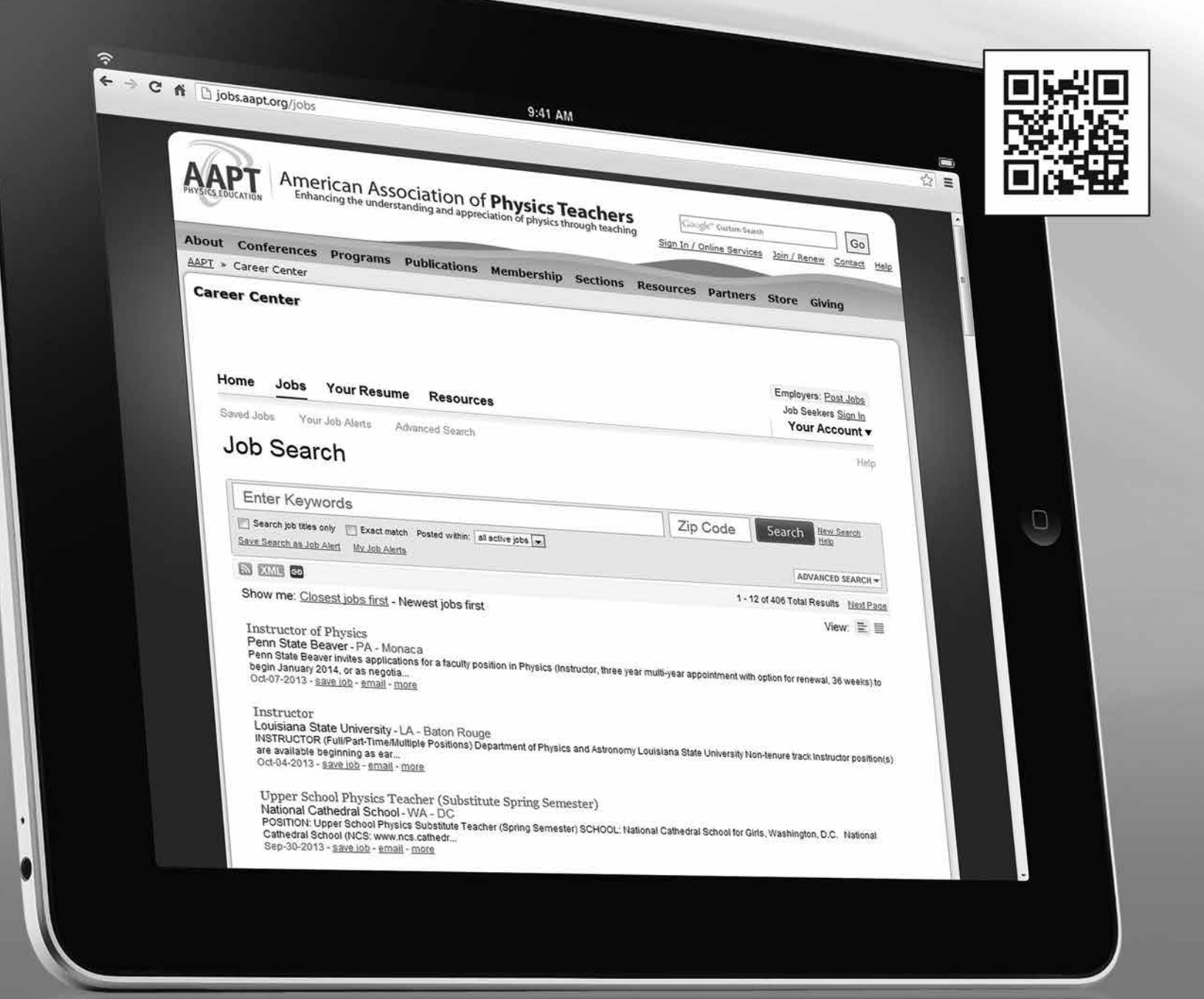

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Meeting-at-a-Glance

Meeting-at-a-Glance includes sessions, workshops, committee meetings and other events, including luncheons, Exhibit Hall hours and snacks, plenary sessions, and receptions. All rooms will be in the Rosen Plaza Hotel, Orlando. Workshops on Saturday and Sunday will be at Rollins College, Bush Science Center building. (Tutorials will be held at the Rosen Plaza.)

FRIDAY, January 3

4–7 p.m.		**REGISTRATION**	**Grand Ballroom Foyer**
5–6 p.m.		New Executive Board Orientation	Salon 4
6–10 p.m.		Executive Board I	Salon 4

SATURDAY, January 4

7 a.m.–4 p.m.		**REGISTRATION**	**Grand Ballroom Foyer**
8–10 a.m.		Publications Committee	Salon 9
8–10 a.m.		Meetings Committee	Salon 11
		(WORKSHOPS W01-W27 ARE AT ROLLINS COLLEGE, bus schedule, p. 10)	
8 a.m.–12 p.m.	W08	Ring Flinger Make-n-Take	BSC 160
8 a.m.–12 p.m.	W09	TIPERs in the High School Classroom	BSC 164
8 a.m.–12 p.m.	W11	A Potpourri of Simulation	BSC 310
8 a.m.–5 p.m.	W01	Research-based Alternatives to Traditional Physics Problems	BSC 228
8 a.m.–5 p.m.	W03	Physics and Astronomy by Design	BSC 210
8 a.m.–5 p.m.	W04	Reformed Teaching Observation Protocol (RTOP)	BSC 202
8 a.m.–5 p.m.	W06	Teaching Science with LEGO Mindstorms: FIRST Steps and Beyond	BSC 101
8 a.m.–5 p.m.	W07	Inquiry-based Learning Strategies that Support the New AP Physics 1&2 Courses	BSC 180
10 a.m.–2 p.m.		Orlando Science Center Tour	offsite
10:30 a.m.–1:30 p.m.		Resource Letters Committee	Salon 12
10:30 a.m.–4:30 p.m.		Executive Board II	Salon 4
1–5 p.m.	W12	Using ComPADRE	BSC 301
1–5 p.m.	W13	Sketch N' Etch	BSC 105
1–5 p.m.	W14	Ben Franklin is my Lab Partner	BSC 160
1–5 p.m.	W15	Implementation: Physics for Life and Health Sciences	BSC 310
1–5 p.m.	W16	Distance and Remote Labs	BSC 208
3–4:30 p.m.		Nominating Committee I (closed)	Salon 9
5–6:30 p.m.		ALPhA Committee	Salon 11
5–8 p.m.		Area Chairs Orientation and Programs I	Salon 3
5:30–8 p.m.		Section Representatives and Officers	Salon 12
7:30–9 p.m.		**REGISTRATION**	Grand Ballroom Foyer
8–10 p.m.		SPS Research and Outreach Poster Session	Grand Ballroom A
8–10 p.m.		Exhibit Hall Opens/ Opening Reception	Grand Ballroom A

SUNDAY, January 5

7 a.m.–4 p.m.		**REGISTRATION**	**Grand Ballroom Foyer**
8–9 a.m.		Physics Bowl Committee	Salon 3
8–9:30 a.m.		Review Board	Salon 6
8 a.m.–12 p.m.	W19	A Kaleidoscope of Great Online Tools for Teaching Physics	BSC 310
8 a.m.–12 p.m.	W20	Exploring the Milkyway Way Using Small Remote Radio Telescopes	BSC 160
8 a.m.–12 p.m.	W21	In Home Low-cost Labs	BSC 210
8 a.m.–12 p.m.	W22	Using Invention to Promote Mathematical Thinking	BSC 228
8 a.m.–12 p.m.	W23	Activities for Engaging Girls in Physical Science	BSC 105
8 a.m.–12 p.m.	W24	iPhone and iPad App Development	BSC 212
8 a.m.–12 p.m.	W26	New RTP and ILD Tools and Curricula: Video Analysis, Clickers and E&M Labs	BSC 180
8 a.m.–12 p.m.	W27	Engaging Astronomy Students with Lecture Tutorials	BSC 208
9 a.m.–2 p.m.		Spouse/Guest Scenic Boat Tour of Winter Park, FL	offsite
10 a.m–5 p.m.		**Exhibit Hall Open**	Grand Ballroom A
10–10:30 a.m.		Exhibit Hall Morning Break (10:15 a.m. Raffle Drawing)	Grand Ballroom A
10:30–11:30 a.m.		Governance Structure Committee	Salon 3
10:30 a.m.–12 p.m.		Venture/Bauder Fund Review Committee	Salon 6
12–1 p.m.	CW01	Perimeter Institute: Hands-On Wave-Particle Duality, Commercial Workshop	Salon 13
12–1 p.m.	CW05	Improve Learning and Deter Cheating Using Expert TA and OpenStax	Salon 12
12–1 p.m.		First Timers' Gathering	Salon 4
12–1:45 p.m.		Committee on Laboratories	Salon 11
12–1:45 p.m.		Committee on History & Philosophy in Physics	Salon 6

12–1:45 p.m.		Committee on Physics in Pre-High School Education	Salon 7
12–1:45 p.m.		Committee on Research in Physics Education (RiPE)	Salon 8
12–1:45 p.m.		Committee on Physics in Two-Year Colleges	Salon 9
12:30–2 p.m.		Early Career Professionals Speed Networking Event	Salon 10
1-2 p.m.		High School Physics Teachers Day Luncheon	Salon 14
2–3 p.m.	CW02	Perimeter Institute: Spicing Up Classical Physics with Modern Examples	Salon 13
2–4 p.m.	T01	Electrostatics from Gilbert to Volta, Tutorial	Salon 12
2–4 p.m.	T03	Getting Started in Outreach, Tutorial	Salon 11
2–4 p.m.	T04	Selling Physics as a Major, Tutorial	Grand Ballroom C
2–4 p.m.	AA	SPS Research and Outreach	Salon 3
2–3:50 p.m.	AB	PER: Investigating Classroom Strategies	Salon 4
2–4 p.m.	AC	Panel – Report of the Undergraduate Curriculum Task Force	Salon 7
2–3:30 p.m.	AD	21st Century Physics for the High Schools	Salon 6
2–4 p.m.	AE	Panel – Life After Retirement	Salon 5
2–2:50 p.m.	AF	Using Tablets in the Physics Classroom	Salon 8
3–4 p.m.	AG	The Magic of Astrophotography	Salon 9
4–4:30 p.m.		**Exhibit Hall** Afternoon Break (4:15 p.m. Raffle Drawing)	**Grand Ballroom A**
4:30–5:30 p.m.	BA	SPS Research and Outreach II	Salon 4
4:30–6 p.m.	BB	Pre-College PER	Salon 11
4:30–6 p.m.	BC	Recruiting and Retaining Physics Students	Salon 10
4:30–5:50 p.m.	BD	How Do You Use Videos?	Salon 7
4:30–5:40 p.m.	BE	100Kin10: Training and Retaining Teachers	Salon 6
4:30–5:30 p.m.	BF	A Potpourri of Astronomy and Physics Topics	Salon 8
4:30–6 p.m.	BG	Optics Labs Beyond the First Year	Salon 9
4:30–6 p.m.	BH	Qualitative and Ethnographic Methods in PER	Salon 5
4:30–5:50 p.m.	BI	Teacher Preparation and Enhancement	Salon 3
4:30–5:30 p.m.	TD01	NGSS, Topical Discussion	Salon 12
6–7:30 p.m.	TD02	Physics & Society, Topical Discussion	Salon 11
6–7:30 p.m.		Committee on Apparatus	Salon 3
6–7:30 p.m.		Committee on Physics in High Schools	Salon 4
6–7:30 p.m.		Committee on International Physics Education	Salon 6
6–7:30 p.m.		Committee on Professional Concerns	Salon 13
6–7:30 p.m.		Committee on Space Science and Astronomy	Salon 12
6–7:30 p.m.		SPS Awards Reception	Salon 14
6:30–7:30 p.m.	TD04	History and Philosophy, Topical Discussion	Salon 8
6:30–7:30 p.m.	TD05	Dual and Concurrent Enrollment, Topical Discussion	Salon 7
7:30–8:30 p.m.	**Plenary**	Donald Pettit, NASA Astronaut	Grand Ballroom B
8:30–9 p.m.		Meet and Greet Donald Pettit	Grand Ballroom B
8:30–10 p.m.		High School Share-a-thon	Salon 4
8:30–10 p.m.		AAPT Council Meeting	Grand Ballroom C

MONDAY, January 6

7 a.m.–5 p.m.		**REGISTRATION**	**Grand Ballroom Foyer**
7–8 a.m.		TYC Breakfast	Salon 12
7:30–9 a.m.		Awards Committee (closed)	Salon 3
7:30–9 a.m.		Investment Advisory Committee	Salon 16
8–9:30 a.m.	PST1	Poster Session 1	Grand Ballroom Foyer
9:30–11 a.m.	**Awards**	Richtmyer Memorial Award – Sir Michael Berry; SPS Chapter Advisor Award	Grand Ballroom B
10 a.m.–4 p.m.		**Exhibit Hall Open** (break 10:30–11 a.m., raffle, 10:45 a.m.)	Grand Ballroom A
11 a.m.–12 p.m.	CW08	How to Use a Free, Peer-Reviewed Textbook with OpenStax College	Salon 11
11 a.m.–12 p.m.	CW03	Perimeter Institute: Curved Space-time in the Classroom	Salon 13
11–11:50 a.m.	CA	Physics and Society	Salon 3
11 a.m.–12 p.m.	CB	Low Enrollment Teacher Preparation Programs	Salon 6
11 a.m.–12 p.m.	CC	Recruiting and Retaining Physics Students II	Salon 7
11 a.m.–12 p.m.	CD	Panel – Goals and Assessment Tools for Instructional Labs	Salon 5
11–11:30 a.m.	CF	Introductory Courses	Salon 9
11–11:50 a.m.	CG	PER: Topical Understanding and Attitudes	Salon 4
11–11:40 a.m.	CH	Upper Division and Graduate Topics	Salon 10
12–1 p.m.	CW04	Perimeter Institute: Measuring Planck's Constant	Salon 13
12–1 p.m.		Retired Physicists Luncheon	Salon 18
12–2 p.m.		AAPT Fun Run/Walk	offsite
12:15–2 p.m.		Committee on Teacher Preparation	Salon 12
12:15–2 p.m.		Committee on Physics in Undergraduate Education	Salon 4
12:15–2 p.m.		Committee on Women in Physics	Salon 11

12:30–1:30 p.m.		Multicultural Luncheon	Salon 14
12:30–1:30 p.m.	CW06	Pearson author Paul Hewitt	Salon 9
12:30–1:30 p.m.	CW07	How WebAssign's Online Homework Can Help You Achieve Your Pedagogical Goals	Salon 8
1–2 p.m.		Committee on Interests of Senior Physicists	Salon 3
2–3 p.m.	**Plenary**	Philip Metzger, NASA's Kennedy Space Center	Grand Ballroom B
3–3:30 p.m.		Afternoon Break in Exhibit Hall (raffle drawing, 3:15 p.m.)	Grand Ballroom A
3:30–5:30 p.m.	DA	Panel – What Can MOOCs Do for Us?	Salon 5
3:30–5:20 p.m.	DB	Innovations in Research and Teaching Astronomy	Salon 3
3:30–5:30 p.m.	DC	Panel – Report on the Graduate Education in Physics Conference	Salon 11
3:30–5:10 p.m.	DD	Mentoring High School Teachers	Salon 6
3:30–5:30 p.m.	DE	Physics for the Life and Health Sciences	Salon 7
3:30–5:30 p.m.	DF	International Models of Physics Teacher Preparation	Salon 8
3:30–5:30 p.m.	DG	Responsive Teaching in Science	Salon 9
3:30–5:10 p.m.	DH	Using History to Teach Astronomy and Physics	Salon 10
5:30–7 p.m.		Membership and Benefits Committee	Salon 14
5:30–7 p.m.		Committee on SI Units and Metric Education	Salon 3
5:30–7 p.m.		PTRA Oversight Committee	Salon 6
5:30–7 p.m.		PERLOC	Salon 4
5:30–7:15 p.m.		Committee on Educational Technologies	Salon 10
5:30–7:15 p.m.		Committee on Graduate Education in Physics	Salon 11
5:30–7:15 p.m.		Committee on Science Education for the Public	Salon 12
5:30–7:15 p.m.		Committee on Diversity in Physics	Salon 13
7:30–8:20 p.m.	EA	Apparatus Magic	Salon 3
7:30–8:20 p.m.	EB	Partnerships between Two-Year and Four-Year Schools	Salon 4
7:30–8:30 p.m.	EC	The "Magic" of Engaging Girls in Physical Science	Salon 5
7:30–8:30 p.m.	ED	New Technology for Enhancing Research	Salon 6
7:30–8:30 p.m.	EE	International Professional Development Opportunities for Teachers	Salon 7
7:30–8:30 p.m.	EF	Dealing with Academic Dishonesty	Salon 8
7:30–8:30 p.m.	EG	Cultural Relevance in the Physics Classroom	Salon 9
7:30–8:20 p.m.	EH	Innovative Undergraduate Labs	Salon 10
8:30–10 p.m.	PST2	Poster Session 2	Grand Ballroom Foyer

TUESDAY, January 7

7–8:30 a.m.		Programs II	Salon 14
7:30–8:30 a.m.		PERTG Town Hall Meeting	Salon 4
8 a.m.–3 p.m.		**REGISTRATION**	**Grand Ballroom Foyer**
8:30–10 a.m.	FA	ALPHA Projects: Mentoring and Student Projects	Salon 3
8:30–9:50 a.m.	FB	Broader Perspectives: Active Learning Strategies	Salon 6
8:30–9:40 a.m.	FC	Engaging Physics and Astronomy Students in Service Learning	Salon 7
8:30–9:30 a.m.	FD	Why Do I Need a 3D Printer for my Physics Department?	Salon 8
8:30–10 a.m.	FE	Bridging Teacher Preparation and Professional Development	Salon 11
8:30–9:50 a.m.	FF	Physics for Non-Scientists	Salon 9
8:30–10 a.m.	FG	Distance Labs	Salon 10
8:30–9:50 a.m.	FH	PER: Student Reasoning and Problem Solving	Salon 5
9 a.m.–12 p.m.		SEES (Students to Experience Engineering and Science)	Grand Ballroom C
10–11 a.m.	**Awards**	Oersted Medal Awarded to Dean Zollman	Grand Ballroom B
11–11:30 a.m.	**Awards**	Homer L. Dodge Citations for Distinguished Service to AAPT Awarded	Grand Ballroom B
11:30–11:45 a.m.		AAPT Presidential Transfer Ceremony	Grand Ballroom B
11:45 a.m.–12 p.m.		Great Book Giveaway	Grand Ballroom Foyer
12–1:20 p.m.	GA	Stereotypes and the Princess Threat	Salon 3
12–1:30 p.m.	GB	The "Maturing" Field of PER and Its Associate Implications	Salon 5
12–1:20 p.m.	GC	Effective Practices in Educational Technology	Salon 6
12–1:30 p.m.	GD	Classical Mechanics in the Upper-Level Core: Frontiers and the Classroom	Salon 7
12–1:30 p.m.	GE	Sustainability of Teacher Preparation Programs	Salon 8
12–1:30 p.m.	GF	The Relevance of Laboratory and Apparatus	Salon 9
12–1:20 p.m.	GG	Inservice Preparation for Pre High School Teachers	Salon 10
12–1:10 p.m.	GH	Interactive Lecture Demonstrations-What's New? ILDs Using Clickers & Video Analysis	Salon 11
1:30–3 p.m.	**Plenary**	**AAPT Symposium on Physics Education and Public Policy**	Grand Ballroom B
3–4:30 p.m.		Nominating Committee II (closed)	Salon 7
3–4 p.m.	HA	Post Deadline Papers	Salon 9
3–3:30 p.m.	HB	AP Physics 1&2	Salon 10
3–4 p.m.	HC	Alternative Grading Methods/Standards-based Grading	Salon 8
3–3:50 p.m.	HD	Post Deadline Papers II	Salon 11
3–4:30 p.m.	PST3	Post Deadline Posters	Grand Ballroom Foyer
4–5 p.m.		Executive Board III	Salon 4

Special Events at AAPT 2014 Winter Meeting

Saturday, January 4

▶ **Orlando Science Center Tour**
10 a.m–2 p.m. Saturday offsite

Exploration and discovery await within the Orlando Science Center's hundreds of exhibits, programs and labs, giant screen films, and planetarium shows. The science center provides educational opportunities both within and outside the center's walls. Cost includes transportation and admission to the Science Center. *Fee: $35*

▶ **Grand Opening of Exhibit Hall and Opening Reception Grand Ballroom A**
8–10 p.m. Saturday

Sunday, January 5

▶ **Spouse/Guest Scenic Boat Tour of Winter Park, FL**
9 a.m.–2 p.m. Sunday offsite

Enjoy a relaxing, narrated, cruise through the lakes and canals of historic Winter Park, including Rollins College, Kraft Azalea Gardens, and the Isle of Sicily. View mansions and wildlife. Enjoy lunch on your own and shopping in the historic city of Winter Park. *Fee: $45*

▶ **First Timers' Gathering**
12–1 p.m. Sunday
Salon 4

Are you new to an AAPT National Meeting? If so, this is the best time to learn about AAPT and the Winter Meeting, as well as meet fellow attendees. AAPT leadership will be represented to discuss ways to get more involved with AAPT. You are also welcome to participate in any of AAPT's Area Committee meetings.

▶ **H.S. Physics Teachers Day Luncheon**
1–2 p.m. Sunday
Salon 14

Special luncheon for high school teachers attending conference for the first time. Open to all. *Ticket required. Fee: $35*

▶ **Early Career Professionals Speed Networking Event**
12:30–2 p.m. Sunday
Salon 10

Speed-networking provides the opportunity to discuss career goals and challenges with a new contact for five minutes, exchange information, and then move on to the next person.

▶ **Exhibit Hall Kindle Drawing**
– 10:15 a.m. Sunday

▶ **Exhibit Hall $75 Gift Card Drawing**
– 4:15 p.m. Sunday

Tickets $1 apiece, buy at Registration. You must be present to win!

Monday, January 6

▶ **Two-Year College Breakfast**
7–8 a.m. Monday
Salon 12

Pre-register and enjoy your time and breakfast with like-minded attendees. *Fee: $30*

▶ **AAPT Fun Run / Walk**
12–2 p.m. Monday

Join us for the 5th Annual AAPT Fun Run/Walk – Run for Melba! Fundraiser for Melba Newell Phillips endowment fund. (Location offsite, please meet in front of hotel.) *Fee: $20*

▶ **Retired Physicists Luncheon**
12–1 p.m. Monday
Salon 18

Exchange ideas with our long served and deserving supporters of AAPT. *Ticket required. Fee: $39*

▶ **Multicultural Luncheon**
12:30–1:30 p.m. Monday
Salon 14

Increase awareness and understanding while sharing and celebrating unique perspectives. *Ticket required. Fee: $39*

▶ **Exhibit Hall $75 Gift Card Drawing**
– 10:45 a.m. Monday

▶ **Exhibit Hall Kindle Drawing**
– 3:15 p.m. Monday

Tickets $1; buy at Registration. Must be present to win!

Tuesday, January 7

▶ **Great Book Giveaway**
11:30 a.m.–12 p.m. Tuesday
Grand Ballroom Foyer

Get your raffle ticket from the AAPT booth and attend this popular event to claim your book.

Committee Meetings

All interested attendees are invited and encouraged to attend the Committee meetings with asterisks (*).

Saturday, January 4

Meetings Committee	8–10 a.m.	Salon 11
Publications Committee	8–10 a.m.	Salon 9
Resource Letters Committee	10:30 a.m.–1:30 p.m.	Salon 12
Executive Board II	10:30 a.m.–4:30 p.m.	Salon 4
Nominating Committee I (Closed)	3–4:30 p.m.	Salon 9
ALPhA Committee	5–6:30 p.m.	Salon 11
Area Chairs Orientation and Programs I	5–8 p.m.	Salon 3
Section Representative and Officers	5:30–8 p.m.	Salon 12

Sunday, January 5

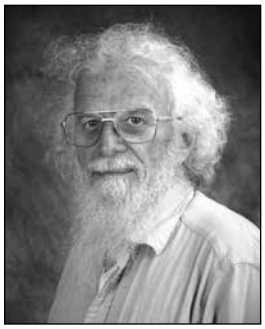
Physics Bowl Advisory Committee	8–9 a.m.	Salon 3
Review Board	8–9:30 a.m.	Salon 6
Governance Structure Committee	10:30–11:30 a.m.	Salon 3
Bauder Fund Review Committee	10:30 a.m.–12 p.m.	Salon 6
History & Philosophy in Physics*	12–1:45 p.m.	Salon 6
Laboratories*	12–1:45 p.m.	Salon 11
Physics in Pre-High School Education*	12–1:45 p.m.	Salon 7
Physics in Two-Year Colleges*	12–1:45 p.m.	Salon 9
Research in Physics Education (RiPE)*	12–1:45 p.m.	Salon 8
International Physics Education*	6–7:30 p.m.	Salon 6
Physics in High Schools*	6–7:30 p.m.	Salon 4
Professional Concerns*	6–7:30 p.m.	Salon 13
Space Science and Astronomy*	6–7:30 p.m.	Salon 12
Apparatus	6–7:30 p.m.	Salon 3
AAPT Council Meeting*	8:30–10 p.m.	Ballroom C

Monday, January 6

Awards Committee (closed)	7:30–9 a.m.	Salon 3
Investment Advisory Committee	7:30–9 a.m.	Salon 16
Physics in Undergraduate Education*	12:15–2 p.m.	Salon 4
Teacher Preparation*	12:15–2 p.m.	Salon 12
Women in Physics*	12:15–2 p.m.	Salon 11
Interests of Senior Physicists*	1–2 p.m.	Salon 3
Membership & Benefits	5:30–7 p.m.	Salon 14
SI Units and Metric Education*	5:30–7 p.m.	Salon 3
PTRA Oversight Committee	5:30–7 p.m.	Salon 6
PERLOC	5:30–7 p.m.	Salon 4
Diversity in Physics*	5:30–7:15 p.m.	Salon 13
Educational Technologies*	5:30–7:15 p.m.	Salon 10
Graduate Education in Physics*	5:30–7:15 p.m.	Salon 11
Science Education for the Public*	5:30–7:15 p.m.	Salon 12

Tuesday, January 7

Programs Committee II	7–8:30 a.m.	Salon 14
PERTG Town Hall Meeting	7:30–8:30 a.m.	Salon 4
Nominating Committee II (Closed)	3–4:30 p.m.	Salon 7
Executive Board III	4–5 p.m.	Salon 4



Dean Zollman
Kansas State University
Department of Physics

Physics Education Research and Teaching Modern Modern Physics

Tuesday, January 7

10–11 a.m.

Grand Ballroom B

Oersted Medal

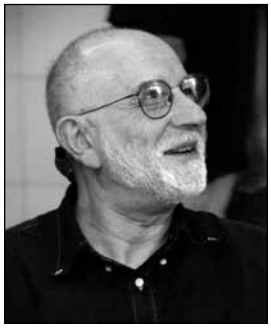
The Oersted Medal for 2014 is presented to **Dean Zollman** in recognition of his significant contributions to physics education research and mentoring of a generation of PER researchers. Zollman earned his BS and MS in Physics from Indiana University, Bloomington. His PhD in Theoretical Nuclear Physics was earned at the University of Maryland, College Park. He started his career as Assistant Professor at Kansas State University in 1970, becoming Associate Professor (1977), Professor (1982), Distinguished University Teaching Scholar (1997), University Distinguished Professor (2001), and Head of the Department of Physics and William and Joan Porter Professor from 2001 to 2011.

Zollman has achieved many of the milestones considered indicative of an intellectual giant in the physics education field—rising up the academic ladder to spend over 30 years as a full professor, authoring an extensive record of research publications with dozens of co-authors, securing an impressive record of consistent extramural funding for over three decades, and mentoring a long list of students and postdocs who have gone on to establish themselves in the field.

His contributions to physics are threefold—a dedicated pursuit to the application of advanced technologies to bring the beauty of physics to all learners, an unwavering commitment to mentoring his protégés long after they leave school to find their own way in the world, and continuing physics education research and the impact of that research on the teaching and learning of physics. He served as AAPT Staff Physicist from 1975-1977 and was instrumental in the development of the AAPT workshop program which has become an important feature of the association's Summer and Winter meetings. In 1981-82 Zollman was Visiting Associate Professor and NSF Faculty Fellow at the University of Utah. He has been a guest professor in Germany at Ludwig Maximilians University in Munich in 1989 and 2006 and at the Institute for Science Education (IPN) in Kiel in 1998 and 2007.

Zollman was recognized for his service to AAPT with a 1986 Distinguished Service Citation for his implementation of the workshop as an interface between knowledge and execution. He has directed workshops, served as a member of *The Physics Teacher* editorial board, served on the Computers in Physics Education Committee and on various task force groups. In 1995 AAPT recognized him as "a teacher who has made notable and creative contributions to the teaching of physics" and awarded him the Robert A. Millikan Medal.

The Oersted Medal is named for Hans Christian Oersted (1777-1851), a Danish physicist who, in the course of creating a demonstration for teaching his class, discovered that electric currents caused a magnetic field. This was a crucial step in establishing the theory of electromagnetism, so important in building modern technology and modern physics. The award was established by AAPT in 1936.



Sir Michael Berry
University of Bristol
emeritus

How Quantum Physics Democratized Music

Monday, January 6

9:30 –10:30 a.m.

Grand Ballroom B

Richtmyer Memorial Lecture Award

The Richtmyer Memorial Lecture Award for 2014 is presented to **Professor Sir Michael Victory Berry** in recognition of outstanding contributions to physics and effectively communicating those contributions to physics educators. Sir Michael Berry is a world-renowned theoretical physicist who is famous for his discovery of geometric phase effects ("Berry's phase") in quantum mechanics. His more than 450 scientific publications cover topics ranging from glaciers, to nonlinear dynamics, to optical diffraction, quantum chaos, and caustics. He is also author of *Principles of Cosmology and Gravitation*. With a well-deserved reputation for polished, elegant, and illuminating lectures, he has brought the excitement of contemporary theoretical physics to audiences around the world.

Regarding his selection for this award Berry said, "I am delighted to receive this unexpected honor from the AAPT, and humbled to be in the company of such distinguished previous recipients."

Berry is Melville Wills Professor of Physics (Emeritus), University of Bristol. He holds a Bachelor of Science degree in physics from the University of Exeter and a PhD in theoretical physics from University of St. Andrews. He holds 10 honorary Doctorates and one honorary professorship. His career has developed at the University of Bristol, first as a postdoctoral fellow, then lecturer and then reader before becoming professor in 1979. From 2006-2012 he was Editor of the journal *Proceedings of the Royal Society*.

His recognition with the Maxwell Medal and Prize of the Institute of Physics in 1978 was followed by numerous other science and mathematics awards, including the ignobel prize in physics in 2000, sharing the prize with Andre Geim for their work on "The Physics of Flying Frogs."Berry was elected to the Royal Society of London in 1982, was elected a Foreign Member of the National Academy of Sciences of the USA in 1995, and knighted by Queen Elizabeth in 1996.

Berry specializes in semiclassical physics (asymptotic physics, quantum chaos) applied to wave phenomena in quantum mechanics and other areas such as optics. He has given many prestigious lectures and has held visiting positions in Nigeria, Italy, Germany, The Netherlands, Switzerland, France, Australia, New Zealand, the United States, Israel, Mexico, and Belgium.

The Richtmyer Memorial Lecture Award is given in memory of Floyd K. Richtmyer, distinguished physicist, teacher, and administrator. Professor Richtmyer was one of the founders of AAPT and served as its president. As a teacher, author, research worker, and dean, he was the guide for many young physicists who became leaders of American science and he has had a wide influence on the development of physics in the United States. The award has been given since 1941 to a person who has made outstanding contributions to physics and effectively communicated those contributions to physics educators.

Homer L. Dodge Citations for Distinguished Service to AAPT

Tuesday, January 7 • 11–11:30 a.m. • Grand Ballroom B

Jan Mader

Jan Mader

Jan Mader has been a physics instructor in the Great Falls Public Schools, where she has also taught physical science, chemistry, and mathematics, for more than 30 years. She has been one of the catalysts for increasing high school enrollment in physics in the United States for the past 15 years. It is no understatement to say that due to her work with the PTRA program, Prisms, and other physics education initiatives, Jan is probably the best known and most widely respected high school physics teacher in the Northwest United States. Her willingness to share her expertise has helped develop a cadre of new teachers that will continue to improve physics education in the United States. Her service to AAPT has included service as President of the Montana Section, as a Physics Teaching Resource Agent (PTRA) since 2002, membership on the Committee on Physics in Pre-High School Education, Committee on Science Education for the Public, the AAPT Nominating Committee, and the Committee on Physics in High Schools, which she has chaired twice. She was the first female recipient of the AAPT Excellence in Pre College Physics Teaching Award and co-recipient of American Physical Society (APS) 2011 Excellence in Physics Education Award given to PTRA "for providing peer-led professional development for 25 years to more than 5000 physics and physical science teachers nationwide through a network of more than 500 master teachers."

Taha Mzoughi

Taha Mzoughi

Taha Mzoughi is Professor of Physics at Kennesaw State University. He earned his PhD in Physics from the University of South Carolina, Columbia in 1990. He is devoted to the cause of physics literacy and has been energetically working in physics education for the last two decades. His experience covers both high school physics teaching and university teaching. Before moving to the Atlanta area as a faculty member at Kennesaw State, he was the co-PI of the National Science Foundation (NSF) funded "WebTOP" project which involved 3D interactive simulations of optical phenomena at the Mississippi State University. Taha has been a long-time member of AAPT and served as a member of the Committee on Educational Technologies, which he chaired in 2010-2011 and the Committee on Research in Physics Education. He worked with ComPADRE for which he helped start The PhysicsSource, the collection for undergraduate physics teaching. He also served in the Mississippi Association of Physicists, the Mississippi section of AAPT. Upon moving to Atlanta, he became an integral part of the Southern Atlantic Coast Section-AAPT serving as the webmaster and, most recently as president of this section. He is also very involved with the Metropolitan Atlanta Physics Teacher Group. He has been the most involved with both pre-service and in-service physics high school teachers and this is, perhaps, the greatest need to promote sustainable physics literacy in our society.

Gabriel C. Spalding

Gabriel C. Spalding

Gabriel C. Spalding is Professor of Physics at Illinois Wesleyan University, where his recent work has utilized holographically textured fields to trap and manipulate matter. Besides being a past member and Chair of the AAPT Committee on Laboratories, he has been active on multiple AAPT committees as either a committee member or friend of the committee. He has been an organizer or contributor to a session at nearly every AAPT semi-annual national meeting for years. He has also been active behind the scenes and on task forces and subcommittees, and served on the AAPT Nominating Committee during 2012-13. His time and energy support advances in physics education and lab education in particular. In July 2012, he chaired the conference on laboratory instruction Beyond the First Year (thereby introducing the "BFY" acronym) at the University of Pennsylvania and Drexel University. This was an extremely unusual opportunity for hands-on exposure to a broad assortment of contemporary instructional labs appropriate to Modern Physics Labs, Electronics, Optics, Advanced Labs, as well as key instructional labs in Statistical Physics, Condensed Matter and Materials Physics, Quantum Mechanics, etc.

Lee Trampleasure

Lee Trampleasure

Lee Trampleasure teaches physics and physical science at Carondelet High School in Concord, CA. A practitioner of the Modeling Method of Instruction and an experienced Modeling Workshop leader, he uses model construction, testing, and application in his classroom to frame student thinking and learning. He identifies his major classroom accomplishments as integration of computers and technology in teaching, development of labs and field trips, and integration of music and theater into course curricula. He serves as Section Representative for the Northern California/Nevada Section. In this role he not only represents the members of his section at AAPT National Meetings, he also serves as a valued and contributing member of the Section Representatives group. This group is part of the AAPT Council, part of the association's governance. He has volunteered to assist other sections in setting up section websites. Lee has attended several National AAPT meetings and has presented sessions and led workshops at both the local and national level. He is not only committed to teaching physics well, he is committed to supporting his fellow physics teachers through his leadership in NCNAAPT and mentoring new teachers.

Homer L. Dodge

The Homer L. Dodge Citation for Distinguished Service to AAPT was established in 1953, was renamed in 2012 to recognize the foundational service and contributions of Homer Levi Dodge, AAPT's first president. The Homer L. Dodge Citation for Distinguished Service to AAPT recognizes AAPT members for their exceptional contributions to the association at the national, section, or local level.

Sharon Rosell
Central Washington University

SPS Outstanding Chapter Advisor Award

Monday, January 6 • 10:30–10:40 a.m. • Grand Ballroom B

The SPS Outstanding Chapter Advisor Award for 2013 will be presented to **Sharon Rosell** from Central Washington University, Ellensburg, WA. This award is the highest recognition of an SPS chapter advisor who has made exceptional contributions toward promoting student leadership, developing and inspiring a broad spectrum of activities, and inspiring enthusiastic student participation. Rosell has been involved with the SPS for her entire career and has been the chapter advisor at Central Washington since 1993. Rosell served as Zone Councilor on the SPS National Council from 1998-2004. Through her unmatched teaching and mentoring, she has impacted the lives of countless students and has seen the SPS chapter recognized for excellence repeatedly. The Central Washington SPS Chapter has been recognized as an Outstanding SPS Chapter many times and has received multiple Marsh White Outreach Awards; members of the chapter have received several SPS Student Leadership Scholarships. Among the many letters written to support Sharon's nomination, we find evidence the impact she has made in her role as teacher and advisor: "Her teaching and mentoring are unmatched. She has impacted the lives of countless students… She seamlessly picks up where classroom efforts leave off to ensure the success of students."

Techno-Stories from Space, *by Donald R. Pettit*

Sunday, January 5 • 7:30–8:30 p.m. • Grand Ballroom B

Donald R. Pettit
NASA's Kennedy Space Center

Donald Roy Pettit, a chemical engineer and NASA astronaut, is a veteran of two long-duration stays aboard the International Space Station, one space shuttle mission, and a six-week expedition to find meteorites in Antarctica. He received a BS in Chemical Engineering from Oregon State University and a PhD in Chemical Engineering from the University of Arizona. A veteran of three spaceflights, Pettit has logged more than 370 days in space and over 13 EVA (spacewalk) hours. He was a staff scientist at Los Alamos National Laboratory, Los Alamos, NM, from 1984 to 1996. Projects there included reduced gravity fluid flow and materials processing experiments onboard the NASA KC-135 airplane, atmospheric spectroscopy on noctilucent clouds seeded from sounding rockets, fumarole gas sampling from volcanoes and problems in detonation physics. He was a member of the Synthesis Group, slated with assembling the technology to return to the Moon and explore Mars (1990) and the Space Station Freedom Redesign Team (1993). In 2006, Pettit joined the Antarctic Search for Meteorites (ANSMET), spending six weeks in Antarctica collecting meteorite samples, including a lunar meteorite. He lived aboard the International Space Station for 5½ months during Expedition 6, was a member of the STS-126 crew, and again lived aboard the station for 6½ months as part of the Expedition 30/31 crew in 2011. During Expedition 30, Petitt made a video using an Angry Birds character to explain how physics works in space.

Meet and Greet NASA Astronaut, Donald Pettit from 8:30–9 p.m.

Preparing Physicists for the Industrial Revolution of Space, *by Philip Metzger*

Monday, January 6 • 2–3 p.m. • Grand Ballroom B

Philip Metzger
NASA's Kennedy Space Center

Philip Metzger, PhD, is a senior research physicist at NASA's Kennedy Space Center, where he founded and leads the Granular Mechanics and Regolith Operations Laboratory, part of the KSC Swamp Works. He performs research related to solar system exploration: predicting how rocket exhaust interacts with extraterrestrial soil, investigating the mechanics of soil, characterizing lunar and martian soil simulants, modeling the migration of volatiles on airless bodies, etc. He leads the agency's work in rocket blast effects for human-class missions. He has participated in architecture studies for the Lunar Architecture Team, the Mars Architecture Team, and the Lunar Exploration Analysis Group. He is also leading projects to develop extraterrestrial excavators, regolith conveyance technologies, dust-tolerant quick disconnects, lunar/martian landing pads, and other surface systems technology. He co-founded NASA's biannual Workshop on Granular Materials in Lunar and Martian Exploration and is a founding member of the ASCE Technical Committee for Regolith Operations, Mobility and Robotics. He received the astronaut's Silver Snoopy award in 2010 and was selected as the Kennedy Space Center's NASA Scientist/Engineer of the Year for 2011.

SYMPOSIUM on Physics Education

AAPT Symposium on Physics Education and Public Policy

Tuesday, January 7 • 1:30–3 p.m. • Grand Ballroom B

Policymakers formulate decisions everyday that impact curriculum, standards, funding, and many other aspects of physics education at all levels. AAPT works with a number of partners to keep policymakers informed on the views of physics educators and to suggest appropriate policy options within the Association's sphere of influence. This session brings together individuals who play pivotal roles in helping to shape policies and who provide information to policymakers. We hope to provide a look at the process of policy making as well as actions you might make to contribute to decisions about policies affecting physics and STEM education.

This Symposium is being partially sponsored by funds contributed to the Memorial Fund in memory of Mario Iona. Iona, a long-standing and dedicated AAPT member, was the first Chair of the Section Representatives and served on the AAPT Executive Board, was a column editor in *The Physics Teacher*, presenter at many national AAPT meetings, recipient of the Robert A. Millikan Award in 1986, and relentless champion of correct diagrams and language in textbooks. Contributions to the Memorial Fund provide support for many AAPT programs such as the Symposium.

Facilitator: *Noah Finkelstein, Professor of Physics at University of Colorado at Boulder*

Juan Carlos Aguilar

Paula Heron

Speakers:

Juan-Carlos Aguilar, *Division of Curriculum, Instruction and Assessment, Georgia Department of Education, Atlanta, GA 30334; jaguilar@doe.k12.ga.us*

Juan-Carlos Aguilar is the Georgia Department of Education science program manager. He oversees state policy in the area of science education, coordinates K-12 science curriculum development, co-directs Georgia's K-12 STEM initiative, supervises the alignment of the state assessments with the Georgia Performance Standards for science and serves as liaison between the Georgia Department of Education and the different science organizations across the state, as well as the Georgia Department of Education and the Georgia University System in the area of science. He is the president of the Council of State Science Supervisors, an organization composed of science education specialists who serve at the state, territorial, or the protectorate educational agency in the United States and U.S. Territories. In addition, Aguilar was the principal investigator on the Georgians Experience Astronomy Research in the Classroom grant ($1.3 million) funded by NASA.

Paula R. Heron, *University of Washington, Dept. of Physics, Seattle, WA 98195; pheron@phys.washington.edu*

Paula R.L. Heron is a Professor of Physics at the University of Washington. She holds a BS. and an MSc in physics from the University of Ottawa and a PhD in theoretical physics from Western University. She joined the Physics Department at the University of Washington in 1995. Her research focuses primarily on student ability to apply what they have learned about the dynamics of point particles in more advanced contexts involving elastic media, rigid bodies, etc. She has given numerous invited talks on her research at national and international meetings and in university science departments. Heron is co-founder and co-chair of the biannual "Foundations and Frontiers in Physics Education Research" conference series, the premier venue for physics education researchers in North America. She has served on the Executive Committee of the Forum on Education of the American Physical Society (APS), the Committee on Research in Physics Education of the American Association of Physics Teachers (AAPT), and on the ad hoc National Research Council committee on the status and outlook for undergraduate physics education. In 2007 she was elected Fellow of the APS. In 2008 she shared the APS Education award with colleagues Peter Shaffer and Lillian McDermott. Heron is a co-author on the upcoming 2nd edition of *Tutorials in Introductory Physics*, a set of instructional materials that has been used in over 200 institutions in the US and that has been translated into German and Spanish.

Free Commercial Workshops

CW01: Perimeter Institute: Hands-On Wave-Particle Duality

Location: Salon 13
Date: Sunday, January 5
Time: 12–1 p.m.
Sponsor: Perimeter Institute

Leaders: Damian Pope, Kevin Donkers

Come explore the Challenge of Quantum Reality, a classroom resource designed by educators in collaboration with Perimeter Institute researchers to introduce senior physics students to the wonder and power of quantum physics. Experience the electron double-slit experiment as you participate in a hands-on classroom activity that will introduce the fundamental concepts involved in wave-particle duality.

CW02: Perimeter Institute: Spicing Up Classical Physics with Modern Examples

Location: Salon 13
Date: Sunday, January 5
Time: 2–3 p.m.
Sponsor: Perimeter Institute

Leaders: Damian Pope, Kevin Donkers, Greg Dick

Tired of using the same examples to illustrate concepts in classical physics every year? Looking for ways to expose your students to modern physics without taking up extra time? This session will show you that what you do every day in class can easily be applied to new, interesting concepts in modern physics. We will show you how to use dark matter in your lessons about circular motion, how to do nuclear physics using electric fields, and how to detect sub-atomic particles using conservation of momentum. Come and see how modern physics can be explored within classical curriculum in these easy-to-adapt examples for your classroom.

CW03: Perimeter Institute: Curved Space-time in the Classroom

Location: Salon 13
Date: Monday, January 6
Time: 11 a.m.–12 p.m.
Sponsor: Perimeter Institute

Leaders: Damian Pope, Kevin Donkers, Greg Dick

Join us and explore Revolutions in Science: What Keeps us Stuck to the Earth?, a classroom resource designed by educators in collaboration with Perimeter Institute researchers to introduce senior high school students to the fascinating topic of general relativity. Through a simple hands-on activity, you will be thoroughly convinced that when you drop something, it does not fall down, but instead, the ground accelerates up!

CW04: Perimeter Institute: Measuring Planck's Constant

Location: Salon 13
Date: Monday, January 6
Time: 12–1 p.m.
Sponsor: Perimeter Institute

Leaders: Damian Pope, Kevin Donkers, Greg Dick

Come explore Measuring Planck's Constant, a classroom resource designed by educators in collaboration with Perimeter Institute researchers to introduce senior students to the basis of quantum mechanics. Using light emitting diodes (LED's), your students will accurately measure Planck's constant, the fundamental constant that defines the scale of quantum physics.

CW05: Improve Learning and Deter Cheating Using Expert TA and OpenStax

Location: Salon 12
Date: Sunday, January 5
Time: 12–1 p.m.
Sponsor: Expert TA

Leader: Jeremy Morton

Expert TA is a commercial online homework and tutorial system for introductory-level physics. It grades problems the way instructors do, considering more than just the final numeric answer. Expert TA has multi-step problems that involve more aspects of physics problem solving; such as symbolic equations, FBDs, algorithmic numeric answers, etc. The majority of our problems involve symbolic answers and our sophisticated math engine grades them in detail. It identifies detailed mistakes within an equation, deducts points, and provides specific feedback. Join us and learn how you can customize assignments and how you can monitor grades and student progress real-time; this includes being able to review detailed work (not just numeric grades) as it happens. We will also discuss how we keep problem solutions off the web and deter cheating. OpenStax College is a nonprofit organization committed to improving student access to quality learning materials by providing free, peer-reviewed textbooks. OpenStax College has teamed up with Expert TA to provide an easy-to-use, affordable, high-tech online homework system for their Physics customers.

CW06: Pearson author Paul Hewitt

Location: Salon 9
Date: Monday, January 6
Time: 12:30–1:30 p.m.
Sponsor: Pearson

Leader: Paul Hewitt

Please join us for a discussion with Pearson author Paul Hewitt regarding changes and updates to the new 12th edition of his hallmark textbook, *Conceptual Physics.* Former silver-medal boxing champion, sign painter, uranium prospector, and soldier, Paul began college at the age of 27, with the help of the GI Bill. He pioneered the conceptual approach to teaching physics at the City College of San Francisco. He has taught as a guest teacher at various middle schools and high schools, the University of California at both the Berkeley and Santa Cruz campuses, and the University of Hawaii at both the Manoa and Hilo campuses. He also taught for 20 years at the Exploratorium in San Francisco, which honored him with its Outstanding Educator Award in 2000. He is the author of *Conceptual Physics* and a co-author of *Conceptual Physical Science* and *Conceptual Physical Science Explorations.*

CW07: How WebAssign's Online Homework Can Help You Achieve Your Pedagogical Goals

Location: Salon 8
Date: Monday, January 6
Time: 12:30–1:30 p.m.
Sponsor: WebAssign

Leader: Matt Kohlmyer

Since 1997, WebAssign has been the online homework and assessment system of choice for introductory physics lecture courses. Through our partnerships with all major academic publishers, WebAssign supports over 160 introductory physics textbooks with precoded, assignable questions, and advanced learning tools. Additionally, WebAssign provides question collections authored by experienced physics educators and designed to strengthen student skills and conceptual understanding. Learn about free resources for WebAssign adopters, including research-based collection that stresses physics education research principles and direct measurement videos that help students to connect real-world scenarios and classroom physics. We will also discuss a new question collection featuring feedback that addresses student misconceptions, tutorials that step students through complex problems and concepts, and a personal study plan that helps improve students' prerequisite math skills.

CW08: How to Use a Free, Peer-Reviewed Textbook with Leading Online Homework System

Location: Salon 11
Date: Monday, January 6
Time: 11 a.m.-12 p.m.
Sponsor: OpenStax College

Leader: David Harris

OpenStax College is a nonprofit organization committed to improving student access to quality learning materials by providing free, peer-reviewed textbooks. OpenStax College has teamed up with Sapling Learning, an interactive online homework provider that is tested and proven to increase student performance, comprehension, retention and problem-solving skills. Learn how to utilize the free OpenStax College College Physics textbook alongside the low-cost Sapling Learning product and provide your students with an affordable, quality learning solution.

AAPT Exhibitors:

Exhibit Hall: Ballroom A (*Hours:* Sat. 8-10, Sun. 10-6, Mon. 10-4)

American Association of Physics Teachers

Booths #310, 312, 314
One Physics Ellipse
College Park, MD 20740
301-209-3300
rrosier@aapt.org
www.aapt.org

Welcome to Orlando! Join us at the AAPT booth and spin the wheel for your chance to win some awesome prizes! We will have a large selection of educational resources available to meet the needs of everyone from students to faculty. Pick up brochures on some of AAPT's leading education programs such as PTRA and the US Physics Team. Learn about some of our engaging online physics demos and lessons from ComPADRE. Check out the latest and greatest items from the Physics Store catalog including publications, AAPT-branded merchandise, and a limited collection of member-only items. Items will be available for purchase at the Booth at a significant savings. Lastly, do not forget to pick up your ticket for the Great Book Giveaway!

American Physical Society

Booth #213
One Physics Ellipse
College Park, MD 20740
301-209-3206
Thompson-flagg@aps.org
www.aps.org

APS Outreach brings the fun and excitement of physics to everyone. From the popular "Spectra" comic book series to the "Science Off the Sphere" DVD, we have something for all ages. Stop by and grab a comic, learn about the SpectraSnapp app, get some posters and snag a DVD. Come by on Monday to meet a special guest.

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The Classroom Astronomer & Hermograph Press

Table A
3605 Sandy Plains Road
Suite 240-203
Marietta, GA 30066
404-702-8147 TOLL FREE 866-HERMO-GRAPH
ContactUs@ToTeachTheStars.net

The Classroom Astronomer, a full-color quarterly, print, PDF and App practitioner journal—The "TPT" of astronomy! —...from Hermograph Press, makers of two unique spectrum viewers, and a new line of books in 2014.

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CPO Science provides high-quality inquiry-based teaching and learning systems for science in grades 6-12. The company offers a wide range of materials and services including innovative science textbook programs that integrate with high-quality lab equipment, classroom equipment packages with curriculum guides, and nationally recognized professional development programs.

eCYBERMISSION

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Arlington, VA 22201
1-866-GO-CYBER
missioncontrol@ecybermission.com
www.ecybermission.com

eCYBERMISSION is a free, web-based STEM competition sponsored by the U.S. Army AEOP and managed by NSTA for students in grades 6-9. Teams come up with a problem that affects their community, and solve that problem using a scientific inquiry or engineering design. Students can win up to $8000 in savings bonds.

Expert TA

Booth #305
624 South Boston Ave., Suite 220
Tulsa, OK 74119
877-572-0734
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www.theexpertta.com

The Expert TA is an online homework and tutorial system for introductory physics courses. Expert TA's proprietary math engine performs partial credit grading of the most complex problems. It analyzes the steps used to solve equations, identifies detailed mistakes and deducts the appropriate points. This method allows instructors to accurately evaluate the mastery of student knowledge and provides students with consistent grading and quality feedback on their work. Stop by Booth 305 for a demonstration.

Klinger Educational Products Corp.

Booth #206
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718-461-1822
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www.KlingerEducational.com

Klinger Educational will be exhibiting the LEYBOLD X-ray machine and Tomography module. Both now have an available locking, storage drawer that fits directly under the main units. Also featured is the HD upgrade for the Goniometer, enabling a 10X higher resolution achieved through narrower apertures and software. An Electron Diffraction tube will be on display as well as a Franck-Hertz Ne experiment.

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openstaxcollege.org

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Perimeter Institute for Theoretical Physics is an independent, non-profit charity, research institute whose mission is to make breakthroughs in our understanding of our universe and the forces that govern it. Such breakthroughs drive advances across the sciences and the development of transformative new technologies. Located in Waterloo, Ontario, Canada, Perimeter also provides a wide array of research, training and educational outreach activities to nurture scientific talent and share the importance of discovery and innovation.

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Created and supported by educators, Sapling Learning's instructional online homework drives student success and saves educators time.

Society of Physics Students

Booth #202
One Physics Ellipse
College Park, MD 20740
301-209-3008
lquijada@aip.org
www.spsnational.org

The Society of Physics Students (SPS), along with Sigma Pi Sigma, the national physics honor society, are chapter based organizations housed within the American Institute of Physics. SPS strives to serve all physics students and their mentors with a chapter in nearly every physics program in the country and several international chapters. Sigma Pi Sigma, with over 80,000 historical members, recognizes high achievement among outstanding students and physics professionals. SPS and Sigma Pi Sigma programs demonstrate a long term commitment to service both within the physics community and throughout society as a whole through outreach and public engagement. Partnerships with AIP member societies introduce SPS student members to the professional culture of physics and convey the importance of participation in a professional society. SPS and Sigma Pi Sigma support scholarships, research awards, physics project awards, outreach/service awards for undergraduate students and a Summer Science Research Clearinghouse, where thousands of summer research positions are listed (www.the-nucleus-org).

TeachSpin, Inc.

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SHARED BOOK EXHIBIT

Take a look at the books exhibited from the following publishers near the AAPT booth.

Cambridge University Press

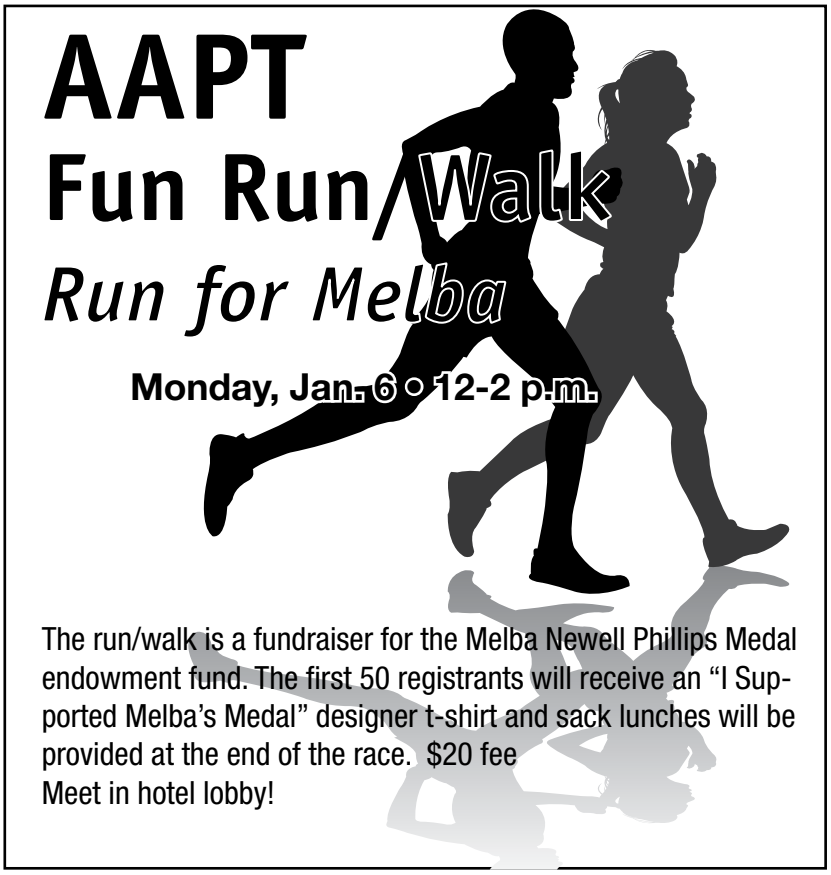
1. Bevan – *Statist Data Analysis Physical Science*
2. Fleisch - *Std's Guide Vectors Tensors*
3. Fleisch – *Student's Guide Maxwell's Equations*
4. Fleisch/Kregenow – *Student's Guide Maths of Astronomy*
5. Greenstein – *Understanding the Universe*
6. Griffiths – *Revolutions in 20th Century Physics*
7. Kleppner/Kolenkow – *An Introduction to Mechanics,* 2nd Ed.
8. Longair – *Quantum Concepts in Physics*
9. Pasachoff/Filippenko – *The Cosmos,* 4th Ed.
10. Pasachoff/Ros/Pasachoff – *Innovation in Astronomy Education*
11. Purcell/Morin – *Electricity and Magnetism,* 3rd Ed.
12. Thomson – *Modern Particle Physics*
13. Weinberg – *Lectures on Quantum Mechanics*
14. Zangwill – *Modern Electrodynamics*

Intellectual Property Associates

1. Robert G. Chester, QSO- *The Mathematics and Physics of Quasi-Spherical Orbits*

Princeton University Press

1. Chamber/Mitton – *From Dust to Life*
2. Cook – *Climate Dynamics*
3. Gardner – *Undiluted Hocus-Pocus*
4. Heller – *Why You Hear What You Hear*
5. Merritt – *Dynamics and Evolution of Galactic Nuclei*
6. Ostriker/Mitton – *Heart of Darkness*
7. Quigg – *Gauge Theories of the Strong, Weak, and Electromagnetic Interactions,* 2nd Ed.
8. Stone – *Einstein and the Quantum*
9. Waller – *The Milky Way*
10. Zee – *Einstein Gravity in a Nutshell*



Sunday, January 5, 2014 – Session Schedule

	SALON 3	SALON 4	SALON 7	SALON 6	SALON 5	SALON 8	SALON 9	SALON 10	SALON 11	SALON 12	GRAND BALL-ROOM B
2:00 p.m.	**AA** SPS Research and Outreach	**AB** PER: Investigating Classroom Strategies	**AC** *Panel* – Report of the Undergraduate Curriculum Task Force	**AD** 21st Century Physics for the High Schools	**AE** *Panel* – Life After Retirement	**AF** Using Tablets in the Physics Classroom					
2:30 p.m.											
3:00 p.m.							**AG** The Magic of Astrophotography				
3:30 p.m.											
4:00 p.m.											
4:30 p.m.	**BI** Teacher Preparation and Enhancement	**BA** SPS Research and Outreach II	**BD** How Do You Use Videos?	**BE** 100Kin10: Training and Retaining Teachers	**BH** Qualitative and Ethnographic Methods in PER	**BF** A Potpourri of Astronomy and Physics Topics	**BG** Optics Labs Beyond the First Year	**BC** Recruiting and Retaining Physics Students	**BB** Pre-College PER	**TD01** NGSS Topical Discussion	
5:00 p.m.											
5:30 p.m.											
6:00 p.m.									**TD02** Physics & Society Topical Discussion		
6:30 p.m.			**TD05** Dual and Concurrent Enrollment			**TD04** History and Philosophy					
7:00 p.m.											
7:30 p.m.											**PLENARY SESSION:** Don Pettit, NASA astronaut
8:00 p.m.											
8:15 p.m.											
8:30 p.m.		**High School Share-a-thon**									**AAPT Council Meeting (Ballroom C)**
9:00 p.m.											
9:30 p.m.											
10:00 p.m.											

AAPT PHYSICS EDUCATION

Monday, January 6, 2014– Session Schedule

Poster Session 1, 8 to 9:30 a.m. • Poster Session 2, 8:30 to 10 p.m. (Grand Ballroom Foyer)

	SALON 3	SALON 4	SALON 7	SALON 6	SALON 5	SALON 8	SALON 9	SALON 10	SALON 11	GRAND BALL-ROOM B
9:30 a.m.										**Richtmyer Award:** Sir Michael Berry **SPS Award**
10:00 a.m.										
10:30 a.m.										
11:00 a.m.	**CA** Physics and Society	**CG** PER: Topical Understanding and Attitudes	**CC** Recruiting and Retaining Physics Students II	**CB** Low Enrollment Teacher Preparation Programs	**CD** *Panel* – Goals and Assessment Tools for Instructional Labs		**CF** Introductory Courses	**CH** Upper Division and Graduate Topics		
11:15 p.m.										
11:45 p.m.										
12:00 p.m.										
1:00 p.m.										
2:00 p.m.										**Plenary Session:** Philip Metzger
2:30 p.m.										
3:00 p.m.										
3:30 p.m.	**DB** Innovations in Research and Teaching Astronomy		**DE** Physics for the Life and Health Sciences	**DD** Mentoring High School Teachers	**DA** *Panel* – What Can MOOCs Do for Us?	**DF** International Models of Physics Teacher Preparation	**DG** Responsive Teaching in Science	**DH** Using History to Teach Astronomy and Physics	**DC** *Panel* – Report on the Graduate Education in Physics Conference	
4:00 p.m.										
4:30 p.m.										
5:00 p.m.										
5:30 p.m.										
6:00 p.m.										
6:30 p.m.										
7:00 p.m.										
7:30 p.m.	**EA** Apparatus Magic	**EB** Partnerships between Two-Year and Four-Year Schools	**EE** International Professional Development Opportunities for Teachers	**ED** New Technology for Enhancing Research	**EC** The "Magic" of Engaging Girls in Physical Science	**EF** Dealing with Academic Dishonesty	**EG** Cultural Relevance in the Physics Classroom	**EH** Innovative Undergraduate Labs		
7:45 p.m.										
8:00 p.m.										
8:30 p.m.										

Orlando 2014 AAPT The Magic of Physics

Tuesday, January 7, 2014– Session Schedule

Poster Session 3, 3 to 4:30 p.m. (Grand Ballroom Foyer)

	SALON 3	SALON 4	SALON 7	SALON 6	SALON 5	SALON 8	SALON 9	SLAON 10	SALON 11	GRAND BALL-ROOM B
8:30 a.m.	**FA** ALPHA Projects: Mentoring and Student Projects		**FC** Engaging Physics and Astronomy Students in Service Learning	**FB** Broader Perspectives: Active Learning Strategies	**FH** PER: Student Reasoning and Problem Solving	**FD** Why do I Need a 3D Printer for my Physics Department?	**FF** Physics for Non-Scientists	**FG** Distance Labs	**FE** Bridging Teacher Preparation and Professional Development	
9:00 a.m.										
9:30 a.m.										
10:00 a.m.										**AWARDS:** Dean Zollman, Oersted Medal
10:30 a.m.										
11:00 a.m.										**AWARDS:** DSCs, Presidential transfer
11:30 p.m.										
12:00 p.m.	**GA** Stereotypes and the Princess Threat		**GD** Classical Mechanics in Upper-Level Core: Frontiers and Classroom	**GC** Effective Practices in Educational Technology	**GB** The "Maturing" Field of PER and Its Associate Implications	**GE** Sustainability of Teacher Preparation Programs	**GF** The Relevance of Laboratory and Apparatus	**GG** Inservice Prep.for Pre High School Teachers	**GH** Interactive Lecture Demonstrations	
12:30 p.m.										
1:00 p.m.										
1:30 p.m.										**AAPT Symposium:** Physics Education & Public Policy
2:00 p.m.										
2:30 p.m.										
3:00 p.m.						**HC** Alternative Grading Methods	**HA** Post Deadline Papers	**HB** AP Physics 1&2	**HD** Post Deadline Papers II	
3:30 p.m.										
4:00 p.m.										
4:30 p.m.										
5:00 p.m.										

Workshops – Saturday, January 4

All workshops are held at Rollins College, Bush Science Center

W01: Research-based Alternatives to Traditional Physics Problems

Sponsor: Committee on Research in Physics Education
Time: 8 a.m.–5 p.m. Saturday
Member Price: $80 **Non-Member Price:** $105
Location: 228

Kathy Harper, Engineering Education Innovation Center, Ohio State University, 244 Hitchcock Hall, Columbus, OH 43210; harper.217@osu.edu

Thomas M. Foster, David P. Maloney

Accumulating research on problem solving in physics clearly indicates that traditional, end-of-chapter exercises in physics texts are not useful and may actually hinder students' learning of important physics concepts. The research also raises questions about the efficacy of such tasks for helping students develop "problem solving skills." In light of these results the question is: What alternative tasks can we use to help students develop problem solving skills and a conceptual understanding? This workshop will review the research and then provide examples of several alternative tasks and their use. Participants will also get practice writing alternative problems in a variety of formats for use in their own classrooms.

W03: Physics and Astronomy by Design

Sponsor: Committee on Teacher Preparation
Co-sponsor: Committee on Space Science and Astronomy
Time: 8 a.m.–5 p.m. Saturday
Member Price: $105 **Non-Member Price:** $130
Location: 210

Julia Olsen; jkolsen@u.arizona.edu

What is understanding? What is the relationship between knowledge and understanding? What does "teaching for understanding" look like in the physics and/or astronomy classroom? How can we implement reformed teaching along with new standards? These and other important questions will be explored as participants design, develop, and refine a cohesive unit plan based on the principles found in Understanding by Design (UbD). In the UbD classroom, there are high expectations and incentives for all students while exploration of big ideas and essential questions is differentiated, so students who are able delve more deeply into the subject matter than others. This workshop is appropriate for instructors from pre-high school through college levels. Participants will receive a copy of UbD, 2ndEd.(print or pdf) *Note:* participants are strongly encouraged to bring their own laptops to the workshop.

W04: Reformed Teaching Observation Protocol (RTOP)

Sponsor: Committee Physics in Undergraduate Education
Co-sponsor: Committee on Physics in Pre-High School Education
Time: 8 a.m.–5 p.m. Saturday
Member Price: $80 **Non-Member Price:** $105
Location: 202

Kathleen Falconer, Buffalo State College, 1300 Elmwood Ave., Buffalo, NY 14222; Falconka@buffalostate.edu

Daniel MacIsaac

The Reformed Teaching Observation Protocol (RTOP) is a 25-item rubric that provides a percentile measure of the degree and type of student-centered, constructivist, inquiry-based engagement in an instructional situation. RTOP scores correlate very highly with student conceptual gains. In this workshop, we will score video vignettes of teaching to learn how to use RTOP for guiding personal reflection and improvement and change of our own teaching; for mentoring peers, novice teachers, and student teachers; and to establish a vocabulary for discussing reformed teaching practices. If you wish, you may bring a DVD of your own teaching to score.

W06: Teaching Science with LEGO Mindstorms: FIRST Steps and Beyond

Sponsor: Committee on Science Education for the Public
Co-sponsor: Committee on Apparatus
Time: 8 a.m.–5 p.m. Saturday
Member Price: $90 **Non-Member Price:** $115
Location: 101

Jeremy Benson, Department of Chemistry & Physics; 109 Chanticleer Dr. East; Conway, SC 29526; jjbenson@niu.edu

Steve Lindaas

One of the many challenges associated with teaching science and engineering is including the creativity aspects of the fields. Too often material is taught as a sequence of conceptual ideas strung together by mathematical proofs or historical asides. The use of LEGO Mindstorms allows for a hands-on exploration of the same scientific concepts while explicitly incorporating scientific reasoning skills and emphasizing the creativity side of science and engineering. In this workshop we will introduce the LEGO Mindstorms kits and the NXT programming software by having participants build and program LEGO robots similar to those used in the FIRST LEGO League (FLL). Initially we will focus on developing simple programming algorithms, tips for teaching the material, and avoiding common pitfalls. This will be followed by having participants perform a few example experiments that demonstrate the interplay of content knowledge, scientific reasoning, and creativity.

W07: Inquiry-based Learning Strategies that Support the New AP Physics 1&2 Courses

Sponsor: Committee on Physics in High Schools
Time: 8 a.m.–5 p.m. Saturday
Member Price: $100 **Non-Member Price:** $125
Location: 180

Dolores Gende; mdgende@yahoo.com

Connie Wells

The new AP Physics: Algebra-Based 1 and 2 courses have a strong emphasis on inquiry-based learning. This workshop will provide participants with several inquiry-based labs as well as strategies for modifying more traditional labs to include inquiry. Other non-laboratory related inquiry-based strategies will be discussed as well. The workshop will be presented by Dolores Gende, CBA to the AP Physics 1 Development Committee.

W08: Ring Flinger Make-n-take

Sponsor: Committee on Apparatus
Time: 8 a.m.–12 p.m. Saturday
Member Price: $185 **Non-Member Price:** $210
Location: 160

Sam Sampere, Syracuse University, Department of Physics, 201 Physics Building, Syracuse, NY 13244; smsamper@syr.edu

During this session, you will build (PIRA 5K20.30) a Thompson-Elihu coil, commonly known as the Ring Flinger demonstration. Your completed device will toss 2-in OD aluminum rings six meters into the air, and higher when you cool them! Rings fashioned from other materials will jump to different heights. Learn why this is so, and build your own coil to take home by attending this workshop. The completed project weighs about 10 lbs. You should plan to ship your new favorite demo home via UPS or USPS.

W09: TIPERs in the High School Classroom

Sponsor: Committee on Physics in High Schools
Time: 8 a.m.– 12 p.m. Saturday
Member Price: $65 **Non-Member Price:** $90
Location: 164

Martha Lietz; marlie@d219.org

Stephen Kanim

TIPERs are Tasks Inspired by Physics Education Research. These tasks are not like traditional physics textbook problems, but rather, require the students to think conceptually about a particular physical situation. They include ranking tasks, working backwards tasks, conflicting contentions tasks, linked multiple choice tasks and others. In this workshop, we will work with different kinds of tasks, discuss how they might be effectively used in the physics classroom, and learn how to write some of our own tasks.

W11: A Potpourri of Simulation

Sponsor: Committee on Physics in Two-Year Colleges
Co-sponsor: Committee on Educational Technologies
Time: 8 a.m.–12 p.m. Saturday
Member Price: $60 **Non-Member Price:** $85
Location: 310

Paul Williams; pwill@austincc.edu

Tom O'Kuma

A large number of simulations have become available over the last few years. This workshop will look at simulations from a consumer's point of view with a focus on effectively using simulations in the physics classroom. A number of strategies for incorporating simulations into instruction such as free inquiry activities, guided inquiry activities, lab activities (including quantitative data acquisition), and conceptual exercises based on simulations will be explored. The workshop will focus on three packages of simulations/animations that are available for free on the web including PhET simulations, Physlet simulations, and simulations and animations from the MIT TEAL site. As part of the workshop, participants will design an activity which incorporates a simulation. Participants who wish to run the simulations from their own laptop are encouraged to bring their laptop to the workshop.

W12: Using ComPADRE

Sponsor: Committee on Educational Technologies
Time: 1–5 p.m. Saturday
Member Price: $60 **Non-Member Price:** $85
Location: 301

Bruce Mason, Homer L. Dodge Dept. of Physics & Astronomy, 440 W. Brooks St., Norman, OK 73019; bmason@ou.edu

The ComPADRE physics education online resource collections provide a number of tools to help you find, organize, and share your favorite resources with colleagues and students. Participants in this workshop will use ComPADRE tools to create a personalized collection for a course, mentoring, or collaboration. Workshop attendees should bring their own computers to participate. An exploration and discussion of Open Educational Resources, both finding them and using them, will be an important aspect of this workshop. A brief tour of ComPADRE will also be included. The ComPADRE portal page is at http://www.compadre.org.

W13: Sketch N' Etch

Sponsor: Committee on Laboratories
Co-sponsor: Committee on Apparatus
Time: 1–5 p.m. Saturday
Member Price: $80 **Non-Member Price:** $105
Location: 105

Eric Ayars, Campus Box 202, Department of Physics, Chico, CA 95929-0202; Ayars@mailaps.org

Steve Lindaas

Make your own circuit boards! This workshop will offer hands-on experience in the physical process of creating your own circuit board from scratch. Participants will design, print, etch, and solder a really cool electronic gizmo they can wear on their badge for the rest of the meeting, making them the envy of all the other nerds. (Additionally, the skills gained may be useful in building experimental apparatus for physics labs.)

W14: Ben Franklin is my Lab Partner

Sponsor: Committee on History and Philosophy in Physics
Time: 1–5 p.m. Saturday
Member Price: $72 **Non-Member Price:** $97
Location: 160

Bob Morse, 5530 Nevada Ave., NW, Washington, DC 20015; rmorse@cathedral.org

Benjamin Franklin's experiments and observations on electricity established not only his reputation as a scientist, but also our electrical conventions and vocabulary, and the principle of charge conservation. In his letters, Franklin builds, tests, and defends his model with skill and eloquence, arguing from experiment and sharing both his wisdom and doubts, while clearly conveying his fascination with electricity. As Franklin was not formally schooled in mathematics, his theory was qualitative, and is an approachable example of hands-on and minds-on construction of a conceptual model with explanatory power. In this workshop, developed by the author at the Wright Center for Science Teaching at Tufts University, we will work with Franklin's descriptions to recreate several of his experiments using modern, inexpensive materials. Participants will receive equipment and a CD-ROM containing the workshop manual, a collection of Franklin's letters relating to electricity, and movie clips illustrating the experiments.

W15: Implementation: Physics for Life and Health Sciences

Sponsor: Committee on Physics in Undergraduate Education
Time: 1–5 p.m. Saturday
Member Price: $65 **Non-Member Price:** $90
Location: 310

Nancy Beverly, Mercy College, 555 Broadway, Dobbs Ferry, NY 10522; Nbeverly@mercy.edu

Nancy Donaldson

Building on the many efforts to reform the Introductory Physics for Life Science (IPLS) majors, institutions are increasingly expanding the physics major by integrating biology and medicine applications in new majors, minors, and higher level courses. How do the foundational topics in an IPLS course taught in a life science context compare with the same physics topics taught at higher levels, for example, in a Physics in Medicine major? How do the student learning outcomes compare? What can student projects or lab activities look like at different levels? How is spiraling of student learning achieved? Representatives from different institutions with varying approaches in course design will provide a spectrum of curricular materials and resources to help participants implement their own profile of life or health science focus to existing or new courses.

W16: Distance and Remote Labs

Sponsor: Committee on Laboratories
Co-sponsor: Committee on Apparatus
Time: 1–5 p.m. Saturday
Member Price: $60 **Non-Member Price: $85**
Location: 208

Jacob Millspaw; millspaj@ipfw.edu

Distance education is on the rise. This includes courses delivered through live video feed to remote locations or through online learning. The need for hands-on exploration in distance classes and developing labs for online courses poses new challenges! Come explore various tabletop physics investigations that can be packaged into an inexpensive kit for remote class and online students! The topics include motion, forces, harmonic motion, work, color mixing, geometric optics and various other introductory physics concepts.

Workshops – Sunday, January 5

All workshops are held at Rollins College, Bush Science Center

W19: A Kaleidoscope of Great Online Tools for Teaching Physics

Sponsor: Committee on Educational Technologies
Co-sponsor: Committee on Teacher Preparation
Time: 8 a.m.–12 p.m. Sunday
Member Price: $62 **Non-Member Price: $87**
Location: 310

Cathy Ezrailson, 1301 Over Drive, Vermillion, SD 57069; Cathy.Ezrailson@usd.edu

Educators have more opportunities than ever to begin teaching in today's "smart environments" through e-texts, simulations, and today's emerging and "customizable" web-tools—especially since web-based tools can also be pressed into service in order to organize, design, and assess learning. This workshop is one opportunity to access, investigate, and begin to use a few of these resources in your courses. Most of these tools and applications are free on the web, easy to grasp and implement. Coupled with a course redesign, implementation could markedly enhance your course and communication with students. This workshop aims to help you to model, create and gain experience with some of these free tools.

C.M. Ezrailson, A Kaleidoscope of Free and Easy Web Tools for Teachers, WM13, New Orleans, LA. (2013, Jan.).

W20: Exploring the Milky Way Using Small Remote Radio Telescopes

Sponsor: Committee on Space Science and Astronomy
Time: 8 a.m.–12 p.m. Sunday
Member Price: $60 **Non-Member Price: $85**
Location: 160

Joe Heafner, Department of Physics, Guilford College, 5800 West Friendly, Greensboro, NC 27410; heafnerj@sticksandshadows.com

Don Smith

This workshop will demonstrate, and allow, participants to operate a remotely controlled radio telescope, take data, and analyze that data.

W21: In Home Low-cost Labs

Sponsor: Committee on Laboratories
Time: 8 a.m.–12 p.m. Sunday
Member Price: $75 **Non-Member Price: $100**
Location: 210

Alex Burr, 695 Stone Canyon Drive, Las Cruces, NM 88011; aburr@aol.com

A physics course without experiments is not a physics course. However many general physics instructors in high schools and colleges feel pressured in terms of money and time to neglect this aspect of physics instruction. This workshop will address these problems. The participants will actually do real experiments that do not have to use expensive sophisticated equipment and take up valuable class time. These experiments can illustrate advanced experimental concepts and show that if you ask questions of nature, she will answer. Topics mentioned include mechanics, electricity, and optics. They will be done individually and in groups. Participants should bring Apple or Android smart phones or tablets if they have them. Participants will leave with inexpensive apparatus, detailed notes, and a renewed commitment to physics as an experimental science.

W22: Using Invention to Promote Mathematical Thinking

Sponsor: Committee on Research in Physics Education
Time: 8 a.m.–12 p.m. Sunday
Member Price: $62 **Non-Member Price: $87**
Location: 228

Andrew Boudreaux; Andrew.Boudreaux@wwu.edu

Stephen E. Kanim, Suzanne White Brahmia

Students often struggle to make sense of mathematical representations of physics concepts. Invention instruction, developed by Schwartz and colleagues, requires students to invent procedures or quantities that allow them to compare a set of situations, a process that primes students to make sense of the subsequently presented scientific procedure or quantity. In an ongoing collaboration between Rutgers, WWU, and NMSU, we have adapted this approach for use in introductory physics courses. Before a new quantity is introduced, students work collaboratively through an invention sequence designed to connect students' sense-making resources to the scientific challenge at hand. A primary goal is to promote active sense-making in lieu of common memorization or equation matching approaches. Preliminary assessment data indicate positive impacts on student reasoning, including in some cases the closing of performance gaps between mainstream and underrepresented groups. In this workshop, we will engage participants in invention work and present assessment data.

W23: Activities for Engaging Girls in Physical Science

Sponsor: Committee on Science Education for the Public
Co-sponsor: Committee on Physics in Pre-High School Education
Time: 8 a.m.–12 p.m. Sunday
Member Price: $60 **Non-Member Price: $85**
Location: 105

Peggy Norris, Sanford Underground Research Facility, 630 E. Summit St., Lead, SD 57754; norris@sanfordlab.org

Patricia Sievert

AIP statistics show that the number of females majoring in physics and engineering in college is still hovering around 20%, well below gender equity. How can girls become engaged—inside or outside of formal school time—in activities that lead them to identify physics as

a potential career choice? Research shows that if girls are engaged in open-ended, collaborative science projects that are relevant to their world, they gain self confidence and begin to identify themselves as a scientist. Relatively new programs such as SciGirls™, FabFems, and Design Squad seek to build this confidence and identity in young women. To date, however, activities in these programs have been heavily weighted to life and environmental science, engineering and technology. Participants in this workshop will have the opportunity to try tested physics activities that fit with the strategies for engaging girls in grades 5-12.

W24: iPhone and iPad App Development

Sponsor: Committee on Educational Technologies
Time: 8 a.m.–12 p.m. Sunday
Member Price: $70 **Non-Member Price: $95**
Location: 212

Andrew Duffy, Physics, Boston University, 590 Commonwealth Ave., Boston, MA 02215 ; aduffy@bu.edu

This workshop is a basic introduction to creating apps for the iPhone, the iPod Touch, and the iPad. No prior knowledge is assumed. We will cover the basics of drawing and animating; learn a little Objective-C; become familiar with the XCode environment in which apps are created on the Mac; and get an introduction to Interface Builder, where we lay out various buttons and sliders, etc. Important note—workshop attendees must bring their own Mac computers, with Apple's latest version of XCode already downloaded and installed. This is a free download from Apple. Attendees should have OS 10.7 or higher on their Mac's—previous OS versions do not have access to the features in the version of XCode that will be used in the workshop.

W26: New RTP and ILD Tools and Curricula: Video Analysis, Clickers and E&M Labs

Sponsor: Committee on Research in Physics Education
Co-sponsor: Committee on Educational Technologies
Time: 8 a.m.–12 p.m. Sunday
Member Price: $75 **Non-Member Price: $100**
Location: 180

David Sokoloff, Department of Physics, 1274 University of Oregon, Eugene, OR 97403-1274 ; sokoloff@uoregon.edu

Ronald Thornton, Priscilla Laws

RealTime Physics (RTP) and Interactive Lecture Demonstrations (ILDs) have been available for over 15 years so what's new? The 3rd Edition of RTP includes five new labs on basic electricity and magnetism in Module 3 as well a new approach to projectile motion in Module 1. Some of these new labs make use of video analysis. Also new are clicker-based ILDs. This hands-on workshop is designed for those who want to make effective use of active learning with computer-based tools in their introductory courses. These active learning approaches for lectures, labs, and recitations (tutorials) are based on physics education research (PER). The following will be distributed: Modules from the Third Edition of RTP, the ILD book, the Physics with Video Analysis book and CD, and Teaching Physics with the Physics Suite by E.F. Redish.

W27: Engaging Astronomy Students with Lecture Tutorials

Sponsor: Committee on Space Science and Astronomy
Time: 8 a.m.–12 p.m. Sunday
Member Price: $60 **Non-Member Price: $85**
Location: 208

Julia Olsen, CAPER Center for Astronomy & Physics Education Research, 604 S 26th St., Laramie, WY 82070; jkolsen@u.arizona.edu

Timothy F. Slater

In this half-day, participatory workshop specially designed for introductory college faculty, graduate students, and high school teachers, participants will learn how to use a lecture-tutorial approach to actively engage astronomy students. Created by faculty affiliated with the CAPER Center for Astronomy & Physics Education Research Team, lecture-tutorials are purposefully designed to support students' intellectual engagement with challenging astronomy concepts by augmenting lectures for 10-minute intervals where students collaboratively wrestle with how to apply ideas in novel settings. Astronomy education research consistently demonstrates that students significantly increase their understanding of astronomy through the use of lecture-tutorials and that professors find them easy to implement. Classroom-ready materials will be provided to all participants. This teaching excellence workshop is funded in part by the Wyoming Excellence in Higher Education Endowment, NASA EPOESS FINESSE and the NSF GeoEd OEDG & TUES Programs.

Tutorials will be held at the Rosen Plaza Hotel

T01: Electrostatics from Gilbert to Volta

Sponsor: Committee on Physics in High Schools
Co-sponsor: Committee on Physics in Pre-High School Education
Time: 2–4 p.m. Sunday
Member Price: $50 **Non-Member Price: $75**
Location: Salon 12 (Rosen Plaza)

Robert Morse, 5530 Nevada Ave. NW, Washington DC 20015; ramorse@rcn.com

With inexpensive equipment, students can carry out activities to build a conceptual understanding of electrostatic phenomena. In this short tutorial we will build the equipment and learn to carry out experiments patterned after those from William Gilbert to Alessandro Volta, including charge detection, electric field patterns and electrostatic induction.

T03: Getting Started in Outreach

Sponsor: Committee on Science Education for the Public
Time: 2–4 p.m. Sunday
Member Price: $50 **Non-Member Price: $75**
Location: Salon 11 (Rosen Plaza)

David Sturm, Department of Physics & Astronomy, University of Maine, Orono, ME 04469-5709; sturmde@maine.edu

Rebecca Thompson, Dale Stille, Sam Sampere

A two-hour tutorial session on how to start and build Outreach Programming for universities and colleges to engage the public, with presentations from the APS Head of Public Outreach Rebecca Thompson, from established University Outreach programs run by PIRA members such as Dale Stille, UIowa; Sam Sampere, Syracuse U.; and David Sturm, UMaine; and from other members of the outreach community.

T04: Selling Physics as a Major

Sponsor: Committee on Physics in Two-Year Colleges
Co-sponsor: Committee on Professional Concerns
Time: 2–4 p.m. Sunday
Member Price: $125 **Non-Member Price: $150**
Location: Grand Ballroom C (Rosen Plaza)

Renee Lathrop, (845) 431-8544; lathrop@sunydutchess.edu

Increasing the number of physics majors is a perennial goal of physics departments around the country. How to increase the number of physics majors is a problematic issue. This question will be explored via discussions of successful case studies. Additionally, we will spend time brainstorming ways to increase majors, solutions that will be tailored to participants' specific home institutions.

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Two-Year Colleges: T04, W11, CB, EB. GF

Undergraduate Education: W04, W15, AA, AC, BC, DE, EF, FA, FC, FF, GD

Women in Physics: BC, FF, GA

Session SPS: SPS Research and Outreach Poster Reception

Location: Grand Ballroom A
Sponsor: AAPT
Date: Saturday, January 4
Time: 8–10 p.m.

Presider: Toni Sauncy

SPS01: 8-10 p.m. A Comparative Analysis of Atwood's Machine Configurations

Poster – Thomas Predey, Loyola University Chicago, Chicago, IL 60660; predey34@mac.com

Thomas Ruubel, Loyola University Chicago

We are studying the effects of different pulley configurations on the Atwood's machine. The goal is to determine if the number of pulleys in the system affects the accuracy of the measurements. We are testing the claim that a two-pulley system yields more accurate results than a single pulley setup. We investigated the performance of each system as we varied the masses involved. This project provides a detailed comparative analysis of the pulleys' role in the Atwood's machine setup.

SPS02: 8-10 p.m. Measuring and Modeling a Boleadora

Poster – Jacob T. Brooks, High Point University, High Point, NC 27262-3598; brookj12@highpoint.edu

Aaron Titus, High Point University

The effects of the throwing technique on the motion of a boleadora in flight were investigated. The boleadora is an ancient hunting weapon made of three individual masses connected by rope to a common knot. The dynamics of the boleadora depend on whether it is thrown by the knot or by one of the masses. A computational model was developed for each throwing technique. Predictions of the models were compared to results from 3D video analysis. The models and results from video analysis for the two throwing techniques will be presented.

SPS03: 8-10 p.m. Physics of Stringed Instruments

Poster – Katarzyna Pomian, Loyola University Chicago, Chicago, IL 60660; kpomian@luc.edu

We are studying the properties of stringed instruments that contribute to their unique sounds and yet, set them apart. The goal is to understand how stringed instruments function, and what sets the different instruments apart in sound and function. We have analyzed the string resonances and body properties of 13 instruments including some of the lesser studied ones. We analyzed sound data for each instrument under different initial conditions. The strings were excited at different locations using various techniques, such as plucking and bowing. We also took high-speed videos for a better understanding of the wave generated by each instrument. Body analysis using Chladi patterns helped us to observe the properties of the bodies. A cross comparison of the instruments revealed variances in the sound, based upon the unique characteristics of each instrument. This project provides a comprehensive analysis of stringed instruments.

SPS04: 8-10 p.m. Springs Released from Uniform Circular Motion – The Slinky Drop Extended

Poster – Matthew Carnaghi, High Point University, Greensboro, NC 27410 carnam12@highpoint.edu

Aaron Titus, High Point University

Thomas Dooling, The University Of North Carolina at Pembroke

Jeff Regester, Greensboro Day School

The path of a spring released from uniform circular motion was investigated and compared to a computational model. This study is an extension of the "Slinky drop" experiment, which consists of holding the top of a Slinky™ above the ground, allowing it to stretch due to the gravitational force, and releasing it from rest. For the falling slinky the bottom portion of the slinky remains stationary until the slinky collapses. Similarly, for a spring in uniform circular motion, the spring is not uniformly stretched but is most stretched near the center of the circle. When released, it is expected that the furthest end of the spring will continue in uniform circular motion until the spring has collapsed. Video analysis was used to measure the motion of a spring released from uniform circular motion, and results were compared to a computational model of the system. It was found that the free end of the spring continues in uniform circular motion after the fixed end is released and before the spring fully collapses.

SPS05: 8-10 p.m. Investigating Traditional Methods of Inertial Navigation Versus Using a Smartphone

Poster – Timothy Slesinger, Randolph College, Lynchburg, VA 24503; psheldon@randolphcollege.edu*

Alex T. Tran, Peter A. Sheldon, Randolph College

Kacey L. Meaker, University of California, Berkeley

Inertial navigation has long been used for measurement of position and orientation in commercial travel (boats, planes), but the systems are complicated and expensive. GPS is good for two-dimensional positioning on the surface of the Earth, but not for orientation or altitude, and GPS signals are not always available. Inertial navigation systems are self-contained and do not require communication with an outside agent. Very recent improvements in micro-machined electromechanical systems (MEMS) have made the application of inertial navigation techniques easily available. We became interested in this project through our work in mapping roller coaster rides. We will report on our efforts to develop techniques of averaging, noise-reduction, and reduction of drift in a navigation signal generated by accelerometers and gyroscopes. In addition, we show a comparison of research-grade inertial navigation equipment to the sensors built into a standard smartphone.

*Sponsored by Peter Sheldon

SPS06: 8-10 p.m. A Novel Low-cost Gamma Ray Spectroscopy for Undergraduate Physics Labs

Poster – Abaz Kryemadhi, Messiah College, Mechanicsburg, PA 17055; akryemadhi@messiah.edu

Kyler Chrestay, Joel Love, Messiah College

Gamma Ray Spectroscopy has been traditionally expensive for physics labs due to needs for multichannel analyzers and/or NIM crates. We have been able to design a low-cost gamma ray spectroscopy for physics labs using a silicon photomultiplier as a photodetector, a LYSO crystal for scintillation, and a typical digital oscilloscope with Labview. The method we use does not only provide low-cost gamma ray spectra from different isotopes but also unlike the black box approach in multichannel analyzers, it provides opportunities for undergraduate students to be familiar with detection techniques in particle and nuclear physics.

SPS07: 8-10 p.m. Scintillator Studies for Cryogenic Dark Matter Search (CDMS) Experiment

Poster – Abaz Kryemadhi, Messiah College, Mechanicsburg, PA 17055; akryemadhi@messiah.edu

Joel Love, Jack Bluebaugh, Messiah College

We spent this past summer studying scintillators for a neutron veto for CDMS Experiment. The CDMS searches for Weakly Interactive Massive Particles (WIMPs) using germanium crystals kept at milliKelvin and it is currently located at Soudan mine in Minnesota. The superCDMS which will be the next phase of CDMS, will be located at SNOLAB in a deep mine in Canada. Neutron Veto is one of possible active sub-detectors to be deployed in order to tag neutrons which carry similar signature to WIMPS. We studied different scintillators and different photo-detectors in search of high light yield and low-cost detector prototype. We collaborated with Fermi National Laboratory CDMS group and were sponsored by Department of Energy under Visiting Faculty Team grant.

SPS08: 8-10 p.m. Growth of Metal Nanostructures via Physical Vapor Deposition

Poster – Richard Floyd, Coastal Carolina University, Conway, SC 29526; rdfloyd@g.coastal.edu

James C. Moore, Coastal Carolina University

We have used a low-cost single zone tube furnace to fabricate metal nanostructures on silicon substrates. Specifically, we evaporate copper, zinc, and gold and control furnace properties such as temperature, carrier gas pressure and composition, and the distance from the evaporant to the substrate to enhance nanowire growth. This project should lead to the creation of a new, advanced laboratory activity for physics majors.

SPS09: 8-10 p.m. Metal Nanoparticle Enhanced Zinc Oxide Photodetectors

Poster – Cody V. Thompson, Coastal Carolina University, Conway, SC 29526; codyt@homesc.com

James C. Moore, Coastal Carolina University

We present an investigation into the device characteristics of zinc oxide thin-film photodetectors grown via a sol-gel technique. Specifically, we compare properties of devices having active layers doped with varying concentrations of silver nanoparticles. We have also investigated the effect on device characteristics when active layers are grown on top of periodic silver nanostructure plasmonic waveguides. Devices where fabricated by spin coating zinc acetate sol-gels on sapphire substrates. Doping was achieved using varying concentrations of silver nitrate. Waveguides consist of periodic silver nanostructures grown on substrates using electrodeposition through 200 nm alumina filters. Silver interdigitated contacts were then applied via photolithography and sputter deposition for all devices. The current-voltage and transient ultraviolet photoresponse behaviors for all devices where determined. Optimizing the responsivity and sensitivity of ZnO photodetector devices to UV light is key for future real-world applications.

SPS10: 8-10 p.m. Current Distribution on a Two-Dimensional Plane

Poster – Claire Soupene, Loyola University Chicago; csoupene@luc.edu

Virginia Bailey, Thomas Predey, Asim Gangopadhyaya, Thomas Ruubel, Loyola University Chicago

We studied the current distribution generated by a source and a sink on a two-dimensional plane. We developed a theoretical model for the distribution, carried out a detailed experimental investigation, and analyzed our data using our theoretical model as well as a model commonly used in the electronics industry.

SPS11: 8-10 p.m. Electron Transport in Hall Thrusters

Poster – Russell Swinton, Eckerd College, St. Petersburg, FL 33711; Rsswinto@eckerd.edu

Zachary Charbonneau, Eduardo Fernandez, Eckerd College

Electron transport in Hall thrusters has been long known to deviate from classical predictions based on particle collisions. As a consequence, our ability to predict basic features such as current-voltage curves for plasma discharge is limited. In this paper we present a hybrid fluid, particle in cell model for Hall thruster plasmas in axial and azimuthal coordinates. The goal of this investigation is to determine the role of azimuthal physics on the overall plasma discharge, paying particular attention to internal fluctuations and electron transport dynamics. Results from the simulations reveal long wavelength (m<5), low frequency (<100 kHz), correlated tilted structures, which result in enhanced electron transport. This is in qualitative agreement with experiments. Results from our simulations will be compared with experimental data from Stanford's Hall thruster.

SPS12: 8-10 p.m. Broadening Participation of SBIR/STTR Research Experiences for Secondary Students

Poster – Steve Griffin, Triangle Coalition/National Science Foundation (Directorate for Engineering-Division of Industrial Innovation and Partnerships), Arlington, VA 22203; stgriffi@nsf.gov

Research experiences for high school students in the STEM real-world setting are uncommon. By reaching out to high school students and teachers, small businesses involved in innovation partnerships can produce collective teams generating important research and human resources for a growing economy. The National Science Foundation Directorate for Engineering Division of Industrial Innovation and Partnerships encourages high school students and teachers to work collaboratively with Small Business Innovative Research grantees and Small Business Technology Transfer grantees motivating more young people into considering a vocation in a STEM related field. With a high demand for a workforce trained in science and engineering the possibilities for business incorporating research with a trained workforce could provide an extraordinary return. More importantly, the opportunity for under-represented groups to participate in scientific research could be monumental.

SPS13: 8-10 p.m. Development of Feasible Science Activities in Elementary School

Poster – Jaime E. Demick, Huntingdon College, Montgomery, AL 36106; jdemick@hawks.huntingdon.edu

Allyson Brislinger, Kendall Fant, Carly Williamson, Huntingdon College

A broad understanding of science topics in elementary-age students is vital to the cognitive development of the student. Students who perceive achievement in scientific topics and who actively learn and retain basic scientific principles and information at a young age increase their likelihood of success in these topical areas in middle and high school. With this premise in mind, Huntingdon College students worked with a faculty member to develop curriculum-based science modules incorporating the science standards of the state of Alabama. This project resulted in the production of several science booklets for student use and step-by-step guides for instructors to lead inexpensive, easy, hands-on student activities that addressed grade-level standards in an exciting and memorable fashion.

SPS14: 8-10 p.m. Local University Astronomy Club + Local High School Astronomy Club = Success!

Poster – Kathleen A. Gustavson, Nicolet High School, Glendale, WI 53217; kathy.gustavson@nicolet.us

Having a RET position at the local university with a faculty-led astronomy club has opened a wide door, for both myself and my students. There now exists a partnership between the astronomy club at the local university (UWM) and the astronomy club at my high school (Nicolet HS). I frequently take my students to UWM for the meetings, where they enjoy talks by undergrads, graduates, post docs, faculty, and guest speakers. The occasional field trips are also enjoyed. Processed radio data is available for the students to search for pulsars. From these opportunities, the students get first-hand knowledge of the processes of science at the university level. They see the research positions available to undergraduates and graduate students, and the in-depth work the faculty does in their own research.

SPS15: 8-10 p.m. Measurements, Sensors, and Detectors: The 2013 SPS SOCK

Poster – Nicole Quist, Society of Physics Students, 1480 Elnora Ct., Los Altos, CA 94024; nquist@byu.net

Caleb Heath, Society of Physics Students

The advancement of science requires the advancement of measurement and detection standards. The Society of Physics Students (SPS) partnered with the National Institute of Standards and Technology (NIST) to create Science Outreach Catalyst Kit (SOCK). The theme for the SOCK activities and demonstrations focused on Measurement, Sensors, and Detectors. Half of the kit focused on measurement activities and the need for standards, while the other half focused on detectors using the modular Theremin. These hands-on kits will be sent out

to SPS chapters throughout the nation to use in their communities to heighten interest in science. We were able to test the kits with middle school science teachers who were attending the Summer Institute for Middle School Teachers at NIST and integrate their feedback.

SPS16: 8-10 p.m. Stratospheric Thermal Wake Investigation

Poster – Mara Blish, St. Catherine University, St. Paul, MN 55105; epagrimson@stkate.edu*

Rachel Hedden, Amanda Grove, Erick Agrimson, St. Catherine Univ. James Flatten, University of Minnesota

We present data characterizing the thermal wake that trails below ascending high-altitude balloons (AKA weather balloons) as they ascend into the stratosphere. This wake, which is warmer than the ambient air during the day but colder during night flights, is reported to be significant within 25 feet of the base of the balloon. We have built and flown a "wake boom" that hangs below latex weather balloons with a 1-D array of temperature sensors that extends horizontally from directly beneath the balloon to outside of the predicted width of the thermal wake. We present analysis of the temperature profiles collected utilizing this apparatus.

*Sponsored by Erick Agrimson

SPS17: 8-10 p.m. Undergraduates Building a High-Performance Cluster

Poster – William E. Dixon, Francis Marion University, Florence, SC 29505; dixonwille@hotmail.com*

Chad Garland, Larry Engelhardt, Ginger Bryngelson, Francis Marion University

Galen Collier, Clemson University.

High-performance computing is becoming a necessity to universities. Setting up such a device requires money and patience. First, figure out the hardware that the university would make use of. GPUs are great for simple algorithms, but CPUs are better for heavy programming. Once hardware is figured out, then networking and configuration is yet another task. Configuring takes most of the time tweaking the cluster for administrators ease and for the user's use. This project is supported by the NSF EPSCoR RII Track 1 cooperative agreement awarded to the University of South Carolina.

*Sponsored by Larry Engelhardt

SPS18: 8-10 p.m. GPUs: What Language Do You Speak?[1]

Poster – Tiffany Prosser, Francis Marion University, Florence, SC 29506; tcp1123@yahoo.com*

Larry Engelhardt, Francis Marion University

We present the results of an undergraduate research project that explores the use of Graphics Processing Units (GPUs) for scientific computing. In recent years GPUs have become popular for scientific computing due to their ability to provide massive parallelism (with thousands of cores) at a reasonable price. Since GPUs are still relatively foreign to most people, we present a comparison of a few basic GPU programming languages. These languages includes CUDA and OpenACC. CUDA C is an extended version of C/C++. OpenACC (accULL and PGI) is a programming standard that allows FORTRAN and C/C++ programmers to easily take advantage of CPU/GPU systems.

*Sponsored by Larry Engelhardt.

1. This project is supported by the NSF EPSCoR RII Track 1 cooperative agreement awarded to the University of South Carolina.

SPS19: 8-10 p.m. Analyzing Images of 2010ih

Poster – Dorothy A.Dickson-Vandervelde, Francis Marion University, Florence, SC 29506; dadicksonvandervelde@gmail.com

Ginger Bryngelson, Francis Marion University

SN 2010ih is a type Ia supernova, which is thought to come from a binary star system in which at least one of the stars is a white dwarf. The white dwarf gains mass until it reaches the Chandrasekhar limit, where the pressure and temperature set off a runaway thermonuclear explosion. We plan to analyze the light curve of the supernova to characterize the late-time behavior of the supernova and also to figure out the distribution of the different radioactive isotopes. I reduced and combined images of the Supernova 2010ih and then analyzed it for brightness and began the formation of a light curve, which is a graph of magnitude verses time. SN 2010ih was observed on January 10 and 11, 2011, about five months after it was discovered, at Kitt Peak National Observatory with the 4m Mayall Telescope in the visible light bands B, V, R, and I. I used the software Image Reduction and Analysis Facility (IRAF) to analyze and reduce the images. I removed bad pixels and crosstalk, subtracted the darks and the zeros, divided out the flats, fit the image to a world coordinate system, and then combined the images into a final image, for each filter; B, V, R, and I. After achieving the four final images, I found the magnitude for the supernova and thirty field stars using a standard star field.

SPS20: 8-10 p.m. STEM Education and Federal Government

Poster – Dayton J. Syme, Florida State University, Tallahasse, FL 32301; syme.dayton@gmail.com

On April 14th, 2013 the President of the United States put forth an aggressive budgetary plan for fiscal year 2014 that included changes in funding and a reorganization of programs that support STEM (Science, Technology, Engineering, and Math) education. The proposed changes drew support and harsh criticism from both parties. Together, the American Physical Society and American Institute of Physics supported a Society of Physics Students undergraduate intern to work at the Department of Education for the summer of 2013. I spent the summer researching and helping to develop STEM education policies, laying the groundwork for a new APS/AIP/AAAS fellow position that has since been approved. In this poster I will describe my work, the events that led up to what was called the STEM Reorganization, and preview what can be expected with regard to STEM education from the Department of Education and beyond.

SPS21: 8-10 p.m. Assessing Social Deficits in Two Mouse Models of Disease

Poster – Christopher Hollingsworth, Randolph College, Lynchburg, VA 24503; psheldon@randolphcollege.edu*

Zahra Adahman, Alex Kwakye, Katrin Schenk, Randolph College

Lily Y Jan, Howard Hughes Medical Institute

Many neuropsychiatric diseases are associated with communication or social deficits. Here we report on the usefulness of an adult ultrasonic vocalization (USV) paradigm as an assay of social communication. This paradigm consists of recording the USVs of adult male mice in response to sexual/social stimuli. Solitary male mice are recorded in a baseline condition for a fixed time . Then either a female mouse or female urine soaked bedding is added to the chamber and the male mouse's responses are recorded. The recorded vocalizations are analyzed for number of calls before and after the stimuli, latency to first call, and other spectral and timing parameters. We present preliminary results from the application of this paradigm to assay for social communication deficits in two mouse models of disease, a fragile X syndrome (FXS) model mouse with altered Kv4.2 expression, and a mouse model of childhood traumatic brain injury (TBI).

*Sponsored by Peter Sheldon

Melba Newell Phillips Medal Endowment Campaign

The AAPT Awards Committee expresses deep gratitude to all the donors who have responded so generously to our initiative to fully endow the Melba Newell Phillips Medal. To date we have raised over $17,000, more than half of the target amount of $30,000 (half of the estimated amount for full endowment). We have plans for a collection of articles on women in physics to be published next year in memory of Melba Phillips, the proceeds of which will support the campaign. We are planning a "Melba Toast" release event for the collection at SM14. Here in Orlando, our traditional Run/Walk will also be a fundraiser for the medal endowment, so please join us at noon on Monday in the hotel lobby and run or walk for Melba!

Early Career Professionals Speed Networking Event

Discuss career goals and challenges with one colleague for five minutes…
…and then move on to the next.

Sunday, Jan. 5, 12:30–2 p.m.
Salon 10

Sunday, January 5 Highlights

REGISTRATION	7 a.m.–4 p.m.	Grand Ballroom Foyer
Spouse/Guest Scenic Boat Tour of Winter Park, FL	9 a.m.–2 p.m.	offsite
Kindle Raffle	10:15 a.m.	Exhibit Hall
First Timers' Gathering	12–1 p.m.	Salon 4
Early Career Professionals Speed Networking	12:30–2 p.m.	Salon 10
H.S. Physics Teachers Day Luncheon	1–2 p.m.	Salon 14
SPS Awards Reception	6–7:30 p.m.	Salon 14
High School Share-a-Thon	8:30–10 p.m.	Salon 4
AAPT Council Meeting	8:30–10 p.m.	Ballroom C

COMMITTEE MEETINGS, 12–1:45 p.m.

–History & Philosophy	Salon 6
–Laboratories	Salon 11
–Pre-High School Education	Salon 7
–Physics in Two-Year Colleges	Salon 9
–Research in Physics Education (RiPE)	Salon 8

COMMERCIAL WORKSHOPS, 12–1 p.m.

–CW01: Perimeter Institute	Salon 13
–CW05: Expert TA	Salon 12

COMMERCIAL WORKSHOP, 2–3 p.m.

–CW02: Perimeter Institute	Salon 13

Afternoon Break, Exhibits	4 p.m.	Exhibit Hall
Gift Card Raffle	4:15 p.m.	Exhibit Hall

COMMITTEE MEETINGS, 6-7:30 p.m.

–Apparatus	Salon 3
–International Physics Education	Salon 6
–Physics in High Schools	Salon 4
–Professional Concerns	Salon 13
–Space Science and Astronomy	Salon 12

PLENARY: DON PETTIT 7:30–8:30 p.m. Ballroom B

EXHIBIT HALL OPEN: 10 a.m.–5 p.m. Ballroom A

Session AA: SPS Research and Outreach

Location: Salon 3
Sponsor: Committee on Physics in Undergraduate Education
Date: Sunday, January 5
Time: 2–4 p.m.

Presider: Toni Sauncy

AA01: 2-2:30 p.m. SPS Mather Internship: US House of Representatives Committee on Science, Space, and Technology

Invited – Nikki L. Sanford, American Institute of Physics-SPS, 9035 Spicewood Run, Bel Alton, MD 20611; sanfon09@highpoint.edu

As a Society of Physics Student Mather Intern, I worked in the US House of Representatives' Committee on Science Space and Technology. Nobel Laureate Physicist John Mather created this program to promote awareness of science policy among young physicists. In the Science Committee, I was directly involved in the legislative process through research projects, working with staff, and attending committee hearings and markups. I will discuss my experiences on Capitol Hill and interactions with Congressmen, staff, and experts in the scientific community. A physics/scientific background, along with opportunities from this SPS Internship with Congress has been extremely applicable and beneficial to my future career path and current studies at William and Mary Law School.

AA02: 2:30-2:40 p.m. Undergraduate Research Component within College Physics Course

Contributed – Irina Struganova, Valencia College, Orlando, FL 32811; istruganova@valenciacollege.edu

I would like to share my experience of incorporating mini research projects in an honors college physics course. Students were given an option to choose to work on one of the following projects: Kepler Mission, Diffraction of Electrons, Photoelectric Effect, or the Cavendish Experiment. Assignments included learning basic physics principles related to the project, the history and the significance of a particular experiment, conducting a modern version of the experiment and/or the data analysis, and writing a paper. Developed guidelines and resources, as well as students' accomplishments, will be presented.

AA03: 2:40-2:50 p.m. Undergraduates Creating a High-Performance Computer Cluster

Contributed – Scott C. Garland, Francis Marion University, Florence, SC 29505; sgarland2084@g.fmarion.edu*

William Dixon, Larry P. Engelhardt, Ginger Bryngelson, Francis Marion University

Galen Collier Clemson University

We present the student-led creation and management of Francis Marion University's new Patriot Cluster. Supercomputers have become essential tools for many computational scientists. Undergraduate access to such machines can, therefore, boost the competency of computational physics students who have opportunities to interact with them. For this reason, the Patriot Cluster's creation and resources are being used as tools for undergraduate education and research. This project is supported by the NSF EPSCoR RII Track 1 cooperative agreement awarded to the University of South Carolina.

*Sponsored by Larry Engelhardt

AA04: 2:50-3 p.m. Using a Semiconductor Defect to Connect Diffusion Lengths with Lifetimes

Contributed – Ashley Finger, Davidson College, Physics Department, Davidson, NC 28035; tigfroerer@davidson.edu

Tim Gfroerer, Davidson College

When a semiconductor absorbs light, electron-hole pairs are generated and subsequently recombine. In this study, we use the light emitted by a semiconduc-

tor to compare two related properties of the recombination process. In the first experiment, we use an isolated defect to measure effective diffusion lengths, i.e. the average distance traveled by a charge carrier before recombining. In the second experiment, we measure effective lifetimes, i.e. the average time it takes for a charge carrier to recombine. We use these measurements to connect the temporal and spatial distribution of electron-hole pair recombination. These complementary properties can be used to further our understanding of charge carrier behavior in solar cell materials as a function of temperature and illumination.

AA05: 3-3:10 p.m. Conquering Quantum Physics One Photon at a Time

Contributed – Jamie L. Garrett, Southern Polytechnic State University, Powder Springs, GA 30127; jgarrett@spsu.edu

PhysicsQuest is a story-based activity book for middle school students created by the American Physical Society that introduces them to physics concepts through hands-on activities. Free kits are provided to teachers or parents who register on the PhysicsCentral website, as a way to engage middle school students at an age in which many students become disinterested in science. As the Society of Physics Students PhysicsQuest intern, I developed easy-to-do, inexpensive extension activities to complement the activities provided in the latest kit. The topic this year is Quantum Mechanics. Students will explore the photoelectric effect, spectroscopy, absorption spectra, and angular momentum and rotation. This talk will highlight several of the activities created.

AA06: 3:10-3:20 p.m. Modeling Mass-Radius Relationships of Planets Using Differential Equations

Contributed – Kevin D. Thielen, Eckerd College, St. Petersburg, FL 33711; kdthiele@eckerd.edu*

Alexander K. Zielinski, Stephen P. Weppner, Eckerd College

Models of mass-radius relationships for planets have been recently developed by making assumptions about the relationship between pressure and density in order to avoid having to work with more complex equations of state. In our model we construct a Non-linear Homogeneous Ordinary Differential Equation, whose parameters can be readily obtained experimentally, and solve it numerically by making an observation about the relationship of density and compressibility as a function of pressure. We then compare our numerical results to models such as the Preliminary Earth Reference Model (PREM) and models of pressure density relationships of materials from low pressures up to pressures within the region of the Thomas Fermi Dirac theoretical EOS where electron degeneracy pressure becomes a factor.
*Sponsored by Anne Cox

AA07: 3:20-3:30 p.m. Evidence for Dark Matter in the Galactic Rotation Curve

Contributed – Melvin Jason Ezell, Campbell University, P.O. Box 308, Buies Creek, NC 27506; ezell@campbell.edu

Jacob K. Bartlett, Campbell University

The mass of the dark matter halo, or "missing mass" interior to the Sun's orbit was calculated by creating a galactic rotation curve for the Milky Way galaxy. This rotation curve was created by measuring the orbital velocity of interstellar hydrogen at different distances from the galactic core. A 4.6-meter radio telescope was used to collect data on the radio waves emitted by hydrogen at various galactic longitudes. Since hydrogen emits radio waves at a baseline frequency of 1.42 GHz, the Doppler shifted wavelengths observed provided a means to calculate the orbital velocity of the galaxy's matter. This rotation curve was then compared to the amount of visible mass in the galaxy and the missing mass was calculated. This research was converted to a laboratory exercise for undergraduate physics students at Campbell University which included a pre-assessment of content-specific knowledge and a post-assessment of learning outcomes.

AA08: 3:30-3:40 p.m. Incorporating Data Visualization into ZENODO

Contributed – Kevin Sanders, High Point University, High Point, NC 27262; sandek10@highpoint.edu

ZENODO is a research hosting website made for all disciplines. It is built on the idea of all research shared, no matter the subject, no matter the status of the researcher. ZENODO was developed alongside and on top of INVENIO, a digital library software suite, produced by the Digital Library Technology group at CERN. This talk will cover some of the technologies that came into play, as well as my role of beginning to incorporate data visualization into the website during my time spent at CERN through the University of Michigan REU.

AA09: 3:40-3:50 p.m. A New Approach to Optics for Life Science Majors

Contributed – Shauna Novobilsky, Mercyhurst University, Erie, PA 16546l; snovob93@lakers.mercyhurst.edu

Dyan Jones, Mercyhurst University

Interactive learning strategies are frequently used in the teaching of introductory physics topics. Here we describe the development of a course for undergraduate students who are not majoring in the field of physics. By adapting the learning materials from a Studio Optics course and Optics for Biophysics course, we hope to create a course designed to bring interactive learning to the topic of optics. Adapting the course to fit our curriculum will require a reduction in the amount of mathematics in the course, but the majority of the course requirements from the courses mentioned above will remain. This will create an environment that integrates lectures, lab, and simple problem solving as well as a focus on a long-term project for the course. The hope is to create a course that is advantageous to non-physics majors who still have an interest in optics.

AA10: 3:50-4 p.m. Behavioral Analysis Techniques for Mobile Phone Collected Data

Contributed – Yong J. Kwon, Randolph College, Lynchburg, VA 24503; psheldon@randolphcollege.edu

Evan Goulding, Northwestern University

Bipolar disorder (BPD) is a severe and chronic mental illness that increases mortality nearly three-fold. Despite the use of mood stabilizers for many decades, BPD still disables many, and is listed as the ninth leading cause of disability worldwide. The ongoing suffering produced by this disease drives a clear need for improved treatment. This project aims to develop a smartphone intervention that will capture and feed back behavioral data to improve patient self-management and increase the effectiveness of psychological interventions to reduce symptoms and prevent relapse in BPD patients. The study is currently testing various techniques to capture the behavioral data in a useful form. Among them are, Eigenbehavior – identifying principle components of the daily behavior, Non-Parametric measure – discovering intradaily and inter-daily activity pattern, and Detrended Fluctuation Analysis – determining scale-invarianceness of the activity. We will discuss the effectiveness of above techniques for capturing the behavioral data.

Session AB: PER: Investigating Classroom Strategies

Location: Salon 4
Sponsor: AAPT
Date: Sunday, January 5
Time: 2–3:50 p.m.

Presider: Chris Whittaker

AB01: 2-2:10 p.m. Implementing, Documenting, and Assessing Evidence-based Physics Instruction*

Contributed – David E. Meltzer, Arizona State University, Mesa, AZ 85212; david.meltzer@asu.edu

For at least 90 years, physics educators have attempted to improve instructional practices through systematic analysis of student-learning data. I will review some of the highlights of these investigations in order to focus on key issues and problems that have surfaced. For example, although some analysis of students' physics ideas had occurred in the 1930s and 1940s, implementation of instructional materials based closely on such research did not take place until the 1970s. I will also address the evolution in diagnostic instruments and offer perspective on issues related to statistical analysis of assessment data, the validity of observational protocols, and trade-offs between practicality and reliability.

*Supported in part by NSF DUE #1256333

AB02: 2:10-2:20 p.m. Challenges Faced by Learning Assistants in a Studio Physics Course

Contributed – Joshua S. Von Korff, Georgia State University, Atlanta, GA 30303; jvonkorff@gsu.edu

Anna-Marie Smith, Megan Smith, Georgia State University

Georgia State University's Learning Assistant program recruits undergraduates to assist with instruction in our introductory algebra-based physics courses. Although the Learning Assistant model has been shown to be effective at enhancing student learning, little is known about the obstacles that Learning Assistants face. How do these obstacles evolve over the semester, and how do Learning Assistants deal with them? In order to investigate these questions, we interviewed four learning assistants who were assigned to SCALE-UP studio physics courses. We arranged four interviews with each Learning Assistant and examined all of their weekly essays written for the required science pedagogy course. We analyzed this data using constant comparative analysis, a technique associated with the grounded theory approach to qualitative research. The Learning Assistants described many barriers that they encountered including student disengagement, difficulty finding the right question to ask, and others.

AB03: 2:20-2:30 p.m. Facilitating Discourse in Physics Whiteboard Meetings

Contributed – Scot A. Hovan, University of Minnesota, Minneapolis, MN 55417; scothovan@gmail.com

The Next Generation Science Standards (NGSS)[1] identify eight practices as essential to science and engineering, and several of these emphasize the role of students' constructing explanations, engaging in argumentation, and communicating scientific information. However, few teacher-training programs instruct teachers on how to facilitate discourse in the classroom. Developed at Arizona State University, Modeling Instruction[2] emphasizes the role of student discourse in the construction of scientific knowledge by having students participate in large group conversations called whiteboard meetings. However, the novelty of this conversation format can inhibit student participation and make the facilitation of this discourse mode quite challenging. This research is a portion of one high school teacher's self study analyzing his experiences facilitating discourse in his attempt to move students closer to those practices espoused by the NGSS.

1. National Research Council (2012). *A Framework for K-12 science education: Practices,* crosscutting concepts, and core ideas. Committee on a Conceptual Framework for New K-12 Science Education Standards. Board on Science Education, Division of Behavioral and Social Sciences and Education. Washington, DC: National Academy Press.

2. http://modelinginstruction.org/

AB04: 2:30-2:40 p.m. Video Resource for Professional Development of University Physics Educators

Contributed – Rachel E. Scherr, Seattle Pacific University, Seattle, WA 98119; rescherr@gmail.com

Renee Michelle Goertzen, American Physical Society

The Video Resource for Professional Development of University Physics Educators is being developed to support a wide range of university physics educators (four-year university faculty, two-year-college faculty, graduate teaching assistants, and undergraduate learning assistants) in engaging with key issues in teaching and learning. Based on compelling classroom video of best-practices university physics instruction, the resource is organized into "video workshops" that each introduce a significant topic in the teaching and learning of physics, such as formative assessment or cooperative learning. The topic is introduced through a captioned video episode of introductory physics students in the classroom, chosen to prompt collaborative discussion. Discussion questions prompt participants who view the episode to reflect on their pedagogical beliefs and on their own practice. The Video Resource will provide materials to be incorporated into a variety of professional development situations, including self-organized groups of professors, graduate TA training, LA pedagogy courses, and online professional development communities.

AB05: 2:40-2:50 p.m. A Taxonomy for Identifying Visual Elements of Textbooks

Contributed – Juan R. Burciaga, Mount Holyoke College, Department of Physics, Hadley, MA 01075-1424; jburciag@mtholyoke.edu

Alexandra Lau, Mount Holyoke College

Visual elements are integral components of todays textbooks. The applications for these elements vary from simply breaking up the textual narrative ... to establishing a supplemental or an alternative narrative ... to summarizing or communicating key concepts. To better understand the impact of visual elements in the pedagogical framework of textbooks we have created a taxonomy to identify their roles. The taxonomy is being used to analyze the number and placement of visual elements in both a traditional text and a non-traditional one. The resulting analysis is being used as a basis for designing additional visual elements.

AB06: 2:50-3 p.m. Representing Processes of Energy Transfer and Transformation**

Contributed – Amy D. Robertson, Seattle Pacific University, Seattle, WA 98119-1997; robertsona2@spu.edu

Rachel E. Scherr, Seattle Pacific University

Energy Tracking Representations[1,2] developed by Seattle Pacific University Energy Project researchers, are designed to track energy as it transfers and transforms in complex, real-world scenarios. Learners represent transfers and transformations by arrows that connect symbols representing forms of energy (e.g., K --> T represents a transformation of kinetic to thermal energy within an object, and K --> K represents a transfer of kinetic energy between two objects). Recent professional development efforts have supported teachers in not only identifying different kinds of transfer and transformation processes, but also in developing models for those processes. In this talk, we offer examples of the models K-12 teachers negotiated for specific transfers and transformations, and describe the effect of the negotiation process on their understanding of energy.

1. R. E. Scherr, H. G. Close, S. B. McKagan, and S. Vokos, "Representing energy. I. Representing a substance ontology for energy," P*hys. Rev. - Spec. Topics: Phys. Educ. Res*. **8**(2), 020114 1-11 (2012).

2. R. E. Scherr, H. G. Close, E. W. Close, and S. Vokos, "Representing energy. II. Energy tracking representations," *Phys. Rev. - Spec. Topics: Phys. Educ. Res*. **8** (2), 020115 1-11 (2012).

** This material is based upon work supported by the National Science Foundation under Grant No. 0822342.

AB07: 3-3:10 p.m. Describing Student Participation and Performance in an Introductory Physics MOOC

Contributed – John M. Aiken, Georgia State University, Atlanta, GA 30303; johnm.aiken@gmail.com

Shih-Yin Lin, Scott S. Douglas, Edwin F. Greco, Michael F. Schatz, Georgia Institute of Technology

Brian D. Thoms, Georgia State University

Marcos D. Caballero, Michigan State University

We describe the results of an introductory physics Massively Open Online Course (MOOC) offered through Coursera during summer and fall 2013. This MOOC, modeled after an on-campus implementation of an introductory mechanic course, engages students in activities involving interactive lectures, homework, exams, forum discussion, and laboratories. Student demographics, participation, and performance on various assessment tools (e.g., the Force and Motion Conceptual Evaluation) will be presented. Specific challenges in data collection will also be discussed.

AB08: 3:10-3:20 p.m. Peer Evaluations of Video Lab Reports by Introductory Physics Students

Contributed – Shih-Yin Lin, Georgia Institute of Technology, Atlanta, GA 30332-0002; hellosilpn@gmail.com

John M. Aiken, Scott Douglas, Michael F. Schatz, Georgia Institute of Technology

Marcos D. Caballero, Michigan State University

Assessing student performance becomes challenging when course enrollment becomes very large (~10^5 students). As part of an introductory physics Massive Open Online Course (MOOC) offered by Georgia Institute of Technology, students submit video reports on force and motion labs. Peer evaluation of reports provides the primary method for evaluating student laboratory work. This paper describes the methods developed and used to guide students in evaluating each others' video lab reports when the course is offered in summer 2013 and fall 2013. Results of how students' peer evaluation compares to experts' evaluation will be presented.

AB09: 3:20-3:30 p.m. Implementing PER-based Materials in the Introductory Algebra-based Lecture-supported Mini-studio

Contributed – Jarrad W.T. Pond, University of Central Florida, Orlando, FL 32816; jarradpond@gmail.com*

Jacquelyn J. Chini, Talat S. Rahman, University of Central Florida

We present the impact of incorporating physics education research-based (PER) materials into our lecture-supported mini-studios for introductory algebra-based physics. These courses are being redesigned to provide improved integration of traditional lecture, recitation, and laboratory components for a large number of introductory students who cannot be served by our limited number of full-studio courses. Previously, worksheet materials for the three-hour lab portion of the mini-studio were mostly in-house designed. We have updated these worksheets with exercises from the Maryland Open Source Tutorials and the Minnesota Context-Rich Problem archive. Our previous results have shown lecture-supported mini-studios to perform similarly to or better than studio-based courses on standard conceptual and attitudinal assessments. We will investigate the sustainability of this trend with our redesigned worksheets, and document our struggles to identify existing PER-based materials for some topics.

*Sponsored by Jacquelyn Chini

AB10: 3:30-3:40 p.m. Project-based and Team-based Learning

Contributed – Carolann Koleci, Harvard University, Cambridge, MA 02938; ckoleci@seas.harvard.edu

Eric Mazur, Kelly Miller, Laura Tucker, Harvard University

Have you ever journeyed to a learning environment in which students take ownership of their learning, one in which students are encouraged to take risks, a learning community in which life skills-sets are sharpened with real-world problem solving? Suppose in such a learning environment, all within the course of one year, introductory applied physics students: plan a manned or unmanned mission to Mars; design and build electromagnetic safe locking mechanisms; address the energy crisis; clean up the environment; design and build a musical instrument; and, create an intricate Rube Goldberg Machine. We invite you to Applied Physics 50*, a team-based and project-based learning community whereby students own their learning.

*The AP50 Experience: http://www.youtube.com/watch?v=Wzs2zXl_aZc

AB11: 3:40-3:50 p.m. Spontaneous Formation of Learning Communities and its Reflection on Learning

Contributed – Binod Nainabasti, Florida International University, Miami, FL 33199; bnain001@fiu.edu

David T. Brookes, Florida International University

This study seeks to understand the patterns of formation of spontaneous learning communities outside the classroom from the students of a calculus-based introductory college physics class that is a studio-format course implementing the Investigative Science Learning Environment (ISLE). We build up a network pattern among students from the self-reported data about who works with whom every week during the whole semester. Our study also analyzes the relationship between students' network position or status as they work together in groups outside the classroom, their interactions in the classroom, and their performance on homework and exams.

Session AC: Panel – Report of the Undergraduate Curriculum Task Force

Location: Salon 7
Sponsor: Committee on Physics in Undergraduate Education
Date: Sunday, January 5
Time: 2–4 p.m.

Presider: Jerry Feldman

The AAPT Undergraduate Curriculum Task Force (UCTF) is charged with: (1) developing specific recommendations for coherent and relevant undergraduate curricula (including course work, undergraduate research, mentoring, etc.) for different types of physics majors and (2) developing recommendations for the implementation and assessment of such curricula. The work of the UCTF over the past year will be discussed and plans for the coming year will be presented.

Session AD: 21st Century Physics for the High Schools

Location: Salon 6
Sponsor: Committee on Physics in High Schools
Date: Sunday, January 5
Time: 2–3:30 p.m.

Presider: Kris Whelan

AD01: 2-2:30 p.m. The QuarkNet Data Portfolio: Using Data from 21st Century Experiments to Teach Entry-level Physics

Invited – Thomas Jordan, University of Massachusetts-Amherst, Amherst, MA 01003; jordant@fnal.gov

21st century physics can seem obscure and esoteric. Experiments at the Large Hadron Collider have written 75 petabytes of data in just three short years. "Big Data" is in the public eye in news stories about Amazon, Google, or the NSA. QuarkNet has partnered with experiments at Fermilab, CERN, LIGO and others to gain access to datasets and created a Data Portfolio: a suite of investigations that allow students to explore the data and the physics encoded in them. Students can explore momentum conservation, mass-energy equivalence, pattern recognition, histogramming, and other topics using these data. The investigations range from simple to complex, from using paper-and-pencil to web-browsers, and from tens of minutes to days. The investigations allow the students to explore 21st century data and appreciate that they can study some aspect of even the most esoteric experiments. They can access Big Data and ask their own questions.

AD02: 2:30-3 P.M. Connect Students to LHC Physics Using Cosmic Ray Detectors

Invited – Francisco Yumiceva, Florida Institute of Technology, Melbourne, FL 32901; fyumiceva@fit.edu

In 2012, the most powerful particle collider in the world known as the Large Hadron Collider (LHC) discovered the long-sought Higgs boson particle; a crucial component of the standard model of particle physics. The LHC is now gearing up to collide protons at even higher energies that could open a window to observe new physics such as Supersymmetry, Extradimensions, or micro black holes. Classroom cosmic ray muon detectors that use the same technology as the experiments at the LHC are used to introduce particle physics to teachers and students. Cosmic ray studies give students a hands-on window to experimental particle physics. Similarly, masterclasses are one-day national events in which teams of students visit a nearby university or research center to gain insight into topics and methods of particle physics by analyzing data from the LHC experiments.

AD03: 3-3:10 p.m. Nuclear Physics Provides Teachable Moments

Contributed – Margaret A. Norris, Black Hills State University, Spearfish, SD 57799; pnorris@sanfordlab.org

C. John McEnelly, Chamberlain High School

The American Physical Society piloted a program in 2012 pairing high school physics teachers with university physicists to develop new curriculum units for high school physics. A partnership of Black Hills State University and Chamberlain High School, both located in South Dakota, received a grant under this PAIR program (Physics And Instructional Resources) to develop a unit in nuclear and particle physics. Most of the funding was used to purchase classroom equipment. The unit was planned to be nine weeks long and culminate in a class field trip to the Sanford Underground Research Facility. While initially planned to cover both nuclear and particle physics, it was quickly discovered that nuclear physics provides much fertile material to teach critical thinking skills and other 21st Century skills. It also provides the opportunity to feature 21st century STEM careers in medicine, national security and energy. Successes and challenges will be discussed.

AD04: 3:10-3:20 p.m. Graphene Supercapacitors: Getting Students "Charged Up" about Physics

Contributed – Sarah Richter, Nicolet High School, Glendale, WI 53217; Suddend4@uwm.edu

This is a lesson designed to introduce students to physics research while learning about charge at the same time. Students will be able to experience 21st century physics by looking at the amazing properties of graphene and the different ways the material is made. Next, the lesson challenges students to envision how this new material could change capacitors and improve current technology. Finally, students will be able to apply the information by creating a LightScribed Graphene Supercapcitor, a lab that was developed as part of a summer RET program, that gives students a hands on opportunity to compare the new material with a traditional material in a capacitor.

AD05: 3:20-3:30 p.m. Classification of Historical Experiments in High School Physics Course

Contributed – Genrikh Golin, Touro College, New York, NY 448 Neptune Ave., Brooklyn, NY 11224; Genrikhgolin@yahoo.com

The HS physics course describes with varying details many historical experiments. In the textbooks and popular scientific literature these experiments are referred to as great, crucial, key, fundamental, basic, etc. Though they all promoted the development of physics to a certain extent, not all of them are really fundamental. If these experiments are systematized by dividing them into groups based on their contribution to scientific practice and to the development of physics, the teacher can inform students about important aspects of the experimental method. The table that will be present during our contributed talk shows one such possible classification. This classification helps students to avoid the erroneous idea that all the historical experiments were equally important. It also shows students the range of tasks and problems resolved by experiments in science. Using the classification, a teacher can also choose the most typical experiments that are relevant for teaching.

Session AE: Panel – Life After Retirement

Location: Salon 5
Sponsor: Committee on the Interests of Senior Physicists
Date: Sunday, January 5
Time: 2–4 p.m.

Presider: Ann Brandon

This is a panel discussion on the opportunities for retired physics teachers.

Session AF: Using Tablets in the Physics Classroom

Location: Salon 8
Sponsor: Committee on Educational Technologies
Date: Sunday, January 5
Time: 2–2:50 p.m.

Presider: Benjamin Van Dusen

AF01: 2-2:10 p.m. An Electricity and Magnetism Problem-based Learning Experience Using Tablets

Contributed – Rosa Maria Garcia-Castelan, ITESM-CCM, Calle del Puente 222, Col. Ejidos de Huipulco, Tlalpan, Mexico, DF 14380; rmggarci@itesm.mx

A neutrino detection scenery taken from the Science 360 app is analyzed in the problem-based learning (PBL) formalism. This activity was worked out in three undergraduate electricity and magnetism courses where 90 students majoring in engineering participated in the 2013 fall semester. Tablets were the main tool used in all PBL steps. The way in which the PBL technique was worked out before tablets were invented is contrasted with the way in which it is applied now with tablets.

AF02: 2:10-2:20 p.m. First Year Experiences Using Tablets in Physics First

Contributed – Gail Van Ekeren, Mount Olive High School, Flanders, NJ 07836; gvanekeren@mtoliveboe.org

Brian Holton, Mount Olive High School

Our school adopted Physics First for all students three years ago, but this is the first year where all freshmen are taking the course. At the same time, this is our rollout year for every freshman using AMPLIFY tablets in all classes. The Amplify system allows in-class interaction through several very useful classroom tools including, of course, access to the Internet by every student at all times. With our ever advancing digital students, using tablets for classroom learning activities has opened up many avenues of instruction. We will discuss our successes and failures in implementing Physics First with tablets.

AF03: 2:20-2:30 p.m. Augmenting Reality for Teaching with Tablets or Smartphones

Contributed – Anne J. Cox, Eckerd College, St. Petersburg, FL 33711; coxaj@eckerd.edu

Trying to find a way to engage students with tablets and smartphones? Now there's a way to make lab equipment "come alive" through the use of augmented reality. By aiming their camera at lab equipment, students can, at their own pace, get detailed image, video, and audio directions. This talk will demonstrate the use of the Aurasma App (http://www.aurasma.com) to use and build these resources for your lab and classroom.

AF04: 2:30-2:40 p.m. How to Develop JavaScript Models for Tablets

Contributed – Wolfgang Christian, Davidson College, Davidson, NC 28035-6926; wochristian@davidson.edu

Felix G. Clemente, Francisco Esquembre Universidad de Murcia

A free open source version of the Easy Java Simulations (EJS) modeling and authoring tool is now available for teachers and students who wish to create simulations that run on any JavaScript-enabled device, including tablets. In this talk, I will describes the EJS 5 JavaScript platform and demonstrate how it creates ready-to-run simulations. Additional JavaScript simulations are hosted on and distributed from the OSP Collection of the ComPADRE National Science Digital Library and can be found by searching this library for "JS Model." The Open Source Physics Collection is available at .

AF05: 2:40-2:50 p.m. Using a TabletPC as a Double-sized Virtual Whiteboard

Contributed – Roberto Salgado, University of Wisconsin - La Crosse, La Crosse, WI 54601; rsalgado@uwlax.edu

One complaint about using a TabletPC as a projected virtual whiteboard is that only one board is visible at a time, unlike the multiple whiteboard setup in a typical classroom. Using a DisplayLink USB graphics adapter and a second projector, we show how to ink on the primary desktop display while using the extended desktop display for something else (e.g., a screenshot of a past board or a PowerPoint presentation). We can interact with the extended display with a mouse, keyboard shortcut, or automated macro (AutoHotkey script).

Session AG: The Magic of Astrophotography

Location: Salon 9
Sponsor: Committee on Space Science and Astronomy
Co-Sponsor: Committee on Educational Technologies
Date: Sunday, January 5
Time: 3–4 p.m.

Presider: Don Smith

AG01: 3-3:30 p.m. PROMPT and the Skynet Robotic Telescope Network: Science and Education

Invited – Dan Reichart, University of North Carolina, Chapel Hill, NC 27599-3255; reichart@physics.unc.edu

Funded primarily by the National Science Foundation and recently by the American Recovery and Reinvestment Act, Skynet is a growing collection of fully automated, or robotic, professional-quality telescopes under the control of software developed by the University of North Carolina. Spanning four continents, Skynet is an easy-to-use, web-based, shared resource between participating colleges, universities, and private individuals. Originally conceived to observe cosmic explosions called gamma-ray bursts, which are the deaths of massive stars and the births of black holes, Skynet has now taken over 6 million images for hundreds of professional astronomers, for thousands of college and university students, for thousands of high school students, and for tens of thousands of middle and elementary school students and members of the public.

AG02: 3:30-4 p.m. Budget Astrophotography: How to Make the Most of Your Equipment

Invited – Mario J. Belloni, Davidson College, Physics Department, Davidson, NC 28035-6910; mabelloni@davidson.edu

Over the past dozen years, the field of digital astrophotography has changed by leaps and bounds. With new computerized tracking and autoguiding mounts and digital still and video photography it has become easier and cheaper to take high-quality astrophotographs. While it is easy to spend $15,000 or more on a single astrophotography setup or even a single device (telescope, camera, and mount), taking simple,

short exposure photos can cost anywhere from $50 to a few hundred dollars depending on how much equipment you already have. In this talk we outline the techniques that can be used to take astrophotographs with as little (additional) money as possible focusing on using iPhones, DSLRs and inexpensive web cams.

Session BA: SPS Research and Outreach II

Location: Salon 4
Sponsor: AAPT/SPS
Date: Sunday, January 5
Time: 4:30–5:30 p.m.

Presider: Toni Sauncy

BA01: 4:30-4:40 p.m. Aerodynamics of a Vehicle Head

Contributed – Priyanka Kompella, Issaquah High School, Issaquah, WA 98027; priyankakompella@live.com*

Allison Hsu, Issaquah High School

Using a wind tunnel to detect the amount of drag with which each cone is affected, we will calculate what cone is most efficient for each sub-sonic speed. The type of cone head will be manipulated by (1) changing its angle at the tip and (2) the shape of the cone's surface (curved vs. flat). We can determine optimal velocity by observing the drag force on the cone and how the air moves around it. Through this experiment, we will be able to determine the most economical shape of a vehicle head for different speeds.

*Sponsored by Thomas Haff

BA02: 4:40-4:50 p.m. The 'Plane Out' of a Wakeboard Boat

Contributed – Hayley B. Alexander, Issaquah High School, Issaquah, WA 98027; hay_5686@hotmail.com*

Matthew S. Hanna, Issaquah High School

As the velocity of the boat increases, the angle of the bow and wake increase to a maximum. As the velocity continues to increase the boat then begins to "plane out." We have developed measuring apparatuses to measure the angle of the wake, the angle of the bow, and RPMs to discover if there is a mathematical correlation between these measured variables. Come hop on our virtual boat!

*Sponsored by Thomas Haff

BA03: 4:50-5 p.m. Hang Glider Control Bar Placement's Impact on Glide Ratio

Contributed – Katherine Chun, Issaquah High School, Issaquah, WA 98027; hello529@comcast.net*

Catie Ball, Sabreena Rajan, Issaquah High School

A hang glider's descent is commonly measured as a glide ratio-- the ratio of horizontal distance traveled compared to vertical distance traveled. The purpose of this experiment is to find the maximum glide ratio by changing the glider's control bar position along the keel. By moving the control bar forward and backward along the keel, the position of weight on the glider is also moved along the keel. When the glider is dropped from a constant height, with the weight in different positions, the glide ratio changes depending on the horizontal distance traveled. This experiment and subsequent research seeks to find optimal positions of weight on a glider and to fix other variable elements of a glider's design in order to determine the glider with the greatest glide ratio.

*Sponsored by Thomas Haff

BA04: 5-5:30 p.m. Sensors and Measurement: The 2013 Science Outreach Catalyst Kit (SOCK)

Invited – Caleb L. Heath, University of Arkansas, Fayetteville, AR 72703; caleb.heath@gmail.com

Nicole Quist, Oregon State University

A SOCK is a collection of materials and activities designed to be a self-contained outreach experience. They are produced by Society of Physics Students summer interns and provided to campus chapters (around 25 each year) in need of outreach materials to use with local classrooms or in other community outreach programs. Each year's SOCKs are organized around a theme. The National Institute of Standards and Technology (NIST) partnered with SPS on the 2013 SOCK with its theme of sensors and measurement. Though the detection and quantification of phenomena are essential to scientific inquiry, these topics have never before been the focus of a SOCK. Standards and measurement are explored through a variety of hands-on activities, while custom-made electronics (and optional smartphone integration) allow for cost-effective exploration of sensor technology. This talk will introduce the SOCK, and include demonstrations of our most popular activities.

Session BB: Pre-College PER

Location: Salon 11
Sponsor: Committee on Research in Physics Education
Co-Sponsor: Committee on Physics in High Schools
Date: Sunday, January 5
Time: 4:30–6 p.m.

Presider: Dan Crowe

BB01: 4:30-5 p.m. Assessing Whether and How Professional Development Affects Teachers' Classroom Practices

Invited – Andrew Elby, University of Maryland, College Park, MD 20742-1115; elby@umd.edu

Ayush Gupta, Jennifer Richards, University of Maryland

PER-informed professional development with practicing teachers often focuses on deepening content knowledge and/or introducing specific curricula and pedagogical techniques.[1,2] By contrast, other professional development for practicing teachers focuses less on content and more on helping teachers rethink what counts as learning and teaching physics (or science).[3] Assessing such projects is tricky; it's hard to determine whether and how the professional development affects teachers' classroom practices. Observation rubrics like RTOP[4] can detect changes toward more student-centered instruction but are not designed to assess the quality of classroom discourse in a nuanced way. In this talk, we discuss our halting first efforts to trace the effects of specific aspects of teachers' experiences in our professional development program to changes in their classroom practices. Our big generalization is that generalizations are misleading; we observed large variations in what teachers took away from our program and how it affected their teaching.

1. L. C. McDermott, P. S. Shaffer, and C. Constantinou, *Physics Education* **35**, 411 (2000).
2. R. E. Scherr, H. G. Close, E. W. Close, and S. Vokos, *Physical Review Special Topics-Physics Education Research* **8**, 020115 (2012).
3. D. Hammer, F. Goldberg, and S. Fargason, *Review of Science, Mathematics and ICT Education* **6**, 51 (2012).
4. M. Piburn, D. Sawada, J. Turley, K. Falconer, R. Benford, I. Bloom, and E. Judson, Tempe, Arizona: Arizona Collaborative for Excellence in the Preparation of Teachers (2000).

BB02: 5-5:30 p.m. The Enactment of Content Knowledge for Teaching Energy During Instruction

Invited – Robert Zisk, Rutgers University, 10 Seminary Pl, New Brunswick, NJ 08901-1281; robert.zisk@gse.rutgers.edu

Content knowledge for teaching (CKT) is a practice-based theory of the professional knowledge that a person needs in order to be able to

effectively teach a subject (Ball, Thames and Phelps, 2008). Originally conceptualized in the subject of mathematics, our work is centered on CKT for physics, specifically in the area of energy. In developing the framework for CKT for teaching energy, we have identified the aspects and tasks of teaching physics, and more specifically, of teaching energy, that are needed for effective instruction. This talk will discuss the development of the tasks of teaching and demonstrate how these tasks are enacted in the classroom during instruction using video collected from a group of teachers during the teaching of energy.

BB03: 5:30-5:40 p.m. Misconceptions in Wave Propagation and the Principle of Superposition: A Short Study of High School Level Understanding

Contributed – Layla M. Quinones, New York University, New York, NY 10012; lmq210@nyu.edu

This study evaluates and analyzes misconceptions that high school students have regarding wave propagation, transmission, and the principle of superposition. Two groups of students in an inner-city high school were given surveys that sought to identify common misconceptions in wave-physics: a group of juniors who were learning about waves at the time the surveys were given, and a group of seniors who had previous instruction in introductory physics. Surveys consisted of open-response questions that presented basic concepts in wave propagation and superposition for both mechanical and sound waves. Results show that the most common misconceptions for both groups are in the transmission and superposition of waves. Misconceptions where characterized using the wave and object-like models described in the literature.[1]

1. M.C. Wittmann, "The object coordination class applied to wavepulses: Analysing student reasoning in wave physics," *Int. J. of Sci. Educ.* **24**, 97-118 (2002).

BB04: 5:40-5:50 p.m. Pre-High School Students' Understandings and Representations of Electric Field

Contributed – Ying Cao, Tufts University, Medford, MA 02155; ying.cao@tufts.edu

This study investigated Chinese pre-high school students' (aged 15-16) understanding and representations of electric field when they were engaged in informal tasks as a group in class, playing a web-based electric hockey game and drawing comic strips about charged bodies as characters. The literature has reported high school and college students' performance after instruction by having them do textbook style questionnaires and have primarily focused on students' learning difficulties. This study focused on students' understanding prior to formal instruction and emphasized their strengths rather than weaknesses. I conducted post-class face-to-face interviews with three students, during which they were asked to explain their work in more detail. The results show that even before any formal instruction, pre-high school students possess rich ideas of electric field, and are able to produce representations that express features of electric field.

BB05: 5:50-6 p.m. Characterizing Student-Educator Interactions in an After-School Physics Program

Contributed – Peter Madigan, University of Colorado, Boulder, CO 80302; peter.madigan@colorado.edu*

Kathleen Hinko, Noah Finkelstein, University of Colorado Boulder

In order to study how undergraduate and graduate physics students approach teaching in an informal setting, we analyze their student-educator interactions as volunteers in an after-school physics program for children in grades K-8. We have collected in situ video footage of several university volunteers using hands-on, inquiry-based activities with students throughout the semester. Through qualitative analysis of the university educators' communication and children's affective response during these interactions, we are able to classify and compare different educators' approaches to teaching and learning. Additionally, we start to examine children's learning outcomes with these varied approaches through interviews with children and analysis of their science notebooks.

*Sponsored by Kathleen Hinko

Session BC: Recruiting and Retaining Physics Students

Location: Salon 10
Sponsor: Committee on Women in Physics
Co-Sponsor: Committee on Physics in Undergraduate Education
Date: Sunday, January 5
Time: 4:30–6 p.m.

Presider: Kathleen Falconer

BC01: 4:30-5 p.m. The Next Steps in Developing Inclusive Physics Departments

Invited – Juan Burciaga, Mount Holyoke College, Department of Physics, South Hadley, MA 01075-1424; jburciag@mtholyoke.edu

Many departments operate under the assumptions that the key to developing inclusive departments is to focus on strategic recruiting. That somehow getting students from under-represented groups to enter the department was by itself a sufficient development to catalyze wide-spread change. But recruiting is just one step, and may not even be the first step, in developing a department that is diverse ... inclusive ... and excellent. But what are the steps that will allow a department to keep momentum moving toward a diverse, inclusive and engaged community of students and faculty? And how does such a community help promote and develop an atmosphere of excellence in the students? ...in the faculty? ... and in the department?

BC02: 5-5:30 p.m. Establishing a Path to Mathematization for All Introductory Physics Students*

Invited – Suzanne Brahmia, Rutgers University, Department of Physics and Astronomy, Piscataway, NJ 08854-8019; brahmia@physics.rutgers.edu

Sensemaking in physics involves translating non-mathematical understanding into conceptualized mathematics, and formal mathematical statements into narrative explanations. These processes, referred to as mathematization, have been studied in mid- to upper-level undergraduate physics courses (1,2). Successful students actively generate mathematical relationships to describe physical situations. This understanding becomes integral to their physics knowledge. As part of a collaboration between Rutgers, WWU and NMSU, we target the much larger population of high school and college students in introductory physics, developing curricular materials and methods in which students generate mathematically sensible explanations. We're also developing assessments of mathematical reasoning that is expected in a physics course. Unlike the successful upper-level students, these students tend to view math in physics as a process of memorizing and mastering algorithms. Socioeconomically disadvantaged school districts often have weak mathematics programs in the middle and secondary levels, so our findings may be particularly beneficial for these students.

*This work is supported by NSF DUE-1045227, NSF DUE-1045231, NSF DUE-1045250.

1.T. J. Bing and E. F. Redish, "Analyzing problem solving using math in physics: Epistemological framing via warrants," *Phys. Rev. ST Phys. Educ. Res.* **5**, 020108 (2009).

2. B.L. Sherin, "How students understand physics equations," *Cognition and Instruction,***19**, 479-541 (2001).

BC03: 5:30-6 p.m. Facilitating Undergraduate Community at Florida International University*

Invited – Laird Kramer, Florida International University, Department of Physics, Miami, FL 33199; kramerl@fiu.edu

Florida International University's (FIU's) Physics Department has transformed its undergraduate program over the past 13 years, leading to a 2,300% increase in the number of intended and declared majors as well as a 900% increase in the number of graduates (comparing current three-year averages to the early 1990s). FIU's undergraduate enrollment increased by 104% in the same period. To

achieve these results, the department has taken a systematic approach to reforming the undergraduate experience, targeting introductory course transformations, revising the undergraduate degree programs (including a new teacher preparation program), promoting strong advising within the department, engaging local high school teachers, and establishing a major Physics Education Research Group. FIU, as a minority-serving institution in South Florida, serves as a unique laboratory to investigate how to effectively support success of historically underrepresented groups including women. An overview of the critical community elements will be presented.
*Supported by NSF Award # PHY-0802184.

Session BD: How Do You Use Videos?

Location: Salon 7
Sponsor: AAPT
Date: Sunday, January 5
Time: 4:30–5:50 p.m.

Presider: Susan Johnston

BD01: 4:30-5 p.m. YouTube Physics – Not Just for Internet Celebrities

Invited – Edwin Greco, Georgia Institute of Technology, Atlanta, GA 30332; ed.greco@gatech.edu

Jarrad Reddick

In this talk we will discuss our experiences implementing student-created videos in our physics classes at Georgia Tech. We have implemented student-created videos in three different settings: large introductory courses with non-majors, freshman seminar, and as online tutoring resources for undergraduates. We will discuss our use of these videos in a variety of different aspects within our courses. For example, we have asked our students to create video solutions to physics problems, post-exam reflection exercises, and submit term projects as video presentations of their work. In our freshman seminar course, physics majors were asked to create video interviews with physics alumni as part of their career exploration. We will also discuss methods for evaluating student created videos and some of the difficulties that we have encountered along the way.

BD02: 5-5:10 p.m. A Bullet-Block Experiment as a Capstone Mechanics Experiment*

Contributed – David P. Jackson, Dickinson College, Department of Physics Carlisle, PA 17013-2896; jacksond@dickinson.edu

Priscilla W. Laws, Dickinson College

Robert B. Teese, Rochester Institute of Technology

Imagine a bullet fired vertically into a block of wood directly in line with its center-of-mass. Now imagine repeating the experiment with the bullet being fired off center. Would the block travel straight up in each case? Would the block rise to the same height in each case? These questions (and more) will be discussed in this talk, which focuses on how we used high-speed video to capture a fascinating (and very surprising) experiment that is difficult to perform in the classroom. This experiment was performed and filmed by the LivePhoto Group as part of the Interactive Video Vignettes project and elements are featured on Derek Muller's Veritasium YouTube channel. *Supported by NSF grants DUE-1122828 and DUE-1123118
*Supported by NSF grants DUE-1122828 and DUE-1123118

BD03: 5:10-5:20 p.m. The Bullet-Block Experiment: A Sample Interactive Video Vignette

Contributed – Priscilla W. Laws, Dickinson College, Department of Physics, Carlisle, PA 17013; lawsp@dickinson.edu

David P. Jackson, Dickinson College

Robert Teese, Rochester Institute of Technology

The LivePhoto Physics Group has been creating and testing a series of Interactive Video Vignettes (IVVs) involving topics normally covered in introductory physics courses. Each Vignette includes videos of a physical phenomenon, invites the student to make a prediction, complete an observation or analysis, and, finally, compare findings to the initial prediction. Vignettes are designed for web delivery as ungraded exercises to supplement textbook reading, or serve as pre-lecture or pre-laboratory activities. A sample Vignette will be shown, and the speaker will comment briefly about ongoing research on the impact of Vignettes on motivation, learning and student attitudes. (NSF 1122828 and 1123118)

BD04: 5:20-5:30 p.m. Video Capture and Analysis Projects to Engage Students

Contributed – Zenobia S. Lojewska, Springfield College, Springfield, MA 01109-3788; lojewskz@spfldcol.edu

I will address how to use digital video motion analysis as a teaching tool in an introductory physics course. This presentation focuses on a Physics for Movement Science course geared towards Physical Education, Athletic Training, and Exercise Science majors. It is explained how students capture their own video clips and analyze them. Some of the video clips are presented.

BD05: 5:30-5:40 p.m. Now You See It

Contributed – Nina M. Morley Daye, Orange High School, Hillsborough, NC 27278-9413; nina.daye@orange.k12.nc.us

Come and see some of the ways I am using videos in my classroom. I am using videos for implementing a "flipped" classroom, virtual field trips and assessment.

BD06: 5:40-5:50 p.m. Hybrid Visual-Tutorial Instruction Model to Learn the Concept of Density

Contributed – Sergio Flores, University of Juarez, Juarez, Chihuahua, Mexico; seflores@uacj.mx

Maria D. Gonzalez, University of Texas at El Paso

Juan E. Chavez, Luis L. Alfaro, Juan Luna, University of Juarez

The University of Juarez and the University of Texas at El Paso have developed a hybrid instruction model to combine lab activities and a tutorial-based inquiry through the use of a video. Students from the Introductory Physical Sciences Courses can construct the concept of density in the contexts of solids and liquids. Data were collected through a post-test, a pre-test and homework designed in the same context of the corresponding learning topics. Students are exposed to a 30-min video of the lab activities. This video is available for the students though the whole lab. Students have the option to watch any section of the video as many times as they need it. Results show that students' questions related to lab procedures and conceptual content are reduced. Finally, we will present the corresponding learning gains of both sets of groups, treatment and control groups.

Session BE: 100Kin10: Training and Retaining Teachers

Location: Salon 6
Sponsor: Committee on Teacher Preparation
Date: Sunday, January 5
Time: 4:30–5:40 p.m.

Presider: Julia Olsen

BE01: 4:30-5 p.m. The 100Kin10 Partnership Effect: Many Hands Make Light Work

Invited – M. Colleen Megowan-Romanowicz, American Modeling Teachers Association, 2164 E Ellis Dr., Tempe, AZ 85282 Megowan@asu.edu

In his 2011 State of the Union address, President Obama outlined the need for 100,000 new STEM teachers within the next 10 years. Shortly thereafter Carnegie Corporation of New York and Opportunity Equation convened representatives from teacher education and professional development programs and foundations across the country and in June of 2011 the 100Kin10 partnership was launched at the Clinton Global Initiative Meeting. Of the 150 partner organizations 22 are funding partners. The rest are best-in-class organizations who prepare, develop, and retain excellent STEM teachers who are incentivized by funding from donor partners to work together and multiply the effectiveness of partners' programs. This presentation will highlight the work of a number of AAPT-affiliated associations and institutions that are 100Kin10 partners, discuss collaborations among these partners and outline how other organizations can join or connect with the movement.

BE02: 5-5:30 p.m. 100Kin10: A Response from the STEM Community and Physics Organizations

Invited – Aline D. McNaull, American Institute of Physics, One Physics Ellipse, College Park, MD 20740; amcnaull@aip.org

In his 2011 State of the Union address, President Obama called for the training of 100,000 new, excellent science, technology, engineering, and math (STEM) teachers over the next decade. In my talk, I will describe this initiative, the partnerships that have formed, and the work being done at the federal level to improve the number of highly qualified STEM teachers. I will also provide an overview of the discussions within the STEM community in Washington, which includes scientific societies, research universities, and industry about increasing the number of highly qualified STEM teachers. Physics societies have played a major role in teacher pre- and in-service professional development at the local, state, and national levels. I will provide an update on the joint efforts of the American Association of Physics Teachers, American Astronomical Society, American Physical Society, The Optical Society, and American Institute of Physics to improve teacher training and professional development.

BE03: 5:30-5:40 p.m. Strategies to Enhance the Joy of Learning and Teaching Physics

Contributed – C. Dianne Phillips, Northwest Arkansas Community College, Division of Science and Mathematics, Bentonville, AR 72712; dphillips@nwacc.edu

Pre-Service teachers are given the opportunity to engage in curriculum-driven, project-based learning projects and activities in the framework of an Introduction to Physical Science course. Learners work in teams to apply course content as they develop college-level peer presentations, classroom demonstrations and engage in skill building projects and activities, as well as formative and summative self-assessments. Future teachers are given the opportunity to design, test, and produce grade appropriate (K-12) lesson plans and activities, which are trialed with their peers and then shared with area school faculty mentors and their science students. Pre-Service teachers leave the course with their own lesson plans and activities to be added to their professional teaching portfolios. The course is specifically designed to engage the learner in self-directed exploration and discovery. The joy of learning and teaching is enhanced as students are given the opportunity to be actively engaged learners in a safe learning environment.

Session BF: A Potpourri of Astronomy and Physics Topics

Location: Salon 8
Sponsor: AAPT
Date: Sunday, January 5
Time: 4:30–5:30 p.m.

Presider: Lee Trampleasure

BF01: 4:30-4:40 p.m. Integrating Robotic Telescopes in Introductory Astronomy Labs

Contributed – Gerald T. Ruch, University of St. Thomas, St. Paul, MN 55105; gtruch@stthomas.edu

The University of St. Thomas (UST) and a consortium of five local schools are using the UST Robotic Observatory, housing a 17' telescope, to develop labs and image processing tools that allow easy integration of observational labs into existing introductory astronomy curriculum. Our lab design removes the burden of equipment ownership by sharing access to a common resource and removes the burden of data processing by automating processing tasks that are not relevant to the learning objectives. Each laboratory exercise takes place over two lab periods. During period one, students design and submit observation requests via the lab website. Between periods, the telescope automatically acquires the data and our image processing pipeline produces data ready for student analysis. During period two, the students retrieve their data from the website and perform the analysis. The first lab, "Weighing Jupiter," was successfully implemented at UST and several of our partner schools.

BF02: 4:40-4:50 p.m. Teaching, Outreach, and Research with the Guilford College Observatory

Contributed – Donald Andrew Smith, Guilford College, Greensboro, NC 27410, dsmith4@guilford.edu

The Guilford College Cline Observatory hosts a 16' optical telescope (connected to the worldwide SkyNet network of automated telescopes), two 2.4 m radio telescopes, a 10' optical telescope, several 8' telescopes, and a 50' planetarium dome. We use these facilities for public outreach, classroom instruction, and student research. In this talk, I will give examples of how we integrate learning activities across our resources: students learn about the universe through laboratory explorations using telescopes, recording images, and analyzing observations. We involve students in public outreach both through planetarium shows on campus as well as remote radio observations from public school classrooms. Students have also used the facility for senior thesis research projects, ranging from vibrational studies of the support pier to interferometric radio observations of sunspots. These examples will show how a small observatory can be a dynamic, productive facility to connect the dots between research, teaching, and public outreach.

BF03: 4:50-5 p.m. Balls Rolling in Cones: New-ish Examples of Learning-by-Contrast

Contributed – Gary Dane White, AAPT and GWU, College Park, MD 20740; gwhite@aapt.org

The motion of a ball rolling-without-slipping on a conical surface reveals many analogies with classical celestial phenomena, and many contrasts as well. The initial conditions of the ball's "spin" can be adjusted so that one can observe quite different orbital periods even at a fixed orbital radius! Even so, the analogy with Kepler's Third Law--"(period squared)/(radius cubed) = constant"--is robust; for a ball rolling in a cone the dictum is "(period squared)/(radius) = constant," providing a nice contrast with real gravity, and with balls rolling in spandex wells for which the mandate is "(period cubed)/(radius squared) = constant," curiously.* Furthermore, one can choose to

mimic the closed elliptical orbits of the planets--or not--by carefully selecting the conical angle and the ball's moment of inertia. Learning-by-contrast, at least for this author, is effective, and its benefits far outweigh any disappointment that celestial phenomena are not reproduced precisely.

*Gary D. White and Michael Walker, "The shape of 'the Spandex' and orbits upon its surface," *Am. J. Phys*. **70**, 48 (2002).

BF04: 5-5:10 p.m. What Frame of Reference Is Your Smartphone Accelerometer In?

Contributed – Jonathan C. Hall, Pennsylvania State University - The Behrend College, Erie, PA 16563-0203; jch12@psu.edu

Accelerometers such as found in smartphones respond to both acceleration caused by contact forces, and also to the gravitational field intensity when not accelerating. (When the device is accelerating in free-fall, the reading is zero.) The resulting measurements from the "smart" devices have been incorrectly reported as the acceleration several times in *The Physics Teacher*. Strategies for correcting this misunderstanding of acceleration will be discussed.

BF05: 5:10-5:20 p.m. Weapons Development in Revolutionary France

Contributed – Ruth H. Howes, Ball State University, emerita, 714 Agua Fria St., Santa Fe, NM 87501; rhowes@bsu.edu

On March 30, 1775, Controller General Anne Robert Jacques Turgot appointed the French chemist Antoine Lavoisier to a commission with three other members to run his newly created Gunpowder and Saltpeter Administration. As a perk, Lavoisier was given an apartment in the Arsenal belonging to the Gunpowder and Saltpeter Administration with ample space to establish a chemical laboratory. Lavoisier developed better methods for producing gunpowder which enabled the surplus supply which France used to supply the American rebels in their war with the British. Lavoisier and his colleagues worked in an effort to develop more effective explosives to reverse the French military defeats that marked the end of the ancient regime and the initial efforts of the revolutionary government to defend itself against most of the rest of Europe

BF06: 5:20-5:30 p.m. Increasing AP Test Scores

Contributed – Thomas F. Haff, Issaquah High School, Issaquah, WA 98027-4319; hafft@issaquah.wednet.edu

The evidence of increased AP (C exam) scores is anecdotal, but my students have experienced increase scores on the exam. This talk is not about increasing physics knowledge but how time-saving tips coupled with simple instructional techniques will give students more confidence and increased scores. 98% of my past students have passed the exam.

Session BG: Optics Labs Beyond the First Year

Location: Salon 9
Sponsor: Committee on Laboratories
Co-Sponsor: Committee on Apparatus
Date: Sunday, January 5
Time: 4:30–6 p.m.

Presider: Gabe Spalding

BG01: 4:30-5 p.m. Open-ended Laboratory Projects in an Undergraduate Lasers Course

Invited – Chad Hoyt, Bethel University, St. Paul, MN 55112; hoycha@bethel.edu

We describe the format and experience of an undergraduate Lasers course at Bethel University. The course, which includes a standard, rigorous lecture portion, is built on open-ended research projects that have a novel aspect. It begins with four weeks of small student groups rotating between several standard laser laboratory exercises such as alignment and characterization of a helium neon laser. During the remainder of the course, student groups (2-4 people) choose and pursue research questions in the lab. Their work culminates in a group manuscript typeset in LaTeX and a 20-minute presentation to the class. Projects in the spring 2013 Lasers course included ultrafast optics with a mode-locked erbium fiber laser, quantum optics, saturated spectroscopy of indium, nano-optics and plasmonics (led by Nathan Lindquist), and improvements to a lithium magneto-optical trap. The experience in Lasers is representative of other upper-level courses at Bethel, including Optics, Fluid Mechanics and Computer Methods.

BG02: 5-5:10 p.m. A Collection of Laboratory Projects for Modern Optics and Photonics

Contributed – A. James Mallmann, Milwaukee School of Engineering, Milwaukee, WI 53202; mallmann@msoe.edu

I will describe some of the 58 laboratory projects produced for the curriculum development project Optics and Photonics for the 21st Century—An Innovative Interdisciplinary Modular Laboratory Curriculum.* Each module includes a historical note and, if appropriate, biographical sketches; a discussion of practical applications; a discussion of the fundamental physics and mathematics for the projects; a statement of goals for a collection of projects; questions and problems; and a list of references. None of the projects are of the "cookbook" variety, and, except for the first module, for which an optical power meter is used, all the projects can be performed using equipment that is likely to be available in a typical college physics or engineering laboratory.

*Supported by NSF grant DUE-9555048.

BG03: 5:10-5:20 p.m. Optics in Advanced Laboratory Experiments

Contributed – Robert Deserio, University of Florida, Gainesville, FL 32611-8440; deserio@phys.ufl.edu

Stephen J. Hagen, University of Florida

We will report on the construction and progress made with two new optics-based experiments for the advanced lab: an optical tweezers and a molecular fluorescence correlation spectrometer. Optical tweezers trap micron-sized particles in suspension using a laser focused through a microscope objective. The scattered light is detected to encode the particle position as it is buffeted by Brownian forces. The position power spectrum is analyzed for the restoring force and damping. In the molecule fluorescence apparatus, a laser is focused through a microscope objective where fluorescing particles are suspended. The fluorescing volume is imaged at high magnification where a pinhole is positioned. Behind the pinhole, enhanced photon rates are observed when as few as one fluorescing molecule traverses the focal volume. The photon stream is analyzed for the focal geometry, the average number of molecules in the volume, and properties associated with diffusion and fluorescence. This work supported by NSF DUE award 1139906.

BG04: 5:20-5:30 p.m. Spy Physics: Using a Laser to 'Hear' a Conversation

Contributed – Timothy Todd Grove, IPFW, Fort Wayne, IN 46805; grovet@ipfw.edu

Trunghieu T Nguyen, IPFW

We will present a simply constructed laser experiment for students beyond their first year in physics. The goal of this particular experiment is to not only give students experience with laser interferometry, but to allow students to have greater excitement than they would normally get counting fringes or making precision measurements. Our experiment started when a student asked "Is it true that you could use a laser beam to detect a conversation in an office by its reflection off of a window." To accomplish this task we used a simple Michelson interferometer in which one mirror vibrated in response to a sound source. A speaker connected to a radio inside a small box with a

tinted glass window served as a mirror for the laser beam and also represented the office that we were "spying upon." At present time, we have tried the experiment in two different ways--one in which the sound source is directly connected to the mirror (the easy version) and one in which the sound must propagate through air to vibrate the mirror (the harder version). We will demonstrate our results if the audio equipment is willing.

BG05: 5:30-5:40 p.m. Microscopy as a Context for Upper-Division Optics

Contributed – Dyan L. Jones, Mercyhurst University, Erie, PA 16546; djones3@mercyhurst.edu

Shauna Novobilsky, Mercyhurst University

Jennifer Ross, University of Massachusetts - Amherst

We have undertaken the challenge of creating a novel upper-division course in optics. This is particularly unique given that we do not have a physics major and therefore must appeal to other natural and life science majors. As such, we have created a course that centers on the principles of microscopy. This talk will describe how we use the construction of a transmitted light microscope to both frame the course and present fundamental optics content. In the first module, students learn about geometric optics while building the condenser system. Next, the students will learn the basics of microscopy by building the image path and bringing the images into a computer with a CMOS camera. In the final stage of the course, students apply their basic microscopy knowledge and further their understanding by building a novel microscope system.

BG06: 5:40-5:50 p.m. Calibration of a Grating Spectrometer and Its Application

Contributed – Yongkang Le, Fudan University, Physics Department, Shanghai 200433; yongkangle@gmail.com

A thorough calibration of a portable grating spectrometer will be reported. The calibration includes suppression of higher order diffraction, wavelength calibration and intensity calibration. Examples of application: such as measurement of the electron temperature in a glow discharge plasma and test of the Stefan-Boltzmann law, will be presented and discussed in detail.

BG07: 5:50-6 p.m. Fiber Optics and the Physics of Medicine

Contributed – Mary L. Lowe, Loyola University Maryland, Physics Department, Baltimore, MD 21210; mlowe@loyola.edu

Nancy Donaldson, Charles Gosselin, Rockhurst University

Alex Spiro, Loyola University Maryland

We developed two fiber optics modules that employ an active-learning, inquiry-based pedagogy to teach students the physics of fiber optics and its applications in medicine. The first module ("Level 1") is intended for introductory/ intermediate students of physics. The module integrates medical case studies, prediction, hands-on activities, direct instruction and problem solving. Building on basic geometric optics, Level 1 extends student learning in fiber optics to principles of illumination, numerical aperture and coupling, wave guiding, loss, and viewing. The second module ("Level 2") is designed for intermediate/advanced students interested in working with industrial optical fiber, and concentrates on the physics and experimental techniques of coupling laser light into a 200 um fiber. Topics include numerical aperture, coupling, beam waist due to diffraction and spherical aberration, optical alignment techniques, overfilling and underfilling of fibers, skew rays, and loss. Our materials have been classroom-tested, and instructors' guides are available.

Session BH: Qualitative and Ethnographic Methods in PER

Location: Salon 5
Sponsor: Committee on Research in Physics Education
Date: Sunday, January 5
Time: 4:30–6 p.m.

Presider: Kathleen Falconer

BH01: 4:30-5 p.m. Selecting and Analyzing Mountains of Data: Creating Ethnographies

Invited – Idaykis Rodriguez, Florida International University, Miami, FL 33199; irodr020@fiu.edu

Ethnographies may sometimes be viewed as a catch-all qualitative research method, but there is more to ethnographies than just collecting all types of data. Between participant observations, interviews, document analysis, and fieldwork it can be daunting to sort through all the data. This talk discusses how researchers organize, select, and analyze the multiple forms of data in an ethnographic study to tell a story about a group's culture. Within the specific example of an ethnography of a physics research group, I will present field notes of participant observation, interviews with group members, video recording of research meetings, and final group documents to understand graduate student development of writing scientific papers.

BH02: 5:-5:30 p.m. We Know It When We See It: Thinking Like Physicists

Invited – Eleanor C. Sayre, Kansas State University, Manhattan, KS 66506; esayre@gmail.com

Paul W. Irving, Kansas State University

A major goal of undergraduate education in physics is fostering "thinking like a physicist" (TLP) among physics students. This is an elusive goal because we're not really sure what TLP entails, but we know it when we see it. As a goal, it combines both technical content about physical systems with cultural ideas and values about physics as a field. In this talk, I discuss efforts to operationalize TLP using video-based observations of physics students and practicing physicists. I present some discourse markers for identifying when students are more likely to be physicist-like, and suggest strategies for both researchers and classroom teachers to promote TLP.

BH03: 5:30-6 p.m. Epistemological and Methodological Consistency in Qualitative Research

Invited – Mirka Koro-Ljungberg, 119A Norman Hall, Gainesville, FL 32611; mirka@ufl.edu

Qualitative research design can be viewed as epistemologically interconnected unit of theoretical perspective, research questions, and research methods. The articulation of one's epistemological and methodological connections is an important goal for qualitative researchers and this practice can work against perceptions of qualitative research as random, unintentionally intuitive, or nonsystematic. In this presentation I draw examples from the articles published in the *Journal of Engineering Education* to discuss the extent to which these articles appear epistemologically and methodologically consistent with the goals of qualitative inquiry. Based on my review of the articles, only very few demonstrated consistency. This lack of consistency may limit the rich, descriptive, and culturally important information that could be gained from qualitative inquiry. I call on researchers to expand their knowledge and use of qualitative methods and I encourage scholars to design studies with careful attention to the questions of knowledge and methods.

Session BI: Teacher Preparation and Enhancement

Location: Salon 3
Sponsor: AAPT
Date: Sunday, January 5
Time: 4:30–5:50 p.m.

Presider: Ntungwa Maasha

BI01: 4:30-4:40 p.m. Regular Classroom Tests as a Means of Motivating Teacher Trainees Learn Concepts in Electronics

Contributed – Kodjo Donkor, Taale University of Education, Winneba, Ghana Department of Physics Education, Winneba, Central Region GH 25 Ghana; ktaale@yahoo.com

This study was an action research that employed regular classroom tests to help students learn and understand some concepts in electronics. The participants were Level 400 students of the Department of Physics Education of the University of Education, Winneba, Ghana. The study was carried out in two phases, pre-intervention and post-intervention activities. Students were taught for 12 weeks and at the end of each forth night, made to take a test made up of practical activities and essay-type test on the concepts learned in the previous two weeks. Most of student responses in the weekly tests reflected understanding of the concepts learned in that their scores improved and could set up simple practical activities in electronics and carry them out successfully in the laboratory. The outcome of this study shows that students, if tested regularly, may improve in their understanding of electronics and other physics concepts.

BI02: 4:40-4:50 p.m. Tracking High School Physics Teaching in Iowa

Contributed – Jeffrey T. Morgan, University of Northern Iowa, Cedar Falls, IA 50614-0150; jeff.morgan@uni.edu

Darian Everding, University of Northern Iowa

In 2009, we surveyed Iowa high school physics teachers to ascertain their educational backgrounds, content coverage, and pedagogical approaches in their courses, and views of effective instruction, among others.[1] We repeated the survey in 2013, keeping many questions the same but tweaking others to gain new insights into the reasons some teachers leave the profession and the amount of inquiry-oriented instruction that teachers employ. We present survey highlights and trends observed over the four-year period that inform stakeholders in Iowa and similar states with significant numbers of small, rural schools.

1. The survey report is available at http://www.physics.uni.edu/teacher-survey.

BI03: 4:50-5 p.m. Undergraduate Pathway to Teaching Physics at Georgia State University

Contributed – Brian D. Thoms, Georgia State University, Department of Physics & Astronomy, Atlanta, GA 30302-5060; bthoms@gsu.edu

Elizabeth Walker, Sumith Doluweera, Joshua Von Korff, GSU

The Department of Physics & Astronomy at Georgia State University has begun an effort to increase the quantity and quality of high school physics teachers with an emphasis on increasing recruitment into teaching of students from under-represented groups. GSU is a large, growing, urban, research university with a diverse student body. Recently a teacher certification pathway within our BS in Physics program has been added to the existing master's level program. As a new PhysTEC comprehensive site, our efforts include new recruiting, mentoring, and induction strategies, reform of introductory, calculus-based physics courses, and the addition of a teacher-on-residence. We will describe the recruiting and mentoring efforts and early success of the new undergraduate path to certification which is projected to produce four physics teachers in 2013-2014 and five in 2014-2015.

BI04: 5-5:10 p.m. Exploring Technology-Enhanced Active Learning in Physics Teacher Education

Contributed – Marina Milner-Bolotin, The University of British Columbia, Vancouver, BC V6T 1Z4 Canada; marina.milner-bolotin@ubc.ca

Heather Fisher, Alexandra MacDonald, University of British Columbia

Active learning pedagogies, such as Peer Instruction (PI), have been proven to be effective in undergraduate physics teaching. However, they are still rare in secondary schools and in physics teacher education programs. One of the reasons for that is methods instructors' mistrust of the pedagogical effectiveness of multiple-choice conceptual questions. While modern educational technologies open opportunities for using open-ended questions in PI, multiple-choice conceptual questions in teacher education are still underutilized. In this study Peer Instruction pedagogy was supplemented by the use of a collaborative online system—PeerWise (PW) (peerwise.cs.auckland.ac.nz). PI&PW pedagogy allowed researchers to investigate the development of questioning skills in secondary teacher-candidates through the use of peer collaboration. We report on the effects of PI&PW implementation in a semester-long physics methods course on teacher-candidates' content and pedagogical knowledge, on their attitudes about active learning, and on willingness and ability to implement active learning pedagogy during their practicum.

BI05: 5:10-5:20 p.m. Investigating the Impact of Clicker-Enhanced Pedagogy in a Secondary Physics `Methods Course

Contributed – Alexandra MacDonald, The University of British Columbia, Vancouver, BC V6T 1Z4, Canada; marina.milner-bolotin@ubc.ca

Heather Fisher, Marina Milner-Bolotin, University of British Columbia

One of the most commonly explored technologies in contemporary STEM educational research is electronic response systems (clickers). Benefits of clicker-enhanced pedagogy include: encouraging active student participation, reducing anxiety, supporting formative assessment, and promoting conceptual understanding. Most studies, however, investigate the effects of these technologies in large undergraduate STEM courses. The role of clicker-enhanced pedagogy in small secondary or post-secondary classrooms is still relatively unexplored, especially in the context of teacher education programs. This study investigates whether clicker-enhanced pedagogy is effective in a small secondary physics methods course by considering its impact on supporting an inquiry-oriented curriculum, increasing the instructor's ability to diagnose gaps in teacher-candidates' pedagogical-content knowledge, and consequently to improve it. This study sheds light on developing teacher-candidates' capacities to utilize, design, and implement inquiry-oriented clicker-enhanced pedagogy, the impact of this process on their pedagogical-content knowledge and attitudes toward the value of conceptual learning.

BI06: 5:20-5:30 p.m. Who Is Teaching High School Physics in Central Florida?

Contributed – Jacquelyn J. Chini, University of Central Florida, Orlando, FL 32816; jchini@ucf.edu

Kevin H. Thomas, Malcolm B. Butler, Talat S. Rahman, University of Central Florida

The University of Central Florida has recently become a PhysTEC comprehensive site to promote the recruitment and training of highly qualified physics teachers in the Central Florida area. PhysTEC has identified several key components of successful physics teacher preparation programs, including efforts directed at our own students, such as a learning assistant program and early teaching experiences, as well as efforts directed at the teaching community, such as fostering communication and mentoring with and between local physics teachers. To better support the local high school physics teaching community and provide relevant mentoring to our future teachers, we need to understand the backgrounds of our local teachers. We will present results from a survey of the pathways local teachers took to their current positions, highlighting their certification process and other training, and discuss how these results will shape our future efforts to engage and support the high school physics teaching community.

BI07: 5:30-5:40 p.m. In-service Teachers as an Inroad for Newly Certified Physics Teachers*

Contributed – Steven J. Maier, Northwestern Oklahoma State University, Alva, OK 73717-2799; sjmaier@nwosu.edu

Saeed Sarani, Oklahoma State Regents for Higher Education

As part of an ongoing professional development AAPT/PTRA program at NWOSU since 2011, ToPPS has provided K-12 Oklahoma educators opportunities to expand and deepen their understanding of physics. Now, the ToPPS project has taken on the goal of increasing the number of certified HS physics teachers in the state of Oklahoma. Because many ToPPS participants have little formal physics coursework, this has become a multi-year effort on the part of the program and the participants. In this talk, the means of achieving this goal through alternative certification will be discussed.

*This project is made possible by funding from the Oklahoma State Regents for Higher Education http://www.aapt.org/PTRA/ www.nwosu.edu/ToPPS

BI08: 5:40-5:50 p.m. Transforming Physics Education at BU through Peer Learning and Mentoring

Contributed – Manher Jariwala, Boston University, Boston, MA 02215; manher@bu.edu

Andrew Duffy, Bennett Goldberg, Mark Greenman, Boston University

Boston University has seen significant transformation in its physics instruction, in large part due to two programs that incorporate peer learning and peer mentoring. We describe how our Learning Assistant (LA) program impacts not only the all of our physics courses and the students in these courses, but also the undergraduate physics major community. We also describe our Teaching Fellow (TF) peer-mentoring program, which not only helps train incoming graduate students in active-learning and student-centered pedagogy, but also fosters a community of practice around professional development. Finally, we discuss the synergies between the two programs that result in a vertical learning community within our department, from advanced graduate students to incoming undergraduate majors.

Session TD01: NGSS, Topical Discussion

Location: Salon 12
Sponsor: Committee on Physics in High Schools
Co-Sponsor: Committee on Physics in Pre-High School Education
Date: Sunday, January 5
Time: 4:30–5:30 p.m.

Presider: Trina Cannon

NGSS—What impact will this have on your school and school curriculum or will it have any? Share your thoughts and concerns with others who feel the "pain and change."

Session TD02: Physics & Society, Topical Discussion

Location: Salon 11
Sponsor: Committee on Science Education for the Public
Date: Sunday, January 5
Time: 6–7:30 p.m.

Presider: Stan Micklavzina

Join your colleagues to discuss how AAPT members can contribute and coordinate efforts to teaching physics-related societal issues such as science literacy, energy use and production, pseudoscience, and other topics bound to raise interesting conversations in the classroom, public venues, and even the dinner table with friends and relatives!

Session TD04: History and Philosophy, Topical Discussion

Location: Salon 8
Sponsor: Committee on History and Philosophy in Physics
Date: Sunday, January 5
Time: 6:30–7:30 p.m.

Presider: Shawn Reeves

We will continue and expand the discussion that began at our Winter 2013 meeting, exploring not only how history and philosophy shape our teaching, but how we might engage students in learning about history and philosophy of physics. Philosophical approaches in the classroom are unavoidable, even if subliminal, so let's begin interpreting and shaping them.

Session TD05: Dual and Concurrent Enrollment, Topical Discussion

Location: Salon 7
Sponsor: Committee on Physics in Two-Year Colleges
Date: Sunday, January 5
Time: 6:30–7:30 p.m.

Presider: Paul Williams

Concurrent and dual-credit enrollment between two-year and four-year colleges is becoming increasingly common. Join in on this topical discussion. We will share experiences with concurrent and dual enrollment, and discuss issues such as transfer of credits and articulation.

2014 Winter Meeting Plenary

Location: Grand Ballroom B
Date: Sunday, January 5
Time: 7:30–8:30 p.m. **Meet and Greet Dr. Pettit from 8:30–9 p.m.**

Presider: Mary Mogge

Donald R. Pettit

Techno-Stories from Space, *by Don Pettit, NASA astronaut*

Donald Roy Pettit, a chemical engineer and NASA astronaut, is a veteran of two long-duration stays aboard the International Space Station, one space shuttle mission, and a six-week expedition to find meteorites in Antarctica. He received a BS in Chemical Engineering from Oregon State University and a PhD in Chemical Engineering from the University of Arizona. A veteran of three spaceflights, Pettit has logged more than 370 days in space and over 13 EVA (spacewalk) hours. He was a staff scientist at Los Alamos National Laboratory, Los Alamos, NM, from 1984 to 1996. Projects there included reduced gravity fluid flow and materials processing experiments onboard the NASA KC-135 airplane, atmospheric spectroscopy on noctilucent clouds seeded from sounding rockets, fumarole gas sampling from volcanoes and problems in detonation physics. He was a member of the Synthesis Group, slated with assembling the technology to return to the Moon and explore Mars (1990) and the Space Station Freedom Redesign Team (1993). In 2006, Pettit joined the Antarctic Search for Meteorites (ANSMET), spending six weeks in Antarctica collecting meteorite samples, including a lunar meteorite. He lived aboard the International Space Station for 5½ months during Expedition 6, was a member of the STS-126 crew, and again lived aboard the station for 6½ months as part of the Expedition 30/31 crew in 2011. During Expedition 30, Pettit made a video using an Angry Birds character to explain how physics works in space.

Poster Session 1

Location: Grand Ballroom Foyer
Sponsor: AAPT
Date: Monday, January 6
Time: 8–9:30 a.m.

Persons with odd-numbered posters will present their posters from 8–8:45 a.m.; even-numbered will present 8:45–9:30 a.m.

Astronomy

PST1A01: 8-8:45 a.m. How Did the Moon Form? Evaluating Alternative Explanations

Poster – Doug Lombardi, Temple University, Philadelphia, PA 19122; doug.lombardi@temple.edu

Janelle M. Bailey, Temple University

Scientifically literate citizens need to understand how scientists evaluate competing explanations. Likewise, science learning demands that students increase their ability to critically evaluate scientific knowledge and weigh alternative explanations. Our poster introduces an instructional scaffold—the model-evidence link (MEL) diagram--designed to promote students' ability to critically evaluate scientific explanations and knowledge of fundamental concepts. The structure and mode of MEL diagrams were originally developed by Rutgers University researchers under a NSF-supported middle school life science project (Chinn & Buckland, 2012). We adapted their format and created a MEL diagram around a compelling astronomy topic: the Moon's formation. Students draw arrows in different shapes to indicate the degree of support between lines of evidence and two models of the Moon's formation. By engaging in the MEL, students use critical evaluation in weighing the connections between these lines of evidence and the alternative explanations to gain a deeper understanding about the Moon.

*This work is supported by the National Science Foundation, Award DRL-131605. Chinn, C. A., & Buckland, L. A. (2012). Model-based instruction: Fostering change in evolutionary conceptions and in epistemic practices. In K. S. Rosengren, E. M. Evans, S. Brem, & G. M. Sinatra (Eds.), Evolution challenges: Integrating research and practice in teaching and learning about evolution (pp. 211-232). New York: Oxford University Press.

PST1A02: 8:45-9:30 a.m. Parallax Lab for Introductory Astronomy Students

Poster – Amanda Mashburn, University of West Georgia, Carrollton, GA 30118; awhite15@my.westga.edu*

Ben Jenkins, Bob Powell, University of West Georgia

Parallax is the angular displacement in apparent position of a celestial body, most commonly a star, when observed from two widely separated lines of sight. Parallax, measured in arc seconds, is inversely proportional to its distance in parsecs. A daytime lab has been created and tested to give students experience measuring the parallax angle of campus objects and calculating the distances to them. Students learn that it is possible to calculate these distances accurately without directly measuring them. A Brunton surveyor's compass was used to measure the bearings along two lines of sight to obtain a parallax angle. In a typical trial, a baseline of 16.5 m has a parallax angle of 7.8 degrees; the actual distance is 117.5 m, and the calculated distance being 117.9 m.

*Sponsored by Bob Powell

PST1A03: 8-8:45 a.m. More Effective Use of Video Watching in ASTRO 101*

Poster – Timothy F. Slater, University of Wyoming, Laramie, WY 82071; tslater@uwyo.edu

Ken Brandt, ShiAnne Kattner, Mark Reiser, Richard Sanchezm University of Wyoming

Online, freely available, high-definition video productions on astronomy include high-quality simulations with precise explana-

Monday, January 6 Highlights

REGISTRATION 7 a.m.–5 p.m. Ballroom Foyer

Two-Year College Breakfast
7–8 a.m. Salon 12

Poster Session 1: 8–9:30 a.m. Grand Ballroom Foyer

RICHTMYER AWARD TO: SIR MICHAEL BERRY
9:30–10:30 a.m. Grand Ballroom B
– SPS Chapter Advisor Award, 10:30 a.m.

Kindle Raffle 10:45 a.m. Exhibit Hall

Retired Physicists Luncheon
12–1 p.m. Salon 18

AAPT Fun Run/Walk – *Run for Melba*
12–2 p.m. offsite

Multicultural Luncheon
12:30–1:30 p.m. Salon 14

PLENARY: PHILIP METZGER, NASA SCIENTIST
2–3 p.m. Grand Ballroom B

Poster Session 2: 8:30–10 p.m. Grand Ballroom Foyer

COMMITTEE MEETINGS, 12:15–2 p.m.
–Teacher Preparation Salon 12
–Undergraduate Education Salon 4
–Women in Physics Salon 11
–Interests of Senior Physicists (1–2 p.m.) Salon 3

COMMERCIAL WORKSHOPS, 11 a.m.–12 p.m.
–CW08: OpenStax College Salon 11
–CW03: Perimeter Institute Salon 13

COMMERCIAL WORKSHOP, 12–1 p.m.
–CW04: Perimeter Institute Salon 13

COMMERCIAL WORKSHOPS, 12:30–1:30 p.m.
–CW06: Pearson author Paul Hewitt Salon 9
–CW07: WebAssign Salon 8

Afternoon Break Exhibits 3 p.m. Exhibit Hall
Gift Card Raffle 3:15 p.m. Exhibit Hall

COMMITTEE MEETINGS, 5:30-7:15 p.m. (or 7 p.m.)
–Educational Technologies Salon 10
–Graduate Education Salon 11
–Science Educ. for the Public Salon 12
–Diversity in Physics Salon 13
–Membership & Benefits, ends 7 p.m. Salon 14
–SI Units and Measurement, ends 7 p.m. Salon 3
–PERLOC, ends 7 p.m. Salon 4
–PTRA Oversight, ends 7 p.m. Salon 6

tions and are poised to greatly benefit the learning of ASTRO 101 astronomy students. At the same time, some faculty are understandably reluctant to assign videos to students because of difficulties in making students accountable. Moreover, for students who are taking courses via distance learning technologies and MOOCs, developing pedagogical strategies to use some of these new videos to effectively teach off-campus students is even more critical. In response, we are experimenting with creating highly structured video discussion guide worksheets to mediate students' engagement with videos. We have developed three different styles of questions for a variety of 45-60 min. videos, where we pose: 4-8 factual questions, 2-4 synthesis & evaluation questions, and 1-2 self-reflection questions.

*Classroom-ready examples available in the online faculty lounge at http://www.caperteam.com

Labs/Apparatus

PST1B01: 8-8:45 a.m. Acoustic Wave Lab for Introductory and Upper-level Physics Majors

Poster – Daniel Hartman, University of West Georgia, Carrollton, GA 30118; dhartma2@my.westga.edu*

Ben Jenkins, Bob Powell, University of West Georgia

Iowa Doppler Products' (IDP) instrumentation has been used to measure the speed of sound through a variety of media. Other measurements, such as a single slit experiment and refraction at a corner, have also been performed. Errors in the speed of sound in water were typically about 0.5%. This equipment will be used in the University of West Georgia's (UWG) introductory honors physics lab and upper level experimental physics labs. The tool's versatility also will allow for multiple junior and senior level research projects for our undergraduate majors.

*Sponsored by Bob Powell

PST1B02: 8:45-9:30 a.m. An Inexpensive Quantitative Demonstration of Harmonics in Piped Sound Makers

Poster – Stephen A. Minnick, Kent State University at Tuscarawas, New Philadelphia, OH 44663; sminnick@kent.edu

A simple inexpensive activity, which can be included as part of a larger laboratory experiment, utilizes open-source software and a computer microphone to display the harmonics of open and closed end pipes. Students calculate the theoretical frequencies produced by blowing across the top of short lengths of PVC tubing and compare them to the display of actual frequencies present.

PST1B03: 8-8:45 a.m. Using Arduino and a Microphone to Listen for Time

Poster – Jeffrey R. Groff, Shepherd University, Shepherdstown, WV 25443-5000; jgroff@shepherd.edu

Sytil Murphy; Shepherd University

An Arduino microcontroller, electret microphone, and an operation amplifier provide a low-cost setup for measuring the intervals of time between intermittent sounds. The hardware and software components of this apparatus are described, and the apparatus is demonstrated by measuring the frequency of a spinning motor and the coefficient of restitution of a bouncing ball.

PST1B04: 8:45-9:30 a.m. Spy Physics: Using a Laser to 'Hear' a Conversation

Poster – Timothy Todd Grove, IPFW, Fort Wayne, IN 46805; grovet@ipfw.edu

Trunghieu T. Nguyen, IPFW

We will present a simply constructed laser experiment for students beyond their first year in physics. The goal of this particular experiment is to not only give students experience with laser interferometry, but to allow students to have greater excitement than they would normally get counting fringes or making precision measurements. Our experiment started when a student asked "Is it true that you could use a laser beam to detect a conversation in an office by its reflection off of a window." To accomplish this task we used a simple Michelson interferometer in which one mirror vibrated in response to a sound source. A speaker connected to a radio inside a small box with a tinted glass window served as a mirror for the laser beam and also represented the office that we were "spying upon." At present time, we have tried the experiment in two different ways—one in which the sound source is directly connected to the mirror (the easy version) and one in which the sound must propagate through air to vibrate the mirror (the harder version). We will demonstrate our results if the audio equipment is willing.

PST1B05: 8-8:45 a.m. Speed of Mechanical Waves: Lab Exercises with Free Software and Hardware

Poster – Fabian Martinez, Gimnasio La Montaña Carrera, 51 No. 214-55, Bogotá, 09002 Colombia; fabianmartinez@glm.edu.co

Mauricio Mendivelso-Villaquiran, Gimnasio La Montaña

Some ways to measure speed of mechanical waves on diverse media is presented in this poster. Using ideas introduced by B. Jones and others, we improve them using easy setup hardware and free license software in the physics lab.

PST1B06: 8:45-9:30 a.m. Sound Pressure Dependence on the Air Temperature and Air Pressure

Poster – Dongryul Jeon, Seoul National University, Seoul, 151-748 South Korea; jeon@snu.ac.kr

Yanghee Oh, Yanghwa Middle School

As is often demonstrated in physics classes, sound cannot be heard without air. We investigated the propagation of sound when the air pressure was varied between 80 and 610 mmHg and the temperature between 25 and 33 degrees C. The experiment was performed by placing a speaker, microphone and a heater in a desiccator equipped with a pressure gauge. After stabilizing the temperature by heating and the pressure by pumping out the air, we measured the sound intensity. The speaker was driven by a sine wave ranging between 1 and 2 kHz. Our results showed that the sound pressure increased linearly with the temperature when the air pressure was fixed. The sound pressure also increased linearly with the air density when the temperature was fixed. Analysis showed that at a given temperature the maximum change in the sound pressure was proportional to the air density, which agrees with our experimental results.

PST1B07: 8-8:45 a.m. Redesign of Introductory Mechanics Labs to Increase Retention and Graduation of STEM Students

Poster – Nina Abramzon, Cal Poly Pomona, Pomona, CA 91768-4031; nabramzon@csupomona.edu

Barbara M. Hoeling, University of Applied Sciences Landshut

Phu Tran, Norco College

Peter B. Siegel, Claudia L. Pinter-Lucke, Cal Poly Pomona

Programs aimed at increasing retention and graduation rates of STEM students have been implemented at Cal Poly Pomona and at Norco College. As part of these programs there were interventions done to the freshman physics labs. The new labs were designed to follow the inquiry-based approach. The design elements will be presented in detail together with assessment of student learning and student attitudes.

PST1B08: 8:45-9:30 a.m. Low-cost Experiments in Optics & Material Science Using Candy Glass

Poster – William R. Heffner, Lehigh University, Bethlehem, PA 18015; wrh304@lehigh.edu

Himanshu Jain, Lehigh University

We present a collection of hands-on experiment and home-built apparatus designed to explore physics and "real" glass science through a

common and accessible sugar glass also known as hard candy. Experiments are all low-cost and inter-related and include: synthesis, phase diagram, refractive index measurement, crystallization phenomena, and a fiber drawing tower, as well as differential thermal analysis and electrical conductivity apparatus. Most of the experiments can be assembled in a high school or college lab with minimal cost. The scientific content of these experiments progresses systematically, providing an environment to develop an understanding of glassy materials within a framework of active prolonged engagement.

PST1B09: 8-8:45 a.m. Measuring Fluorescence and Absorption in Caramelized Sugar Glass

Poster – William R. Heffner, Lehigh University, Bethlehem, PA 18015; wrh304@lehigh.edu

Donald Wright III, Oakwood University

While using home-molded optical elements made from candy glass (hard candy) and a green laser, we also observed a distinct, lower wavelength emission form the candy. We present here our apparatus and results for measuring the fluorescence and absorption observed in the sugar glass (hard candy) using the student grade Ocean Optics Red Tide Spectrometer. The fluorescence was found to span between about 470 nm and 650 nm and the emission demonstrated a marked drop in intensity for LED excitation below green. Absorption was measured with the Red Tide and with a commercial spectrometer for comparison. Both fluorescence and absorption increased significantly with further cooking (caramelization). Literature suggests that the fluorescence and absorption can be attributed to the formation of carbon nanoparticles. We propose that our Red Tide Spectrometer based experiment would be an interesting and appropriate one for an undergraduate lab in physics, chemistry or material science.

PST1B10: 8:45-9:30 a.m. Colorado Learning about Science Survey for Experimental Physics (E-CLASS)

Poster – Heather Lewandowski, University of Colorado, Boulder, CO 80309; lewandoh@colorado.edu

Ben Zwickl, Rochester Institute of Technology

Takako Hirokawa, Noah Finkelstein, University of Colorado

The Colorado Learning Attitudes about Science Survey for Experimental Physics (E-CLASS) is a short multiple-choice survey that assesses students' attitudes about conducting physics experiments in an instructional setting and in professional research. The survey is given at the beginning and at the end of a course, whereupon students are also asked about what helped to earn a good grade in the course. A variety of aspects of experimentation are explored, including students' sense-making, affect, self-confidence, and the value of collaboration. Over 4000 E-CLASS responses have been gathered from over 30 courses at 17 colleges and universities. We will present a broad overview of our findings, including which student views are the least expert-like, which views shift most over the course of a semester, and which have largest differences between introductory and upper-division courses.

PST1B11: 8:45-9:30 a.m. Some Characteristics of Wetland Water through Open Source Spectrometry

Poster – John J. Zafra, Gimnasio La Montaña, Bogotá, 09002 Colombia; johnzafra@glm.edu.co*

Fabian Martinez, Mauricio Mendivelso-Villaquiran, Gimnasio La Montaña

Using the low-cost spectrometer proposal carried out by publiclaboratory.org team and free video and photography analysis software, we have developed an initial physical-chemical characterization of the water of the Torca wetland in chemistry and physics high school classroom and we identified the presence of some contaminants. Our purpose is to determine the environmental impact that such contaminants have in this ecosystem.

*Sponsored by Fabian Martinez

PST1B12: 8:45-9:30 a.m. Mechanical NMR 2.0

Poster – Mark F. Masters, IPFW, Fort Wayne, IN 46805; masters@ipfw.edu

Jacob Millspaw, IPFW

An updated version of the mechanical analog of NMR utilizing Cypress PSoC to drive the perturbing magnetic field. This magnetic field is either a fixed frequency sinusoid, a swept sinusoid, or a pulsed sinusoid.

PST1B13: 8-8:45 a.m. How Weight Influences Lift

Poster – Jeff A. Mays, Issaquah High School, Issaquah, WA 98027-4319; jeffmay34@yahoo.com*

Every time an aircraft, whether a private Cessna or a multimillion-dollar jumbo jet, takes off, weight is always an important key variable. The amount of weight an airplane can hold is limited. In my experiment, I will be testing on how different increments of weight affect the lift of a particular plane. This test involves showing the problems that every day engineers face when building and testing aircraft. I will test this experiment by using an R/C airplane and different masses placed at the center of gravity to determine the distance required to take off. What is the mathematical relationship between take-off distance and load?

*Sponsored by Thomas Haff

PST1B14: 8:45-9:30 a.m. Integrating Robotic Observatories into Introductory Astronomy Labs

Poster – Gerald T. Ruch, University of St. Thomas, St. Paul, MN 55105; gtruch@stthomas.edu

The University of St. Thomas (UST) and a consortium of five local schools are using the UST Robotic Observatory, housing a 17' telescope, to develop labs and image processing tools that allow easy integration of observational labs into existing introductory astronomy curriculum. Our lab design removes the burden of equipment ownership by sharing access to a common resource and removes the burden of data processing by automating processing tasks that are not relevant to the learning objectives. Each laboratory exercise takes place over two lab periods. During period one, students design and submit observation requests via the lab website. Between periods, the telescope automatically acquires the data and our image processing pipeline produces data ready for student analysis. During period two, the students retrieve their data from the website and perform the analysis. The first lab, "Weighing Jupiter," was successfully implemented at UST and several of our partner schools.

PST1B15: 8-8:45 a.m. What Can You Do with PSoC?

Poster – Jacob Millspaw, IPFW, Fort Wayne, IN 46805; millspaj@ipfw.edu

Mark F. Masters, IPFW

If you had a single device that could do reconfigurable active analog circuitry, reconfigurable digital circuitry, on the fly pulse width modulation, capacitive sensing, reconfigurable pin out, analog to digital conversion, digital to analog conversion, what would you do? What could you build?

PST1B16: 8:45-9:30 a.m. MOOCs in the Physics Lab? Reports from the Front

Poster – Sean P. Robinson, MIT, Cambridge, MA 02139-4307; spatrick@mit.edu

Gunther Roland, Charles I. Bosse, Christopher Sarabalis, MIT

We report on progress, challenges, and lessons learned in the first semester (fall 2013) of using the edX software platform—principally targeted at delivering so-called massive open online courses (MOOCs) --- to deliver parts of a residential physics advanced lab course at MIT which is neither massive, open, nor predominantly online. The MOOC tools were used to enable "flipped classroom" methods for teaching data analysis and basic equipment usage: content delivery was shifted to online preparatory exercises and video lectures, free-

ing up lab time for active learning exercises, group discussion, and student-teacher dialog. MOOC tools were also used to deliver preparatory background material which students were required to complete before starting each new experiment.

PST1B17: 8-8:45 a.m. Lessons Learned Implementing Online Laboratories at the University of Arkansas

Poster – John C. Stewart, University of Arkansas, Fayetteville, AR 72701; johns@UARK.EDU

To increase access and to improve ease of transfer, the University of Arkansas-Fayetteville will be offering its first-semester, calculus-based physics class online to all 11 campuses of the University of Arkansas system beginning in the spring 2014 semester. This requires implementation of online laboratory experiences that were piloted at the Fayetteville campus during the fall 2013 semester. These laboratories used a mix of simulations and video recording of experiments to replace face-to-face laboratories. The interactive nature of the face-to-face laboratory was partially replaced by inserting quiz questions at points in the laboratory. A video recording of the instructor discussing each quiz question was made available to the students. This poster will report on the lessons learned in this project.

Physics Education Research

PST1C02: 8:45-9:30 a.m. Clarifying the Force Concept Inventory via Think-Aloud Interviews

Poster – Matthew R. Semak, University of Northern Colorado, Greeley, CO 80639; matthew.semak@unco.edu

Wendy K. Adams, Richard D. Dietz, University of Northern Colorado

Over the past two years we have conducted three iterations of think-aloud interviews with students as they grappled with questions on the Force Concept Inventory (FCI). Doing so has shown us that the difficulties they have with some questions have nothing to do with their understanding of physics. These difficulties involve diagrams, notations, and vocabulary that make perfect sense to physics teachers but can easily confuse beginning students. Informed by those think-aloud interviews, we have been modifying a subset of questions to improve clarity and then administered each version of the clarified FCI to students in two introductory physics courses. Here we show how and why we modified a few specific questions to construct our latest version of the clarified FCI and compare the consequent results with several years of archival data generated with the canonical Inventory.

PST1C03: 8-8:45 a.m. Japanese Pre-concepts of Force and Motion Probed by the FCI

Poster – Michi Ishimoto, Kochi University of Technology, Tosayamada-cho Kami-shi, Kochi 782-8502; ishimoto.michi@kochi-tech.ac.jp

The Force and Concept Inventory (FCI) is used around the world to assess students' understanding of force and motion. The FCI has been translated into over 21 languages. Because Japanese belongs to a different language family from the Indo-European language family (to which English belongs), it is important to validate the translation of the FCI from English into Japanese. Translation requires a proper selection of words and writing styles, which may influence students' response choices. Based on the classical test theory, the results of reliability and discrimination testing of the translated version indicate that it is a high-quality test. An analysis of individual items shows that the surveyed Japanese students exhibited the same most common-sense concepts about motion and force (e.g. impetus and active force) as those of American students. The probed concepts are compared to concepts introduced in the taxonomy of misconceptions.

PST1C04: 8:45-9:30 a.m. Representational and Writing Style Influences on Concept Inventories

Poster – Michi Ishimoto, Kochi University of Technology, Tosayamada-cho Kami-shi, Kochi 782-8502; ishimoto.michi@kochi-tech.ac.jp

The Force Concept Inventory (FCI) and the Force and Motion Conceptual Evaluation (FMCE) probe not only Newtonian responses but also commonsense concepts of force and motion. The representation and writing styles of questions may influence students' responses. Presumably, these influences are greater on responses to questions concerning commonsense concepts. Four items regarding Newton's 3rd law on the FCI and the FMCE are identical in terms of their contents. A comparison of representational styles reveals that three of the four questions are different and that one question is identical. Different writing styles are used to translate the FCI and the FMCE into Japanese. Representational and writing style influences on the responses to the four questions are statistically examined using data from the same groups of students. The FMCE produces results with fewer correct answers and more common-sense answers. A greater difference is observed on questions with different representational styles.

PST1C05: 8-8:45 a.m. Linguistic Misinterpretations of Fundamental Concepts of Physics of Semiconductors

Poster – Emanuela Ene, Oklahoma State University, Stillwater, OK 74078; eene@okstate.edu

Interviews conducted at Oklahoma State University with undergraduates enrolled in an introductory course of semiconductor devices revealed surprising linguistic misinterpretations. The instruction in the lecture format course had no significant effect on linguistic representations, but was significantly associated with the graphical representations.

PST1C07: 8-8:45 a.m. Development of a Standardized Static Fluids Assessment

Poster – DJ Wagner, Grove City College, Grove City, PA 16127; djwagner@gcc.edu

Ashley Lindow, Elizabeth Carbone, Anna Olson, Grove City College

We are developing an FCI-style assessment covering static fluids topics commonly included in introductory physics courses. Beta versions have been sent to other institutions, and we are continuing to refine the assessment. This poster will focus on our efforts to identify which conceptions persist into our target audience of late high school and introductory college students. We're particularly interested in receiving suggestions from other educators and in recruiting more beta-testers. Stop by and chat!

PST1C08: 8:45-9:30 a.m. Students' Blending of Mathematical Integrals with Physics

Poster – Dehui Hu, Rochester Institute of Technology, Rochester, NY 14623; dxhsps@rit.edu

N. Sanjay Rebello, Kansas State University

College calculus is used across many physics topics from introductory to upper-division level courses. The fundamental concepts of differentiation and integration are important tools for solving real-world problems involving non-uniformly distributed quantities. Research in physics education has reported students' lack of ability to transfer their calculus knowledge to physics. In order to better understand students' deficiencies, we collected data from group teaching/learning interviews as students solved physics problems requiring setting up integrals. We adapted the conceptual blending framework from cognitive science to make sense of the ways in which students combined their knowledge from calculus and physics to set up integrals. We report on our analysis of the ways in which students blend knowledge in several mental spaces to set up integrals in physics contexts. Finally, we compare students' conceptual blends and discuss the implications of our study

PST1C09: 8-8:45 a.m. Explicit Instruction in Metacognition: An Example from Physics

Poster – Alistair G. McInerny, Western Washington University, Bellingham, WA 98225; mcinera@students.wwu.edu

Andrew Boudreaux, Western Washington University

Mila Kryjevskaia, North Dakota State University

Metacognition, or "thinking about thinking", is known to be involved in expert learning, but is generally difficult to observe. At Western Washington University, exercises have been created and administered in introductory course labs in order to (1) help students develop metacognitive skills, and (2) allow researchers to characterize facility with those skills. A rubric has been developed to code and analyze students' written responses. Initial application of the rubric suggests that analysis of this kind can lead to useful insights. With the use of a more detailed and comprehensive rubric, it should be possible to make concrete claims about student metacognitive thinking in physics and the development of student metacognitive abilities facilitated by instruction.

PST1C10: 8:45-9:30 a.m. Effect of Visual Cueing on Students' Eye Movements and Reasoning*

*Poster – Amy S. Rouinfar,** Kansas State University, Manhattan, KS 66506; amy.rouinfar@gmail.com*

Elise Agra, Jeffrey Murray, Lester C Loschky, N. Sanjay Rebello, Kansas State University

Visual cues overlaid on diagrams and animations can help students attend to the relevant areas and facilitate problem solving. In this study we investigate the effect of visual cues on students' eye movements as they solve conceptual physics problems. Students (N=90) enrolled in an introductory physics course were individually interviewed. During each interview students worked through four sets of problems containing a diagram while their eye movements were recorded. The diagrams contained features relevant to solving the problem correctly and separate areas related to common incorrect responses documented in the literature. Each problem set contained an initial problem, six isomorphic training problems, and a transfer problem. Those in the cued condition saw visual cues overlaid on the training problems. Students provided their responses verbally. We discuss the influence of visual cueing on students' attention and reasoning.

*This work is supported by the National Science Foundation under grants 1138697 and 0841414.

**Sponsored by N. Sanjay Rebello.

PST1C11: 8-8:45 a.m. Probing Visual-Spatial Abilities in Relation to Specific Reasoning Approaches

Poster – Alexandra Lau, Mount Holyoke College, South Hadley, MA 01075; alau693@gmail.com

Mila Kryjevskaia North Dakota State University

There are several different lines of reasoning students employ when they attempt to solve the wave tasks administered in introductory physics courses. We speculated that students' visual-spatial abilities may be related to the reasoning approaches they used on the wave tasks. We used the Paper Folding Test (PFT) to measure students' visual-spatial skills. We have observed notable differences in the PFT scores between specific categories of reasoning approaches used in solving wave tasks.

Pre-college/Informal and Outreach

PST1D01: 8-8:45 a.m. AAPT's PhysicsBowl: A Contest for High Schools

Poster – Michael C. Faleski, Delta College, University Center, MI 48710; michaelfaleski@delta.edu

The PhysicsBowl is an annual contest for high school students. The contest itself is 40 multiple-choice questions in length to be answered in no more than 45 minutes. There are about 5000 students participating from more than 250 schools across the world. In the past few years, schools have competed from the United States, Canada, China, Taiwan, Japan, Spain, the Republic of Korea, and Italy. Prizes are awarded to both the students and schools for high performers. This poster is to give high school teachers more information about the contest.

PST1D02: 8:45-9:30 a.m. Bridging Theory to Practice: Student Model of Greenhouse Effects in a Ninth Grade Classroom

Poster – Nicole Strickhouser, Jefferson High School, Lafayette, IN 47904; aroychou@purdue.edu*

Anita Roychoudhury, Andrew Hirsch, Daniel Shepardson, Purdue University

Studies have shown that secondary students have difficulty in understanding greenhouse effect (GHE). Students tend to view greenhouse gases forming a lid on the Earth preventing the "heat" from escaping. It is understandable because classroom experiments often use a model of greenhouse rather than that of GHE. We used Keating's (2007) suggestions to develop a model of GHE. We found that the ninth grade students in a school, with a large proportion of students from non-dominant groups (NGSS, 2013), were able to construct the GHE model based on the data they collected. Their performance on the post-test also showed that they could compare models of the Earth's atmosphere with or without the greenhouse gases and support their claims with appropriate evidence.

*Sponsored by Anita Roychoudhury

PST1D03: 8-8:45 a.m. International Young Physicists Tournament – For High School Students Around the World

Poster – Donald G. Franklin, Spelman College/ Mercer University, Hampton, GA 30228; dgfrank1@aol.com

Martin Plecsh, IYPT Secretary General

Alan Allison, IYPT President

IYPT will be held in Shrewsbury, United Kingdom in July of 2014. This contest has 17 questions that are used for the Physics Fights between high school students from different countries. The teams take turns in the role of Reporter, Opponent, and Reviewer. The top three point winners advance to the final Physics Fight to determine the winner.

PST1D04: 8:45-9:30 a.m. Student Models of Weather, Climate, and Climate Change

Poster – Jignesh Mehta, Purdue University, West Lafayette, IN 47907-2040; jmehta@purdue.edu*

Anita Roychoudhury, Andrew Hirsch, Daniel Shepardson, Purdue University

Climate change is an important challenge of out time but public understanding of it is limited at best. Newly released Next Generation Science Standards (2013) suggests that climate change be taught from the middle school level onwards. We think that teaching of this complex topic needs to begin with what students know about weather, climate, climate change, and global warming. This exploration of student understanding needs to be done at the level where climate change education is expected to begin. To meet this need, we explored middle school students' responses to open-ended questions and constructed student models of these concepts. These models have implications for curriculum development and instruction at the secondary (7-12) grades.

*Sponsored by Anita Roychoudhury

PST1D05: 8-8:45 a.m. Dealing with Climate Myths

Poster – Gordon J. Aubrecht, OSU, Marion, OH 43015-1609; aubrecht.1@osu.edu

Many scientists understand that climate change has a sociopolitical aspect, but some scientists are unwilling to address the issue lest they be perceived as political themselves. Nevertheless, when we scientists find climate myths, I think it is our duty as scientists to be willing to debunk them. This poster exhibits some myths and contrasts them with the science.

Technologies

PST1E01: 8-8:45 a.m. Gauging Effectiveness of Pen-based Computing for Collaborative Introductory Physics Problem Solving

Poster – Duncan Cantrell, Columbus State University, Columbus, GA 31907; shaw_kimberly@columbusstate.edu

Kimberly A. Shaw, Zdeslav Hrepic, Columbus State University

Advancements in pen-input computing technology combined with synchronously interactive software opened new venues for promoting active instruction and collaborative problem solving.[1] The research goal of the present study was to isolate the effect of the methodology itself from that of the involved educational technology. We repeated the comparison of the performance of students taking the same introductory physics lecture course while enrolled in two separate problem-solving sections. [2] One section used tablet PCs to facilitate group problem solving while the other section used whiteboards or paper for one third of the semester (covering Kinematics). Sections then traded technologies for the middle third of the term (covering Dynamics). For the last segment of the semester, students were free to choose between tablet PCs or low tech. Preliminary analysis of quiz, exam and standardized pre-post test results indicate primacy of methodology over technology for student learning.

1. Sisson, C.J., Tablet-based recitations in *Physics: Less lecture, more success, in The impact of Tablet PCs and pen-based technology on education: new horizons,* D.A. Berque, L.M. Konkle, and R.H. Reed, Editors. 2009, Purdue University Press: West Lafayette, IN. p. 133-139.
2. Hrepic, Z., K. Lodder, and K.A. Shaw, Pedagogy and/or Technology: Making Difference in Improving Students' Problem Solving Skills. AIP Conf. Proceedings (2012 Physics Education Research Conference), 2013. 1513: p. 182-185.

PST1E02: 8:45-9:30 a.m. Using 3D Game Engines to Overcome Naive Concepts of Motion

Poster – Andre Bresges, University of Cologne, Institute of Physics Education, Gronewaldstrasse 2, 50931 Cologne, Germany; andre.bresges@uni-koeln.de

Marga Kreiten, University of Cologne, Institute of Physics Education

During childhood and youth, students build up a number of naive concepts of motion that help them to cope with the behavior of real-world objects around them. As Driver [5,6], diSessa and others pointed out, this naive concept of motion may work as a serious obstacle towards deeper understanding of scientific concepts of motion. We use the 3D Game Engine "Unity 3d" to develop a rich surrounding, in which tossing a ball can be analyzed in multiple perspectives to overcome classical naive concepts. This is embedded in a lab assignment, consisting of several hands-on experiments and motion capturing tasks. Naive concepts of learners are discussed based on the outcome.

1, Driver, R., Squires, A.; Rushworth, P.; Wood- Robinson, V.: *Making Sense of Secondary Science. Research into Childrens ideas*. London: Routledge, 1994.
2. Driver, R., Guesne, E.; Tiberghien, A. (eds.): *Children's Ideas in Science. Milton Keynes:* Open University Press, 1985.

PST1E03: 8-8:45 a.m. Simulating Simple Roller Coaster Physics for Animation and Interactive Applets

Poster – Michael R. Gallis, Penn State Schuylkill, Orwigsburg, PA 17961; mrg3@psu.edu

This poster presents the underlying physics used to simulate motions typically discussed under the auspices of "Roller Coaster Physics" in animation and an interactive java applet used in introductory physics. The car is modeled as a mass moving along a parametric curve, either at constant speed or coasting (with and without friction). Generating solutions to the resulting equations of motion places some constraints on the parametric equations describing the path of the track through space. The resulting materials are used to explore topics such as energy, power, circular motion, reaction forces and friction. In order to dramatize the repercussions of failing to loop at sufficient speed, collision dynamics are employed to simulate the car bounding off of the track and ground. Visual materials generated using the model are available online.[1,2]

1. Roller Coaster Model (Java applet) http://www.opensourcephysics.org/items/detail.cfm?ID=8228
2. Roller Coaster Physics Animation http://www.youtube.com/watch?v=5yD2tOhI8SU

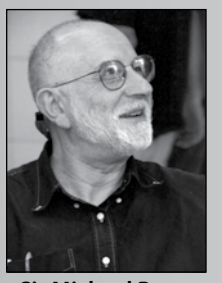
AAPT PHYSICS EDUCATION

Awards Session – Richtmyer Memorial Award

presented to Sir Michael Berry

Location: Grand Ballroom B
Date: Monday, January 6
Time: 9:30–11 a.m.

Presider: Jill Marshall



Sir Michael Berry

Sharon Rosell

How quantum physics democratized music

Michael Berry, H H Wills Physics Laboratory, University of Bristol

Connections between physics and technological invention and aspects of human life that seem far from science are both unexpected and unexpectedly common. And rather than flowing one way—from physics to gadgets—the connections form an intricate web, linking all aspects of human culture, in a way that frustrates our convenient compartmentalizations and coarse interventions aimed at promoting technology transfer. I will discuss this theme not abstractly but with examples, ranging from music to the colour of gold, and explain how quantum physics helps me do quantum physics (sic).

SPS Outstanding Chapter Advisor Award

presented to Sharon Rosell, Central Washington University

10:30 a.m.

Orlando 2014 AAPT The Magic of Physics

Session CA: Physics and Society

Location: Salon 3
Sponsor: Committee on Science Education for the Public
Date: Monday, January 6
Time: 11–11:50 a.m.

Presider: Michael Orleski

CA01: 11-11:10 a.m. WI Make Sustainability: Project-oriented Physics Sustainability Education

Contributed – Duncan L. Carlsmith, University of Wisconsin-Madison, Madison, WI 53706; duncan@hep.wisc.edu

Creating solutions to the sustainability challenges of the future will require integrated teams and a comprehensive approach that address coupled sustainability problems such as water, finance, energy, health, food and community. Addressing these challenges in practice will require an educated workforce that has been trained to consider sustainability broadly. The University of Wisconsin/Madison is embarking on an ambitious plan to integrate and enhance research and education thrusts in sustainability science and practice across all parts of campus. WI Make Sustainability, an interdisciplinary project-oriented class using an open lab Physics Garage (www.physics.wisc.edu/garage), will be described.

CA02: 11:10-11:20 a.m. Teaching Physics Using a Public Policy Framework

Contributed – Jennifer K. Perrella, Cesar Chavez Public Charter Schools for Public Policy, Washington, DC 20019; jennifer.perrella@chavezschools.org*

Incorporating topics of interest to the general public into a physics course can be a daunting challenge. Yet doing so successfully can not only increase understanding of physics concepts as they apply in everyday life, but also can serve as a way to engage students who historically struggle in STEM classes. With the nationwide shift to Common Core standards and a resulting emphasis on literacy and critical thinking in all disciplines, public policy issues act as a structure upon which to build a physics class that incorporates these changes. A variety of performance tasks centered on policy issues such as helmet laws, wind turbine designs, and radio frequency identification can be used to assess student understanding of both the concepts and calculations of a physics course. This approach also aligns with the Next Generation Science Standards.

*Sponsored by Kim Quire

CA03: 11:20-11:30 a.m. Net-Zero Energy Houses Revisited

Contributed – Celia Chung Chow, (CSU) 9 Andrew Drive Weatogue, CT 06089; cchungchow@comcast.net

Carefully considering all natural resources and elements, we can build net-zero energy houses at any location. Canadians did build the net-zero energy houses at their cold locations. We can learn and build them too. Why should we, modern people, waste so much energy in our life-time?

CA04: 11:30-11:40 a.m. Physics of the Desert: Evaporation Gone Wild

Contributed – Eric A. Hagedorn, University of Texas at El Paso, El Paso, TX 79968-0513; ehagedorn@utep.edu

Living in the Chihuahuan Desert (in El Paso, TX) includes daily reminders of the effects of the enhanced evaporation rates of the high desert. Getting out of the pool when it is over 100°F (38°C) and shivering because the water is evaporating so quickly, using water evaporative coolers to cool one's home, plant leaves designed to minimize evaporation; these are all daily experiences that one can use to connect with the general public. Sharing these experiences can then be a segue to the underlying physical principles and an opportunity to discuss water conservation. A hands-on/minds-on activity with desert canteens allows even children to measure the temperature difference between a moistened cloth covered canteen and a dry one (at least 18°C difference). Activities such as these are an effective means of connecting physics educators with local environmental and resource conservation groups, expanding the breadth of our academic department's outreach efforts.

CA05: 11:40-11:50 a.m. Solar Cookers, a Multiple-topic Apparatus for Lifelong Learning

Contributed – Shawn Reeves, EnergyTeachers.org, Ithaca, NY 14850-4811; shawn@energyteachers.org

We will discuss building and using solar cookers during a physics course to explore radiation, temperature, convection, energy, reflection, selective materials and other topics in physics and engineering. Students from 10 up have shown special interest in the physical concepts when couched in a discussion of cooking, something everyone appreciates. Food- and cooking-proof probes help students analyze processes, and misconceptions concerning sunlight and insulation may be addressed.

Session CB: Low Enrollment Teacher Preparation Programs

Location: Salon 6
Sponsor: Committee on Teacher Preparation
Date: Monday, January 6
Time: 11 a.m.–12 p.m.

Presider: Wendy Adams

CB01: 11-11:30 a.m. Developing a Nurturing Environment for Physics/Secondary Education Majors

Invited – Robert C. Bishop, Wheaton College, Wheaton, IL 60187-5593; Robert.Bishop@wheaton.edu

Fostering a community that is supportive of secondary education physics teaching as a valued vocation is essential for giving students the vision and support they need to pursue a secondary education degree path. I will share what our department has been doing to create a welcoming and supportive atmosphere for students to consider teaching high school physics as a first choice rather than as the last choice for what they might do with their physics degree.

CB02: 11:30-12 p.m. Sustaining a Physics Teacher Preparation Program at a Major Research University

Invited – Laurie McNeil, University of North Carolina at Chapel Hill, Chapel Hill, NC 27599-3255; mcneil@physics.unc.edu

Most research-intensive universities do not regard teacher education as being a strong part of their missions, and students who choose to attend them rarely do so with the intention of becoming high school teachers. Further, only a small fraction of students will choose to major in physics. This means that a physics teacher preparation program at a major research university might expect its output to constitute less than a tenth of a percent of the students who receive undergraduate degrees in a given year. For such a program to be sustained, it needs (at least) two things: bigger partners and ancillary missions. I will discuss how at UNC-CH we have formed strong partnerships across the science departments and have embedded our program into the educational life of the College of Arts & Sciences, allowing it to thrive even though we graduate only a small number of (excellent!) physics teachers.

Session CC: Recruiting and Retaining Physics Students II

Location: Salon 7
Sponsor: AAPT
Date: Monday, January 6
Time: 11 a.m.–12 p.m.

Presider: Kathleen Falconer

CC01: 11-11:30 a.m. Increasing Physics Enrollments by Targeting Underrepresented Minorities

Invited – Jesus Pando, DePaul University, Chicago, IL 60614; jpando@depaul.edu

Underrepresented minorities (URM) such as African-Americans, Hispanics, and Native Americans collectively accounted for less then 10% of physics bachelor's degrees in 2010 (NSF data). These groups comprised 32% of the population in 2010 and predictions indicate that this percentage will increase. There appears to be an untapped pool of students among these groups from which to recruit into physics programs. Yet despite repeated efforts over the last 20 years, the percentage of URM students in physics is little changed. This talk will outline some of the reasons why previous efforts have failed by identifying in broad terms, some of the characteristics of URM students that these programs have not addressed. Examples of programs that have addressed some of the unique issues the URM students bring to the table and hence, successfully attracted URM students, will be discussed.

CC02: 11:30–11:40 a.m. Step Up to Physical Science and Engineering at Randolph (SUPER)*

Contributed – Peter A. Sheldon, Randolph College, Lynchburg, VA 24503; psheldon@randolphcollege.edu

With the help of a National Science Foundation S-STEM grant, we have instituted a recruitment and retention plan to increase the number of physical science majors at Randolph College (total 600 students). While the grant provides scholarships to two cohorts of 12 students, our goal is to recruit 24 students each year into the physical sciences, and to retain them at a higher rate than the college as a whole. For three years prior to receiving the grant, we instituted some parts of the program, and we currently have four senior physics majors, nine juniors, and eleven sophomores, compared to our historical average of 2.7 physics majors/year. As well as an active recruitment program, we have a summer transition program, an industry mentor program, enhanced tutoring, a first-year seminar, and many start research early. In this presentation, I will elaborate on these programs, and discuss how we got it done.

*This project is supported by the National Science Foundation under Grant No. DUE-1153997. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

CC03: 11:40-11:50 a.m. Designing a Physics Major at an All-Women's College

Contributed – Jolene L. Johnson, St. Catherine University, St. Paul, MN 55105; jljohnsonarmstrong@stkate.edu

Erick Agrimson, Kaye Smith, St. Catherine University

St. Catherine University is a small women's liberal arts college in the upper Midwest. We have not a physics major in the past for a variety of reasons, but are considering adding a physics major. Our physics program will incorporate some traditional classes taught in innovative ways along with a large number of non-traditional innovative classes that are project based and designed to increase student retention and prepare them for future education or jobs. A few classes we are exploring include a robotics class, a study abroad service learning engineering project and biophysics. In this talk we will outline our proposed major and the research we have conducted to design our major. It is our hope that this major will increase the number of women expressing an interest in majoring in physics and retention of these students.

CC04: 11:50 a.m.-12 p.m. Authentic Research in the Undergraduate Curriculum at Austin College

Contributed – Andra Troncalli, Austin College, Department of Physics, Sherman, TX 75090; atroncalli@austincollege.edu

David Baker, Don Salisbury, Peter Hyland, Austin College

At Austin College, we believe that students learn physics best by doing physics. What better opportunity for our students to do physics and be active participants in their learning than by conducting authentic scientific research? Our physics majors (minors) are required to take two (one) of our "Research Experience in Physics" courses. Students work in small groups on independent research projects under the supervision of a faculty member. Research areas match the faculty members' expertise and interests, which include superconductivity, cosmology, weather, and observational astronomy. We will present recent research investigations and discuss the benefits of these courses both to our current students and to our graduates.

Session CD: Panel – Goals and Assessment Tools for Instructional Labs

Location: Salon 5
Sponsor: Committee on Laboratories
Co-Sponsor: Committee on Research in Physics Education
Date: Monday, January 6
Time: 11 a.m.–12 p.m.

Presider: Mark Masters

This panel will discuss both the goals of instructional labs and how we assess the achievement of those goals. It is critical that we understand that there are a variety of goals in laboratory. However, we need to have mechanisms to assess the success of these goals, whatever they may be. The panel will present their goals and describe assessment methods. The forum will then be opened up to the floor in hopes that a lively debate will ensue, as might be expected anytime someone mentions the four letter word known as "assessment" in polite company.

Session CF: Introductory Courses

Location: Salon 9
Date: Monday, January 6
Time: 11–11:30 a.m.

Presider: Dyan Jones

CF01: 11-11:10 a.m. Student Use of Office Hours: An Exploratory Survey-based Study

Contributed – Kristen M. Burson, Gettysburg College, Gettysburg, PA 17325-1486; kburson@gettysburg.edu

Whitney Griffin, University of Maryland - College Park

Office hours provide an opportunity for student-faculty interaction, one key benchmark of student engagement. Yet this potential goes unrealized if students do not show up, or feel uncomfortable. Here we present and analyze the results from a survey of undergraduate students at a large, public mid-Atlantic research university that captured the factors influencing their attendance of office hours. With our results and analysis, we shed light not only on those factors that

do influence student attendance of office hours, but also those factors that do not, in some cases confirming and in other cases negating commonly held assumptions. Survey results for physical science courses are compared to campus wide results. We conclude that in the current culture surrounding office hours individual instructors have limited agency in influencing student attendance and discuss best practices in light of the survey results.

CF02: 11:10-11:20 a.m. Studio Physics for Life-Science Majors at Boston University

Contributed – Andrew G. Duffy, Boston University, Boston, MA 02215; aduffy@bu.edu

Bennett B. Goldberg, Boston University

After two years of a pilot project, we are now in the first year of a large-scale studio physics implementation in the algebra-based introductory physics class for life-science majors at Boston University. In fall 2013, three of the five sections of the course were taught in a new 81-student studio classroom, using the traditional studio elements of round tables and active-learning with pre-class quizzes, worksheets, interactive clicker questions, directed peer learning, and experiential activities. With 241 students in the studio, and 200 students learning in the more traditional lecture/lab/recitation style, we are able to do a good comparison of the two learning modes. All students did the same pre- and post-tests (FMCE and CLASS), homework, quizzes, and the same midterm tests and final exam. We will report on the outcomes of our study.

CF03: 11:20-11:30 a.m. Textbook Presentations of Weight: Conceptual and Associated Terminological Ambiguities

Contributed – Rex N. Taibu, Western Michigan University, Kalamazoo, MI 49009; rex.taibu@wmich.edu

David W. Rudge, David Schuster, Western Michigan University

The concept of weight is ambiguously defined (e.g., as the Earth's gravitational force on an object or as the force an object exerts on a measuring scale). But while the underlying physical constructs behind these different definitions for weight are well understood, it is unclear how the concept should be introduced to students. Our goal was to document language issues associated with the term "weight" in introductory physics textbooks, and to assess how textbooks deal with the alternative ways the term is used. Relevant passages from a sample of 20 textbooks were subjected to content analysis by two researchers with strong backgrounds in both physics and teaching. Results indicate that language issues were prevalent within and across the textbooks. The relation between the two physical constructs was rarely clearly presented, particularly in non-inertial reference frames such as spaceships or elevators. The study concludes by considering the implications for teaching.

Session CG: PER: Topical Understanding and Attitudes

Location: Salon 4
Sponsor: AAPT
Date: Monday, January 6
Time: 11–11:50 a.m.

Presider: Brian Piper

CG01: 11-11:10 a.m. Classroom Experiences Associated to Students' Disaffection with Physics

Contributed – Geoff Potvin, Florida International University, Clemson University, Clemson, SC 29634; gpotvin@clemson.edu

Zahra Hazari, Florida International University, Clemson University

Allison Godwin, Clemson University

Often, research into physics education is focused on seeking out practices that improve student outcomes—such as improved conceptual gains, motivation, etc.—in comparison to the status quo of traditional/unreformed practices. Recently, we have instead validated a construct of student "disaffection" to identify practices that are significantly associated to this undesirable, negative student attitude. Using regression analysis on nationally representative college student data, we identify high school physics experiences that are associated to student disaffection including, importantly, having a teacher who relies more regularly on lecturing. There are gender interactions as well, such that women's disaffection is strongly related to their evaluations of their high school physics teachers (lower evaluations are associated to higher disaffection), whereas men show no such relationship.

CG02: 11:10-11:20 a.m. Physics Identity Recognition: Coherence Between Teachers' and Students' Perceptions*

Contributed – Zahra Hazari, Florida International University, Miami, FL 33199; zahra@clemson.edu

Cheryl AP Cass, North Carolina State University

Carrie Beattie

Robynne M. Lock, Clemson University

Prior research has emphasized the importance of recognition to physics identity development. In this study, we examine the coherence between students' perceptions of their physics teacher recognizing them and the beliefs of physics teachers with regards to students. We draw on data from four case studies of physics teachers and their classes. Our quantitative analysis revealed that one of the teachers, Dr. D, had a different coherence pattern. His students also perceived greater recognition and identified more as being a "physics person" than the students of the other teachers. Focusing in on a student with the lowest coherence, Kristina, we examine the ways in which Dr. D's actions served to help her feel recognized -- actions that superseded his beliefs about her. Our results indicate that despite his beliefs (about her and his other students on average), his actions facilitated students seeing themselves in positive ways with respect to physics.

*This work was supported by NSF grant 0952460.

CG03: 11:20-11:30 a.m. Understanding the Relationship Between Physics Identity and Interdisciplinarity

Contributed – Tyler D. Scott, Clemson University, Department of Engineering and Science Education, Clemson, SC 29634; tdscott@clemson.edu

Zahra Hazari, Geoff Potvin, Clemson University

Much recent work in physics education research has focused on identity. Since physics identity is related to physics career choice and persistence, it is valuable to understand what helps students develop a physics identity and what other attitudes are related to physics identity. Recent work suggests characteristics of interdisciplinary thinking are related to having a higher physics identity. However, the nature of this connection is still unexplained. This qualitative study examines students' interdisciplinary actions and beliefs, particularly with respect to their physics classes, as well as their physics identity. Through analysis of interviews and classroom observations, we seek to explain how these actions and beliefs may be related to students' physics identity, i.e. the possible mechanisms by which one may influence the other and how such mechanisms are activated.

CG04: 11:30-11:40 a.m. Investigating Physics and Engineering Students' Understanding of op-amp Circuits*

Contributed – MacKenzie R. Stetzer, University of Maine, Orono, ME 04469-5709; mackenzie.stetzer@maine.edu

Kevin L. Van De Bogart, Christos P. Papanikolaou, University of Athens

As part of a new effort at the University of Maine to investigate the learning and teaching of concepts in thermodynamics and electronics that are integral to both undergraduate physics and engineering programs, we have been examining student learning in electrical engineering and physics courses on electric circuits and electronics. A major goal of this work at the physics-engineering interface is to probe the extent to which the nature of student understanding

(including the prevalence of specific difficulties) depends upon the disciplinary context. In this talk, I will focus on our efforts to probe student understanding of basic operational-amplifier circuits using free-response questions. Preliminary results from questions administered in both physics and engineering courses will be presented.
*This work has been supported in part by the National Science Foundation under Grant Nos. DUE-1323426, DUE-1022449, and DUE-0962805.

CG05: 11:40-11:50 a.m. Probing College Student Ideas about Buoyancy and Pressure

Contributed – DJ Wagner Grove City College, Grove City, PA 16127; djwagner@gcc.edu

Ashley Lindow, Elizabeth Carbone, Anna Olson, Grove City College

Numerous studies have identified student conceptions about buoyancy, but most of those studies involved children younger than 15 years old. As part of developing a standardized static fluids assessment, our research group is seeking to identify which of those conceptions persist into late high school and college. This fall, we used a Likert-style approach to our assessment, asking students to agree or disagree with individual statements (rather than choose from multiple options for a single physical situation). We also videotaped volunteers taking this assessment. This talk will report on some of our preliminary findings.

Session CH: Upper Division and Graduate Topics

Location: Salon 10
Sponsor: AAPT
Date: Monday, January 6
Time: 11–11:40 a.m.

Presider: TBD

CH01: 11-11:10 a.m. Applying the Correspondence Principle to the Three-Dimensional Rigid Rotor

Contributed – David Keeports, Mills College, Oakland, CA 94613; dave@mills.edu

According to the quantum mechanical correspondence principle, a quantum system can pass well as a classical system if the system's quantum numbers are very large. Application of the correspondence principle to some basic problems in quantum mechanics including the particle in a one-dimensional infinite well, the linear harmonic oscillator, and the two-dimensional rigid rotor is quite straightforward. However, the three-dimensional rigid rotor provides a greater challenge due to the complexity of the spherical harmonic functions that describe the rotor's angular orientation. I will explain why the seemingly classical rotation of a large rigid rotor in the xy-plane implies that quantum numbers J and MJ are equal and very large. Furthermore, I will demonstrate that the values of these quantum numbers imply a very simple spherical harmonic function that is consistent with the rotor's apparently classical behavior.

CH02: 11:10-11:20 a.m. SpaceTime: A Software Tool for Teaching Special Relativity

Contributed – Randy W. Wolfmeyer, John Wood Community College, IL 62305; rwolfmeyer@jwcc.edu

Melissa A. Vigil, Marquette University

Spacetime diagrams provide a powerful tool to aid in the conceptual understanding of special relativity. The SpaceTime applet is designed to aid students in understanding how to create spacetime diagrams, set up diagrams for specific problems, and make accurate measurements from their diagrams. A lab activity is also developed for use with the applet in adding spacetime diagrams to an introductory physics program. http://www.uwplatt.edu/~evensenh/SpaceTimeLab/SpaceTime/SpaceTime.html

CH03: 11:20-11:30 a.m. Teaching Undergraduates Space and Plasma Physics: Make It Fly!

Contributed – Dimitris Vassiliadis, West Virginia University - Physics and Astronomy, Morgantown, WV 26506-6315; dimitris.vassiliadis@mail.wvu.edu

We summarize an effort to develop a teaching unit on experimental space and plasma physics at the undergraduate level at the WVU Department of Physics in the last four years. We have focused on these topics due to their inherent popularity with students and due to the strengths of the research arm of the department. A small number of faculty and students participated in an introductory workshop in summer 2009 at NASA/Wallops Flight Facility, and a special topics course was developed in the fall. Since then a team of physics and engineering students has participated in the annual launch of a two-stage rocket from Wallops into the ionosphere and they have created a number of fluid, plasma, magnetism, and mechanics experiments. I discuss the course development, strengths and weaknesses of the approach, the student response to the project, the impact on their studies and post-graduation paths, and the experiments flown.

CH04: 11:30-11:40 a.m. The IMAAS Plots: Helping Students to Understand Logarithmic Quantities

Contributed – Saami J. Shaibani, Instruction Methods, Academics & Advanced Scholarship (IMAAS), PO Box 12255, Lynchburg, VA 24506; shaibani@imaas.org

The everyday world is filled with phenomena whose values are represented by logarithms. Familiar examples include the Richter scale and the decibel unit, with entropy and other measures occurring at a more advanced level. Many students struggle when they first encounter logarithms in the mathematics classroom, even before they encounter it in the scientific realm. As a teacher certified in physics, mathematics and chemistry, with postgraduate status in the license, this author has a particularly suitable multidisciplinary background to combine aspects from all of these fields. The result of such a skill set is the creation of a novel device that promotes understanding of logarithmic quantities. A key feature of the device is its graphical nature, and the principles involved in various example plots here are readily applicable to other subjects. Students report an enhanced level of learning gained from employing the plots, and teachers have also made favorable comments.

Session TD03: Graduate Student Topical Discussion

Location: TBD
Sponsor: Committee on Research in Physics Education
Co-Sponsor: Committee on Graduate Education in Physics
Date: Monday, January 6
Time: TBD (email organizer for details at abigail.daane@gmail.com)

Presider: Ben Van Dusen

Come meet with fellow doctoral students to discuss topical issues.

2014 Winter Meeting Plenary

Location: Grand Ballroom B
Date: Monday, January 6
Time: 2–3 p.m.

Presider: Mary Mogge

Philip Metzger

Preparing physicists for the industrial revolution of space

by *Philip Metzger,* NASA's Kennedy Space Center

Advances in robotics during the coming decades will revolutionize the human experience in many ways. I believe this will include explosive economic growth through space mining and industry, producing at least a thousand-fold increase in economic productivity per capita. The result will begin to approach what the Russian physicist Nikolai Kardashev has called a Type II civilization, one that has gone far beyond a single planet but is still centered on a single star. Physicists are already playing a central role in this nascent revolution and will continue to do so as it progresses. This economic expansion in the solar system should also provide unprecedented opportunities for doing physics on a grand scale. Teaching physics is therefore more important than ever.

Session DA: Panel – What Can MOOCs Do for Us?

Location: Salon 5
Sponsor: Committee on Educational Technologies
Co-Sponsor: Committee on Research in Physics Education
Date: Monday, January 6
Time: 3:30–5:30 p.m.

Presider: Danny Caballero

Massively open online courses (MOOCs) are quickly becoming a standard offering by many colleges and universities seeking to expand their brand and reach more potential students. But, what can MOOCs do for us—physics educators? In this panel, several MOOC authors will share their experiences with their own courses and discuss how they think MOOCs as well as other open online resources fit with our educational goals. That is, what can we learn from MOOCs to help us in our own teaching?

Invited panelists:

Louis Bloomfield *(Virginia, How Things Work)*
George Djorgovski *(Caltech, Galaxies and Cosmology)*
Terry Matilsky *(Rutgers, Analyzing the Universe)*
Daniel Seaton *(MITx, 8.MReV)*
John Stewart *(Arkansas)*

Session DB: Innovations in Research and Teaching Astronomy

Location: Salon 3
Sponsor: Committee on Space Science and Astronomy
Date: Monday, January 6
Time: 3:30–5:20 p.m.

Presider: Julia Olsen

DB01: 3:30-4 p.m. State of the Art Astronomy: An Experiment in Online Learning

Invited – Matthew Wenger, Steward Observatory, University of Arizona, Tucson, AZ 85721; mwenger@email.arizona.edu

Chris Impey, Steward Observatory, University of Arizona

Astronomy: State of the Art is a seven-week online astronomy course initially offered during spring semester 2011. This course was the first astronomy class offered through Udemy, an online learning platform. The target audience of Astronomy: State of the Art includes high school science teachers, college astronomy instructors, science center and planetarium educators, amateur astronomers, and members of the public. Over 5000 students are enrolled and it continues to grow weekly. This presentation will detail how the course is structured, how we use social media and live discussions to interact with students, and plans for a second version of the course that will be conducted concurrently with an on-campus "flipped" course for registered undergraduate students.

DB02: 4-4:30 p.m. A New Model of Misconceptions for Learning Challenges in Cognition*

Invited – Stephanie J. Slater, CAPER Ctr. for Physics & Astronomy Education Research, Laramie, WY 82070; stephanie@caperteam.com

Despite the substantial body of "misconceptions" literature, the development of an actionable theory of conceptual change to mitigate misconceptions continues to be less than satisfying. We offer a new, action-oriented cognitive model that allows us to operate on students' learning difficulties in a more fruitful manner. Instead of binning erroneous student thinking into a single construct, which leads to prescribing only a single instructional strategy, this new model sug-

gests that "misconceptions" are a mixture of at least four learning barriers: incorrect factual information, inappropriately applied mental algorithms (phenomenological primitives), insufficient cognitive structures (e.g. spatial reasoning), and affective/emotional difficulties. Each of these types of barriers should be addressed with an appropriately designed instructional strategy.

*Further details and resulting curriculum materials freely available at http://www.caperteam.com.; S.J.Slater sponsored by T.F. Slater

DB03: 4:30-5 p.m. Leveraging Cognitive Science Research to Create Better ASTRO101 Teaching Materials*

Invited – Timothy F. Slater, University of Wyoming, Laramie, WY 82071; tslater@uwyo.edu

In the course of learning astronomy, our goal for students is an enhanced understanding of the nature of scientific inquiry as well as deeper and more flexible conceptual understanding. However, a robust literature argues that students do not readily develop those complex understandings without purposefully targeted instruction. In response, scholars with the CAPER Center for Astronomy & Physics Education Research are creating and field-testing a series of learning experiences that leverage recent results in cognitive science and the learning sciences. One strategy is to provide instructors with in-class, learning activities extending and reinvigorating lecture-tutorial style approaches. A second is to provide computer-mediated, inquiry learning experiences based upon an inquiry-oriented teaching approach framed by the notions of backwards faded-scaffolding as an overarching theme. Early results strongly suggest that these two approaches enhance student learning as measured by the Views on Scientific Inquiry (VOSI) and the Test of Astronomy STandards (TOAST).

*Classroom-ready samples of referenced curriculum materials freely available at http://www.caperteam.com

DB04: 5-5:10 p.m. Engaging General Education Astronomy Students with Internet-based Robotic Telescopes

Contributed – Kimberly Coble, Chicago State University, Chicago, IL 60628-1598; kcoble@csu.edu

Katie Berryhill, Timothy F. Slater, University of Wyoming

Kevin M. McLin, Lynn R. Cominsky, Sonoma State University

At Chicago State University we have implemented an observational project in our general education astronomy class using the Global Telescope Network (GTN), which is controlled using Skynet. We wanted to expose students to realistic practices used by professional astronomers, including proposal writing and peer review. The project consisted of the use of planetarium software to determine object visibility, observing proposals (with abstract, background, goals, and dissemination sections), peer review (including written reviews and panel discussion according to NSF intellectual merit and broader impacts criteria), and classroom presentations showing the results of the observation. GTN is a network of small telescopes funded by the Fermi mission and managed by the NASA E/PO Group at Sonoma State University.*

*This work was supported by CCLI Grant #0632563 and IL Space Grant.

Also see our associated presentation on Evaluating the Use of Internet-Based Robotic Telescopes for General Education by Berryhill et al.

DB05: 5:10-5:20 p.m. Evaluating the Use of Internet-based Robotic Telescopes for General Education

Contributed – Katie J. Berryhill, American Public University System and University of Wyoming, 763 Primrose Lane, Benicia, CA 94510-3820; profberryhill@gmail.com

Kim Coble, Chicago State University

Timothy F. Slater, University of Wyoming

Kevin M. McLin, Lynn R. Cominsky Sonoma State University

Responding to national science education reform documents calling for students to have more opportunities for authentic research experiences, several national projects have developed online telescope networks to provide students with Internet-access to research grade telescopes. Internet-based robotic telescopes allow scientists and STEM educators to conduct observing sessions on research-grade telescopes remotely. This project examines the educational value of using Internet-based robotic telescopes in general education astronomy courses. Students at several institutions conducted observational programs using telescopes that are part of Skynet. Using a grounded theory approach, we examined what the students did or did not gain from the project, including students' understanding of the process of science. Analysis suggests that students value using research-grade instrumentation and develop deeper understandings of the nature of scientific research when formulating proposals for telescope use.[1]

1. Also see our associated presentation on Engaging General Education Astronomy Students with Internet-Based Robotic Telescopes by Coble et al.

Session DC: Panel – Report on the Graduate Education in Physics Conference

Location: Salon 11
Sponsor: Committee on Graduate Education in Physics
Date: Monday, January 6
Time: 3:30–5:30 p.m.

Presider: Juan Burciaga

DC01: 3:30-5:30 p.m. Highlights From the 2nd Conference on Graduate Education in Physics

Panel – Renee D. Diehl, Penn State University, University Park, PA 16802; rdiehl@psu.edu

The Second Conference on Graduate Education in Physics was held in January 2013 with more than 100 participants from 74 different institutions. The conference aimed at fostering innovation and creativity in our approach to graduate education in physics, which for many departments is a rather new concept. However, the fact that the majority of physics PhDs ultimately find permanent employment outside academia, and the changing demands on academic physicists, have led many departments to review their programs and procedures. Presentations and discussions at the conference included the increasing attention being paid to broader and more flexible graduate curricula, forming industrial partnerships, strategies to increase diversity, professional skills training for graduate students and postdocs, improving mentoring practices and instituting family-friendly policies for graduate students. The participants in this conference included diverse group faculty from large and small departments, staff from industry and national labs, and graduate students and postdocs.

DC02: 3:30-5:30 p.m. Preparing Graduate Students for Non-Academic Careers

Panel – Lawrence Woolf, General Atomics Aeronautical Systems, Inc., 6995 Flanders Dr., San Diego, CA 92121; Lawrence.Woolf@ga-asi.com*

One of the primary topics discussed at the conference concerned career development, since most graduate students will not have the academic careers of their advisors. Goals included reviewing the primary functions of physicists in industry, evaluating how students are currently prepared for these careers, and identifying how to fill gaps in preparation. A number of nonacademic physicists provided insight into meeting these goals. Most physics graduate programs in general do not purposely prepare students for a nonacademic career. Strategies for overcoming this shortcoming include advising students about these careers and providing training on broadly valued professional skills such as written and verbal communication, time and project management, leadership, working in teams, innovation, and proposal writing. Academic training should be expanded to include engineering and cross disciplinary problem solving and product development, developing prototype products and increasing their technological readiness, and working with software and toolsets common in industry.

*Sponsored by Juan Burciaga

DC03: 3:30-5:30 p.m. Using Minimum Acceptable GRE Scores for Graduate Admissions Suppresses Diversity in STEM

Panel – Casey Miller, University of South Florida, Physics, Tampa, FL 33620-5700; millercw@usf.edu

I will present data showing that significant performance disparities on the GRE general test exist based on the test taker's race and gender.[1] Because of the belief that high GRE scores qualify one for graduate studies, the diversity issues faced by STEM fields may originate, at least in part, in misuse of the GRE scores by graduate admissions committees. I will quantitatively demonstrate this by showing that the combination of a hard cut-off and the different score distributions leads to the systematic underrepresentation of certain groups. I will present data from USF's PhD program that shows a lack of correlation between GRE scores and research ability; similar null results are emerging from numerous other programs. I will then discuss how assessing non-cognitive competencies in the selection process may lead to a more enlightened search for the next generation of scientists.

1. C. W. Miller, "Admissions Criteria and Diversity in Graduate School", *APS News* **22**, Issue 2, The Back Page (2013) http://www.aps.org/publications/apsnews/201302/backpage.cfm Supported in part by the NSF.

DC04: 3:30-5:30 p.m. Graduate Education in Physics: Problem Solving, Curriculum, and Approaches to Problem Solving

Panel – Andrew Mason, University of Central Arkansas, Lewis Science Center, Conway, AR 72035-0001; ajmason@uca.edu

Physics problem solving for graduate-level students was first analyzed in a study by Chi et al. (1981), in which graduate students were expert-like problem solvers in categorizing introductory level physics problems. This hallmark study is revisited in light of graduate students' concerns with regard to further development of problem solving skills. Data collected with regard to attitudes and approaches toward problem solving is used to explore graduate students' own concerns and areas of growth towards an expert-like approach to problem solving. An investigation into the role of graduate-level core courses at the University of Pittsburgh was also conducted; topics explored include the advanced role of quantitative mathematical approaches in more rigorous material, the use of conceptual understanding within the core course material, and the degree of congruence of success in core courses with future success as researchers.

Session DD: Mentoring High School Teachers

Location: Salon 6
Sponsor: Committee on Diversity in Physics
Co-Sponsor: Committee on Physics in High Schools
Date: Monday, January 6
Time: 3:30–5:10 p.m.

Presider: Geraldine Cochran

DD01: 3:30-4 p.m. Mentoring HS Teachers – How did I get here?

Invited – David Jones, Florida International University, Miami, FL 33199; djones@fiu.edu

This is a talk on the details of mentoring HS physics teachers. I have evolved from a "Mr. Physics" teacher role into a slightly different role that involves mentoring high school teachers on many different parts of the "mentoring spectrum." My current professional role as the TIR at FIU has allowed me to actively participate in the mentoring of teachers through my interactions with HS teachers in our local physics teaching community. Mentoring other people who love and enjoy physics teaching has given me a burst of energy and enthusiasm toward teaching at a time in my career when energy and enthusiasm can be in short supply! I hope to highlight some of the different types of mentoring roles that veteran teachers may find themselves in at certain points in their teaching career...you never know when your career path may veer into the mentoring role!

DD02: 4-4:30 p.m. Mentoring Teachers Through Conversations

Invited – Ximena Cid, University of Washington, Department of Physics, Seattle, WA 98195-1560; xcid@uw.edu

The Physics Education Group (PEG) at the University of Washington (UW) offers courses that directly impact teachers. One sequence of courses is focused on the preparation of pre-service K-12 teachers held during the academic-year and the other sequence of courses provides professional development for in-service K-12 teachers during the Summer Institute. In-service teachers who have participated in the Summer Institute, and who live within commuting distance of UW, also attend the academic-year Continuation Course. During the Continuation Course, teachers have the opportunity to collaborate with other teachers or with instructors from PEG as they continue to adapt their teaching practices. In addition, pre-service teachers are invited once a year to attend the Continuation Course in order to interact with current K-12 teachers. This talk will focus on the discussions that take place during the Continuation Course and how mentoring develops organically through teacher-teacher interactions as well as through teacher-instructor interactions.

DD03: 4:30-5 p.m. Mentoring Pre-service Teachers as Part of the Teaching Immersion Institute (TII)

Invited – Kara Weisenburger, Chicago State University and Chicago High School for the Arts, 3847 N Kenmore Ave., Chicago, IL 60613; karaweisen@gmail.com

Mentoring programs for teachers are traditionally implemented in high schools to increase the retention and promote effective teaching practices of a novice teacher. Chicago High School for the Arts, Gary Comer High School, and Chicago State University are collaborating on a project that introduces mentoring early to pre-service teachers as part of our Teaching Immersion Institute (TII). In this talk I will discuss the informal process of mentoring pre-service teachers through the TII course and describe how it fosters the relationship between pre-service and in-service high school teachers in a semester-long action research project. In addition, I will highlight resources and discuss the importance of including diverse mentoring experiences in a teacher preparation program.

*supported by the American Physical Society PhysTEC Program.

DD04: 5-5:10 p.m. High School Electronics Course with College Faculty Collaboration

Contributed – Andrew F. Rex, University of Puget Sound, Department of Physics, Tacoma, WA 98416; rex@ups.edu

Johnny Devine Science and Math Institute

The APS Physics and Instructional Resources (PAIR) program supports teams of college and high school faculty members working together to improve physics education in the high schools. Supported by a PAIR grant, we designed and taught a project-based high school course in electronics, first during an intensive January term and then in the spring semester. We will discuss how our collaboration was supported by the PAIR program and will present test results from these first classes.

Session DE: Physics for the Life and Health Sciences

Location: Salon 7
Sponsor: Committee on Physics in Undergraduate Education
Date: Monday, January 6
Time: 3:30–5:30 p.m.

Presider: Nancy Beverly

DE01: 3:30-4 p.m. The Challenges and Rewards of Teaching Physics for Biology and Medicine

Invited – Jack Tuszynski, University of Alberta, Department of Physics, Edmonton, AB T6G 2J1 Canada; jackt@ualberta.ca

I made a transition from condensed matter physics to biophysics following my sabbatical year in Europe in 1993/4. Since that time I made efforts to build a research program in biophysics and in computational biology. My efforts to teach physics for biology and medicine resulted in a textbook but the experience of teaching this course was less than satisfying. Subsequently, I published graduate-level textbooks in biophysics and taught biophysics to a class of physicists and various blocks and invited classes in various departments including Oncology and biochemistry. I also mentored medical students in the Discovery Learning blocks covering almost all areas of medicine and tried to introduce physical thinking whenever possible. I will describe this experience and my conclusions about where the greatest challenges and potential rewards lie in trying to educate life sciences students in quantitative subjects such as physics and biophysics.

DE02: 4-4:30 p.m. Adventures in Bioelectricity

Invited – Francis X. Hart, The University of the South, Sewanee, TN 37383-1000 fhart@sewanee.edu

All objects have material properties, such as conductivity and permittivity. All objects also respond in some way to applied electric fields. Living systems are no different in these respects from any other material system. I will present three examples of bioelectric processes and their applications. The first two examples concern responses to applied electric fields. Galvanotaxis is the movement of cells under the application of a weak dc field. It presents a simple experimental system to investigate how cells detect the presence of an applied field. Electroporation is a clinical technique in which very strong electric fields are applied for very short times to cancerous tissue shortly after the administration of a cancer drug. The strong fields open pores in the cell membranes so that the drugs enter the cells more readily. The third example involves measuring the increase with time of skin's inter-electrode capacitance to determine its viscoelastic properties.

DE03: 4:30-5 p.m. The X-Laboratory: A Freshman Laboratory Integrating Biology, Chemistry, and Physics

Invited – David Julian, University of Florida, Gainesville, FL 32611-8525; djulian@ufl.edu*

Gabriela Waschewsky, University of Florida

The Cross-Disciplinary Laboratory (X-Lab), part of the UF-HHMI Science for Life Program, has three main goals: increase STEM retention by helping students develop a synthetic, cross-disciplinary approach to understanding the natural sciences; engage students in inquiry-based experiments that model modern, authentic research; and train students in the key theoretical and practical skills necessary to participate meaningfully in modern biomedical research as undergraduates. The two-semester, six-credit course is targeted to STEM undergraduates as an alternative to traditional laboratory courses in general biology, general chemistry and physics. All laboratory activities and experiments merge key concepts from at least two of the traditional disciplines while emphasizing critical thinking, formulating and testing hypotheses, quantitative and analytical reasoning, and communicating results. The courses meet the traditional laboratory course requirements for all UF undergraduate STEM majors and the Schools of Medicine, Dentistry and Veterinary Medicine. More information, including learning outcomes and skills, is at x-laboratory.org.
*Sponsored by Nancy Beverly

DE04: 5-5:10 p.m. A Virtual Optics Lab for Pre-health Students Using Interactive Screen Captures

Contributed – Ralf Widenhorn, Portland State University SRTC, Portland, OR 97201; ralfw@pdx.edu

Elliot Mylott Portland State University

Heike Theyßen, Sarah Struzyna, Universität Duisburg-Essen

We present a lab exercise based on interactive screen experiments (ISEs) teaching geometrical optics and the functioning of the human eye. The ISEs use a large number of screen captures of an actual lab experiment and allows students to manipulate the experimental setup online using a computer. The online lab was given to students at University of Duisburg-Essen, Heinrich-Heine-University of Duesseldorf, Germany, and at Portland State University (PSU) in the U.S. The participants at the Germany universities took an introductory physics course as medical students, while the students at PSU were pre-health majors. We will present pre- and post-test data as well as demographic data and assessment of student attitudes toward the learning environment. We found significant learning gains and a positive response by students in Germany and the U.S. even though the educational systems and background differ significantly. The lab can be used instead of an in-class lab or as a supplement or homework assignment for pre-health students taking an introductory physics course.

DE05: 5:10-5:20 p.m. Student Inquiry in Life Science Homework Problem Solving

Contributed – Nancy Beverly, Mercy College, Dobbs Ferry, NY 10522; nbeverly@mercy.edu

Inquiry-based, real world homework problems for a first semester algebra-based physics course for life/health science students were formulated and answered by the students themselves. The standard end-of-chapter word problems typically give all the values of the unknowns and students often see this as having to determine what equation to use to plug the values into. But students will not use this kind of problem solving outside of physics class. An alternative is presented where students considered or created scenarios in which they raised their own questions of interest about a measurable quantity within the confines of a topic, determined a strategy for finding an answer, determined what information was needed for this strategy, found the needed information either by measurement, estimation or from the web and then calculated an answer to their question.

DE06: 5:20-5:30 p.m. The Surprising Statistics of Birth Control: Thermodynamics for Health Science

Contributed – Michael Daugherity, Abilene Christian University, Abilene, TX 7969;9 mike.daugherity@acu.edu

Health Science students often see physics at best as an obstacle to overcome, and at worst as a waste of their time. However, by making physics interesting and relevant it is possible to motivate these students to cultivate a curiosity about the world which can last a lifetime. My algebra-based physics courses for pre-health majors have often struggled in the thermodynamics and statistical mechanics units. This talk will focus on two specific approaches that I have found to be effective. First, probability lies at the heart of thermodynamics and statistical mechanics, but it is difficult to address the many common misconceptions such as the classic Gambler's Fallacy. A simple exercise in calculating probabilities associated with contraception provides a surprising illustration for students. Second, investing in discussing philosophical ideas such as the arrow of time helps to spark student interest.

Session DF: International Models of Physics Teacher Preparation

Location: Salon 8
Sponsor: Committee on International Physics Education
Co-Sponsor: Committee on Teacher Preparation
Date: Monday, January 6
Time: 3:30–5:30 p.m.

Presider: Dan MacIsaac

DF01: 3:30-4 p.m. The Undergraduate-graduate Integrated Cultivation Mechanism of Government-supported Teacher-Students Majored in Physics: Taking ECNU as an Example

Invited – Sudong Pan, Physics Department, East China Normal University, Shanghai, P.R. China Shanghai; sdpan@phy.ecnu.edu.cn

In order to attract more high-quality students to apply for normal universities, six national normal universities have enrolled tuition-free normal school students since 2007, and the students were mainly from Central and Western China. After getting their bachelor degree, teacher-students came back to their hometown as high school physics teachers, then after a year, they returned to the original university to peruse the education master degree part-time. In ECNU, teacher-students majoring in physics were cultivated based on the concept of integration between pre-service and in-service, their curriculum plan, cultivation methods and research skills training linked closely between undergraduate and graduate, expecting this could effectively cultivate a group of outstanding middle school physics teachers. This lecture will cover the following topics: 1. A brief introduction of Chinese tuition-free teacher-students; 2. The stage of undergraduate; 3. The stage of graduate; 4. The characteristics of this cultivation mechanism.

DF02A: 4-4:30 p.m. Standards and Practice of Teacher Preparation in Germany and USA

Invited – André Bresges, Institute of physics and physics education, University of Cologne, 50931 Germany; andre.bresges@uni-koeln.de

Nina Glutsch, Institute of physics and physics education

A central advantage of education in Math, Science and Technology is that the core science and its essential rules and models stay the same when educators and students travel from one country to another. This predestines STEM Education for both exchange programmes for teacher training students, and cross-cultural studies in language and the social sciences. Currently, we want to design a U.S.-German exchange programme for STEM teacher preparation courses that implements a network of universities and their cooperating schools. Goals are to make STEM education a more attractive field of work, balance the supply and demand of qualified STEM teachers, and foster international research in the PER community. Students and teachers should be encouraged to study or work in the field of STEM education in both countries, thus opening paths to international careers in STEM teaching. The Keynote therefore compares National Science Education Standards of both countries.

DF02B: 4-4:30 p.m. Models and Perspectives of International Student Exchanges in Teacher Education

Invited – Nina Glutsch, Center for Teacher Education/ University of Cologne, Immermannstraße 49, Cologne, 50931 Germany; nina.glutsch@uni-koeln.de

André Bresges, Myrle Dziak-Mahler, Christiane M. Bongartz, University of Cologne

In Europe, e.g. Germany, teacher education has changed in the past years. By adapting the international Bachelor/Master degrees, the approach to a more practice-orientated teacher education has been focused on. Also, a more internationalized teacher education is emphasized. As it is necessary for students—our future teachers—to deal creatively with diversity in schools and work with bi- or multilingual children, gaining the experience of living in another country and working in a foreign school system is highly supported by the University of Cologne. Successful concepts of other countries are seen to be a motivating factor for students in order to implement new and innovative ideas back home. However, teachers in general are still more "local activists" than "global players" (Jaritz 2011). Therefore, the University of Cologne is about to develop different exchange programs with schools all over the world, e.g. the U.S., South Africa, Uganda, Europe, and Finland.

DF03: 4:30-5 p.m. Integrating Studies in Physics, Education and Teacher Preparation in Germany

Invited – Stefan Hoffmann, Institute of Physics and Physics Education, University of Cologne, 50931 Germany; stefan.hoffmann@uni-koeln.de

At the University of Cologne, seminar structures in the educational sciences embed students' practical experiences during internships in schools and support the reflection of the students' views of their own role as teachers, what qualities they think a "good teacher" must possess, and what they believe to be a successful education. More and more, teacher education focuses not only on performance but also on appreciation of individual accomplishments according to one's individual abilities and efforts. This talk focuses on examples of integrated science and education studies for teacher preparation at the University of Cologne, home of the largest teacher education institution in Germany (>10.000 educational science students). Highlights are the use of e-portfolio techniques, simulated physics lessons, learning-by-teaching, digital media usage and small "design-based research" projects for school internships. That way, students are able to combine their theoretical knowledge with practical experience.

DF04: 5-5:30 p.m. Comparing Finland to Germany: Lessons Learned in Teacher Preparation

Invited – Meike Kricke, Center for Teacher Education, University of Cologne, 50931 Germany; mkricke@uni-koeln.de

Since the "PISA Shock" after 2001, educational research in Europe has recognized new emphasis on the success of the Finnish educational system: Finland is "seen as a major international leader in education" (OECD 2010, 118). The approach of integrating core sciences and education curricula in the one-phase teacher preparation studies, was identified as a key factor of success, as well as the intense use of dialogical reflection tools, like portfolio techniques in school and in teacher preparation. The focus is directed toward pupils at schools and students at universities. As is highlighted in this talk, adapting the key factors from the Finnish into the central European educational systems is not an easy task. One example of the University of Cologne is presented. It shows how Finnish key factors and educational ideas can be integrated into teacher education: "International teacher education laboratory—Developing inclusive values and ideas through e-portfolios."

Session DG: Responsive Teaching in Science

Location: Salon 9
Sponsor: Committee on Research in Physics Education
Date: Monday, January 6
Time: 3:30–5:30 p.m.

Presider: Amy Robertson

DG01: 3:30-4 p.m. Responsive Teaching: A Practitioner's View

Invited – Sharon G. Fargason, Fay Elementary School, San Diego, CA 92105; sharonfargason@gmail.com*

Responsive teaching offers students the opportunity to learn science in the spirit of the discipline itself. Students work together to explain,

question, model, test, and evaluate their own ideas, rather than follow a prescribed set of directions or recipes for experiments. The curriculum evolves on the basis of the ideas that students bring up, and the role of the teacher is to recognize, draw out, and build on the nascent scientific ideas that students offer. Data from my third grade classroom will highlight what responsive teaching is, how teacher pedagogy and planning are affected, and the ways that students develop skills and routines that are critical to the discipline of science.
*Sponsored by Amy Robertson

DG02: 4-4:30 p.m. The Content Outcomes of Responsive Teaching in Physics

Invited – Leslie J. Atkins, California State University, Chico, 400 W 1st St., Chico, CA 95926; ljatkins@csuchico.edu

"Responsive teaching" has been described as an instructional approach that can bridge the epistemological and content goals of physics teaching. That bridge, however, is never straightforward. For while there are regularities in student ideas and classroom dynamics, a consequence—even a hallmark—of responsive teaching is the idiosyncratic nature of student inquiries. Such variation is apparent in my own classes, in both the routes taken and the "destinations" that are reached. And even as I intend to cover similar sets of topics from one class to the next, I find that the final products of those inquiries vary from year to year, and the nature of these products can be difficult to compare to one other and even to the canon. In this talk, I discuss the content outcomes of a responsively taught inquiry course, highlighting both the significant physics that students learn, and the challenges that their ideas pose.

DG03: 4:30-5:00 p.m. Learning to Teach Responsively: Implications and Challenges for Teacher Education

Invited – Janet Coffey, Gordon & Betty Moore Foundation, 1661 Page Mill Road, Palo Alto, CA 94304; janet.coffey@moore.org

In this talk I'll consider responsive teaching from the perspective of teacher education—"what does it mean for how we think about work with prospective teachers?" Drawing on data from a one-year master's teacher certification program, I examine some of the more significant factors at play as prospective teachers learn to listen and respond to the substance of student ideas in science. Data suggests that learning to teach responsively has disciplinary grounding, which raises implications for science coursework for prospective teachers.

DG04: 5-5:30 p.m. Trying for Responsiveness in Lecture

Invited – David Hammer, Tufts University, Paige Hall, Medford, MA 02155-5555; david.hammer@tufts.edu

The notion we are considering in this session, "responsive teaching," is of attending to, making sense of, and working with the substance of student thinking. Much of the point is epistemological: When student questions become the focus of conversation, students can see that their understandings and experiences are central to what is taking place. But it seems like a notion of teaching that's only for small classes. My purpose here is to consider possibilities in lecture, using one or two video examples from my attempts. I'll talk, mostly as a practitioner, about attending to student thinking in that context, how there is evidence for individuals and for the "class as a whole" in clicker tallies and in student statements, certainly, but also in affective displays, something like "the feeling of the room." Of course, interpreting the evidence is challenging, especially for on-the-fly decisions.

Session DH: Using History to Teach Astronomy and Physics

Location: Salon 10
Sponsor: Committee on History and Philosophy in Physics
Date: Monday, January 6
Time: 3:30–5:10 p.m.

Presider: Todd Timberlake

DH01: 3:30-4 p.m. On the History and Future of Teaching Science Through History

Invited – Travis Norsen, 210 Middle St., Hadley, MA 01035; travisnorsen@gmail.com

For those interested in the incorporation of historical material into the physics/astronomy curriculum, Santayana's dictum -- that "those who cannot remember the past are condemned to repeat it" -- suggests taking a careful look at the surprisingly long and interesting history of this project. The talk will thus survey past and present attempts to bring historical content and themes into the science classroom, searching especially for practical lessons, convincing motivations, and viable strategies that might help history achieve more success in the future.

DH02: 4-4:30 p.m. Contact with the Past, Hands on the Phenomena: Laboratory Activities in Ancient Astronomy

Invited – James Evans, University of Puget Sound, Tacoma, WA 98416-0002; jcevans@pugetsound.edu*

Ancient astronomy is rich in opportunities for hands-on learning, about the natural world, as well as about intellectual and cultural history. This talk will illustrate some ways in which students can develop a deeper appreciation of the history of science while also learning some astronomy that is still perfectly valid and applicable today. Topics to be covered include constructing a sundial, making a parapegma (a star calendar), and predicting the position of a planet in the zodiac.
*Invited by Todd Timberlake

DH03: 4:30-5 p.m. Teaching Physics with Conceptual History

Invited – Chuck Winrich, Babson College, 231 Forest St., Babson Park, MA 02457-0310; cwinrich@babson.edu

Andrew Duffy, Peter Garik, Nicholas Gross, Manher Jariwala, Boston University

The Improving the Teaching of Physics (ITOP) Project at Boston University combines physics content with the conceptual history of physics and physics education research (PER) literature in professional development courses for physics teachers. Teachers are introduced to the history of conceptual development of mechanics, thermodynamics, optics, electricity, magnetism, electromagnetism and modern physics through readings from original and secondary sources. This historical development is exploited to help teachers better understand the nature of scientific models. It also supports readings from the PER literature in which misconceptions of modern students often echo archaic models. Interactive classroom discourse is fostered through the use of compare-and-contrast exercises between the archaic and modern theories. In addition to examples of these exercises, we will present examples of how the teachers use history themselves, and discuss the barriers they perceive to the use of history in the physics classroom.

DH04: 5-5:10 p.m. Exploring Artificial Solar Systems with Ptolemy and Copernicus

Contributed – Todd K. Timberlake, Berry College, Mount Berry, GA 30149-5004; ttimberlake@berry.edu

I have developed a series of projects in which students model an artificial solar system based on their own observations.[1] The students use computer simulations to observe the shadows cast by a gnomon and the motion of planets against the starry background. From their observations students can construct detailed models for their solar system using either the principles of Ptolemy or Copernicus. By constructing both models, students gain a better understanding of the relationship between Ptolemaic and Copernican astronomy. This deeper understanding helps them to see why Ptolemaic astronomy was so successful and to appreciate the elegance of the Copernican model. Students can also verify that their Copernican model adheres to Kepler's laws of planetary motion.

1. Todd Timberlake, "Modeling the History of Astronomy," *Astron. Educ. Review* **12**, 010201 (2013).

Session EA: Apparatus Magic

Location: Salon 3
Sponsor: Committee on Apparatus
Date: Monday, January 6
Time: 7:30–8:20 p.m.

Presider: David Sturm

EA01: 7:30-7:40 p.m. Mission to Mars

Contributed – David Venne, 3735 Burr Oak Dr., Racine, WI 53406; ddvenne@gmail.com

Lego's Mindstorm robots will be the vehicle used to teach my students the physics of spaceflight and astronomy. Students will be expected to build and program Martian rovers that will actually travel on a "Mars board." The rovers will be required to visit and test samples at two sites to determine what the Martian environment is like. Students will be exposed to a variety of STEM applications while at the same time having fun!

EA02: 7:40-7:50 p.m. A Quantitative Comparison of Four Different Lighting Types

Contributed – Stephen A. Minnick, Kent State University, at Tuscarawas, New Philadelphia, OH 44663; sminnick@kent.edu

Most students have little idea of the differences between the four basic types, incandescent, CFL, LED, and halogen, of household light bulbs being marketed. In order to drive home these differences and demonstrate the tradeoffs between lighting quality, efficiency, and costs, a new laboratory experiment has been developed suitable for high school and undergraduate students in basic science courses. For each lighting type, various quantities such as input power, light output, and efficiency are measured and then compared. Light quality from each bulb is determined by using inexpensive spectroscopes.

EA03: 7:50-8 p.m. A Simple LED Light Source for Multiple Online Experiments

Contributed – Joseph J. Calabrese, DeVry University, Columbus, OH 43209; jcalabrese@devry.edu

If experiments conducted outside of the physics laboratory are to become a standard part of online physics courses, the cost to the student must be minimized. Additionally any apparatus used by students without supervision must be easy to use. I will present a relatively inexpensive, easy to use, LED circuit that can be used for experiments in physical and geometric optics as well as a measurement of Planck's constant. Using one piece of apparatus for multiple experiments can help control costs. Using the same apparatus multiple times can help the student gain confidence and reduce the overall learning curve for the laboratory portion of an online course. Data from experiments will be shown.

EA04: 8-8:10 p.m. The Magic (Demos) of Paramagnetism and Diamagnetism

Contributed – James J. Lincoln, PhysicsVideos.net, 5 Federation Way, Irvine, CA 92603; james@physicsvideos.net

This past summer I made a video on Diamagnetic and Paramagnetic substances. This gave me a chance to research and discover some of the more familiar materials that have these properties and figure out creative ways to demonstrate that they are influenced by magnetic fields; even when the effect is weak. In this talk I will explain what makes a substance Diamagnetic and/or Paramagnetic and provide ideas and tips for acquiring and utilizing the most familiar and most powerful among these substances.

EA05: 8:10-8:20 p.m. Young's Modulus of Selected Metallic Wires Using Improvised Apparatus

Contributed – Judelyn L. Patero, Surigao del Sur State University, Cantilan, Surigao del Sur Tandag City, Philippines; judy_pats29@yahoo.com.

In the elasticity of matter, the behavior of elastic materials are described in terms of elongation, external force applied to elastic materials, stress, strain, and elastic moduli such as Young's modulus, Shear modulus, and Bulk modulus. Demonstrations of this elastic modulus, particularly Young's modulus in the classroom are usual problem because acquiring an apparatus for this purpose is expensive. In this project, Young's modulus apparatus is fabricated. The improvised Young's modulus apparatus is tested using copper, stainless steel, and galvanized iron wires. The copper wire of diameter 0.42 mm has a Young's Modulus of 10.04 x 1010 $N/m^2 \pm 6.783$ N/m^2 which is 8.7% than the known value. On the other hand, the Young's modulus of GI wire of diameter 0.555 mm and stainless steel wire of diameter 0.42 mm are 17.92 x 1010 N/m^2 and 18.021 x 1010 N/m^2, respectively. The improvised apparatus is functional and can be used for classroom experiments and demonstration.

Session EB: Partnerships between Two-Year and Four-Year Schools

Location: Salon 4
Sponsor: Committee on Physics in Two-Year Colleges
Co-Sponsor: Committee on Professional Concerns
Date: Monday, January 6
Time: 7:30–8:20 p.m.

Presider: Tom Herring

EB01: 7:30-8 p.m. Inquiry Lab Modules: Research-like Labs in a Community College

Invited – Chitra G. Solomonson, Green River Community College, Auburn, WA 98092-3622; csolomonson@greenriver.edu

Christine K. Luscombe, Andrew H. Rice, University of Washington

Keith A. Clay, Green River Community College

Partnerships between two-year and four-year colleges can be a win-win for both schools. This talk will describe one such partnership between Green River Community College and the University of Washington. The partnership exists at many levels -- the speaker, a two-year college instructor, works in a research lab at the University of Washington during the summer where she learns to fabricate and characterize organic solar cells. She uses this to create a research-like lab for her students in the calculus-based physics class at the two-year college. The talk will detail why the partnership works, the benefits for both institutions, as well as some of the hurdles that arise in building and sustaining the partnership. Ideas for similar partnerships will be discussed.

EB02: 8-8:10 p.m. AACCESS: A Partnership to Recruit Students to Major in Physics and Chemistry

Contributed – Ramon E. Lopez, University of Texas at Arlington, Department of Physics, Arlington, TX 76019; relopez@uta.edu

The Arlington Academy for Community College Exceptional Students in Science (AACCESS) is a partnership between the University of Texas at Arlington (UTA) and Tarrant Community College District (TCCD) that is funded by the National Science Foundation under its S-STEM program. AACCESS recruits talented students from TCCD who then transfer to UTA to major in physics or chemistry. AACCESS students receive a $10,000/yr scholarship, the opportunity to engage in research with UTA faculty, and academic support and mentoring. In this presentation, we will describe the partnership between TCCD and UTA, how students are selected and mentored, and how an AACCESS community of students has been created. The program is now entering its fifth year, so we have data that allows us to judge the effectiveness of the program. We will demonstrate that retention and graduation rates for AACCESS students are much higher than

in the College of Science as a whole. Finally, we will share a variety of "lessons learned" that might prove useful to others contemplating similar projects.

EB03: 8:10-8:20 p.m. Transferring from Red Rocks to Mines

Contributed – Todd Ruskell, Colorado School of Mines, Golden, CO 80401; truskell@mines.edu

Barbra Maher, Red Rocks Community College

Red Rocks Community College (RRCC) and Colorado School of Mines (CSM) have benefited from a formal transfer agreement for about 15 years. Roughly 30% of all students transferring to CSM originate at RRCC. We will discuss the steps we take to maintain the agreement, which include faculty-to-faculty meetings and recruiting events attended by CSM staff and faculty at RRCC. This agreement results in a nearly seamless student transition from RRCC to CSM, regardless of when students transfer. The agreement ensures a large enrollment in physics courses at RRCC, to the point that RRCC should be able to add a modern physics course to their offerings in the near future. And CSM is ensured that transfer students have a solid math and science background, including their understanding of physics.

Session EC: The "Magic" of Engaging Girls in Physical Science

Location: Salon 5
Sponsor: Committee on Science Education for the Public
Co-Sponsor: Committee on Physics in Pre-High School Education
Date: Monday, January 6
Time: 7:30–8:30 p.m.

Presider: Peggy Norris

EC01: 7:30-8 p.m. SciGirls Seven: a Tool Box for Engaging Girls in STEM

Invited – Patricia Sievert, Northern Illinois University, STEM Outreach, De Kalb, IL 60115; psievert@niu.edu

What if there was a simple list of research-based tools for engaging more girls in the physical sciences? Would you implement the ideas? Join us as we explore the SciGirls Seven and the AAUW report, Why so Few, which complement each other: one a two-page list, the other a book providing a glance at the research that informed the list. Through my work as STEM Outreach Director and the Illinois Girls Collaborative Project, I have experienced successes and "learning opportunities" to share. How do I get 75-90% girls registering for some of my co-ed middle school STEM camps? The concepts can be used either in the classroom or out-of-school-time programs to increase the number of girls and other underrepresented groups interested in STEM.

EC02: 8-8:10 p.m. 'Mädchen machen Technik': A Girls' Summer Tech Program in Germany

Contributed – Barbara Maria Hoeling, University of Applied Sciences, Landshut, 84028 Germany; hoeling@haw-landshut.de

Peter B. Siegel, California State Polytechnic University Pomona

We report on the two-day technology workshop for high school girls "Building a programmable LED display" at the University of Applied Sciences in Landshut, Germany. It was part of the program "Mädchen machen Technik", organized by the Technical University of Munich. Nine girls (ages 14-18) worked for two days toward the goal of designing a display with LEDs and controlling the lighting pattern of the LEDs via a programmable microcontroller chip.They learned how to use a protoboard to light LEDs in an electric circuit, and how to modify an existing computer program to achieve the desired lighting pattern of the LEDs. The individual programs were burnt into the microchips, and the LEDs were soldered onto a circuit board, which was then decorated. The girls participated with excitement, worked very hard, and had a lot of fun.

EC03: 8:10-8:20 p.m. Physics for Girls Who Dance

Contributed – Kenneth L. Laws, Dickinson College, Carlisle, PA 17013-1714; laws@dickinson.edu

Melanie Lott, Denison University

It is well known that many more girls than boys participate in dance, particularly classical ballet. It is becoming recognized that young people are considerably more adept at understanding physical principles than adults give them credit for, if the use of jargon and sophisticated math is avoided. It is becoming increasingly recognized that understanding the physics of dance movement contributes to dancers' efficiency of learning dance and their proficiency of performing the movements learned. These facts combined lead to the conclusion that dance is an effective way of attracting girls into the activity of physics. Examples of the application of physics to dance movement include maintaining or regaining balance, maximizing the effectiveness of partnered pirouettes, and the creating of illusions such as floating horizontally during a leap. Examples will be demonstrated.

"Resource Letter PoD-1: The physics of dance," *Am. J. Phys.* **81** (1), January, 2013.

EC04: 8:20-8:30 p.m. Getting Elementary School Girls Excited about Physics

Contributed – Michael J. Ponnambalam, Sundaranar University, Vadakkankulam Tirunelvely Dt, TN 627116 India; michael.ponnambalam@gmail.com

The laws of physics are objective. However, their presentation is subjective. When the presenter has experienced with Einstein "a rapturous amazement at the harmony of Natural Law," when the presenter is passionate about physics, when the presenter is bubbling with infectious enthusiasm and explosive energy, and when that presenter sings and dances using the wavelength and vocabulary of little children, then the little ones experience an enjoyable excitement. In this paper, the author presents such an experience of the girls in the Elementary Schools in Belize in Central America.

Session ED: New Technology for Enhancing Research

Location: Salon 6
Sponsor: Committee on Research in Physics Education
Date: Monday, January 6
Time: 7:30–8:30 p.m.

Presider: David Rosengrant

ED01: 7:30-8 p.m. Using Eye Tracking to Explore Expert-Novice Differences*

Invited – Jose P. Mestre, University of Illinois Urbana-Champaign, Urbana, IL 61801; mestre@illinois.edu

Jennifer L. Docktor, University of Wisconsin-La Crosse

Elizabeth Gire, University of Memphis

Sanjay Rebello, Kansas State University

We describe three experiments that combine behavioral measures with eye-tracking data to explore expert-novices differences. Eye tracking is a technique by which an individual's eye fixations (locations and duration) are recorded while s/he performs a task, and has been commonly used in psychology/psycholinguistics in the past to study reading and other cognitive processes. As per the eye-mind hypothesis, where the eyes go while performing a task is a proxy for what people are attending to; thus one can draw inferences on task performance by combining eye tracking with theoretical models of cognition. Two of the experiments explore the fluidity of experts and novices in using different representations (e.g., text, graphical, symbolic) to portray physics phenomena. The third experiment applies a psychological reading comprehension model to explore whether

or not physics novices and experts display deep understanding of problem solutions while reading them. Preliminary data and findings will also be presented.

*Work supported in part by a mini-grant from Physics Education Research Leadership Organizing Council.

ED02: 8-8:30 p.m. Eye Tracking and Electroencephalography in Psychological Research and Education

Invited – Jeffrey S. Bedwell, University of Central Florida, Orlando, FL 32816-1390; jeffrey.bedwell@ucf.edu

Technology has provided tools that allow valuable insights into the mechanisms of many psychiatric disorders. A better understanding of the underlying mechanisms of the disorders opens the door to improved treatment and prevention efforts. Two technologies in particular, eye tracking and electroencephalography (EEG), are being used in a current research project funded by the National Institute of Mental Health. Specifically, the EEG signal is examined in synchrony with a visual processing task to produce visual-evoked potentials (VEPs), and abnormalities are assessed in relation to particular psychiatric symptoms. A remote eye tracker is used to ensure that the participant is looking at each visual stimulus on a computer monitor and will pause the presentation until the participant looks back at the center of the screen. This work highlights how this technology can be used to improve PER practices.

Session EE: International Professional Development Opportunities for Teachers

Location: Salon 7
Sponsor: Committee on International Physics Education
Date: Monday, January 6
Time: 7:30–8:30 p.m.

Presider: Tiberiu Dragoiu

EE01: 7:30-8 p.m. Gaining First-hand Experience at CERN to Excite the Next Generation

Invited – Jeff Paradis, Rush Henrietta Senior High School, Henrietta, NY 14467; jeff.s.paradis@gmail.com

Sara Karbeling, Central Academy, Des Moines Schools

Inspiring students to pursue careers in science is an implied part of our job description. Staying current on the discoveries and research in the fields of science gives us the ability to help students connect to the content and how it impacts their lives. An international high school teacher program hosted at CERN—in Geneva, Switzerland—provides an experience for high school teachers to interact with colleagues from around the world and challenges their perspective on teaching physics, all while providing direct access to the particle physicists and engineers that are at the forefront of major discoveries. During this joint presentation, members of the U.S. delegation to the program in 2012 will share their experience, classroom resources and provide information on how teachers can participate in subsequent programs.

EE02: 8-8:30 p.m. EinsteinPlus Summer Program

Invited – Laura Flatt, Perimeter Institute, Educational Outreach, Ontario, N2L 2Y5 Canada, lflatt@perimeterinstitute.ca

Greg Dick, Perimeter Institute

EinsteinPlus is an immersive week-long workshop on modern physics for high schools held every summer in the Stephen Hawking Centre at Perimeter Institute for Theoretical Physics in Canada. Open to teachers from around the globe, it explores a range of topics including quantum physics, relativity and cosmology at a level suitable for high school physics students. Throughout, there is a strong emphasis on a hands-on approach and good pedagogy applicable to teaching both modern and classical physics, as well as opportunities to explore Perimeter's suite of in-class resources. The week also includes lectures by Perimeter physicists working at the cutting-edge of modern physics along with numerous informal interactions with them. This session will outline the workshop, opportunities to join Perimeter's Teacher Network and the application process.

Session EF: Dealing with Academic Dishonesty

Location: Salon 8
Sponsor: Committee on Physics in Undergraduate Education
Co-Sponsor: Committee on Physics in High Schools
Date: Monday, January 6
Time: 7:30–8:30 p.m.

Presider: Andy Gavrin

EF01: 7:30-8 p.m. Student Academic Misconduct: The Conflicting Motivations of Higher Education

Invited – Louis A. Bloomfield, University of Virginia, Charlottesville, VA 22904-4714; LAB3E@VIRGINIA.EDU

Academic misconduct is a study in market forces and the corporatization of the academy. Students cheat when they believe it is in their best interest to do so. When the rewards are great and the risks are low, cheating is likely to be a problem. Institutions of high education also respond to market forces and often handle cheating in the same ways that companies handle misconduct by employees or clients. Faculty are torn in two directions, between the ancient academic ideal and the modern corporate academy. In this talk, I will recount my two-year immersion in the world of student academic misconduct, beginning in 2001, and discuss the complex motivations, market forces, and attitudes that I encountered.

EF02: 8-8:30 p.m. Encouraging Academic Honesty at BYU

Invited – R. Steven Turley, Brigham Young University, Provo, UT 84602-0002; turley@byu.edu

In some sense academic honesty should be a natural outgrowth of the core values we have in a disciplines like physics which are devoted to the search for truth. Sadly, a large fraction of high school and college students admit to having cheated in some form at least once in their academic careers.[1] I will discuss ways we encourage academic honesty at BYU which include setting high expectations, establishing a culture of honesty, lowering the incentive and opportunity to cheat, and responding to students who cheat. This culture and environment makes cheating a relatively rare (but observed) occurrence on our campus. As a religiously affiliated school, BYU may be somewhat unique in the role that moral issues are integrated into our academic life. However, given the increasing emphasis in ethical responsibility in our discipline, I believe the principles we apply can be generalized to other institutions.

1. James H. Lang, *Time Magazine*, Sept. 11, 2013.

Session EG: Cultural Relevance in the Physics Classroom

Location: Salon 9
Sponsor: Committee on Diversity in Physics
Date: Monday, January 6
Time: 7:30–8:30 p.m.

Presider: Ximena Cid

EG01: 7:30-8 p.m. Culturally Relevant Physics Teaching Through Using CMPLE

Invited – Natan Samuels, Florida International University, Miami, FL 33125; nsamu002@fiu.edu

Eric Brewe, Laird Kramer, Florida International University

We discuss a successful method for helping physics instructors

shape their learning environments to be more representative of students' cultures and learning preferences. Physics instructors come from different backgrounds than their students, and have difficulty relating across cultures. Rather than focusing on boundaries, instructors can build upon shared classroom cultures that naturally develop. The Cogenerative Mediation Process for Learning Environments (CMPLE) is our formative intervention designed to help instructors better engage with students by first gaining awareness of learning and cultural issues. Then, instructors and students collaborate to design and implement pedagogical changes that are connected to their students' backgrounds. Using CMPLE, instructors have the advantage of knowing their methods are culturally relevant, through giving their students meaningful and active roles. We highlight CMPLE's use in a high school honors physics class using the Modeling Instruction curriculum, and a university course for pre-service elementary teachers using the PET curriculum.

EG02: 8-8:30 p.m. Using Real Life Examples and Manipulatives in Conceptual Physics

Invited – Virginia L. Hayes, 4226 S. Wabash Ave. Apt 2N, Chicago, IL 60653; virginialenisehayes@yahoo.com

Students are motivated and excited when given real-life examples when a topic is introduced in physics. When I work with students, after a brief group discussion about real-life situations, the students must connect the physics to the specific situations. There are other times when students are given the key physics concepts and then are required to create a real-life example that is relevant to the physics concept. Students also use manipulatives to learn physics. Students are given these tools along with the physics concepts and their definitions to discuss the connection between the manipulatives and the terms. There are two reasons for using these approaches to teach physics to students in urban areas. Specifically, these techniques show the students that physics is everywhere. The other benefit is to help students see physics as relevant to them and for them to see themselves as scientists. In this talk I will describe some of my experiences as a science learner in the urban environment and how these experiences inform my teaching.

Session EH: Innovative Undergraduate Labs

Location: Salon 10
Sponsor: AAPT
Date: Monday, January 6
Time: 7:30–8:20 p.m.

Presider: Kendra Sibbernsen

EH01: 7:30-7:40 p.m. Exploring Fluorescence in Homemade Candy Glass

Contributed – William R. Heffner, Lehigh University, Bethlehem, PA 18015; wrh304@lehigh.edu

Donald Wright III, Oakwood University

We present an investigation of the fluorescence observed in homemade sugar glass (hard candy). Our home-built "Fluorescent Monitoring System" utilized high-intensity LEDs for the excitation and the student grade Ocean Optics Red Tide Spectrometer to resolve the emission. The fluorescence was found to span between about 470 nm and 650 nm and the emission demonstrated a marked drop in intensity for LED excitation below green. We measured the fluorescence as a function of temperature and found it to decrease with increasing temperature. The fluorescence also increased as the glass caramelized (browned) with further heat treatment (cooking). Recent literature has shown similar fluorescence in caramelized sugars to be due to the production of carbon nanoparticles, and we propose the experiment as a cross-disciplinary and open-ended one for an undergraduate lab in physics, chemistry, or material science.

EH02: 7:40-7:50 p.m. A Laser Range Finder for the First-Year Labs?

Contributed – Daniel E. Beeker, Indiana University, Bloomington, IN 47405; debeeker@indiana.edu

An industrial laser range finder is evaluated for use in the first-year physics labs. Performance is compared to a typical ultrasonic motion detector.

EH03: 7:50-8 p.m. Magnetic Field Measurements

Contributed – Barbara Wolff-Reichert, TeachSpin, Inc., 2495 Main St., Buffalo, NY 14214-2153; bwr@teachSpin.com

The existence of cheap commercial Hall effect sensors make it possible for both high schools and colleges to create valuable experiments where their students can measure the magnetic fields that they study in their theoretical courses. This includes the fields from currents in a long straight wire, a wire loop, and a Helmholtz pair of wire loops, as well as their dependence on distance. Students can measure the on-axis magnetic field dependence as a function of distance for a small uniformly magnetized disk and discover the 1/r3 dependence. They can determine the local Earth's magnetic field. All these measurements require the calibration of the sensor by the student. This in itself, is a useful exercise in standards measurement. Something rarely done in this computerized-instrument age.

EH04: 8-8:10 p.m. A Low-cost AFM for Undergraduate Students

Contributed – Yingzi Li, Beijing University of Aeronautics and Astronautics, Beijing, China; beijing beijing yingzilee@163.com

Jin Li, Liwen Zhang, Jianqiang Qian, Hua Li, Beijing University of Aeronautics and Astronautics

Atomic force microscopy (AFM) is an import tool in nanotechnology. This invention makes it possible to observe nanoscale surfaces beyond the resolution limitation of light microscopy. In this paper we developed a low-cost AFM with quartz tuning fork. It is easy for undergraduate students to obtain deep insights into the nano world with its simple operation and principle. Some parts of this device are designed to be operated almost completely manually and it is a way for student to understand the principle of AFM. This paper consists of three parts. The principle of quartz tuning fork is shown first, then mechanical structure and control system is introduced, and at last the results of experiments done by students are shown. The compare between these results and those that are obtained by commercial AFM shows the validity and usability.

EH05: 8:10-8:20 p.m. SPAD – The World's Cheapest Single Photon Detector

Contributed – Jonathan F. Reichert, TeachSpin, Inc., 2495 Main St. Buffalo, NY 14214-2153 United States jreichert@teachSpin.com

Chances are you already have several of the world's cheapest single photon detectors in your parts junk drawer. For those "n-the-know", these are called Single Photon Avalanche Diodes (SPADs), but most of us know them as LEDs. It turns out, if you reverse bias some LEDs with about 25 volts DC, they exhibit avalanche breakdown when a visible photon strikes the sensitive area of the p-n junction. Studying this breakdown phenomenon to confirm that it is a single photon event, and that it obeys the Poissonian statistics for some experimental parameters and not for others, is an important exercise for students. One only needs an LED, an operational amplifier, associated power supplies, oscilloscope, pulse counter, and a computer in order to study these pulses. These may be the world's cheapest single photon detectors, but they are also probably the world's most inefficient!

Poster Session 2

Location: Grand Ballroom Foyer
Sponsor: AAPT
Date: Monday, January 6
Time: 8:30–10 p.m.

Persons with odd-numbered posters will present their posters from 8:30–9:15 p.m.; even-numbered will present 9:15–10 p.m.

Upper Division and Graduate

PST2A01: 8:30-9:15 p.m. Constructing a Multiple-Choice Assessment for Upper-Division Quantum Physics from an Open-Ended Tool

Poster – Homeyra Sadaghiani, Cal Poly Pomona, Pomona, CA 91768-2557; hrsadaghiani@csupomona.edu

John Miller, Cal Poly Pomona

Steven Pollock, Daniel Rehn, University of Colorado, Boulder

As part of an ongoing investigation of students' learning in upper-division quantum mechanics, we needed a high-quality conceptual assessment instrument for comparing outcomes of different curricular approaches. The 14 item open-ended Quantum Mechanics Assessment Tool (QMAT) was previously developed for this purpose. However, open-ended tests require complex scoring rubrics, are difficult to score consistently, and demand substantial investment of faculty time to grade. Here, we present the process of converting open-ended questions to multiple-choice (MC) format. We highlight the construction of effective distractors and the use of student interviews to revise and validate questions and distractors. We examine other elements of the process, including results of a preliminary implementation of the MC assessment given at Cal Poly Pomona and CU Boulder. This test will likely go through more iterations and further statistical analyses of reliability and validity are pending upon collection of additional.

PST2A02: 9:15-10 p.m. Relativity on Rotated Graph Paper: Lorentz-Invariant Calculations with Causal Diamonds

Poster – Roberto Salgado, 1725 State St., La Crosse, WI 54601; rsalgado@uwlax.edu

We extend our earlier work (Relativity on Rotated Graph Paper, arXiv:1111.7254) by visualizing Lorentz-invariant calculations associated with the Causal Diamonds between pairs of events, rather than observer-dependent calculations with light-clock diamonds associated with a given inertial observer. In our approach, we use spacetime diagrams drawn on graph paper that has been rotated by 45 degrees. Quantitative results can be read off the diagram by counting boxes, using a minimal amount of algebra.

Teacher Training and Enhancement

PST2B01: 8:30-9:15 p.m. ATE Workshop for Physics Faculty*

Poster – Thomas L. O'Kuma, Lee College, Baytown, TX 77522-0818; tokuma@lee.edu

Dwain M. Desbien, Estrella Mountain Community College

The ATE Workshop for Physics Faculty project has started its fourth year and has finished its 16th workshop/conference. In this poster, we will display information about the project, information about these workshops/conferences, and information about future workshops/conferences. Information concerning development of laboratory activities will also be displayed.

*Supported in part by NSF DUE #1003633.

PST2B02: 9:15-10 p.m. Characterizing Noyce Scholars' Classrooms with RTOP

Poster – Kathleen Ann Falconer, Buffalo State College, Department of Physics, Buffalo, NY 14217; falconka@buffalostate.edu

Dan MacIsaac, Buffalo State College

Griffin Harmon, Christian Brothers Academy

In 2009, we proposed a renewal and extension of the Robert Noyce Teacher Scholarship Program at Buffalo State College to support an additional 35 scholars seeking initial science and mathematics teacher certification over the next five years. As a component of the Phase 2 Teacher Scholarships Project at Buffalo State College: Science, Technology, Engineering and Mathematics (STEM) Teacher Effectiveness Study, we included research and evaluation of the Noyce participants. Several Noyce scholars, in their first few years of teaching, have been observed and evaluated using the Reformed Teaching Observation Protocol (RTOP). We will be reporting on the results from several classrooms.

PST2B03: 8:30-9:15 p.m. Using RTOP and Other Reformed Tools to Build and Strengthen My Teaching

Poster – Griffin Harmon, Christian Brothers Academy, Syracuse, NY 13214; gharmon@cbasyracuse.org*

Kathleen Falconer, Dan MacIsaac, Buffalo State College

As a nontraditional teacher candidate, the Robert Noyce Teacher Scholarship Program has provided me with the opportunity to receive my masters in physics education at SUNY Buffalo State College. My involvement in physics education at Buffalo State has been an amazing experience. Often in the summer courses, when doing a specific activity or whiteboarding session, I realized how productive learning and intense was our learning. Similarly in my high school classroom, I have been engaging students and fostering an understanding of physics using reformed teaching. Being assessed with the Reformed Teaching Observation Protocol (RTOP), numerous occasions, has given me confidence and helped me improve my instruction. Previous assessments by school administrators focused on items, which had little impact on the learning going on in the classroom. The RTOP assessments have provided me with useful notes and have highlighted the areas I need to work on, while re-enforcing my good habits.

*Sponsored by Kathleen Falconer

PST2B04: 9:15-10 p.m. Undergraduate Pathway to Teaching Physics at Georgia State University

Poster – Brian D. Thoms, Georgia State University, Department of Physics & Astronomy, Atlanta, GA 30303-4106; bthoms@gsu.edu

Elizabeth Walker, Sumith Doluweera, Joshua Von Korff, Georgia State University

The Department of Physics & Astronomy at Georgia State University has begun an effort to increase the quantity and quality of high school physics teachers with an emphasis on increasing recruitment into teaching of students from under-represented groups. GSU is a large, growing, urban, research university with a diverse student body. Recently a teacher certification pathway within our BS in Physics program has been added to the existing master's level program. As a new PhysTEC comprehensive site, our efforts include new recruiting, mentoring, and induction strategies, reform of introductory, calculus-based physics courses, and the addition of a teacher-on-residence. We will describe the recruiting and mentoring efforts and early success of the new undergraduate path to certification which is projected to produce four physics teachers in 2013-2014 and five in 2014-2015.

PST2B05: 8:30-9:15 p.m. Supporting the Metamorphosis from Physics Student to Physics Teacher

Poster – Mary A. Norris, Virginia Tech, Physics Department, Blacksburg, VA 24060; mnorris@vt.edu

John Simonetti, Leo Piilonen, George Glasson, Brenda Brand, Virginia Tech

The Virginia Tech Physics Department and School of Education are in their third year of a collaboration with the Physics Teaching

Education Coalition (PhysTEC) to increase the number of highly prepared physics teachers graduating from the university. Among the techniques employed to realize this goal are providing early field experiences for students, providing a course on physics-specific pedagogy, and providing financial support during the master's of education (MAEd) program through a physics graduate assistantship. In the past two years, six students have graduated from the program with their MAEd. All currently teach high school physics. All entered the classroom well prepared and excited to teach. What happened after they met their students and closed their doors? This study traces the evolution of these teachers' beliefs and practices during their first semester of teaching and the effect of both local and PhysTEC mentoring efforts.

PST2B06: 9:15-10 p.m. SUNY Buffalo State Summer Physics Teachers' Academy: The First Decade

Poster – Alyssa Cederman, SUNY Buffalo State College, Buffalo, NY 14222; adcede19@gmail.com

Dan MacIsaac, David Abbott, Kathleen Falconer, David Henry, SUNY Buffalo State College

The SUNY Buffalo State Summer Physics Teachers' Academy, partially modeled after the Arizona State University Summer Modeling workshops, has run since summer 2002, serving more than 400 individual teachers seeking NYSED physics certification, including over 100 M.S.Ed. (Physics) degree graduates and candidates from the Buffalo State Physics Department. Each summer between two and five graduate credit teacher workshop courses have been offered, serving as many as 30 students per class. We share demographic data, insights, and experiences from the first decade of our summer academy, including recommendations and pitfalls for others interested in creating summer academies for physics teachers.

PST2B07: 8:30-9:15 p.m. Models and Perspectives of International Student Exchanges in Teacher Education

Poster – Nina Glutsch, University of Cologne, Center for Teacher Education, Cologne, NRW 50931 Germany; nina.glutsch@uni-koeln.de

Meike Kricke, André Bresges, University of Cologne

We want to design a U.S.-German exchange program for STEM teacher preparation courses that implements a network of universities and their cooperating schools. Goals are to make STEM education a more attractive field of work, balance the supply and demand of qualified STEM teachers, and foster international research in the PER community. Students and teachers should be encouraged to study or work in the field of STEM education in both countries, thus opening paths to international careers in STEM teaching. The University of Cologne is about to develop different exchange programs with schools all over the world, e.g. the U.S., South Africa, Uganda, Europe, and Finland. At the poster, we want to discuss how a global network of schools and universities can transform teachers from "local activists" to "global players."

PST2B08: 9:15-10 p.m. Merging Engineering Design, Technology and Physics for K-12 Teachers

Poster – Dan L. MacIsaac, SUNY Buffalo State College, Physics, Buffalo, NY 14222; danmacisaac@mac.com

Sam Cirpili, Bradley Gearhart, Buffalo Public Schools and SUNY Buffalo State College

Kathleen Stadler, Lancaster Central SD and SUNY Buffalo State

Clark Greene, SUNY Buffalo State College Engineering Technology

We describe efforts of the Interdisciplinary Science and Engineering Partnership (ISEP), a $10M NSF Math Science Partnership supported project involving SUNY at Buffalo (UB), Buffalo Public Schools, Buffalo State College, the Buffalo Museum of Science, PraxAir Corp and other partnering education institutions and corporate partners. This poster focuses on the creation of specific courses combining Engineering Design, Technology and Physics content addressing NGSS standards for K-12 teachers. These courses are offered as part of the SUNY Buffalo State Summer Physics Teachers' Academy.

PST2B09: 8:30-9:15 p.m. Helping Physics Teacher-Candidates Develop Questioning Skills through Innovative Technology Use

Poster – Marina Milner-Bolotin, The University of British Columbia, Vancouver, BC V6T 1Z4 Canada; marina.milner-bolotin@ubc.ca

Alexandra MacDonald, Heather Fisher, University of British Columbia

Active learning pedagogies, such as Peer Instruction (PI), have been found to be effective in undergraduate physics teaching. However, they are still rare in secondary schools and in physics teacher education programs. One of the reasons for that is physics teachers' lack of experience in asking effective conceptual STEM questions and underestimating their pedagogical value. Thus research-based multiple-choice conceptual questions in STEM teacher education are still underutilized. In this study Peer Instruction pedagogy was supplemented by the use of a collaborative online system—PeerWise (PW) (peerwise.cs.auckland.ac.nz)—to help teacher-candidates develop these skills. In addition, a special STEM resource of conceptual multiple-choice questions (http://scienceres-edcp-educ.sites.olt.ubc.ca/) was developed and used in STEM methods courses. We report on the effects of a research-based technology-enhanced physics methods course on teacher-candidates' content and pedagogical knowledge, on their attitudes about active learning, and on willingness and ability to implement active learning pedagogy during their practicum.

PST2B10: 9:15-10 p.m. Mathematics and Science Teaching and Learning Through Technology

Poster – Heather Fisher, The University of British Columbia, Vancouver, BC, V6T 1Z4 Canada; marina.milner-bolotin@ubc.ca

Alexandra MacDonald, Marina Milner-Bolotin, Univ. of British Columbia

Inquiry-based mathematics and science teaching depends on the teacher's ability to help students learn how to think independently and how to ask meaningful mathematics and science questions. The ability to ask questions that promote student learning is underpinned by the teacher's deep knowledge of the content, awareness of how this content can be taught, and their decisions about how to bring information into the classroom, which in today's classroom includes decisions about technology. Research conducted over the last decade has shown the development of TPCK is a slow and often painful process, making it especially important to address in teacher education programs. One way of addressing this challenge is engaging teachers in designing materials that integrate educational technologies during their teacher education and their formative teaching years. The goals of this study were to (a) implement the Mathematics and Science Teaching and Learning Through Technology (MSTLTT) resource, which uses conceptual questions that were developed using current educational research, into a secondary physics methods course in a teacher education program. Furthermore, we aimed to (b) model active engagement with educational technologies in a physics methods course; (c) explore clickers as a mechanism for active engagement; and (d) examine if and how teacher-candidates' epistemological views were impacted through active engagement with technology-enhanced pedagogy.

PST2B11: 8:30-9:15 p.m. Demographics of Physics Teachers Using the Schools and Staffing Survey

Poster – David Rosengrant, Kennesaw State University, Kennesaw, GA 30144; drosengr@kennesaw.edu

Greg Rushton, Kennesaw State University

This project is part of a multidisciplinary team to study secondary physics teaching using the School and Staffing Survey (SASS) between 1987 and 2012. We will answer the following questions (and when applicable compare AIP survey results to): How many physics teachers are there in the United States? What are trends in the population growth compared to other teacher groups in the past 20 years? What proportion of those that teach physics do so as their main assignment? What other subjects do physics teachers teach? To what extent have physics teachers earned a physics degree at any level? What other backgrounds do these teachers have? What has been the certification status of physics

teachers over time? To what extent has the racial and gender profile of physics teachers changed over time? To what extent have the age and years' of experience distributions change over time?

PST2B12: 9:15-10 p.m. Developing Master Physics Teacher Leaders

Poster – Greg Rushton, Kennesaw State University, Kennesaw, GA 30144; grushton@kennesaw.edu

David Rosengrant, Kennesaw State University

This project is a five-year NSF-funded project to take area physics (and chemistry) teachers who are excelling in the classroom and to help transition them into Master Teachers. We define a Master Teacher as someone who moves from being a consumer of education resources to a producer or resource for others. We have a total of eight physics and eight chemistry teachers participating in this project who are resources at their school. However, our goal is to transform these teachers into resources at a county, state or national level. For this presentation, we will showcase our professional development model (currently in second year), participants, calendar, goals and benefits to the teachers. Furthermore, this presentation will highlight the journey and lessons learned from the education faculty involved in this project. For further information, please visit our website: http://www.ganoycescholars.org/

PST2B13: 9:15-10 p.m. Learning Assistant (LA) Program: A Passage for High School Teacher Education and Recruitment

Poster – Homeyra R. Sadaghiani, CalPoly Pomona, 3801 W. Temple Ave., Pomona, CA 91768-2557; hrsadaghiani@csupomona.edu

Steve McCauley, Alex Rudolph, Cal Poly Pomona

Learning Assistant (LA) program is a mechanism for recruiting and preparing physics majors for careers in teaching. Learning Assistants (LAs) are talented undergraduates who work with faculty members to make courses more collaborative, student-centered, and interactive. Learning Assistant program provides potential future teachers with strongly supported and low-stress early teaching experiences that can encourage them to pursue teaching certification. In the process, faculty use LAs to promote interaction and collaboration among students enrolled in the course, which consequently improves the quality undergraduate physics programs. We will report on our challenges and achievements.

PST2B14: 9:15-10 p.m. Online Physics Problem Solving Frameworks: High School and University-level Implementation*

Poster – Andrew J. Mason, University of Central Arkansas, Lewis Science Center, AR 72035-0001; ajmason@uca.edu

Mishal Benson, University of Central Arkansas

At the University of Central Arkansas we are currently investigating implementations of computer coaches developed at the University of Minnesota, Twin Cities for calculus-based physics. The modules are designed to use cognitive apprenticeships to coach the decision-making process required to develop a problem-solving framework. As such, there exists a potential to apply the modules towards additional learning environments, e.g. a pre-college environment. We describe the considerations needed in implementation between that of a university-level physics course and a high school physics classroom. A sampling of local area high school physics teachers teaching different levels of physics were surveyed during the summer and fall of 2013 about the utility of algebra-based coaching modules in their classroom, as well as for teacher-training purposes. We categorize their statements and compare to the prescribed use of the original calculus-based modules for an introductory university-level course.

*The work is in collaboration with work by L. Hsu, K. Heller, Q. Ryan, and E. Frodermann at the University of Minnesota, Twin Cities.

PST2B15: 8:30-9:15 p.m. STEM Institutes for High School Teachers

Poster – Jennifer Blue, Miami University, Department of Physics, Oxford, OH 45056; bluejm@miamioh.edu

For three years, Sinclair Community College has run STEM Institutes for high school teachers out of their Courseview campus in Mason, OH. The teachers attend the Institute for two weeks in their first summer; in week one, they are pushed into considering inquiry-based pedagogy as they practice lessons in science, math, and engineering, and in week two, they write and present their own multi-day lessons. In the following school year, many of them participate in an iDiscovery online course (www.iDiscovery.org), in which they continue their discussions about active, inquiry-based teaching. In their second summer, they have a job shadowing program in which they are placed in local teach businesses and hospitals. Results of teacher surveys about the program will be shared, as well as an evaluation of the lesson modules the teachers created during the Institute. This work is supported by the National Science Foundation under Grant No. DUE-1003048.

PST2B16: 9:15-10 p.m. High Altitude Balloon Missions

Poster – Joel C. Berlinghieri, The Citadel, Physics Department, Charleston, SC 29409; berlinghieri@citadel.edu

Weather balloons can be used to raise small instrument packages to high altitudes. The instruments flown on these balloons can be used to measure atmospheric properties (temperature, pressure, etc.), measure radiation (cosmic rays, light scattering, etc.), and record stunning pictures (Earth, its curvature, etc.) among other flight projects. With a grant from Google and support from our STEM Center we are establishing a program that involves high school teachers and their students. High school teams propose, design, and build instrument packages which, with the help of our faculty and physics undergraduates, are launched, tracked, recovered, and analyzed by these teams.

PST2B17: 8:30-9:15 p.m. A Standard Model Poster for the Classroom

Poster – Cristina Brazzelli, William Floyd High School, Mastic Beach, NY 11951; cbrazzelli@wfsd.k12.ny.us

Joanne Schwager, Farmingdale High School

Tom Tomaszewski, Shoreham-Wading River High School

Gillian Winters, Smithtown East High School

Harry Stuckey, Stonybrook University

A Standard Model poster for the classroom is presented. This poster summarizes what we know today about the building blocks of matter and how they interact with the Higgs boson. On a single poster we have displayed the various components of matter: quarks, leptons, gauge bosons, along with Feynman diagrams to help explain various observed phenomena. Included on either side of the chart are examples of baryons and mesons.

Physics Education Research Posters 2

PST2C01: 8:30-9:15 p.m. Peer Evaluations of Video Lab Reports by Introductory Physics Students

Poster – Shih-Yin Lin, Georgia Institute of Technology, GA 30332-0002; hellosilpn@gmail.com

John M. Aiken, Scott Douglas, Michael F. Schatz, Georgia Institute of Technology

Marcos D. Caballero, Michigan State University

Assessing student performance becomes challenging when course enrollment becomes very large (~10^5 students). As part of an introductory physics Massive Open Online Course (MOOC) offered by Georgia Institute of Technology, students submit video reports on force and motion labs. Peer evaluation of reports provides the primary method for evaluating student laboratory work. This paper describes the methods developed and used to guide students in evaluating each

others' video lab reports when the course is offered in summer 2013 and fall 2013. Results of how students peer evaluation compares to experts evaluation will be presented.

PST2C02: 9:15-10 p.m. Video Resource for Professional Development of University Physics Educators

Poster – Rachel E. Scherr, Seattle Pacific University, Seattle, WA 98115; rescherr@gmail.com

Renee Michelle Goertzen, American Physical Society

The Video Resource for Professional Development of University Physics Educators is being developed to support a wide range of university physics educators (four-year university faculty, two-year-college faculty, graduate teaching assistants, and undergraduate learning assistants) in engaging with key issues in teaching and learning. Based on compelling classroom video of best-practices university physics instruction, the resource is organized into "video workshops" that each introduce a significant topic in the teaching and learning of physics, such as formative assessment or cooperative learning. The topic is introduced through a captioned video episode of introductory physics students in the classroom, chosen to prompt collaborative discussion. Discussion questions prompt participants who view the episode to reflect on their pedagogical beliefs and on their own practice. The Video Resource will provide materials to be incorporated into a variety of professional development situations, including self-organized groups of professors, graduate TA training, LA pedagogy courses, and online professional development communities.

PST2C03: 8:30-9:15 p.m. Characterizing Students' Use of Models During Experimentation

Poster – Benjamin M. Zwickl, Rochester Institute of Technology, Rochester, NY 14623-5603; benjamin.m.zwickl@rit.edu

H. J. Lewandowski, Noah Finkelstein, University of Colorado Boulder

Models are simplified and abstract representations of real-world phenomena that are used for creating and communicating scientific explanations. In this study we analyze students' use of models in a 30-minute think-aloud lab activity involving basic electronic and optical components. The framework used for our fine-grained analysis of modeling during experimentation was developed independently in the context of curriculum development for upper-division physics laboratories. We review general patterns in students' use of models, describe our coding scheme, and conclude with a discussion of implications for the design of modeling-focused lab activities and lab-appropriate assessments.

PST2C04: 9:15-10 p.m. Movie Physics in Introductory Courses*

Poster – Natalia Schkolnikov, Hampton University, Hampton, VA 23668-0199; natalia.schkolnikov@hamptonu.edu

Students from underrepresented groups in science and engineering often feel disconnected from physics. To make Hampton University students more interested in physics and to assess their critical thinking and scientific reasoning skills, we offer in introductory physics classes presentation topics related to our favorite sci-fi blockbuster epics. Each student is assigned the task of presenting a detailed analysis of one basic scientific assumption in a popular sci-fi movie. For example students analyze artificial gravity in Armageddon, disappearance of the Earth's magnetic field in The Core, and traveling to the center of the Earth in Journey to the Center of the Earth. The students enhance their learning through these presentations since they are required to explain the relations between physical laws and the movie's hypothesis and make a judgment whether it is a bad or good physics movie.

*This work was supported by the National Science Foundation (NSF HRD-1137747).

PST2C05: 8:30-9:15 p.m. Student Attitudes Toward and Perceptions of New Material in Physics*

Poster – Anne E. Tabor-Morris, Georgian Court University, Department of Physics, Lakewood, NJ 08701-2697; tabormorris@georgian.edu

Timothy M. Briles, Georgian Court University School of Education

Learning new materials, especially physics topics, can be overwhelming to students. How do physics students approach and commit to learning new material? The Physics Education Research group at Georgian Court University presents a poster on their current research on student attitudes toward new material and strategies they employ. This includes research on types of materials and student commitment to learning that material.

*For list of our publications and past meeting abstracts see our blog: http://physicseducation.gcublogs.org/

PST2C06: 9:15-10 p.m. The Importance of Undergraduate Research: A SUNY Oswego Approach[1,2]

Poster – Carolina C. Ilie, SUNY Oswego, 254 Shineman Center, Oswego, NY 13126; carolina.ilie@oswego.edu

Julia D'Rozario, Katharyn E. Christiana, Michael Evans, Diana Boyer, SUNY Oswego

Undergraduate research is a valuable educational tool for students pursuing a degree in physics, but these experiences can become problematic and ineffective if not handled properly. This responsibility demands strength and commitment, as undergraduate research should be planned as an immersive learning experience in which the student has the opportunity to develop one's skills in accordance with one's interests. Effective undergraduate research experiences are marked by clear, measurable objectives and frequent student-professor collaboration. These objectives should reflect the long and short-term goals of the individual undergraduates, with a heightened focus on developing research skills for future use, as well as building a strong resume. With SUNY Oswego's mission to encourage our students to be involved in scholarly and creative activity as early as freshmen year, we present the campus opportunities for a successful undergraduate research experience.

1. Seymour, E., Hunter, A.-B., Laursen, S. L. and DeAntoni, T. (2004), "Establishing the benefits of research experiences for undergraduates in the sciences: First findings from a three-year study". *Sci. Edu.* **88,** 493-534.
2. Behar-Horenstein, Linda S., Johnson, Melissa L. "Enticing Students to Enter Into Undergraduate Research: The Instrumentality of an Undergraduate Course." *J. of Coll. Sci. Teach.* **39**.3 (2010): 62-70.

PST2C07: 8:30-9:15 p.m. Reducing the Gender Gap in College Physics

Poster – Wendy K. Adams, University of Northern Colorado, Department of Physics and Astronomy, Greeley, CO 80639; wendy.adams@unco.edu

Richard D. Dietz, Matthew R. Semak, University of Northern Colorado

We have seen a reduction in the gender gap with a population of students who start with low pre-test scores on the FCI, 25% and 38%, and end with similar post-test scores of 65% and 73% for women and men respectively. The course design is highly interactive and uses College Physics, by Knight, Jones and Fields. One unique aspect of the course is our equivalent peer groups, which are matched by GPA and gender, and which work together in class and during recitation/lab. The lecture component uses Peer Instruction with colored cards, group problem solving and University of Maryland Tutorials in Physics Sense-Making. We have also redesigned the three-hour labs by splitting the time into two parts: recitation using the Knight et al. Workbooks followed by a short lab that is designed with student motivation as the primary goal.

Other Posters

PST2D01: 8:30-9:15 p.m. Transforming Academia: Native American Women and Women in Physics

Poster – Carolina C. Ilie, State University of New York at Oswego, 254 Shineman Center, Oswego, NY 13126; carolina.ilie@oswego.edu

Sharity Bassett, Marie T. Romano, Lillie Ghobrial, Michael Evans, SUNY Oswego

Though there are numerous initiatives to recruit and retain both Native American women into higher education, and women in general into the field of physics, rates of success are limited. Trying to improve percentages alone does not do enough to transform western institutions of higher learning into spaces of inclusivity for race and gender. The transformations that are taking place within academia to these ends come from women of diverse backgrounds themselves. This poster will give examples of initiatives meant to increase recruitment and retention of women in physics, as well as Native American women into academia in general. Alongside these important initiatives, this poster will demonstrate the ways women in physics are carving a home for themselves and shaping epistemologies and Native American women are 'Indigenizing the Academy.'

PST2D02: 9:15-10 p.m. Transferring from Red Rocks to Mines

Poster – Todd Ruskell, Colorado School of Mines, Physics Department, Golden, CO 80401; truskell@mines.edu

Barbra Maher, Red Rocks Community College

Red Rocks Community College (RRCC) and Colorado School of Mines (CSM) have benefited from a formal transfer agreement for about 15 years. Roughly 30% of all students transferring to CSM originate at RRCC. We will discuss the steps we take to maintain the agreement, which include faculty-to-faculty meetings and recruiting events attended by CSM staff and faculty at RRCC. We will also discuss the academic arrangements that result in a nearly seamless student transition from RRCC to CSM, regardless of when students transfer. The agreement ensures a large enrollment in physics courses at RRCC, to the point that RRCC should be able to add a modern physics course to their offerings in the near future. In addition, CSM is ensured that transfer students have a solid math and science background, including their understanding of physics.

PST2D03: 8:30-9:15 p.m. Changing the Climate in a Physics Department

Poster – Talat S. Rahman, University of Central Florida, Orlando, FL 32816; talat.rahman@ucf.edu

Jacquelyn Chini, University of Central Florida

The physics department at the University of Central Florida in 2006 was no different from most: emphasis on research and funding as vehicles to achieve excellence and international prominence. The stringent baccalaureate curriculum ensured that most (87%) majors aimed to go to PhD programs. Initial efforts by a faculty group led to the introduction of inquiry-based teaching in the algebra-based physics courses, in an active learning environment. Data collected on student learning gains in these courses were so convincingly in favor of the active learning environment, compared to the traditional lecture-lab-recitation mode, that funds were found to build a new SCALE-UP type collaborative classroom. To accommodate the large enrollment, a variant that coupled lecture format to mini-studios was recently introduced. Learning assistants added further to course reforms. Bi-weekly pedagogy seminars became focal points. The award of a PhysTEC and NSF-TUES grant further helped bring a large number of faculty together.

PST2D04: 9:15-10 p.m. Group-Meeting with Undergraduates

Poster – Yongkang Le, Fudan University, Physics Department, No. 220 Handan Rd., Shanghai 200433, China; yongkangle@gmail.com

Group meetings were organized weekly as a support of the supervision of undergraduate training projects. About 20 undergraduates from different grades attend regularly. The topics of the group meeting cover reports on project progress, introduction of related techniques, discussion on teaching labs, sharing of literature reading, etc. Besides the discussion during each meeting, group members are encouraged to write short notes and comments on a wiki-based website. Evidence of positive impacts of this group meeting on students' development exists in several aspects.

PST2D05: 8:30-9:15 p.m. Summer Honors Camp Promotes STEM and Teaching

Poster – Kimberly A. Shaw, Columbus State University, Department of Earth and Space Sciences, Columbus, GA 31907; shaw_kimberly@columbusstate.edu

Deborah Gober, Tim Howard, Cindy Ticknor, Columbus State University

The Columbus Regional Academy of Future Teachers of STEM (CRAFT-STEM), a Phase I Robert Noyce Teacher Scholarship Program combines internships, scholarships, and a summer STEM Honors Camp. The camp functions both as a recruiting tool to interest high school students in STEM fields and to interest university students in teaching. Rising high school juniors and seniors apply to attend the camp, which is staffed by Noyce interns and university personnel. All assemble for a two-week residential camp (supported by corporate donors) to engage in hands-on activities that nurture and develop interest in STEM areas, and learn about connections between classroom lessons, real world applications, and potential STEM-related careers. The camp's culminating experience includes a student colloquium in which participants present their own STEM research. This camp builds on a historically successful Future Teachers Academy hosted by CSU. Forms and assessment instruments available.

PST2D06: 9:15-10 p.m. Incorporating Job Search Activities into a Modern Physics Class

Poster – Jane D. Flood, Muhlenberg College, Physics Department, Allentown, PA 18104-5586; flood@muhlenberg.edu

Alana Albus, Career Center, Muhlenberg College

As part of its Career Pathways Project, the American Institute of Physics found that physics departments that were particularly successful at placing their students in jobs also had a good relationship with their career services office. In one department identified as successful, University of Wisconsin - Eau Claire, the department incorporated career center activities into majors' seminars. We present a series of job-search activities incorporated into a modern physics class along with assessment results on some of the associated assignments.

PST2D07: 8:30-9:15 p.m. Optics for Life Sciences: A Microscopy-based Course

Poster – Shauna Novobilsky, Mercyhurst University, Erie, PA 16504; snovob93@lakers.mercyhurst.edu

Dyan Jones, Mercyhurst University

Interactive learning strategies are frequently used in the teaching of introductory physics topics. Here we describe the development of a course for undergraduate students who are not majoring in the field of physics. By adapting the learning materials from a Studio Optics course and Optics for Biophysics course, we hope to create a course designed to bring interactive learning to the topic of optics. Adapting the course to fit our curriculum will require a reduction in the amount of mathematics in the course, but the majority of the course requirements from the courses mentioned above will remain. This will create an environment that integrates lectures, lab, and simple problem solving as well as a focus on a long-term project for the course. The hope is to create a course that is advantageous to non-physics majors who still have an interest in optics.

PST2D08: 9:15-10 p.m. Acoustics and Fluid Dynamics of a Helmholtz Resonator

Poster – Maxwell L. Henry, Davidson College, Davidson, NC 28035; mahenry@davidson.edu*

NASA's Langley Research Center developed the software package OVERFLOW to solve the time dependent, Reynolds averaged, Navier-Stokes equation using multiple overset structured grids. The accuracy of the algorithm used in OVERFLOW permits the study of acoustics better than commercial software. To test the accuracy of acoustic prediction of OVERFLOW, the acoustic data from NASA scientist Patricia Block's cavity research[1] will be compared to 2 and 3 dimensional models. This project will focus on simulating 2 and 3-dimensional computational models of the Helmholtz Resonator and comparing it

to not only published data but also my own experimental data.[2]

1. Block, Patricia JW. "Noise response of cavities of varying dimensions at subsonic speeds." (1976).

*Sponsored by Wolfgang Christian

Lecture/Classroom

PST2E01: 8:30-9:15 p.m. Whiteboarding in Conceptual Physics: Evidence From a First Year Experience*

Poster – Bradley F. Gearhart, Buffalo Public Schools, 830 Union Rd., West Seneca, NY 14224; fizz6guy@yahoo.com

John Bihr, Buffalo Public Schools

Dan MacIsaac, Buffalo State College

During the 2012-2013 school year, Riverside High School, a persistently low achieving school in the Buffalo Public School District (Buffalo, NY), launched their first offering of Conceptual Physics to support the a new Health Science Academy within the school. Two teachers integrated whiteboarding into three sections of Conceptual Physics. Despite chronic absenteeism, high levels of initial student apathy, a preponderance of ESL students, and extraordinarily diverse student demographics, whiteboards demonstrated profound levels of student thinking and highly varied interpretations of shared evidence not typically associated with students in low performing urban schools. Evidence gathered from student whiteboards demonstrated cognitive interaction beyond that typically reflected on high stakes standardized testing for this student population.

*This project was supported by Buffalo State College, and the National Science Foundation (NSF) funded Interdisciplinary Science and Engineering Partnership (ISEP) MSP project.

PST2E02: 9:15-10 p.m. Teaching Physics Using a Public Policy Framework

Poster – Jennifer K. Perrella, Cesar Chavez Public Charter Schools for Public Policy, 3701 Hayes St. NE, Washington, DC 20019 jennifer.perrella@chavezschools.org*

Incorporating topics of interest to the general public into a physics course can be a daunting challenge. Yet doing so successfully can not only increase understanding of physics concepts as they apply in everyday life, but also can serve as a way to engage students who historically struggle in STEM classes. With the nationwide shift to Common Core standards and a resulting emphasis on literacy and critical thinking in all disciplines, public policy issues act as a structure upon which to build a physics class that incorporates these changes. A variety of performance tasks centered on policy issues such as helmet laws, wind turbine designs, and radio frequency identification can be used to assess student understanding of both the concepts and calculations of a physics course. This approach also aligns with the Next Generation Science Standards.

*Sponsored by Kim Quire

PST2E03: 8:30-9:15 p.m. The Academic Equity and Ethics Survey

Poster – Frances Ann Mateycik, Penn State Altoona, 3000 Ivyside Dr., Altoona, PA 16601; fam13@psu.edu

As a result of witnessing open disregard to the academic honor code every semester, I was determined to find out why these few students felt it was appropriate to cheat on individual assessments. Through general discussion it was clear that these students never intended on hiding their actions, but rather, defended their cheating using their own resolved code of academic conduct. These students felt that it was their right as learners to provide themselves with the best education, and if they were learning something new while discussing an examination problem, then it was not a dishonorable act. Discussion with these students were used to draft an "academic equity and ethics" survey. The survey was presented to my physics students at the start of every semester, for three consecutive semesters, totaling approximately 200 students. This poster will present the survey questions posed, and the trends in answers given on the survey.

PST2E04: 9:15-10 p.m. Problem-solving Strategies and Tracker to Build Dynamical Models

Poster – Norely Useche-Baron, IED Leonardo Posada Pedraza, Bogota, 00000 Colombia; norelyuseche@gmail.com

Fabian Martinez-Velandia, Gimnasio La Montaña

We use the problem-solving strategies proposed by Knight and others in their book *College Physics*, to give the tools that students need to build dynamic models in a video analysis tool, in this case Tracker. Taking into consideration different situations, we develop a workshop series that allows the students build the free-diagram body. Through this diagram, they can build dynamic models that can be used in Tracker to run a simulation, and compare the latter with a situation showed in video.

PST2E05: 8:30-9:15 p.m. Responsive Teaching: A Practitioner's View

Poster – Sharon G. Fargason, Fay Elementary School, San Diego, CA 92105; sharonfargason@gmail.com*

Responsive teaching offers students the opportunity to learn science in the spirit of the discipline itself. Students work together to explain, question, model, test, and evaluate their own ideas, rather than follow a prescribed set of directions or recipes for experiments. The curriculum evolves on the basis of the ideas that students bring up, and the role of the teacher is to recognize, draw out, and build on the nascent scientific ideas that students offer. Data from my third grade classroom will highlight what responsive teaching is, how teacher pedagogy and planning are affected, and the ways that students develop skills and routines that are critical to the discipline of science.

*Sponsor: Amy Robertson

Session FA: ALPHA Projects: Mentoring and Student Projects

Location: Salon 3
Sponsor: Committee on Laboratories
Co-Sponsor: Committee on Physics in Undergraduate Education
Date: Tuesday, January 7
Time: 8:30–10 a.m.

Presider: Joe Kozminski

FA01: 8:30-9 a.m. The Sure-fire Fool-proof Guaranteed (non-existent?) Project Mentoring System

Invited – Eric Ayars, California State University, Chico, Campus Box 202, Chico, CA 95929-0202; ayars@mailaps.org

Every student is different. Every project is different. It stands to reason, then, that every student project is different-squared, and mentoring student projects in any systematic way becomes a challenge. I don't have the one perfect answer to those challenges, but I hope to present some techniques for time and project management that can help to make student projects productive and beneficial for all concerned.

FA02: 9-9:30 a.m. High Altitude Ballooning

Invited – David Pawlowski, Eastern Michigan University, 325 Strong Hall, Ypsilanti, MI 48197-2207; dpawlows@emich.edu

For the past two years, senior physics students at Eastern Michigan University have been tasked with researching, designing, building, and launching a weather balloon that must reach nearly 100,000 feet above the Earth's surface. While the students are given a list of the primary instrumentation for the balloon, they are asked to determine the best method for integrating the components. This presentation will introduce the details of this project and summarize the successful aspects of it as well as the parts that didn't always go so well. There may also be an image or two of southeastern Michigan from near-space

FA03: 9:30-10 a.m. Mentoring Undergraduate Projects: The Hardest Part Is Before They Start

Invited – Linda S. Barton, Rochester Institute of Technology, School of Physics and Astronomy, Rochester, NY 14623; lsbsps@rit.edu

Mentoring a successful undergraduate research or research-like project presents a number of challenges. Many of the largest hurdles can be avoided or minimized with careful forethought, before the work begins, by the mentor. In this talk, we discuss how to gauge a student's skill set and interests so as to place them in an appropriate project, and how to set realistic limits on the scope of a project. Strategies for fair yet rigorous assessment of student performance will also be discussed. Each of these issues are best addressed before a project ever begins. Examples are taken both from the mandatory year-long capstone project that all physics majors must complete, as well as sophomore and junior projects, at RIT. Finally, we reflect on how the traditional undergraduate curriculum could be improved to bridge the gap between classwork and research.

Tuesday, January 7 Highlights

REGISTRATION	8 a.m.–3 p.m.	Ballroom Foyer
PERTG Town Hall	7:30–8:30 a.m.	Salon 4
Programs Committee II	7–8:30 a.m.	Salon 14
SEES (Students to Experience Engineering and Science)	9 a.m.–12 p.m.	Grand Ballroom C
Kindle Raffle	10:45 a.m.	Exhibit Hall

OERSTED MEDAL TO: DEAN ZOLLMAN
10–11 a.m. Grand Ballroom B

DISTINGUISHED SERVICE AWARDS
11–11:30 a.m. Grand Ballroom B

PRESIDENTIAL TRANSFER
11:30–11:45 Grand Ballroom B

Great Book Giveaway 11:45 a.m. Grand Ballroom Foyer

SYMPOSIUM ON PHYSICS EDUCATION & PUBLIC POLICY
1:30–3 p.m. Grand Ballroom B

Poster Session 3: 3–4 p.m. Grand Ballroom Foyer

Session FB: Broader Perspectives: Active Learning Strategies

Location: Salon 6
Sponsor: Committee on International Physics Education
Co-Sponsor: Committee on Research in Physics Education
Date: Tuesday, January 7
Time: 8:30–9:50 a.m.

Presider: Genaro Zavala

FB01: 8:30-9 a.m. Participationist Perspective on Modeling Instruction*

Invited – Eric Brewe, Florida International University, Miami, FL 33199; United States ebrewe@fiu.edu

Vashti Sawtelle, University of Maryland

Modeling Instruction is an active learning strategy built on the premise that science proceeds through the iterative process of model construction, development, deployment and revision. We adopt a participationist perspective on learning to analyze student engagement in the classroom. In this presentation we provide a theoretical background on models and modeling and describe how these theoretical elements are enacted in the introductory university physics classroom. Using video data, we link the development of a conceptual model to the design of the learning environment. We further discuss the implications of culture and context on the development and enactment of Modeling Instruction.

*Supported in part by NSF 0802184 & DUE 1140706

FB02: 9-9:30 a.m. An Integrated Physics and Math Modeling-based Course

Invited – Jorge E. De La Garza, Becerra Tecnologico de Monterrey, Av. Eugenio Garza Sada 2501, sur Monterrey, NL 64849, Mexico; jedelagb@gmail.com

Angeles Dominguez, Tecnologico de Monterrey

A course based on Modeling Instruction that integrates the teaching of physics and mathematics was designed and implemented at a private university in northern Mexico. This integrated Physics 1 and Calculus 1 course is based on the curriculum developed at Florida International University. This integration is structured having a modeling perspective of learning that allows the construction of increasingly robust models and the need for more sophisticated mathematics as the semester progresses. Also, this course relies heavily on active learning and cooperative learning. At the end of the semester, students commented that they perceive a better connection between the math and the physics topics and gains in the FCI were comparable to those in the Honors classes at the same university. Furthermore, in a final project done by students we found that those who used more representations were less likely to make mistakes. The university is working on the implementation of the entire sequence of integrated courses in physics and mathematics for engineering students.

FB03: 9:30-9:40 a.m. Phenomenon-based Learning: Using Toys to Teach Physics

Contributed – Matthew Bobrowsky, 11300 Classical Ln., Silver Spring, MD 20901; matt@msb-science.com

In the spring, the first in a series of books on "Phenomenon-Based Learning" (PBL) will appear. Why PBL? PISA assessments showed that Finnish students were among the top in science proficiency levels. Of 74 countries, in 2009 Finland ranked #2 in science. (The U.S. ranked #23.) Finland is now seen as a major international leader in education, and U.S. educators and political leaders have been traveling to Finland to learn the secret of their success. The PBL teaching philosophy combines elements of what's done in Finland with what's known about effective science teaching based on science education research to present science in ways that are both fun and educational. The approach includes progressive inquiry, problem-based learning, project-based learning, and, hands-on experiments. The idea is to teach broader concepts and useful thinking and performance skills (as with NGSS) rather than asking students to simply memorize facts.

FB04: 9:40-9:50 a.m. Translation and Dissemination of the FCI in Japan

Contributed – Michi Ishimoto, Tosayamada-cho, Kami-shi, Kochi Japan; ishimoto.michi@kochi-tech.ac.jp

For a decade, the Force Concept Inventory (FCI) has been considered an effective concept inventory in Japan. Several teachers have translated the FCI into Japanese to assess high school- and college-level students. In 2011, these teachers amalgamated several versions into a unified version. This presentation reports on the amalgamation process and on the problems encountered with the translation and implementation during this process. The unified version, along with a preface detailing its proper use and storage for users, has been uploaded to the Arizona State University Modeling Instruction website. I present the peculiar difficulties associated with translating the concept inventory from English into Japanese (two very different languages) and the misuses of the concept inventory owing to Japanese teachers' misunderstanding of its purpose. A brief statistical evaluation is also provided to verify the use of a unified translated version of the FCI for assessing Japanese students.

Session FC: Engaging Physics and Astronomy Students in Service Learning

Location: Salon 7
Sponsor: Committee on Physics in Undergraduate Education
Date: Tuesday, January 7
Time: 8:30–9:40 a.m.

Presider: Kathleen Falconer

FC01: 8:30-9 a.m. Service-learning Perspectives from Engineering and Applied Science: How it Works

Invited – Suzanne Keilson, Loyola University Maryland, Baltimore, MD 21210-2694; skeilson@loyola.edu*

This talk will provide instructors and faculty new to service-learning with some background on the definitions and distinctions among service, service-learning, and engaged scholarship. Specific examples taken from engineering and applied science fields will be presented. Some information on national networks and resources such as Campus Compact as well as venues for scholarly publication will also be provided. Although it may seem daunting, bringing service or service-learning into the science classroom is a pedagogical option and one that can have benefits in engaging students, providing them with additional motivation for STEM studies, and help them see scientific issues in societal and cultural contexts as well as purely technical ones. The use of service-learning in undergraduate engineering education has grown rapidly in the past two decades. It is seen as an excellent methodology for meeting various accreditation learning outcomes (ABET) that promote integrating reflection and various so-called "soft skills" into the engineering curriculum.

*Sponsored by Nancy Donaldson

FC02: 9-9:30 a.m. Service Learning in Introductory Astronomy & Physics

Invited – Michael P. Orleski, Misericordia University, Dallas, PA 18612; morleski@misericordia.edu

Faculty in the Physics Department at Misericordia University incorporate Service Learning into some introductory astronomy and physics courses. Astronomy students conduct observation sessions for local school classes and the MU campus community. Physics students work with not-for-profit organizations such as Habitat for Humanity

and Rails to Trails performing manual work. A key component of Service Learning is reflection on the service activity after it is completed. Astronomy students analyze how the preparation and operation of the observations aids their learning in the class and how it affects the attendees. Physics students analyze how they use physics, such as motion, forces, and levers, in the tasks they perform. A description of how Service Learning in supported at MU will also be presented.

FC03: 9:30-9:40 a.m. Incorporating Service-Learning in Physics for the Life Science Majors: Pedagogy and Practice

Contributed – Irene Guerinot, Maryville College, Maryville, TN 37804; irene.guerinot@maryvillecollege.edu

While service-learning continues to gain credibility as an effective tool for helping students meet course learning objectives, many higher education practitioners still do not consider incorporating this pedagogy into their courses. In an effort to revitalize the introductory physics courses offered at Maryville College, and to engage students in active learning that demonstrates the relevance and importance of academic work for their life experience and career choices, I decided last year to implement service learning in one of my physics classes. My students assisted Maryville Junior High (MJH) students with preparations for the Science Olympiad Competition. In my talk I will discuss the development of this new material and how it facilitates mastery of the course's learning objectives.

Session FD: Why Do I Need a 3D Printer for my Physics Department?

Location: Salon 8
Sponsor: Committee on Educational Technologies
Date: Tuesday, January 7
Time: 8:30–9:30 a.m.

Presider: Anne Cox

FD01: 8:30-9 a.m. 3D Printing: Student Projects and Undergraduate Research

Invited – Andrew Dawes, Pacific University, Forest Grove, OR 97116-1797; dawes@pacificu.edu

Student projects and undergraduate research labs operate on tight time schedules and often realize new equipment needs without advance notice. The ability to respond quickly by creating mechanical parts in-house can make the difference between finishing a project and waiting around for a delivery. I will present and discuss several student projects that have used the 3D printer in our physics department. These include printed parts for classroom projects, summer research activities, and community outreach programs. Additionally, I will give an overview of a typical part-creation workflow using free software tools.

FD02: 9-9:30 a.m. Building a Justification for a 3D Printer Layer by Layer

Invited – Mike Hicks, Nielsen Media Research, 501 Brooker Creek Blvd., Oldsmar, FL 34677; 1mikehicks@gmail.com

Budgets are tighter than ever...but still, you really really want a 3D printer! Why? Because it would be really cool and fun! Unfortunately, cool and fun don't always win in the budget process. This talk is designed to add "quite useful" to your reasons by providing a list of concrete (or at least plastic) benefits, as well as ideas for how your students can meaningfully use 3D printing for labs and experiments. In addition, there will be a discussion of free 3D modelling software options and the variety of places to find ready-made models online. Finally, a realistic view on costs and maintenance will keep the discussion from being two dimensional.

Session FE: Bridging Teacher Preparation and Professional Development

Location: Salon 11
Sponsor: Committee on Teacher Preparation
Date: Tuesday, January 7
Time: 8:30–10 a.m.

Presider: Paula Heron

FE01: 8:30-9 a.m. Preparing Pre-service and In-service Physics Teachers to Teach Through Inquiry *

Invited – Donna L. Messina, University of Washington, Department of Physics, Seattle, WA 98195-1560; messina@phys.washington.edu

The Physics Education Group (PEG) at the University of Washington has a long history of conducting courses for both pre-service and in-service teachers. Two major goals are: (1) to help teachers develop a deep and robust understanding of the pivotal topics in physics that they are expected to teach and (2) to provide them with the experience of learning in the way they are expected to teach (through a process of inquiry). These goals, together with ongoing research on the learning and teaching of physics, have guided the development of Physics by Inquiry.[1] This talk illustrates the ways in which these materials help teachers learn (or relearn) physics content and model an approach to teaching through inquiry. Other course components that contribute to the professional development of both pre- and in-service teachers will also be discussed, including how these courses can help build professional learning communities between both groups.

*This work has been supported in part by the National Science Foundation.

1. L.C. McDermott and the Physics Education Group at the University of Washington, *Physics by Inquiry* (Wiley, 1996).

FE02: 9-9:30 a.m. Teachers in Industry: Bridging Academic and Real-World Learning

Invited – Julia Olsen, University of Arizona/Teachers in Industry College of Education, Tucson, AZ 85721; jkolsen@email.arizona.edu

The Teachers in Industry program (formerly known as MASTER-IP) is now in its fifth successful year. Many teachers have never had practical experience with the content they teach, therefore this program bridges academics and real-world experiences. Our teachers are becoming teacher-leaders and mentors in their schools and some are gaining local and even national recognition. Highly skilled and creative STEM teachers are an asset to schools and districts across the state and to the businesses they work for in the summers. We provide a combination of paid summer work experience in Arizona businesses and industries combined with intensive coursework leading either to a Masters Degree in Teaching and Teacher Education or professional development credits, depending on the needs of each individual teacher. Our program is amassing significant research data, and this talk will describe the program model and results to date.

FE03: 9:30-10 a.m. Teacher Preparation and Teacher Retention: A Missing Link

Invited – James Flakker, Rutgers University, New Brunswick, NJ 08901-1183; jim.flakker@gse.rutgers.edu

Eugenia Etkina, Rutgers University

Physics teacher retention depends strongly not only on the education of teachers, specifically on their knowledge of the discipline (normative content and scientific inquiry practices) and ways to implement inquiry in the classroom, but also on the practical ability to enact this knowledge in the classroom and on the productive interactions with other teachers. The goal of this talk is to describe how a physics teacher preparation program can structure the clinical experiences of the pre-service teachers and develop a learning community of the in-service teachers to purposefully help the program graduates stay in the profession.

Session FF: Physics for Non-Scientists

Location: Salon 9
Sponsor: Committee on Physics in Undergraduate Education
Co-Sponsor: Committee on Women in Physics
Date: Tuesday, January 7
Time: 8:30–9:50 a.m.

Presider: Christopher Moore

FF01: 8:30-9 a.m. Developing General Scientific Literacy in Liberal Arts Students*

Invited – Karen Cummings, Southern Connecticut State University, New Haven, CT 06515; cummingsk2@southernct.edu

Jeffry Marx, McDaniel College

We have developed and assessed a new introductory physics course for liberal arts students in which improving students' scientific literacy and attitudes toward science are the primary and explicit goals. At Southern Connecticut State University this course is a relatively large enrollment course with a laboratory component. The weekly laboratory activities include materials specifically developed for the course under an NSF CCLI (TUES) grant. These activities provide students direct experience with science as a process and routinely engage them in evidence based reasoning and model building. In this talk we will discuss our specific goals for the course and the materials developed. We will also present assessment data collected at Southern Connecticut State University including the initial and final states of our students' attitudes and beliefs about science and their scientific reasoning ability as measured with the Lawson test.

*Support provided by the National Science Foundation (Due-0941899)

FF02: 9-9:30 a.m. Physics for Non-Scientists Does Not Mean 'Physics Light'

Invited – Scott Calvin, Sarah Lawrence College, Bronxville, NY 10708; scalvin@mailaps.org

At Sarah Lawrence College, there are no formal majors, so there is not a sharp distinction between classes for scientists and those for non-scientists. This has led to the creation of a new type of class: the "open" course, meant to appeal both to students with considerable scientific experience and those with none. In order to do this, the subject matter must be orthogonal to the standard physics curriculum, and students need to be asked to draw on skills from a variety of disciplines. This talk will describe both the general philosophy used in designing these courses, and three specific courses of this type: Crazy Ideas in Physics, Rocket Science, and Steampunk Physics. While the curricular structure at Sarah Lawrence is unusual, it is hoped that insights gained from these courses can contribute to rethinking and reinvigorating general education courses at other institutions.

FF03: 9:30-9:40 a.m. Bridge Building to Non-Science Majors and Helping Them Cross

Contributed – Jaime E. Demick, Huntingdon College, Montgomery, AL 36106; jdemick@hawks.huntingdon.edu

Non-science students are the future industrial, business, political and social leaders of the global society. The future of scientific research depends on the willingness of these leaders to support it. Therefore, it is imperative to successfully instill basic scientific knowledge in these students and to cultivate a positive attitude of respect and understanding, which they will carry forward into their respective career fields. The author has developed an undergraduate physical science course that attempts to engage students by making science relevant to their personal and professional lives. This is accomplished by 1. Investigating scientific history and progress and the social, political, and economic factors influencing them, 2. Examining the mathematics and principles involved in areas of science that students already encounter in their daily lives, and 3. Facilitating the self-discovery of the relevance of science to their fields through a series of short written assignments pertaining to climate change.

FF04: 9:40-9:50 a.m. Development of a Blended Physical Science Course

Contributed – Sytil K. Murphy, Shepherd University, Shepherdstown, WV 25443; smurphy@shepherd.edu

Jeff Groff, Shepherd University

A blended course combines both traditional and online course content. In summer 2013, a blended physical science course for non-science majors was developed. A majority of the lecture portion of the course was online while the laboratory portion remained traditional. The blended course was implemented during a summer session concurrent with course development. In this talk, the course, the materials developed, the data obtained after their implementation, and the subsequent refinements to the course will be discussed.

Session FG: Distance Labs

Location: Salon 10
Sponsor: Committee on Laboratories
Co-Sponsor: Committee on Educational Technologies
Date: Tuesday, January 7
Time: 8:30–10 a.m.

Presider: Steve Spicklemire

FG01: 8:30-9 a.m. Interactive Online Laboratories

Invited – Mats Selen, University of Illinois, Urbana, IL 61801; mats@illinois.edu

We have built an inexpensive battery-powered wireless laboratory system that allows students to do hands-on physics activities outside the classroom, guided by their own computer. The system, called IOLab, combines flexible software with a wireless data acquisition platform containing an array of sensors to sample and display real-time measurements of position, velocity, acceleration, force, rotation rate, orientation, magnetic fields, voltages, light intensity, sound intensity, pressure, and temperature. In this talk I will demonstrate the IOLab system and will show results from two clinical studies done at the University of Illinois to assess the learning outcomes of students performing Interactive Online Laboratories in an independent setting.

FG02: 9-9:30 a.m. Do Labs Need to be Done in a Laboratory?

Invited – Curtis M. Shoaf, Parkland College, Champaign, IL 61821; shoaf@uiuc.edu

The Influence of Laboratory Delivery Method on Learning Outcomes. Students in an introductory algebra-based physics laboratory course were randomly assigned labs of different delivery methods. The methods where: Traditional, Virtual and Lab Kit. Each lab, despite using different methodology, was designed to address the same learning objective outcomes. Results of learning objective outcomes as well as students' satisfaction with each method will be discussed.

FG03: 9:30-9:40 a.m. Lessons Learned Implementing Online Laboratories at the University of Arkansas

Contributed – John C. Stewart, University of Arkansas, Fayetteville, AR 72701; johns@uark.edu

To increase access and to improve ease of transfer, the University of Arkansas-Fayetteville will be offering its first-semester, calculus-based physics class online to all 11 campuses of the University of Arkansas system beginning in the spring 2014 semester. This requires implementation of online laboratory experiences that were piloted at the Fayetteville campus during the fall 2013 semester. These laboratories used a mix of simulations and video recording of experiments to replace face-to-face laboratories. The interactive nature of the face-to-face laboratory was partially replaced by inserting quiz questions at points in the laboratory. A video recording of the instructor discussing each quiz question was made available to the students. This talk will report on the lessons learned in this project.

FG04: 9:40-9:50 a.m. Using Mobile Devices in an Online Physics Laboratory

Contributed – Kendra J. Sibbernsen, Metropolitan Community College, Omaha, NE 68103; ksibb@cox.net

A pilot class of the first semester of algebra-based physics lecture and laboratory was offered completely online at MCC in the fall term of this year. The laboratories used inquiry-based activities that focused on getting students to ask their own scientific research questions, take the data to answer those questions, analyze that data, and then draw conclusions. Students were encouraged to use the sensors in their own smart phones or tablets, such as the video camera for measuring motion, the accelerometer to measure acceleration, the microphone for measuring frequencies, and more. A report will be given on the successes and challenges of offering a physics class in this format.

FG05: 9:50-10 a.m. Teaching Physics Labs at a Distance

Contributed – Andreas Veh Kenai, Peninsula College, Soldotna, AK 99669; ifafv@uaa.alaska.edu

The presenter has been developing an at-home physics lab manual for a college introductory physics lab. This talk covers: a comparison to published lab manual(s); the preparation for at-home labs; the successes and challenges of at-home labs.

Session FH: PER: Student Reasoning and Problem Solving

Location: Salon 5
Sponsor: AAPT
Date: Tuesday, January 7
Time: 8:30–9:50 a.m.

Presider: Kathy Harper

FH01: 8:30-8:40 a.m. Learner Intuitions about Thermal Energy and Dispersal*

Contributed – Abigail R. Daane, Seattle Pacific University, West Seattle, WA 98115-3755; abigail.daane@gmail.com

Sarah B. McKagan

Stamatis Vokos, Rachel E. Scherr, Seattle Pacific University

In most energy scenarios, thermal energy is produced and dissipated. For example, when a ball rolls to a stop, kinetic energy transforms into thermal energy that spreads into the environment. The ball's movement is a perceptible indicator of the presence of kinetic energy. The thermal energy, however, is likely to be imperceptible, and as the ball slows, the decrease of a perceptible indicator can seem to suggest a violation of the principle of energy conservation. We present data of teachers-as-learners working to identify evidence of energy which has lost its perceptible indicators. We argue that mechanisms of energy transformation constitute evidence of imperceptible energy for learners.

*This material is based upon work supported by the National Science Foundation under Grant Nos. 0822342 and 1222732.

FH02: 8:40-8:50 a.m. Characterizing Students' Use of Models During Experimentation

Contributed – Benjamin M. Zwickl, Rochester Institute of Technology, Rochester, NY 14623-5603; benjamin.m.zwickl@rit.edu

H. J. Lewandowski, Noah Finkelstein, University of Colorado Boulder

Models are simplified and abstract representations of real-world phenomena that are used for creating and communicating scientific explanations. In this study we analyze students' use of models in a 30-minute think-aloud lab activity involving basic electronic and optical components. The framework used for our fine-grained analysis of modeling during experimentation was developed independently in the context of curriculum development for upper-division physics laboratories. We review general patterns in students' use of models, describe our coding scheme, and conclude with a discussion of implications for the design of modeling-focused lab activities and lab-appropriate assessments.

FH03: 8:50-9 a.m. Do Visual-Spatial Abilities Impact Student Performance on Wave Tasks?

Contributed – Alexandra Lau, Mount Holyoke College, South Hadley, MA 01075; alau693@gmail.com

Mila Kryjevskaia, North Dakota State University

The wave phenomena typically discussed in introductory physics courses form the foundation for more advanced physics topics such as electrodynamics and quantum mechanics. However, it has been found that many students experience significant difficulties when they attempt to express a distance in terms of the wavelength of a periodic wave. The ability to perform such a basic task correctly is essential for understanding interference and diffraction phenomena. We hypothesized that the poor student performance on this type of task may stem from difficulties with visualizing the situation and reasoning spatially. We administered the Paper Folding Test (PFT) in order to assess students' visual-spatial skills. Then, we probed the relationship between these skills and student performance on tasks in the context of water waves. We have identified consistent and statistically significant differences in PFT scores between students who complete basic wave tasks correctly and those students who do not.

FH04: 9-9:10 a.m. Influence of Visual Cueing and Correctness Feedback on Students' Reasoning*

Contributed – Amy S. Rouinfar, Kansas State University, Manhattan, KS 66506; amy.rouinfar@gmail.com

Elise Agra, Jeffrey Murray, Xian Wu, N. Sanjay Rebello, Kansas State University

Research has demonstrated that using visual cues to focus students' attention on relevant areas in diagrams and animations can increase comprehension and facilitate problem solving. In this study we investigate the effectiveness of visual cues and correctness feedback in conceptual physics problems containing a diagram with respect to comprehension and transfer of physics concepts. Students (N=90) enrolled in an introductory mechanics course were individually interviewed. During each interview students worked through four sets of problems containing a diagram. Each problem set contained an initial problem, six isomorphic training problems, and a transfer problem. Answers and explanations were given verbally. Students in the cued conditions saw visual cues on the training problems, and those in the feedback conditions were told if their responses were correct or incorrect. We discuss the influence of both cueing and feedback on students' reasoning.

*This work is supported by the National Science Foundation under grants 1138697 and 0841414. Sponsored by N. Sanjay Rebello.

FH05: 9:10-9:20 a.m. The Role of Heuristic-analytic Theory in Probing Student Metacognition*

Contributed – Mila Kryjevskaia, North Dakota State University, Department of Physics, Fargo, ND 58108-6050; mila.kryjevskaia@ndsu.edu

MacKenzie R. Stetzer, University of Maine

It is commonly expected that, after instruction, students will consciously and systematically construct reasoning chains that start from established scientific principles and lead to well-justified predictions. Poor student performance on exams is often attributed to a lack of understanding or an inability to construct inferential reasoning chains. Psychological research, however, seems to indicate that thinking processes often follow paths that are strikingly different from those outlined above. The extended heuristic-analytic theory of thinking and reasoning suggests that two types of cognitive processes are involved in building inferences: heuristic and analytical. Some researchers argue that metacognition mediates the connection between the two. In this talk, we will illustrate the applicability of this theory to student performance on written questions and describe the theory's relevance to efforts to probe student metacognitive abilities.

*This work has been supported in part by the National Science Foundation under Grant Nos. DUE-1245999, DUE-1245313, and DUE-0962805.

FH06: 9:20-9:30 a.m. Supporting Student Metacognition in Introductory Physics

Contributed – Alistair G. McInerny, Western Washington University, Bellingham, WA 98225; mcinera@students.wwu.edu

Andrew Boudreaux, Western Washington University

Mila Kryjevskaia, North Dakota State University

Metacognition, or "thinking about thinking," is known to be central in the practice of expert learners. Western Washington University introductory physics labs for science and engineering majors incorporate activities designed to encourage the development of metacognitive skills. In weekly writing exercises, students reflect on what they knew before instruction, what they learned during instruction, and how they learned it. Analyses of a large sample of student data has led to insights into how students' reflective writing can be used as a valuable source of data. Data will be presented and implications for both research and instruction will be discussed.

FH07: 9:30-9:40 a.m. Problem Solving Reflection: Homework versus In-Class Problem Solution

Contributed – Andrew J. Mason, University of Central Arkansas, Lewis Science Center, AR 72035-0001; ajmason@uca.edu

A preliminary study in a spring 2013 introductory physics for life sciences (IPLS) course focused on a metacognitive activity of reflecting on a chosen homework problem during the initial portion of each lab over the duration of the course, with the assistance of a reflection rubric. Artifact data was gathered from a MPEX pre-post survey, students' reflection attempts and exam solutions, and a post-test reflection survey. Combined data suggested that students were of mixed-to-positive opinion of the metacognitive activity. While students appeared to benefit somewhat, many chose to obviate the exercise a priori by obtaining the correct solution for the homework problem in advance. To explore the robustness of these indications, implementations to the exercise were made to be more ergonomic to the course material and prevent this occurrence. We revisit the preliminary data from last spring in light of the fall semester's progress.

FH08: 9:40-9:50 a.m. Investigating Impacts of Various Types of Equation Sheets on Problem Solving

Contributed – Bijaya Aryal, University of Minnesota-Rochester, Rochester, MN 55904; baryal@umn.edu

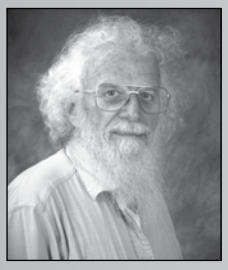
This presentation reports on a comparative study on students' problem solving performances when they use one of the two most popular open resources: either their own equation sheets or instructor-provided equation sheets. The study was carried out for four semesters in an introductory-level physics course. Student cohorts of previous two semesters were allowed to bring their own equation sheets for their tests whereas the student cohorts of the latter two semesters were provided the instructor prepared equation sheets. The results of the two implementations were compared using students' test scores and scores on various problem-solving categories indicated by a problem-solving rubric. This study revealed a relationship between student performance and the quality of their equations sheets. In addition, we found that use of instructor-prepared equation sheets have more positive influence on student performance as compared to student prepared equation sheets.

Awards Session

Location: Grand Ballroom B
Date: Tuesday, January 7
Time: 10–11:45 a.m.

Presider: Jill Marshall

Oersted Medal *presented to Dean Zollman*



Dean Zollman

Physics education research and teaching modern modern physics

Dean Zollman, Kansas State University, Manhattan, KS 66506; dzollman@phys.ksu.edu

Modern Physics has been used as the label for most of physics that was developed since the discovery of x-rays in 1895. Yet, we are teaching students who would not use the label "modern" for anything that happened before about 1995, when they were born. So, are we and our students in worlds that differ by a century? In addition to content, sometimes our students and we have differing views about methods and styles of teaching. A modern course in any topic of physics should include applications of contemporary research in physics education and the learning sciences as well as research and developments in methods of delivering the content. Thus, when we consider teaching Modern Physics, we are challenged with deciding what the content should be, how to adjust for the ever increasing information on how students learn physics, and the constantly changing tools that are available to us for teaching and learning. When we mix all of these together, we can teach modern Modern Physics or maybe teach Modern Physics modernly.

Homer L. Dodge Citations for Distinguished Service to AAPT

Jan Mader
Great Falls, MT
public schools

Taha Mzoughi
Kennesaw State
University

Gabriel C. Spalding
Illinois Wesleyan
University

Lee Trampleasure
Carondelet H.S.
Concord, CA

AAPT Presidential Transfer Ceremony

Gay Stewart
University of Arkansas
2013 AAPT President

Steven Iona
University of Denver
2014 AAPT President

Session GA: Stereotypes and the Princess Threat

Location: Salon 3
Sponsor: Committee on Women in Physics
Date: Tuesday, January 7
Time: 12–1:20 p.m.

Presider: John Ertel

GA01: 12-12:30 p.m. Attitudinal Shifts in Introductory Physics Through an Equity Lens

Invited – Adrienne L. Traxler, Florida International University, Department of Physics, Miami, FL 33199; altraxle@fiu.edu

Previous studies have documented gender and ethnicity "gaps" in grade or conceptual measures in introductory physics classes. The nature, causes, and remedies of these performance differences is of great interest to those attempting to improve the participation and retention of traditionally underrepresented groups in the field. Recent work at Florida International University found that women persistently lag behind men in Force Concept Inventory gains and student odds of success, even in reformed courses where both measures are higher than in traditional lecture. Here, I extend that work along the attitudinal dimension, reporting on six years of data from the Colorado Learning Attitudes about Science Survey. Data is taken from traditional and reformed sections of introductory physics and disaggregated by gender and ethnic representation. I will discuss patterns in student attitude shifts that tell a more ambiguous story than the "gap" narrative often found for conceptual measures.

GA02: 12:30-12:40 p.m. Preservice Teachers' Knowledge of Women's Contributions to Physics

Contributed – Jill A. Marshall, University of Texas at Austin, 1 University Station, Austin, TX 78703-2821; marshall@austin.utexas.edu

Despite their underrepresentation in the field, particularly in professional positions, women have made critical contributions to physics. Still, previous studies have shown that many physics teachers and students are unable to name a woman physicist other than Marie Curie and describe her work in any detail. This presents an equity issue, as access to role models has been shown to mediate access to careers. To remedy this, efforts are under way to create an article pack on women in physics from *The Physics Teacher* and the *American Journal of Physics* as a resource for physics teachers. To evaluate the need for such a resource, I administered an assessment of knowledge of the contributions of women in physics to preservice secondary STEM education teachers, many of whom will ultimately teach physics. The results are compared with a prior survey of preservice elementary teachers and general education students.

GA03: 12:40-12:50 p.m. Strategies for Identifying and Teaching Gifted Students in Physics and Astronomy

Contributed – Alice M. Hawthorne, Allen Concord University, Athens, WV 24740; amhallen@concord.edu

Gifted students in K-12 education become many of the students in our physics classrooms, but our training for university faculty positions contains little to no guidance on how to best teach and address their educational needs. Just based on population statistics and self-selection for additional education, all college classes are bound to have a gifted population regardless of institution and admissions selectivity, and independent of whether the students are identified as such. Recent research has also identified additional twice-exceptional students (i.e. individuals who are both gifted and have other special needs) where their exceptionalities mask each other and lead the student to not stand out academically. The extreme variability amongst gifted individuals makes teaching them an exceptional challenge. However, there are common characteristics that can be identified and teaching strategies that are successful in connecting with these students. These characteristics and strategies will be addressed in this talk.

GA04: 12:50-1:20 p.m. Why Aren't They Here?: The Impacts of Society's and Physics' Cultures on Women's Participation in Physics

Invited – Ramon S. Barthelemy, Western Michigan University, Kalamazoo, MI 49007; ramon.s.barthelemy@wmich.edu

Melinda McCormick, Western Michigan University

The issue of women in physics has been an important conversation in recent years when considering physics education. One aspect of this issue is not only the culture of physics, but also the culture of society at large. This talk will uncover the pressures of society that women experience juxtaposed with the culture of physics. It will be argued that women are both pushed away from physics by the culture of society at large and the micro-culture within physics. Points of discussion will include women in the media, the extreme competitiveness of physics, the conformity of physicists, and more.

Session GB: The "Maturing" Field of PER and Its Associate Implications

Location: Salon 5
Sponsor: Committee on Research in Physics Education
Co-Sponsor: Committee on Professional Concerns
Date: Tuesday, January 7
Time: 12–1:30 p.m.

Presider: Laura McCollough

GB01: 12-12:30 p.m. Graduate Students in PER: Demographics, Trajectory, and Climate Experiences

Invited – Ramon Barthelemy, Western Michigan University, Kalamazoo, MI 49007; ramon.s.barthelemy@wmich.edu

Ben Van Dusen, University of Colorado Boulder

Charles Henderson, Western Michigan University

PER is a new and rapidly growing research subfield of physics. Graduate programs have begun to establish PhD programs in PER within departments of physics and schools of education. However, little research has been conducted exploring the experiences and pathways of graduate students into PER. This talk will present qualitative and quantitative data on the experiences and educational pathways of graduate students in PER. Preliminary data suggests that less than half of PER graduate students intend to specialize in PER at the beginning of graduate school and, instead, switch into the field. This suggests that not enough undergraduate students are aware of PER. Additionally, it was found the students in PER experience a positive national community that affects their persistence in the field.

GB02: 12:30-1 p.m. The Growing Structure(s) of PER

Invited – Michael C. Wittmann, University of Maine, Orono, ME 04469-5709; mwittmann@maine.edu

The field of physics education research (PER) has changed in many ways since I joined it in the mid 90s. We have specialized conferences (PERC and FFPER), specialized journals (the PER section of AJP and Phys Rev), and organizational structures focused on our interests and needs (the PER Topical Group and PERLOC). The funding opportunities have changed (NSF, PhysTEC, and much more), and our interactions have, as well (Facebook, PERticles, and blogging). In this talk, I reflect on the changes in the community, mostly as a storyteller, and speculate on where we might be headed next. With broader goals and richer interactions, we're asking meaningful questions that the community wasn't asking even a decade ago. What comes next? Who knows, but it'll be fun.

GB03: 1-1:30 p.m. A Word of Caution About the Future of PER

Invited – Lillian McDermott, University of Washington, Department of Physics, Seattle, WA 98195-1560; lcmcd@phys.washington.edu

There seems to be an increasing tendency for research in physics education to extend beyond primarily intellectual issues to others that involve social and psychological considerations. Some of these deserve serious attention, but there may be unfortunate consequences if such studies dominate the field. Being able to obtain and retain a regular faculty position in a physics department is much more likely when one's research has a strong disciplinary emphasis. It is hard to make a strong case for tenure or tenure-track positions in physics departments, or even to influence physics faculty, if the research is not sufficiently content specific. For PER to thrive, it is necessary that at least a few universities maintain PER groups (with at least two or three physics faculty) with strong programs to prepare graduate students and post-docs to be future leaders in the field.

Session GC: Effective Practices in Educational Technology

Location: Salon 6
Sponsor: Committee on Educational Technologies
Date: Tuesday, January 7
Time: 12–1:20 p.m.

Presider: Frances Mateycik

GC01: 12-12:10 p.m. Challenges of Teaching a MOOC, Examples from 8.01x and 8.02x

Contributed – Saif Rayyan, MIT, 77 Massachusetts Ave., Cambridge, MA 02139-4307; srayyan@mit.edu

Daniel Seaton, John Belcher, MIT

How do you teach a Massive Open Online Course (MOOC) with tens of thousands of registered students? Who are the participants in your course and how do you meet their needs? What level of activity do you expect throughout the course? What are the best practices in creating interactive content for your course? What level of involvement do you expect to have with your students? I will attempt to answer some of these questions by presenting examples from 8.01x (Introductory Mechanics) and 8.02x (Introductory Electricity and Magnetism), the physics MOOC offerings on the edX platform (http://www.edx.org). I will also present some of the challenges associated with creating the course, including the limitation of the current technologies and the high cost of producing high quality content.

GC02: 12:10-12:20 p.m. Creating Online Learning Modules: Attending to Students Affect and Cognition

Contributed – Dedra N. Demaree, Georgetown University, Washington, DC 20057; dd817@georgetown.edu

Carolyn Wakulchik, Georgetown University

At the Center for New Designs in Learning and Scholarship at Georgetown University, we have been assisting faculty with creating online learning modules using the HTML-5 based Rapid eLearning Content Development tools Adobe Captivate 7 and Articulate Storyline. These modules are being used to supplement learning as well as to flip classrooms. We have found that faculty are excellent at explaining the content in their modules but often do not have a clear template for how to address the holistic student experience in the eLearning environment. In this talk, I will focus on how to structure such modules for physics learning to attend to affective issues and help assure that students' working memory is focused on the physics content rather than side issues such as module navigation. The talk will illustrate key design principles for creating self-directed learning modules that are easy for students to navigate and useful in providing real-time feedback to both the student and the instructor.

GC03: 12:20-12:30 p.m. Interactive Video Vignettes and Interactive Online Lectures*

Contributed – Robert B. Teese, Rochester Institute of Technology, Rochester, NY 14623; rbtsps@rit.edu

Thomas J. Reichlmayr, Rochester Institute of Technology

Priscilla W. Laws, David Jackson, Dickinson College

The LivePhoto Physics Project is creating a set of Interactive Video Vignettes and testing them at multiple institutions. These are short, online activities that combine narrative videos with interactive, hands-on elements for the user including video analysis or making predictions based on replaying segments of a video. Vignettes can also contain branching questions, in which the user's answer affects the sequence of elements that follow. The software that powers vignettes is delivered over the Internet and runs in a normal browser on the user's device. The same software can be used to make Interactive Online Lectures for flipped classrooms, online learning, and MOOCs. A Java application that teachers can use to create their own vignettes and online lectures is under development. The software will be demonstrated and the status of the development will be described.

*Supported by NSF grants DUE-1122828 and DUE-1123118.

GC04: 12:30-12:40 p.m. Integrating Simulations into the Introductory Calculus-based Sequence

Contributed – Ximena C. Cid, University of Washington, Department of Physics, Seattle, WA 98195-1560; xcid@uw.edu

The introductory sequence in physics has topics that are abstract and spatial in nature. These topics can be difficult for students to comprehend due to a variety of reasons, including increases in cognitive load. Previous research suggests that incorporating computer simulations can reduce cognitive load for specific topics, and thereby allowing students to dedicate more of their working memory to the task at hand. This talk will discuss the incorporation of computer-based interactive simulations, using the Glowscript language (based on the Vpython language), into various components of the introductory calculus-based sequence at the University of Washington.

GC05: 12:40-12:50 p.m. It Is Not a Flipped Classroom!

Contributed – Taha Mzoughi, Kennesaw State University, Department of Biology and Physics, Kennesaw, GA 30144-5591; tmzoughi@kennesaw.edu

In an effort to enhance student learning in introductory physics classes, I had gradually transformed my classes into what is now commonly referred to, to my chagrin, as flipped classrooms. The courses follow a hybrid format where most of the learning occurs outside of class. Before class, students complete online multimedia quizzes, embedding both short lecture type recording segments and simulations. Class time is devoted to students solving problems in teams. Homework is completed online. In classes that include labs, students complete pre-laboratory simulation mediated activities. Preliminary results seem to indicate improvement in student learning as well as an increase in the interest and appreciation of the topics covered.

GC06: 12:50-1 p.m. Technologies for Computational Physics*

Contributed – Larry Engelhardt, Francis Marion University, Florence, SC 29501-0547; lengelhardt@fmarion.edu

It is generally recognized that computer simulations provide important tools for solving a wide variety of 21st century physics problems. In this presentation, we discuss the technologies that we use for teaching undergraduate physics students to create and use computer simulations. At the introductory level, students use the Python programming language for creating simulations and analyzing data. At the upper level, students learn parallel programming and execute their simulations on a high-performance computing cluster.

*This project is supported by the NSF EPSCoR RII Track 1 cooperative agreement awarded to the University of South Carolina.

GC07: 1-1:10 p.m. Teaching Free-body Diagrams and Geometrical Optics Using Interactive Whiteboards

Contributed – Tatiana A. Krivosheev, Clayton State University, Morrow, GA 30260-0285; tatianakrivosheev@mail.clayton.edu

We present our experience of developing the interactive whiteboard flipcharts (IBWs) for the end-of-course exam review published by Houghton Mifflin Harcourt. The supplement is designed for Texas high school students and is built around the state performance standards (TEKS). We focus on the advantages that the IBWs present in the classroom compared to standard whiteboard teaching. Specifically, we discuss constructing a free-body diagram and building ray diagrams for lenses and mirrors.

GC08: 1:10-1:20 p.m. 3D Printing for the Undergraduate Lab

Contributed – Eric Ayars, California State University, Chico, Campus Box 202, Chico, CA 95929-0202; ayars@mailaps.org

Three-D printing offers the potential to produce custom-designed parts as easily as we now produce custom-designed paperwork. That potential is starting to be met. Consumer-grade 3D printers are available at reasonable prices, and the technology has reached a point at which it can be cost-effective to print parts for laboratory and student-project use. This talk will focus on the current state of 3D printing technology, with examples of uses from the physics department at CSU Chico. It will address the types of materials and shapes that can be printed, the hardware and software required, advantages and disadvantages of various 3D printer features, and some of the costs and pitfalls one can expect to encounter.

Session GD: Classical Mechanics in the Upper-Level Core: Frontiers and the Classroom

Location: Salon 7
Sponsor: Committee on Physics in Undergraduate Education
Date: Tuesday, January 7
Time: 12–1:30 p.m.

Presider: Juan Burciaga

GD01: 12-12:30 p.m. Using Research to Investigate and Enhance Learning in Upper-division Mechanics

Invited – Bradley Ambrose, Grand Valley State University, Department of Physics, Allendale, MI 49401; ambroseb@gvsu.edu

Researchers in physics education have repeatedly shown that traditionally taught introductory courses have minimal effect on the conceptual understanding, problem solving skills, and scientific reasoning ability of most students' including physics majors. Much of that research suggests that lingering difficulties can adversely impact student learning of more advanced material. Research in the context of sophomore/junior level courses in intermediate mechanics has been particularly fruitful in investigating student learning beyond the introductory level. Such research has also been invaluable in guiding the development and assessment of innovative instructional strategies that can complement (and exceed the effectiveness of) traditional lectures. This presentation will highlight results from research conducted at Grand Valley State University, the University of Maine (by co-PI Michael Wittmann) and pilot site institutions in the Intermediate Mechanics Tutorials project. We present evidence of specific student difficulties as well as examples of the use of guided inquiry in addressing these difficulties.

GD02: 12:30-1 p.m. Classical Mechanics Activities Across the Paradigms in Physics

Invited – Elizabeth Gire, University of Memphis, 421 Manning Hall, Memphis, TN 38152; egire@memphis.edu

Corinne A Manogue, Oregon State University

The Paradigms in Physics courses at Oregon State University are well known for blurring the traditional subdisciplines of physics. Topics in classical mechanics in particular are distributed throughout the curriculum and are often paired with topics from other subdisciplines. These pairings are chosen to reinforce conceptual and mathematical similarities among topics and to highlight important differences. The Paradigms in Physics courses also, and perhaps more importantly, feature a variety of active engagement instructional strategies. I will discuss a few of the classical mechanics activities with emphasis on their instructional goals and affordances, as well as the affordances of sequencing with topics in other subdisciplines. I will also comment on how these activities might be used in more traditionally structured classical mechanics courses.

GD03: 1-1:30 p.m. Developing Practicing Physicists: Transformations in Middle-Division Classical Mechanics

Invited – Marcos Caballero, Michigan State University, East Lansing, MI 48824-1046; caballero@pa.msu.edu

Steven J. Pollock, University of Colorado Boulder

At most universities, upper-division physics majors are taught using a traditional lecture approach that does not make use of instructional techniques that have been found to improve many aspects of student learning at the introductory level. Furthermore, while the scientific community leverages computational modeling to understand many physical systems, much of our physics majors' experience solely emphasizes analytical problem-solving. At the University of Colorado, we have transformed our middle-division classical mechanics course using the principles of active engagement and learning theory, guided by the results of observations, interviews, and analysis of student work. We have also begun to implement computational modeling. We will outline these transformations including consensus learning goals, clicker questions, tutorials, modified homeworks, and more, as an example of what a transformed upper-division course might look like. We are beginning to examine how our transformations impact student learning and affect, and we will report on these results.

Session GE: Sustainability of Teacher Preparation Programs

Location: Salon 8
Sponsor: Committee on Teacher Preparation
Date: Tuesday, January 7
Time: 12–1:30 p.m.

Presider: Steven Maier

GE01: 12-12:30 P.M. Sustainability Study of PhysTEC Sites

Invited – Monica Plisch, APS, 1 Physics Ellipse, College Park, MD 20740; plisch@aps.org

Rachel Scherr

The Physics Teacher Education Coalition (PhysTEC) project conducted a study on the sustainability of teacher preparation programs at sites that had previously received PhysTEC funding. A consultant (Rachel Scherr) conducted site visits and/or telephone interviews with eight institutions, and gathered qualitative and quantitative data. Quantitative data included longitudinal data on program funding, staffing, and physics education graduates. In addition, sites completed a survey to document sustainability of individual key components, i.e. whether each component was maintained, evolved, grown, reduced, or eliminated. Case studies of individual institutions looked at the institutional motivation for sustaining programs, the role of the champion, and the mechanisms for sustaining program activities. Results will be synthesized where possible to identify common themes among sites.

GE02: 12:30-1 p.m. Sustaining UTeach Programs

Invited – Michael Marder, The University of Texas at Austin, Department of Physics, Austin, TX 78712; marder@mail.utexas.edu

UTeach began in the fall of 1997 at UT Austin as a new way to prepare science and mathematics teachers. In 2006 program leaders created the UTeach Institute, and through partnership with several organizations, particularly the National Math and Science Initiative, UTeach began expanding across the U.S. By January 2014, over 40 universities will be part of the UTeach community. The idea of UTeach expansion is that after an initial five-year investment from external partners, each university will become self-sufficient and sustain its new teacher preparation pathway on internal resources. The first cohort of 13 UTeach universities has now completed the funding cycle, and we can begin to assess whether or not the plan has worked. Based on evidence we have gathered so far, despite a very challenging funding environment for public universities, all the original programs have in fact been sustained, and the original plans have worked out as intended. I will present an overview of UTeach, and information on the current status of the national UTeach experiment.

GE03: 1-1:30 p.m. Make It a Good Physics Program, Including Teaching, Teachers Follow*

Invited – Gay B. Stewart, University of Arkansas, Fayetteville, Department of Physics, Fayetteville, AR 72701; gstewart@uark.edu

John C. Stewart, University of Arkansas, Fayetteville

Some physicists still look at a good student who goes into high school teaching as a failure on the part of the department. To get a department behind programmatic changes that support the preparation of teachers, it helps if they can see the impact on the number of majors. Fortunately, at Arkansas, we have found that the two are one and the same. Good teaching, and good teaching skills, benefit all students, regardless of career path. Until UAteach, our UTeach replication, began in fall 2012, we did not have a separate advising sheet for teacher candidates. We still do not have a separate "track." In this presentation, we will explain how we went from an average of two to 25 graduates a year, many very successful by traditional standards (and coincidentally, from 0 to 6 teachers).

*Many thanks for the previous support of these efforts by NSF, through PhysTEC.

Session GF: The Relevance of Laboratory and Apparatus

Location: Salon 9
Sponsor: Committee on Physics in Two-Year Colleges
Co-Sponsor: Committee on Apparatus
Date: Tuesday, January 7
Time: 12–1:30 p.m.

Presider: Robert Hobbs

GF01: 12-12:30 p.m. Transforming Upper-division Lab Courses: Goals, Curriculum, and Assessments

Invited – Heather Lewandowski, University of Colorado, Boulder, CO 80309; lewandoh@colorado.edu

Preparing undergraduate physics majors for future careers in experimental science is one of the main goals of our current physics education system. Upper-division lab courses and undergraduate research experiences are the natural places where this training can take place. At the University of Colorado, traditional and PER faculty have been working together to comprehensively transform our Advanced Lab course and evaluate the impacts of these changes. I will discuss our effort to establish learning goals, transform the course, and measure the impact of the transformation on students' scientific process skills. As part of this effort, we developed a validated survey (E-CLASS) to assess students' attitudes and beliefs about experimental physics. This online survey is available to instructors at any institution that would like to learn more about the impact of their lab courses at all levels on students' attitudes about experimental physics. The survey is designed to give instructors actionable feedback to help them improve their courses.

GF02: 12:30-1 p.m. Four-Semester Laboratory Course: A Ramp Toward Doing Science

Invited – Anna Karelina, 42 Broadmoor Ct., San Ramon, CA 94583; anna.karelina@gmail.com

Through discussions and group meetings with faculty members of the Occidental College, we formulated the learning goals of introductory laboratories for physics and engineering majors. Using methods and approaches of the Investigative Science Learning Environment (ISLE)[1] we were able to create a consistent four-semester course sequence to achieve these goals. The course prepares students for independent research in advanced lab courses, for summer research, and their future scientific work. At the end the course our students demonstrate that they have built up higher-level thinking skills and scientific abilities, such as the ability to design an experiment, to test a hypothesis, to analyze, to evaluate the results and many others.

1. Etkina, E. & Van Heuvelen, A. (2001). Investigative Science Learning Environment: Using the processes of science and cognitive strategies to learn physics. Proceedings of the 2001 Physics Education Research Conference, Rochester, NY, 17-21

GF03: 1-1:10 p.m. Guidelines for the Undergraduate Laboratory Curriculum

Contributed – Joseph F. Kozminski, Lewis University, Romeoville, IL 60446; kozminjo@lewisu.edu

A subcommittee of the AAPT Committee on Laboratories* has been established to review various documents relating to goals of the undergraduate lab at all levels and to recommend guidelines or goals for the laboratory in the undergraduate curriculum. We are working to develop fairly broad guidelines that cut across the various levels of undergraduate labs and that can be implemented at any college or university. Specific recommendations will be given for implementation in introductory and advanced labs. The guidelines and recommendations generated by the subcommittee will be presented in this talk.

The other members of this subcommittee are Nancy Beverly, Duane Deardorff, Dick Dietz, Melissa Eblen-Zayas, Robert Hobbs, Dean Hudek, Heather Lewandowski, Steve Lindaas, Ann Reagan, Randy Tagg, Jeremiah Williams, Benjamin Zwickl.

GF04: 1:10-1:20 p.m. MOOC Tools to Enhance Professional Development in the Advanced Lab

Contributed – Sean P. Robinson, MIT, 77 Massachusetts Ave., Cambridge, MA 02139-4307; spatrick@mit.edu

I will describe recent experiences with the use of online education tools developed for the MOOC community (EdX) to enhance the purely residential educational experience for students in the MIT Physics advanced lab ("Junior Lab"). This is a rigorous academic subject that places heavy emphasis on the student's professional development as a scientist (e.g. oral and written communication, the troubleshooting process, professional scientific attitude, data analysis, reasoning about uncertainty), using experimental physics as the educational medium. Recent curriculum changes attempt to shift the content delivery phase for these broad learning goals into online preparatory exercises and video lectures, freeing up lab time with the faculty for more nuanced dialog and active practice. Preliminary and anecdotal results from the fall 2013 semester will be presented.

GF05: 1:20-1:30 p.m. Ranking College and University Physics Programs, According to their Laboratory Curricula

Contributed – Gabriel C. Spalding, Illinois Wesleyan University, Bloomington, IL 61702; gspalding@iwu.edu

The number of instructional lab courses offered to undergraduate physics majors does NOT appear to scale with the size of the institu-

tion/faculty resources or with endowment/financial resources, but may instead simply reflect the degree to which individual programs explicitly co-value lab instruction, both as a developmental platform for students and as a foundation for their future careers in scientific and technical areas. This talk will share some of the data collected, highlighting a variety of curricular models, and the possibility of ranking physics programs, according to their laboratory curricula.

Session GG: Inservice Preparation for Pre High School Teachers

Location: Salon 10
Sponsor: Committee on Physics in Pre-High School Education
Date: Tuesday, January 7
Time: 12–1:20 p.m.

Presider: Kathleen Falconer

GG01: 12-12:30 p.m. PET and the PET Diagnostic at Buffalo State College

Invited – David Abbott, Buffalo State College, Buffalo, NY 14222; abbottds@buffalostate.edu

Daniel MacIsaac, Buffalo State College

For more than a decade, Buffalo State College Physics has taught courses for pre-service elementary teachers, mostly using the Physics for Everyday Thinking curriculum and its precursor, Physics for Elementary Teachers. Over the last seven years, we have administered the PET Diagnostic Test to these students. We will present data and discuss lessons learned from the use of this instrument.

GG02: 12:30-12:40 p.m. Energy: Deeper and Cheaper: Lessons Low Cost but High Potential Part 1

Contributed – Gene Easter, retired, 540 South Ridgecliff, Tallmadge, OH 44278; gleaster@sbcglobal.net

Bill Reitz, retired

Nina Daye, Orange High School, Hillsborough, NC

Leslie Embrey, Apopka High School, Orlando,FL

Marge Cotton, University of Arkansas

A workshop was given to local Orlando third to fifth grade teachers prior to this Winter 2014 AAPT Meeting by a number of PTRAs. In this talk we will share the difficulties and successes of that workshop and the philosophy and hopes for future workshops. Meant as a guide to teaching energy concepts using the cheap and the familiar, the workshop attempted to develop deeper conceptual understanding of energy storage, transfer, transformation and degradation. We emphasized cutting down the cognitive load by reducing jargon and providing concrete examples from everyday experience. Activities were chosen to align with the NGSS and CCSS and were drawn from Energy Theater (Seattle Pacific University), Operation Primary Physical Science, Robert Karplus, Fred Goldberg and Pat Heller among others.

GG03: 12:40-12:50 p.m. Energy: Deeper and Cheaper: Low Cost High Potential Part 2

Contributed – William E. Reitz, retired, 2921 Kent Rd., Silver Lake, OH 44224; wreitz@neo.rr.com

Leslie Embrey, Apopka High School, Orlando,FL

Mari Hayes, Russelville High School, Russelville,AR

Marge Cotton, University of Arkansas

Nina Daye, Orange High School, Hillsborough,NC

A continuation of the discussion of a workshop presented in Orlando to grade 3 to 5 teachers prior to this Winter AAPT meeting. Part of the motivation to organize this workshop was to serve local pre-high school teachers of host city by utilizing the expertise of members who would be attending the meeting and introducing that community to the services of PTRA and AAPT. We will share the difficulties and successes of the workshop and the philosophy and hopes for future workshops.

GG04: 12:50-1 p.m. Online Inquiry-based Physics Content and Pedagogy for the Enhancement of Science Teacher Development: Elementary and Middle

Contributed – Chuck Fidler, Florida International University, Engineering and Computer Science Building, Miami, FL 33199; cfidler@fiu.edu

With the advent of digital learning platforms, approaches to providing inquiry-based professional development can facilitate physics education for pre- and in-service teachers. This approach uses research-based methods of online techniques and combines a best-practice approach to learner-centered experimental-based physics education. The cohort-model design employs flexibility within an instructor-paced program, uses digital platforms accessible from off-campus web-based environments, and is cost-effective. Proving these types of experience proved to be a valuable mechanism for promoting successful physics education to educational professionals. Results (n=20) demonstrated this approach provides a sustainable platform for the growth and access to exceptional physics teacher development structure within the elementary and middle school levels. Specific design strategies encompassed sustainability concerns including access, cost, time, attendance, resources, availability, peer-collaboration, and professional application. Program development was supported by NASA.

GG05: 1-1:10 p.m. Some Steps Toward Successful School Change*

Contributed – Gordon J. Aubrecht, OSU Marion, Delaware, OH 43015-1609; aubrecht.1@osu.edu

Bill Schmitt, Science Center of Inquiry

Jennifer L. Esswein, Tennessee Department of Education

A project that has been running in a high-needs urban district in a central Ohio rural area for the past five years has resulted in changes in teacher behavior. The project involved a summer and school year content program, grade-level lesson development by teachers working together during the school year, and (most novel) the use of common grade-level formative assessment analysis by teachers. These measures helped teachers become more active and involved students in hands-on, minds-on activities. Originally, the participating middle school teachers worked independently and seldom consulted one another. Minimal consultation also occurred among high school teachers. Now, teachers now work together in coordinating lessons at grade-level through the grant-supported quarterly meetings. After several years, teachers began trading topics among the grade levels, and also started to trust that the teachers at lower grade levels addressed designated topics with students.

*This work supported in part by grants from the Ohio Department of Education C1457-OSCI-09-49 (2008-2009), C1667-MSP-10-410 (2009-2010), EDU01-0000006141 (2010-2011), EDU01-0000007902 (2011-2012), GRT00029161 (2012-2013), and ODE-MSP-10673 (2013-2014).

GG06: 1:10-1:20 p.m. Science and Math Links: Research-based Teaching Institute

Contributed – Sydney C. Henson, Randolph College, Lynchburg, VA 24503; psheldon@randolphcollege.edu*

Katherine P. Lesnak, Peter A. Sheldon, Peggy Schimmoeller, Amanda Rumore, Randolph College

Student success within the science classroom is most evident when the teacher possesses an effective skill set and is fully prepared with a variety of methods and techniques. The Randolph College Science and Mathematics Teaching Institute aims to build teacher knowledge with hands-on and inquiry-based teaching in science and mathematics. The project examines the benefits and improvements in attitude and success displayed by teachers after an intensive week-long institute held on the college campus. The Institute's lessons are led by faculty members from mathematics, science, and education, and

are supported by summer research students. Pre- and post-institute self-reflective surveys of the teachers show a noted increased positive correlation towards teaching science and mathematics. We have also seen an increase in the Reformed Teaching Observation Protocol scores for all teachers participating in the Institute including lesson design, procedural knowledge, propositional knowledge, communicative interactions, and student/teacher relationships.

*Sponsored by Peter Sheldon

Session GH: Interactive Lecture Demonstrations – What's New? ILDs Using Clickers and Video Analysis

Location: Salon 11
Sponsor: Committee on Research in Physics Education
Co-Sponsor: Committee on Educational Technologies
Date: Tuesday, January 7
Time: 12–1:10 p.m.

Presider: Priscilla Laws

GH01: 12-12:30 p.m. Interactive Lecture Demonstrations: Active Learning in Lecture Including Clickers and Video Analysis

Invited – David Sokoloff, University of Oregon, Department of Physics, Eugene, OR 97403-1274; sokoloff@uoregon.edu

Ronald Thornton, Tufts University

The results of physics education research and the availability of microcomputer-based tools have led to the development of the Activity Based Physics Suite.[1] Most of the Suite materials are designed for hands-on learning, for example student-oriented laboratory curricula such as RealTime Physics. One reason for the success of these materials is that they encourage students to take an active part in their learning. This interactive session will demonstrate "through active audience participation" Suite materials designed to promote active learning in lecture, Interactive Lecture Demonstrations (ILDs)[2,3] including those using clickers and video analysis.

1. E.F. Redish, *Teaching Physics with the Physics Suite* (Wiley, Hoboken, NJ, 2004).
2. David R. Sokoloff and Ronald K. Thornton, *Interactive Lecture Demonstrations* (Wiley, Hoboken, NJ, 2004).
3. David R. Sokoloff and Ronald K. Thornton, "Using Interactive Lecture Demonstrations to create an active learning environment," *Phys. Teach.* **35**(6), 340 (1997).

GH02: 12:30-1 p.m. Interactive Lecture Demonstrations: Effectiveness in Teaching Concepts

Invited – Ronald Thornton, Tufts University, 4 Colby St., Medford, MA 02155; ronald.thornton@tufts.edu

David Sokoloff, University of Oregon

The effectiveness of Interactive Lecture Demonstrations (ILDs) in teaching physics concepts has been studied using physics education research based, multiple-choice conceptual evaluations.(1) Results of such studies will be presented, including studies with clicker ILDs. These results should be encouraging to those who wish to improve conceptual learning in their introductory physics course.

1. David R. Sokoloff and Ronald K. Thornton, "Using Interactive Lecture Demonstrations to Create an Active Learning Environment," *Phys. Teach.* **35**, 340 (1997).

GH03: 1-1:10 p.m. Clicker Questions for Interactive Lecture Demonstrations

Contributed – Tetyana Antimirova, Ryerson University, Toronto, ON M5B 2K3 Canada; antimiro@ryerson.ca

Lecture demonstrations are often counterintuitive and potentially confusing to students. Just showing the demonstrations in class can often lead the students to incorrect conclusions. Requiring the students to make predictions about the demonstration outcomes improves the effectiveness of the demonstrations.[1] Clickers allow very fast collection of the predictions in large-enrollment classes. However, the success of this approach relies on the availability of meaningful multiple choice questions to probe the students' understanding. We will discuss the multiple-choice questions writing activities in a large introductory physics class as well as an upper-year independent study project in which the students themselves learn how to create multiple choice questions for the interactive lecture demonstrations.

1. D.R. Sokoloff and R.K.Thornton, *Interactive Lecture Demonstrations, Active Learning in Introductory Physics* (Wiley, 2006).

SYMPOSIUM on Physics Education

AAPT Symposium on Physics Education and Public Policy

Juan-Carlos Aguilar

Paula R. Heron

Tuesday, January 7, 1:30–3 p.m. • Grand Ballroom B

Policymakers formulate decisions everyday that impact curriculum, standards, funding, and many other aspects of physics education at all levels. AAPT works with a number of partners to keep policymakers informed on the views of physics educators and to suggest appropriate policy options within the Association's sphere of influence. This session brings together individuals who play pivotal roles in helping to shape policies and who provide information to policymakers. We hope to provide a look at the process of policy making as well as actions you might make to contribute to decisions about policies affecting physics and STEM education.

This Symposium is being partially sponsored by funds contributed to the Memorial Fund in memory of Mario Iona. Iona, a long-standing and dedicated AAPT member, was the first Chair of the Section Representatives and served on the AAPT Executive Board, was a column editor in *The Physics Teacher*, presenter at many national AAPT meetings, recipient of the Robert A. Millikan Award in 1986, and relentless champion of correct diagrams and language in textbooks. Contributions to the Memorial Fund provide support for many AAPT programs such as the Symposium.

Facilitator: *Noah Finkelstein, Professor of Physics at University of Colorado at Boulder*

Speakers:

Juan-Carlos Aguilar, *Division of Curriculum, Instruction and Assessment, Georgia Department of Education, Atlanta, GA 30334; jaguilar@doe.k12.ga.us*

Paula R. Heron, *University of Washington, Department of Physics, Seattle, WA 98195; pheron@phys.washington.edu*

Session HA: Post Deadline Papers

Location: Salon 9
Sponsor: AAPT
Date: Tuesday, January 7
Time: 3–4 p.m.

Presider: David Sturm

HA01: 3-3:10 p.m. Conceptual Understanding of First Order RC-filters

Contributed– Pieter Coppens, KU Leuven Celestijnenlaan 200C, bus 2406 Heverlee, 3001 Belgium; pieter.coppens@mech.kuleuven.be

Mieke De Cock, KU Leuven

In a series of interviews conducted earlier,[1] several engineering students showed problems with a basic electronic circuit, a passive RC-filter. To verify how widespread these problems are, a series of conceptual questions was developed and administered to a total of 181 students of four Belgian university colleges, both before and after laboratory instruction on the subject. This revealed several issues that persist even after instruction, including problems with voltage divider, Bode plots and current-based reasoning. A detailed analysis with student answer examples will be presented.

1. Coppens, P., Cock, M. De, & Kautz, C. (2012). Student Understanding of Filters in Analog Electronics Lab Courses. In 40th SEFI Annual Conference: Engineering Education 2020: Meet the Future. Thessaloniki.

HA02: 3:10-3:20 p.m. Evaluation of the NGSS' Support of Large-scale Assessment

Contributed – Thomas J. Regan, The College Board, 11955 Democracy Dr., Reston, VA 20190; tregan@collegeboard.org

To evaluate the Next Generation Science Standards' (NGSS) support of a large-scale assessment system, I attempted to write items to the performance expectations (PEs) of Topic HS-PS2, Motion and Stability: Forces and Interactions. As background, the perspective of a large-scale assessment vendor/item writer on standards documents is described. Then, each of the PEs is carefully considered with respect to the guidance given to the item writer. Some difficulties encountered are: insufficiently characterized content and contexts, narrow student tasks, and questionable applications of inquiry activities. In addition, some language presents an inaccurate picture of what scientists do. Specific instances of these difficulties are presented. I conclude that these performance expectations, as written, require too much interpretation by the item writer to support a transparent large-scale assessment system. I will suggest improvements, noting also existing features of the NGSS that are conducive to transparent assessment.

HA03: 3:20-3:30 p.m. Surveying Students' Understanding of Measurement Uncertainty and Proportional Reasoning

Contributed – Jeffrey D. Marx, McDaniel College, Westminster, MD 21158-4100; jmarx@mcdaniel.edu

Karen Cummings, Southern Connecticut State University

As part of our NSF-supported curricular development efforts to create course materials to enhance the scientific literacy of undergraduate non-science majors, we are developing a survey instrument to probe this population's understanding of measurement uncertainty and proportional reasoning ability. By employing everyday items (scales, luggage, and kittens) and activities (weighing oneself and traveling) we have attempted to create an interview instrument and protocol that evokes and accommodates a wide range of responses and interpreta-

tions. Although still in the development phase, we can report that our population has a very difficult time applying measurement uncertainty and proportional reasoning, even after instruction designed to improve those principles.

HA04: 3:30-3:40 p.m. University Students' Reasoning of Transients in Electric Current Through a Conductor Wire

Contributed – Ane Leniz, Department of Applied Physics, University of the Basque Country, EHU-UPV, Polytechnic University College of Donostia-San Sebastian, Gipuzkoa, 20018 Spain; ane.leniz@ehu.es

Kristina Zuza, Jenaro Guisasola, University of the Basque Country, EHU-UPV

Models have been proposed for teaching DC circuits (Chabay & Sherwood). Those models aim to encourage students to articulate macroscopic and microscopic levels of description and understand the physical processes underlying the steady state laws (Kirchhoff laws). The development and implementation of these teaching models, which are more detailed and explicit than often made explicit in the introductory textbooks to electricity, raise new questions about the structure of students' reasoning and understanding of transient states of the electric current. In this paper we present a study of reasoning of first-year engineering students on transient states of electric current at a phenomenological level (macroscopic) and at a microscopic level the mechanisms underlying the flow of electrons.

HA05: 3:40-3:50 p.m. What Do Students Observe and What Do They Explain About the Zeeman Experiment?

Contributed – Zeynep Eygi, Canakkale Onsekiz Mart University, Canakkale, 017000 Turkey; zeynepdeniz@gmail.com

Nilufer Didis, Bulent Ecevit University

Zeeman Effect is one of the important experimental observations to explain quantization phenomena in atoms. Its correct understanding by students provides constructing the basic concepts about the interaction between an atom and external magnetic field and quantization of angular momentum in the atom. In this study, we examined ~40 undergraduate students' understanding of the Zeeman Effect in laboratory sessions of the applied modern physics course through two semesters. Students answered theoretical and conceptual questions individually and experimental questions with group members. Students' artifacts produced before, during, and after the experiment revealed that students had mainly declarative knowledge and limited procedural knowledge about the Zeeman Effect. This prevented (1) students from making sense of experimental observations and interpretation correctly; and (2) transfer and link of the other physical concepts such as optics.

HA06: 3:50-4 p.m. Technology Enhanced Teaching

Contributed – Shannon Feineis, Barrington High School, Barrington, IL 60010; sfeineis@barrington220.org

Technology has enhanced how I use videos in my high school physics classes. I use Paul Hewitt's video series for introducing new topics to my students. I also use YouTube to show relevant video clips for demonstrations during my class discussions. My students find video clips related to class and they post them to my class website. I post Kahn Academy links to my website for students to use as review or if they have to miss a class. We use video analysis in class along with Vernier Logger Pro to take data and make graphs. I post video clips from labs or demos or from YouTube if students miss lab or demos so they can watch them at home. Videos have helped enhance my students learning while keeping them engaged.

Session HB: AP Physics 1&2

Location: Salon 10
Sponsor: AAPT
Date: Tuesday, January 7
Time: 3–3:30 p.m.

Presider: Gay Stewart

HB01: 3-3:10 p.m. Overview of the New Advanced Placement (AP) Physics 1 and 2 Courses

Contributed – Scott C. Beutlich, Crystal Lake South H.S., Crystal Lake, IL 60014; scottbeutlich@rocketmail.com

This presentation will give an overview of the new Advanced Placement (AP) Physics 1 and 2 courses and will guide the audience through the Curriculum Framework that clearly defines what students will be expected to know and do by the end of each course. An overview of the guiding science practices that are now paired with essential knowledge in physics to produce student learning outcomes for each course will be provided, along with examples of how these learning objectives will be used to inform the dramatic changes in test questions for the new exams—including the emphasis on inquiry-based exam questions. The most recent released information from The College Board will be shared with the audience.

HB02: 3:10-3:20 p.m. Overview of the New Advanced Placement (AP) Physics 1 and 2 Courses – Part II

Contributed – Martha Lietz, 2659 Hillside Lane, Evanston, IL 60201-4933; marlie@d219.org

Scott Beutlich, Crystal Lake South HS

Part II of this presentation will continue the overview of the new Advanced Placement (AP) Physics 1 and 2 courses and will guide the audience through the Curriculum Framework that clearly defines what students will be expected to know and do by the end of each course. An overview of the guiding science practices that are now paired with essential knowledge in physics to produce student learning outcomes for each course will be provided, along with examples of how these learning objectives will be used to inform the dramatic changes in test questions for the new exams--including the emphasis on inquiry-based exam questions. The most recent released information from The College Board will be shared with the audience.

HB03: 3:20-3:30 p.m. Whiteboarding and Multiple Representations to Improve Understanding: AP Physics 1 and 2

Contributed – Paul Lulai, College Board, & St Anthony Village Senior High, New Brighton, MN 55112; plulai@stanthony.k12.mn.us

The use of whiteboarding techniques and multiple representations for physics problems can help deepen students' conceptual understanding and help them succeed in AP Physics 1 & 2. The new AP Physics 1 & 2 exams intentionally investigate students' ability to translate from one representation to another. This session will look at specific ways in which both white-boarding and multiple representations can be implemented in the high school physics classroom to deepen student understanding and prepare them for the new AP Physics 1 & 2 course exams.

Session HC: Alternative Grading Methods/Standards-based Grading

Location: Salon 8
Sponsor: Committee on Physics in High Schools
Co-Sponsor: Committee on Professional Concerns
Date: Tuesday, January 7
Time: 3–4 p.m.

Presider: Jeff Funkhouser

HC01: 3-3:30 p.m. Standards-based Grading: Evolution Through Implementation

Invited – Jeffrey Funkhouser, Greenhill School, Addison, TX 75001; jefwfunk@gmail.com

Implementation issues can be addressed through a willingness to evolve the grading standards and grade determination structures across multiple years. This is the process by which a private independent school in Texas has instituted and promulgated to other departments a standards-based grading (SBG) scheme. Initially used in one physics course by one teacher, the Greenhill School has slowly expanded use of SBG to almost all physics classes taught by three different teachers. Difficulties and solutions for this experiment in progress will be highlighted.

HC02: 3:30-4 p.m. The Spirit of SBG

Invited – Frank Noschese, John Jay High School, Cross River, NY 10518; fpn1@cornell.edu

Perhaps you want to switch to SBG, but circumstances prevent you from doing so. In this session, we'll explore how many of the strengths of SBG can still be done within a more traditional grading system.

Session HD: Post Deadline Papers II

Location: Salon 11
Sponsor: AAPT
Date: Tuesday, January 7
Time: 3–3:50 p.m.

Presider: Mike Gallis

HD01: 3-3:10 p.m. Development of Integrated Physics Identity in a Learning Assistant Program

Contributed – Hunter G. Close, Texas State University, San Marcos, TX 78666-4615 hgclose@txstate.edu

Eleanor W. Close, Jessica M. Conn, Texas State University

In the physics department at Texas State University, we are developing a Learning Assistant (LA) program with reform-based instructional changes in our introductory course sequences. We are interested in how participation in the LA program influences LAs' identity both as physics students and as physics teachers; in particular, how being part of the LA community changes participants' self-concepts and their day-to-day practice. We analyze video of interviews with LAs as well as written artifacts from program applications, pedagogy course reflections, and evaluations. Our analysis of self-concepts is informed by the identity framework developed by Hazari et al. [1,2] and our analysis of practice is informed by Lave and Wenger's theory of Communities of Practice.[3,4] Themes emerging from the data include self-perception of increased competence in communication as well as in physics learning and teaching; increased enjoyment of participation in physics activities; and a new sense that being wrong is a healthy part of the process of learning physics.

1. Hazari et al., JRST 47(8), 2010.
2. Lock, Hazari, & Potvin, in AIP Conf. Proceedings 1513, 2013.
3. Lave, J., & Wenger, E., 1991.
4. Wenger, E., 1998.

HD02: 3:10-3:20 p.m. Exploring the Relationship between Elastic Potential Energy and Restorative Forces Using Springs

Contributed – Sairam Tangirala, Georgia Gwinnett College, (SST) 1000 University Center Ln., Lawrenceville, GA 30043; stangira@ggc.edu

Joseph D. Ametepe, Georgia Gwinnett College (SST)

In this undergraduate course embedded project, PHYS 2211K (calculus-based, studio-style Introductory Physics class) instructors designed an activity aimed at providing an intuitive understanding of the harmonic nature of elastic potential energy. The relationship between the elastic potential energy and work done by an elastic restorative force was studied using experimentally obtained data. The data plots obtained from the experiment were used by the students to interpret and understand the work-energy theorem for spring systems. As an extension, we plan to model a polymer as a chain of repetitive monomers (beads) connected via elastic flexible bonds (springs). To achieve this, we plan to employ the Hooke's law and other non-symmetric potentials to explore and interpret the relationship between derivatives and integrals.

HD03: 3:20-3:30 p.m. Monitoring Variable Stars with a DSLR Camera

Contributed – Todd Brown, University of Pittsburgh at Greensburg, 150 Finoli Dr., Greensburg, PA 15601; drkatrinabrown@yahoo.com

Contributions to active astronomy research are not completely confined to large institutions or groups with an array of expensive telescopes and CCD accessories. A standard digital single-lens reflex (DSLR) camera and tripod combined with freeware from the web is all that is required to collect, analyze and submit contributing data on bright variable stars. This presentation will center around the advantages and pitfalls of using the IRIS software package supplied by the American Association of Variable Star Observers (AAVSO) to observe the well-known eclipsing binary Persei (Algol).

HD04: 3:30-3:40 p.m. Project and Problem-based Pedagogy at Spelman College

Contributed – Sharah A. Yasharahla, Spelman College, Atlanta, GA 30314; syasharahla@spelman.edu

Derrick Hylton, Spelman College

Eight years ago the Spelman College physics department decided to embark on a journey of project and problem-based learning. We wanted to increase student learning outcomes based on evidence from PER. Our implementation took the form of students investigating real phenomena, open-ended problems and design challenges. Students were assessed using pre- and post-tests and some of the laboratories were assessed via videos. Although we are in the process of working out specific conclusions from the assessment data, we want to report on our general observations and important results that seem to be emerging from the data. We have possibly seen some progress on motivation, engagement, data analysis skills, process skills, and collaboration skills, while being able to cover the same material and sometimes more. Some problems are training adjunct faculty, managing the classrooms, creating projects and problems, student assessments, creating strategies for effective group work outside of class. We are convinced that there is merit in this approach and we encourage the physics education community to enhance research on the implementation, such as dealing with dysfunctional groups and defining types of relevant data.

HD05: 3:40-3:50 p.m. Mentor/Mentee Relationships

Contributed – Stephanie Marry, Barrington High School; smarry@barrington220.org

I have been through two mentor programs as a mentee. The programs involved support meetings, professional development classes and assigned mentors. Through these programs I have worked with three mentors. My mentors were very different from one another – each used a variety of strategies to help me improve. One of the practices that was most helpful was observing my mentors learn from their experience and being observed by them. Sometimes my mentors took on the role of a counselor to guide me through first-time experiences. Unfortunately, I had some difficult times and my mentor was able to remain positive and supportive throughout. Being in a mentor program has also encouraged me to participate in many professional development opportunities. Mentor programs have been beneficial for me as a new teacher as well as my students.

Poster Session 3A: Post Deadline Posters

Location: Grand Ballroom Foyer
Sponsor: AAPT
Date: Tuesday, January 7
Time: 3–4:30 p.m.

Persons with odd-numbered posters will present their posters from 3–3:45 p.m.; even-numbered will present 3:45–4:30 p.m.

PST3A01: 3-3:45 p.m. Meeting Common Core Standards in an Inquiry-based Physics Classroom

Poster – Andrew S. Marth, Kutztown University, Fogelsville, PA 18051; amart612@live.kutztown.edu

Robert M. Adams, Kutztown University

Today's curriculum is currently driven by the common core standards which have been adopted in most states. However, because the standards focus on reading and writing, it can be intimidating to try to implement them in an inquiry-based physics classroom. With the push towards discovery learning in science education, the goals of meeting the needs of students and applying common core standards, all while maintaining a student-centered classroom is challenging but not impossible. By introducing varied reading strategies to the standard physics curriculum, classroom teachers can successfully enhance students' reading skills while continuing to incorporate inquiry based teaching. This poster focuses on the study and implementation of successful reading and writing strategies that simultaneously meet core standards and enhance physics instruction.

PST3A02: 3:45-4:30 p.m. Inexpensive Nuclear Coincidence Experiments

Poster – Patrick J. Polley, Beloit College, Beloit, WI 53511; polleyp@beloit.edu

Sara Kasten, Elizabeth Kolbeck, Beloit College

We describe a set of experiments involving nuclear coincidence events that we carried out using inexpensive filters, preamplifiers, and analog-to-digital convertors that we added to old Geiger counters. This additional circuitry allows us to monitor events that occur in conjunction with other nuclear events. We present the results of our results for cosmic-ray detection and nuclear decays in 22Na and 137Cs, along with our circuit designs that can be used to refurbish older Geiger counters.

PST3A03: 3-3:45 p.m. Investigation of Bernoulli's Equation in the Undergraduate Laboratory

Poster – Patrick J. Polley, Beloit College, Beloit, WI 53511; polleyp@beloit.edu

Richea Smith, Erik Binter, Beloit College

Bernoulli's equation is a statement of the conservation of energy for the flow of an incompressible fluid. In our work we apply Bernoulli's equation to analyze the flow of water through a horizontal pipe attached to a two-liter bottle that acts as a reservoir. We expand our analysis by examining the loss of kinetic energy that results from viscosity for different diameters and lengths of pipe. We present our work in the format of a laboratory exercise that requires minimal equipment and can be performed in the introductory physics laboratory

PST3A04: 3:45-4:30 p.m. Teacher and Student Ideas on Electronics Laboratories

Poster – Pieter TJD Coppens, KU Leuven Celestijnenlaan 200C, bus 2406 Heverlee, 3001 Belgium; pieter.coppens@mech.kuleuven.be

Mieke De Cock, KU Leuven

Although a significant amount of time is dedicated to lab work in a typical engineering curriculum, the aim of it is not always clear. Therefore, we constructed a survey about laboratory goals that was filled in by over 300 students and teachers of a second-year electronics course at four Belgian university colleges. Results show a difference between teachers' and students' expectations about laboratories, as well as a remarkable agreement between colleges. This poster will present the data along with an analysis and discussion.

PST3A05: 3-3:45 p.m. SN 2009nr Image Reduction and Analysis

Poster – Jonathan J. Heath, Francis Marion University, Florence, SC 29501; jheath8278@gmail.com

Ginger Bryngelson, Francis Marion University

A type Ia supernova (SN Ia) is a white dwarf (WD) [a dense, electron-degenerate vestige of a star] that has appropriated enough mass from a neighboring star that the total mass of the WD reaches a critical point. The star quickly approaches its mass limit (Chandrasekhar limit) until the overall heat and pressure results in a thermonuclear explosion. A plot of this object's brightness over time is known as a light curve. Because of the uniformity of their light curves, SNe Ia are valuable markers for determining the expansion of the universe and other cosmological parameters. Understanding the properties of these supernovae is vital in order to build our confidence in their use as standard candles. A small, but increasing number of SN Ia late-time observations have been made in the near-infrared (NIR). Most exhibit a flattening of the NIR power even as the visible light declines at a steady rate. It is still unclear as to why they exhibit this behavior and how typical this is. In order to characterize the late behavior of SNe Ia, images of the supernova 2009nr were analyzed using the Image Reduction and Analysis Facility (IRAF). NIR (J, H, K) images were taken with the 4m Mayall Telescope at Kitt Peak National-Observatory using the FLAMINGOS IR Imaging Spectrometer while optical (B, V, R, I) images used the Mosaic 1 imager. The supernova's apparent magnitude for each night of observation (by filter) was found by using reference stars. We present preliminary light curves of the supernova 2009nr and a comparison to another SN Ia observed at similar epochs.

PST3A06: 3:45-4:30 p.m. Investigation into How to Evaluate Students' Lab Work

Poster – Dan Liu, University of New Haven, West Haven, CT 06516-1999; DaLiu@newhaven.edu

Whether group lab report assignments can engage students more than individual lab report assignments? Do you give students a final exam in lab sessions? What percentage of the final test should be given? A pool of 90 undergraduate students in five different lab sessions at the University of New Haven completed the survey of their preference. They are from freshman to junior, with different majors. The result of the investigation provides a reference for lab lecturers to set syllabus and rubrics.

PST3A07: 3-3:45 p.m. Using Interdisciplinary Projects in General Physics Courses

Poster – Mojgan Matloob Haghanikar, Towson University, Department of Physics, Towson, MD 21204; mmatloobhagh@towson.edu

To promote transfer of learning, the introductory physics students at several universities were encouraged to get involved in projects that were about application of physics concepts to their major of study. We were seeking to improve students' understanding of physics concepts by enhancing their empirical understanding and facilitating the visualization of abstract concepts. Thinking across disciplines informed students about many applications of physics and improved students' beliefs about relevancy of physics. In addition, integrating several perspectives and learning approaches provided more accessibility in physics. We encouraged group presentations, and students who contributed to the projects were rewarded based on their efforts. At the end of presentation day, students were introduced to many applications of physics through their own research and listening to the research of their peers. Among the example topics were muscle activities and action potentials, electrophoresis of DNA, Micelle formations, polarization angle of carbon fibers in electric fields, RNA replications and electrostatic forces, using center of mass in architecture to prevent earthquake destruction and using fiber optic in architecture lightening design. In this poster we present a few examples of the students' findings.

PST3A08: 3:45-4:30 p.m. Outcome of Learning Physics with Mathematics

Poster – Sunil Dehipawala, Queensborough Community College, Bayside, NY 11364; sdehipawala@qcc.cuny.edu

Vazgen Shekoyan, Haishen Yao, Queensborough Community College

Obtaining a complete understanding of college physics principles and concepts and solving simple problems require strong skills in Algebra and some Trigonometry. However, many students struggle with algebra-based introductory physics courses despite completing college algebra before taking physics. We investigated the potential benefits that could be acquired by teaching physics together with mathematics, focusing on algebraic concepts relevant to problem solving in physics. Two sections of a physics course were utilized in this study. One section had a regular physics lecture that introduced concepts and used examples to demonstrate how to solve simple problems. The investigation section was given a 5-10 minute algebra review before the physics lecture. Both sections contained the same amount of new material everyday. Upon review of class quizzes and exams, it appears that reviewing algebra concepts at the beginning of a physics class helped better students' performance.

PST3A09: 3-3:45 p.m. Physics Labs with Flavor: Error Analysis

Poster – Mikhail M. Agrest, Trident Technical College, Charleston, SC 29414; agrestm@cofc.edu

In Theory, there should be no contradiction between Theory and Practice, but in Practice there always is. Error Analysis is an integral element of any experimental study, and the importance of its teaching in introductory labs is indefeasible. Error Analysis becomes an integral part of students' world outlook. It is used for evaluation of students' performance in the Introductory Physics Labs taught by the recurrent method, also known as Physics Labs with Flavor method.[1-5] This presentation is dedicated to the consideration of ways to make Error Analysis be independent of formulation of the problem. It must not depend on the frame of reference. Traditionally used, Percent Error Formula relates The Deviation of the results to the Accepted Value. It is suggested that The Deviation of the predicted result is related rather to a Characteristic Measure. This would make the evaluation independent of the frame of reference.

1. M. Agrest, Physics Lab with Flavor, SACSAAPT Annual Meeting. Coastal Georgia Community College. Brunswick, Georgia. October 12-13, 2001. http://sacs-aapt.org/Meetings/Meeting_Programs/AbstractsF01.pdf.
2. Mikhail M. Agrest, "Physics labs with flavor," *Phys. Teach.* **47** (5), 297-301, 2009.
3. M.Agrest, "Physics labs with flavor II," *Phys. Teach.* **49,** 295-297, (May 2011).
4. Top 10 Most Read Articles of *TPT* May 2009 http://tpt.aapt.org/most_downloaded?month=5&year=2009
5. Recurrent Studies: Bringing Flavor into Physics Labs 2013 Winter Meeting: New Orleans, Louisiana. 2013 Winter Meeting: New Orleans, Louisiana

PST3A10: 3:45-4:30 p.m. Assessment of Physics by Inquiry Programs for K-12 Teachers*

Poster – Robert J. Endorf, University of Cincinnati, Department of Physics, Cincinnati, OH 45221; robert.endorf@uc.edu

Don Axe, Amy Girkin, Kathleen M. Koenig, Jeffrey Radloff, University of Cincinnati

We describe our most recent results from the continuing assessment of the effectiveness of our Physics by Inquiry[1] professional development programs for K-12 teachers at the University of Cincinnati. This study is based on data obtained from more than 500 teachers who have completed either a 13 quarter-credit-hour graduate course in Physics by Inquiry for teachers in grades 5-12 or a 7 quarter-credit-hour course for teachers in grades K-5. Our data demonstrate that the programs have been effective in increasing the teachers' science content knowledge and their understanding of scientific inquiry. The teachers have also exhibited a significant increase in their self-confidence in designing and teaching inquiry-based science lessons. A large majority of the teachers in the program reported that the quality of their students' work had noticeably improved after implementing inquiry-based science activities in their classrooms.

* Supported by The Improving Teacher Quality Program administered by the Ohio Board of Regents.

1. L.C. McDermott and the Physics Education Group at the University of Washington, *Physics by Inquiry,* (Wiley, 1996).

PST3A11: 3-3:45 p.m. 'Flipping the Classroom' Learning Method Applied to Introductory Physics-I Classroom: Initial Findings

Poster – Sairam Tangirala, Georgia Gwinnett College (SST), 1000 University Center Ln., Lawrenceville, GA 30043; stangira@ggc.edu

In flipping the classroom teaching-method, students are encouraged to study the material prior to attending the class. The learning is then reinforced in the classroom through a combination of lecture, group learning, demonstrations, and active learning exercises involving peers. In this poster, we briefly explore the effectiveness of traditional classroom lectures, our current teaching method, student attitudes, and our initial findings.

PST3A12: 3:45-4:30 p.m. Designing, Developing, and Building High-powered UV Light for Killing Bacteria

Poster – Joseph D. Ametepe, Georgia Gwinnett College (GGC), School of Science and Technology, Lawrenceville, GA 30043; jametepe@ggc.edu

In an interdisciplinary project that engaged students in the basic research process of designing and developing prototypes of UV light sources using microwave energy, students experimented with different gas mixtures to determine the best combination of gases that emits around the 254 nm wavelength. Research students, apart from building microwave driven system from component parts, studied (i) the basic engineering of the microwave lamp system, (ii) fundamental science underlying the discharge process, (iii) evaluate the technical benefits of the system over other existing technologies, and conducted (iv) feasibility studies of the system for various practical applications such as destroying viruses and bacteria.

PST3A13: 3-3:45 p.m. Conducting Fundamental Experiments with UV Light for Destroying Viruses

Poster – Joseph D. Ametepe, Georgia Gwinnett College (GGC), School of Science and Technology, Lawrenceville, GA 30043; jametepe@ggc.edu

This undergraduate interdisciplinary project involved the studying and conducting fundamental experiments in using UV light sources for killing bacteria and viruses. The project was established as part of Georgia Gwinnett College (GGC), School of Science and Technology's STEM initiative of engaging every STEM student in undergraduate research. Faculty from Physics and biology at GGC actively engaged and monitored students in the basic research process of studying the basic discharge mechanism of UV light sources, their interaction with biological agents, growing microbial cultures, conducting UV exposure experiments, data collection and analysis, and report writing. An extension of the project is develop a research protocol in using UV light sources in treating drinking water.

PST3A14: 3:45-4:30 p.m. A New Course for Our Life Science Students

Poster – Al J. Adams, University of Arkansas at Little Rock, 2801 S University Ave., Little Rock, AR 72204-1099; ajadams@ualr.edu

There is a major effort today to tailor the introductory physics courses to better meet the immediate and long-term needs of our students in the life sciences. I am participating in that effort. Here I will describe the curriculum for a new course I am offering in the Spring 2014 term: Intermediate Physics for the Life Sciences. The course builds on the concepts and skills developed in the introductory course. It will be taught in an integrated format, combining lecture and laboratory pedagogies, in our SCALE-UP classroom featuring round-table workstations equipped with computer and hand-held measurement systems. I will illustrate several interactive engagement techniques and several of my own renderings of laboratories that have been proposed by others for the Introductory Physics for Life Science students, including magnetic resonance, acoustic Doppler, laser Doppler, diffusion and Brownian motion, and the optical analog to x-ray diffraction.

PST3A15: 3-3:45 p.m. Hermeneutic Phenomenological Analysis of Postgraduate Researchers? Experiences of Nanotechnology Research*

Poster – Deepa N. Chari, Dublin Institute of Technology, Ireland 18, Clonmore Court, Dublin, N/A 9 Ireland; deepu.chari@gmail.com

Robert Howard, Brian Bowe, Dublin Institute of Technology

Nanotechnology research is a complex integration of many scientific disciplines. PhD researchers working in

this area often need to exchange ideas, concepts and perspectives of their discipline with others. A great interest has been exhibited recently to identify if a different knowledge base and skills are necessary to exchange as well as understand such ideas, concepts, perspective and challenges across the disciplines. Examination of PhD researchers' lived experiences of ?researching in the nanoscience and nanotechnology area? can uncover how researchers approach complex disciplinary integration and further what knowledge base and skills they actually apply during their research. We have conducted in-depth phenomenological interviews with the PhD researchers (n=15) working in nanotechnology area and examined their lived experiences with Van Manen's hermeneutic phenomenology. The PhD researchers' reflections about their own experiences, the authors' interpretation and dialogue with the research text (transcripts) in hermeneutical circles provided a broader understanding of how the PhD researchers perceive and work in this area.

*School of Physics, Dublin Institute of Technology (Travel grant)

PST3A16: 3-3:45 p.m. The Physics of Smart Phone Sensors

Poster – Al J. Adams, University of Arkansas at Little Rock, 2801 S University Ave., Little Rock, AR 72204-1099; ajadams@ualr.edu

Surveys of our students show that approximately 90% of them now carry a smart mobile device. These come equipped with a variety of physical sensors and as such are starting to show up in the physics classroom and laboratory as measurement tools. Here I will review the recent literature for smart phone and tablet applications in physics instruction and describe three of the popular sensors: the 3-axis accelerometer, the proximity sensor, and the magnetic field sensor. These illustrate inertial bending of cantilever beams and capacitive transducers, semiconductor optical detectors, and the Hall Effect magnetometer. The physics behind these systems is within reach of our introductory students. I will suggest ways that physics instructors can use these sensors, specifically their construction and operation, as ready applications of principles presented in the introductory courses.

PST3A17: 3:45–4:30 p.m. Paraxial Geometrical Optics: A Study of 2-Dimensional Image Distortion

Kandiah Manivannan, Missouri State University, Springfield, MO 65897; ManiManivannan@Gmail.com

Anjali Manivannan, New York University

Optical aberration is a distortion in the image formed by an optical system such as a lens or mirror. Minimizing such effects is extremely important in designing optical instruments such as microscope and telescopes. We study the distortions of images produced by a **vertical** or **horizontal 1-D liner object**, and a **vertical** or **horizontal 2-D planer object**, placed in front of spherical mirror or lens. This distortion occurs due to the different *transverse* and *longitudinal* magnifications of the object. Ray tracing and lens formulas are very powerful tools for gaining deeper insight into optical image formation. Using Excel spreadsheets we show the instant image formations of 1-D and 2-D objects such as a vertical line, rectangle, triangle, and various *irregular* 2-D objects. We demonstrate that even in the simplest case of paraxial optics, transverse magnifications behave as expected, but longitudinal magnifications are affected differently, producing distorted images.

Index of Participants

T

U

V

W

Y

Z

Index of Advertisers

Call for Nominations

The AAPT Awards Committee is seeking nominations for the following Awards. All AAPT members are urged to review the descriptions of these awards on the AAPT website and then, following instructions available at a link on that website, to nominate individuals deemed worthy of consideration for any of these awards. The Nomination Form is at http://www.aapt.org/Programs/awards/.

Robert A. Millikan Medal

Oersted Medal

Melba Newell Phillips Medal

Paul E. Klopsteg Memorial Award

Richtmyer Memorial Award

John David Jackson Excellence in Graduate Education Award

David Halliday and Robert Resnick Excellence in Undergraduate Physics Teaching Award

Paul W. Zitzewitz Excellence in Pre-College Physics Teaching Award

AAPT Distinguished Service Citations

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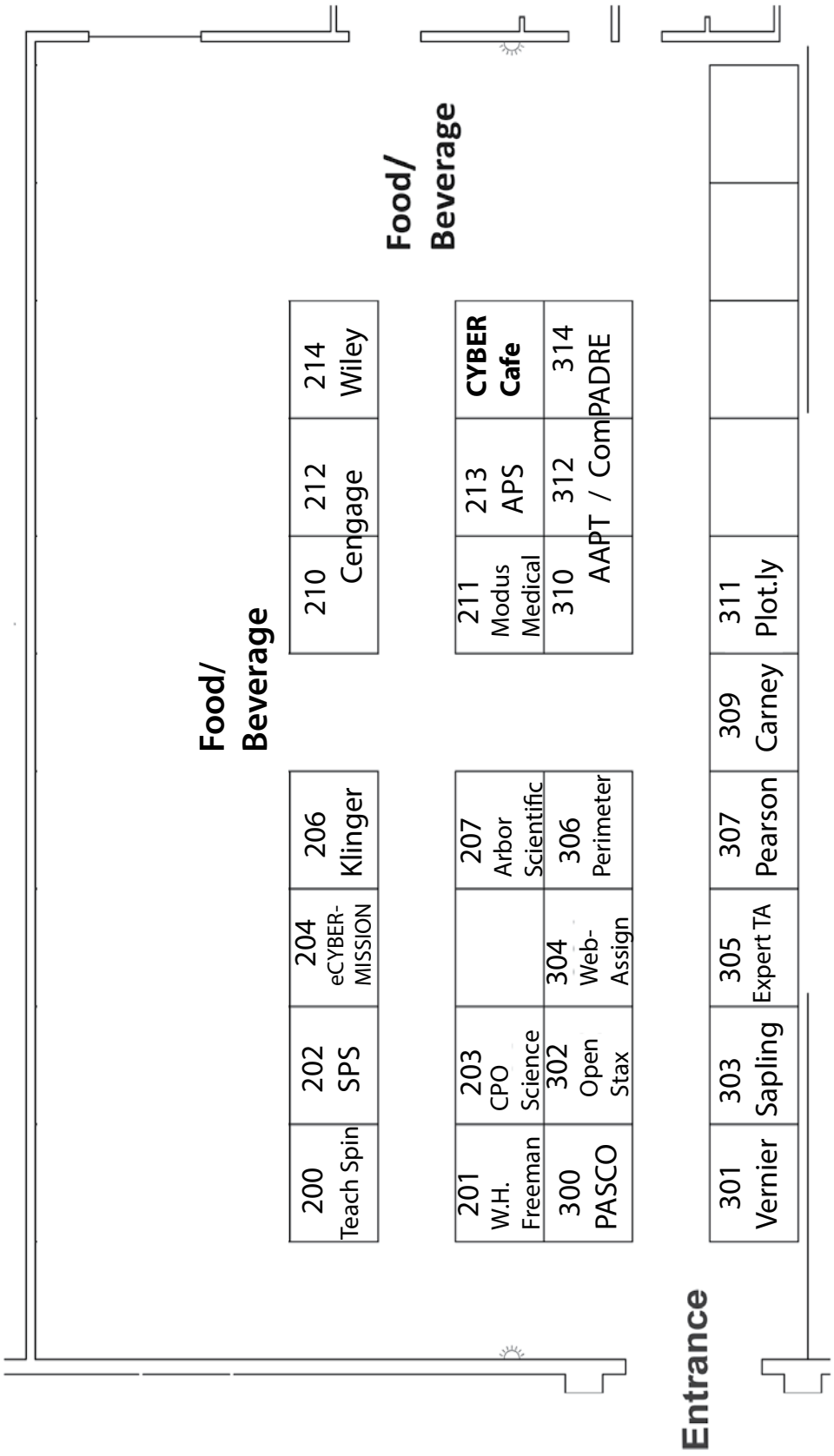
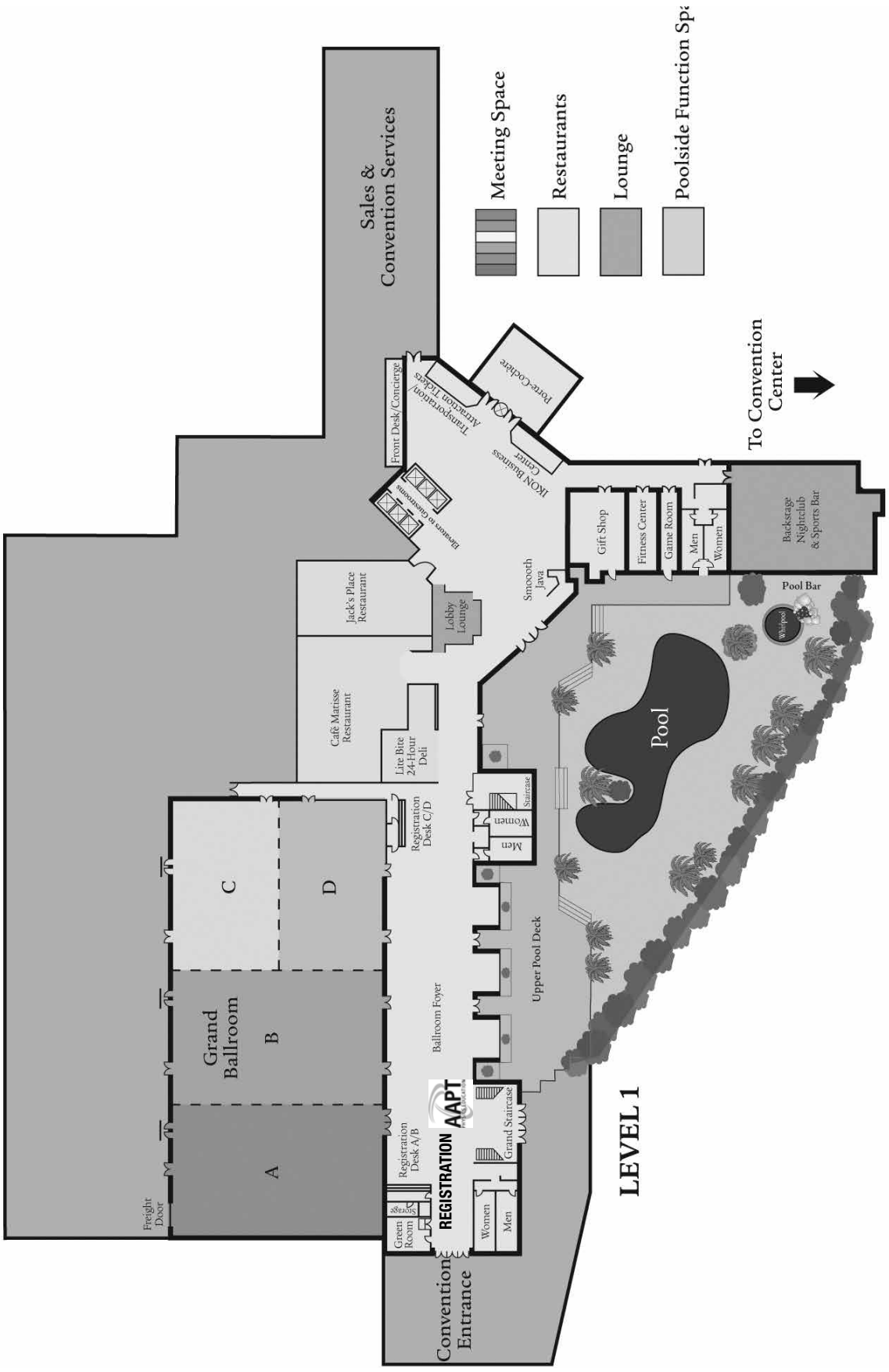
Exhibit Hall
Ballroom A

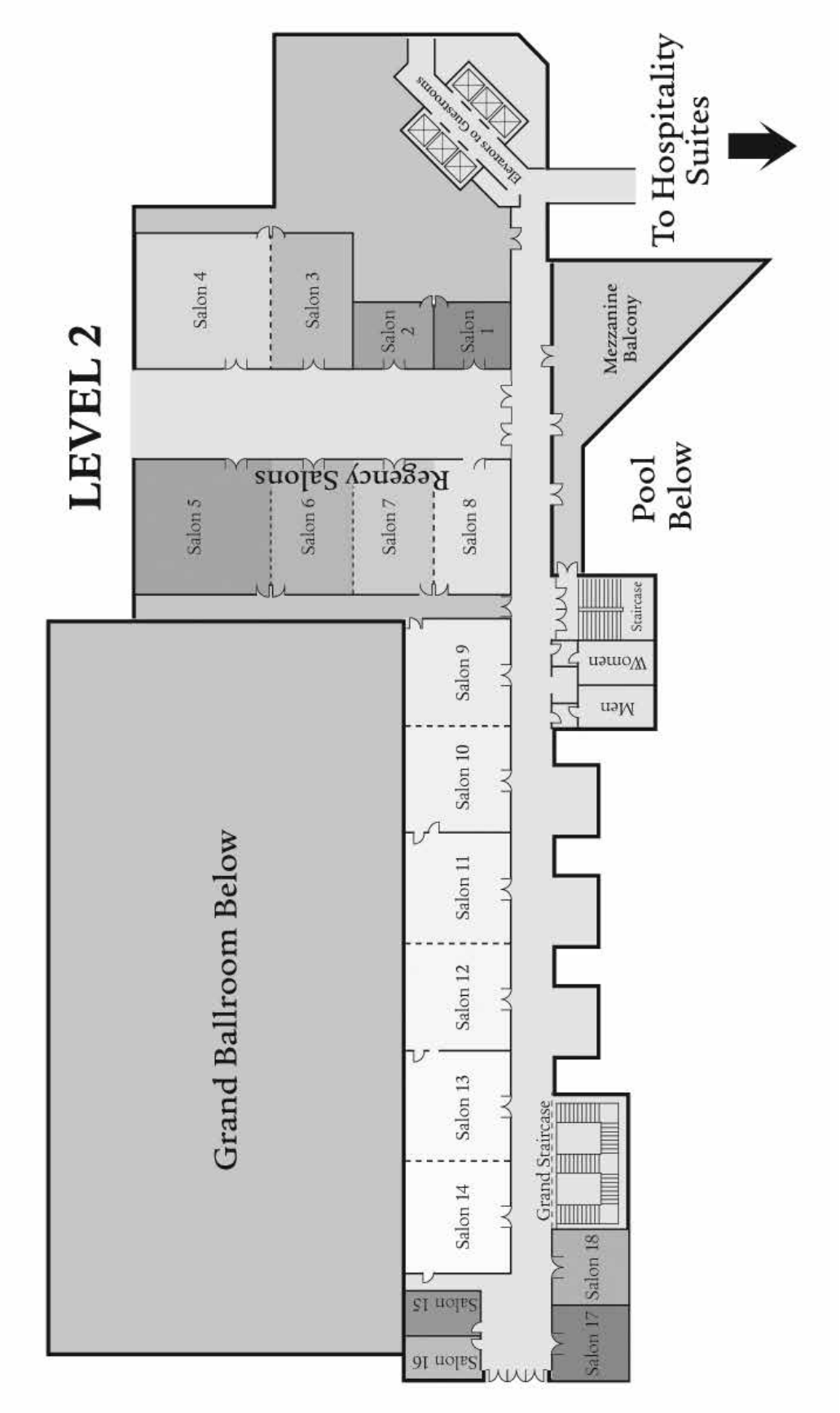


Rosen Hotel Level 1



Buses leave for Work-shops & Special Events

Rosen Hotel Level 2



AAPT Members...

...research, test, prove, and share knowledge.

...create new programs.

...win awards.

...demonstrate proven principles.

...network with fellow physicists.

Learn more at the AAPT booth in the Exhibit Hall, Grand Ballroom A

American Association of Physics Teachers

AAPT

PERC 2014

Outpacing New Technologies with Novel Pedagogies:

The role of PER in the Transforming Landscape of Higher Education

July 30th & 31st, 2014

University of Minnesota
Minneapolis, MN

Bridging Speakers:
Michael Dubson
James Fairweather

Banquet Speaker:
Kenneth Koedinger

Wrap-up & Reflection:
Carl Wieman

Students' unprecedented access to information on-line is dramatically and irreversible transforming higher education. This transformation provides fantastic opportunities to improve education, but at the same time we are presented with the equally fantastic risk of losing the core elements that make higher education so valuable. Whether it has been on-line homework, electronic voting systems, or screen-casted lectures, the physics community has been on the bleeding edge of new educational technology. Our community will engage in a scholarly dialog around these new environments including the opportunities they afford, the challenges they present, and the research enterprise necessary to address these. Conference participants will gain deeper insight into these technologically-driven environments by discussing the magnitude and rapidity of these changes, developing an understanding of the national dialog around on-line education, and discussing how physics education research can guide the development of new pedagogies for and assessments of these environments.

Organizers: Danny Caballero, Mats Selen, & Tim Stelzer
More information: www.compadre.org/per/conferences/2014

CALL for UNIVERSITY HOSTS
for 2017 and 2018 National Meetings

AAPT is in search of Physics Departments of Colleges and Universities interested in hosting national meeting workshops and pre-conference meetings in 2017 and 2018. This is a great opportunity to support AAPT national meetings and showcase the physics program at your university.

The following meetings are in the process of being vetted, and priority will be given to locations where Local Hosts show support.

- **2017 Summer Meeting** host sites would be in the middle of the country.
- **2018 Winter Meeting** host sites would be in the South West Coast.
- **2018 Summer Meeting** host site would be in the Mid-Atlantic and Northeast areas.

General information for Local Hosts to consider:

- National Meetings typically occur in January/February (winter) and July/August (summer).
- Average attendance: 800–1,000 (winter), 1,000–1,200 (summer).
- 30–40 Half-and Full-Day workshops occur on Saturday and Sunday.
- Smaller tandem meetings prior to and following the AAPT National Meeting ranging from 40 to 150 people are planned annually and will be supported by Local Hosts.
- A mix of campus and local hospitality community engagements will be required for a successful National Meeting.
- Local Hosts will need to submit a letter of support to AAPT prior to a site visit being planned and be a part of showcasing the area.
- A final presentation to the Meetings Committee shall take place either during a summer or winter meeting prior to a meeting being awarded.

All interested universities will be properly vetted; however, those that have the support of the hospitality community and resources (hotels, restaurants, distance to airport, activities, etc.) to fully manage the group will be considered for a site visit.

Meeting elements to be considered prior to deciding to become a Local Host

1) ***Proximity to Airport.***
2) ***Sleeping Rooms*** – Dorm rooms (summer meetings only) and proximity to nearby hotels.
3) ***Meals*** – Mostly on own – Proximity to a variety of restaurants during workshops.
4) ***AAPT Workshops*** (Saturday and Sunday only): a minimum of 10 Lab rooms at University.
5) ***PERC*** – Physics Education Research (PER) group begins their "mini" conference for 240 participants, including 50 poster boards, plenary room and five breakout rooms.
6) ***PTRA*** – Possible Physics Teaching Resource Agents (PTRA) meeting for approximately 40 teachers one week prior to Summer Meeting. Will require additional dorm/hotel rooms.
7) ***Additional Pre-meeting Workshops*** – the possibility of an Advance Laboratory Physics Association or Two Year College Workshop would be held during a specific year. Additional information required.

To receive detailed requests for proposal, contact the Programs and Conference Department via *programs@aapt.org* or 301-209-3340.

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PHYSICS EDUCATION

AAPT WM14
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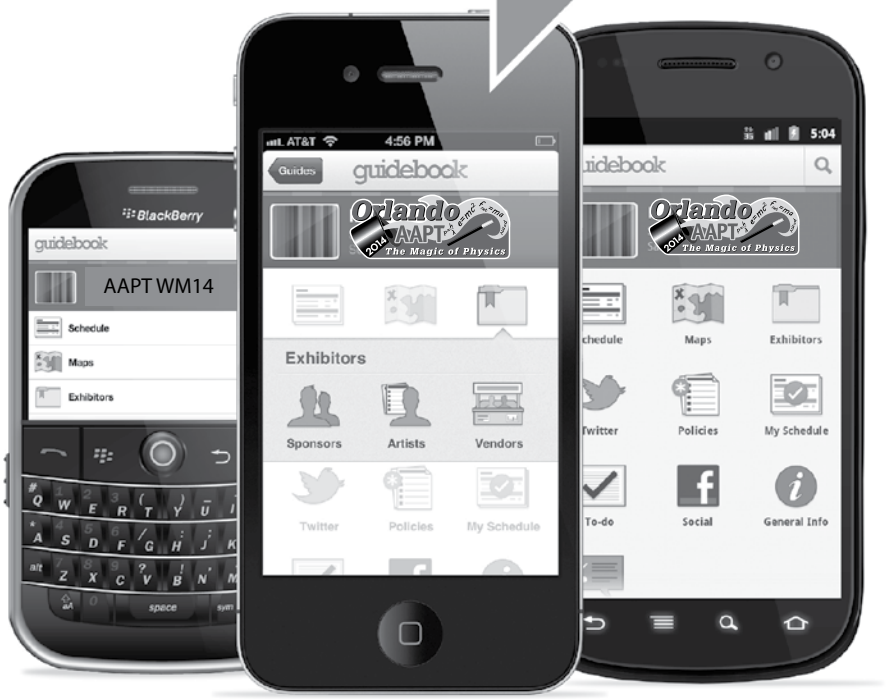

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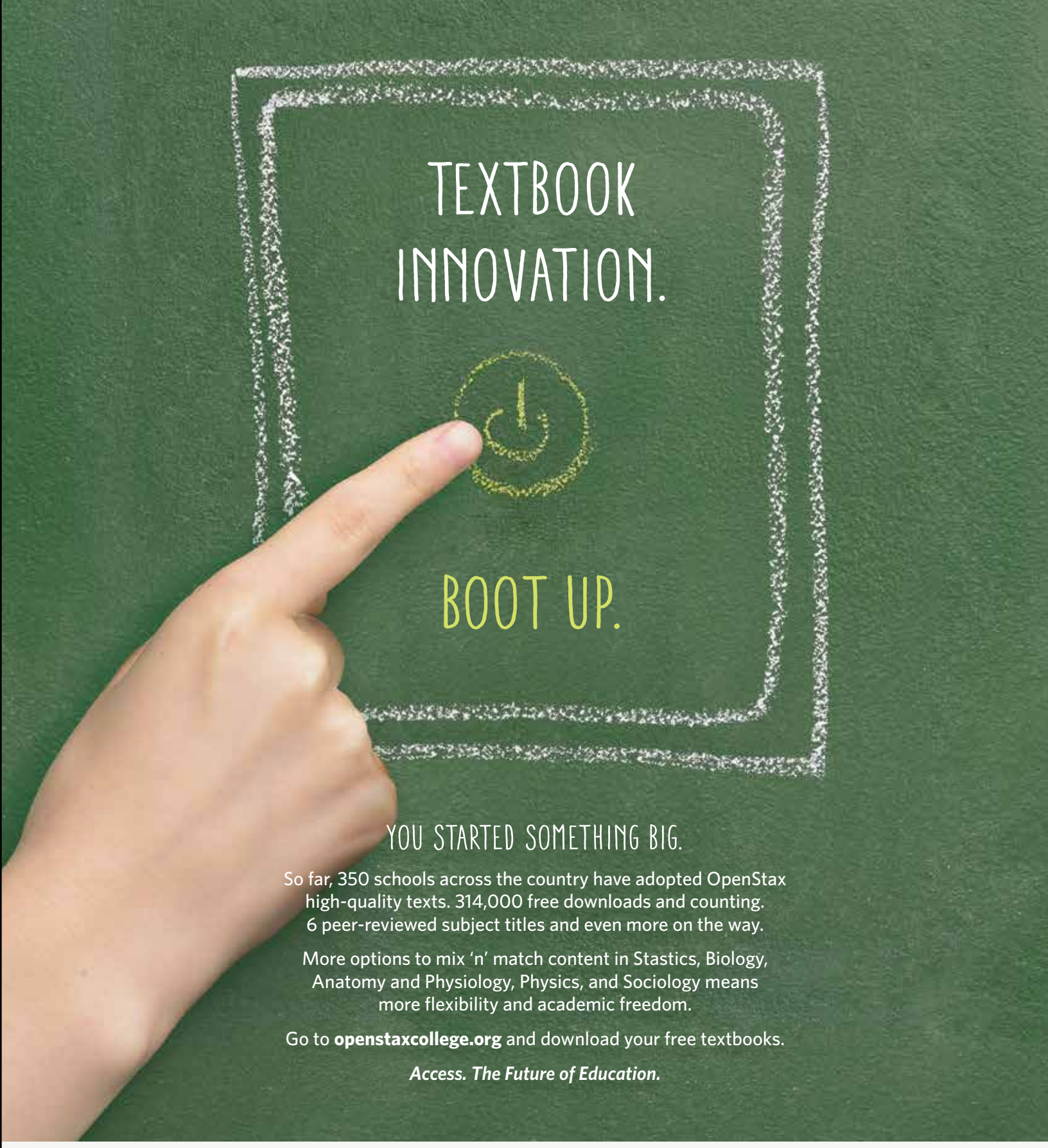

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