Arkansas-Oklahoma-Kansas Section
American Association of Physics Teachers

AOK AAPT
2006 Section Meeting
October 27-28, 2006
Emporia State University

35 Members of the AOK Section pose for the “TEAM PHOTO” during the annual fall meeting held at Emporia St.

Friday, October 27, 2006

Special luncheon with invited speaker "Pinky" Nelson. Reservations required.
2:00-5:00 p.m. On-site registration, poster set-up and viewing
2:00-5:00 p.m. Workshops
5:30-6:30 p.m. Banquet
7:00-8:00 p.m. Public lecture by Dr. George "Pinky" Nelson
8:15 p.m. Section officer's meeting

Saturday, October 28, 2006

7:15 a.m.-noon On-site registration
7:50-8:00 a.m. Greetings, orientation, announcements
8:00-9:30 a.m. Oral presentations (15 minutes each)
9:30-10:15 a.m. Break and poster viewing
10:15-11:00 a.m. Oral presentations
11:00 a.m.-noon Keynote presentation by Dr. George "Pinky" Nelson
12:00 noon-1:00 p.m. Lunch
1:00-1:30 p.m. General section meeting
1:30-3:00 p.m. Oral presentations (two concurrent sessions)
3:00-3:15 p.m. break
Workshop or sharing time

BANQUET AND KEYNOTE SPEAKER

The banquet and keynote speaker will be Dr. George "Pinky" Nelson, astronomer, NASA astronaut during 1978-1989 and former director of Project 2061. Dr. Nelson is scheduled to deliver a public lecture after

the AOK banquet on Friday, October 27 (7:00-8:00 p.m.) and the keynote presentation on Saturday, October 28 (11:00 a.m.-noon).

Dr. Nelson's visit is funded by the Jones Institute for Educational Excellence at Emporia State University as part of the Jones Distinguished Lecture Series.

Flyer for Friday's public lecture.

Dr. Nelson's biography.

ORAL PRESENTATIONS

Painless Post-Graduation Assessment of the Major
Karen Williams
East Central University
Ada, OK

"Assessment" is a necessary evil in our world these days, but it doesn't have to be difficult or time-consuming or leave a bad taste in your mouth. Our university requires our department to survey our physics graduates after graduation. I will present an inexpensive online tool from Formsite and an instrument from the American Institute of Physics that I modified for our department. These quickly and painlessly (for you and for the student) yield assessment statistics and comments from students that can be quickly copied into your assessment reports.

Teaching General Physical Science Students About Saving Energy
Carl Rutledge, East Central University PMB X-4, 1100 E. 14th St., Ada, OK 74820
Email crutledge@mac.com, Telephone 580-310-5392

Most physical science students aren't concerned about saving energy. They just want gasoline to cost less and their utility bills to go down so they can afford to use all the energy they please! As physics teachers, it is our responsibility to point out the need for and benefits of energy conservation, to show students how it can be done, and to be a role model for our students. I will show a short Power Point presentation I make to my classes and welcome suggestions from the audience on other ways to save energy.

Colors of a Rubber Duck and other Optical Adventures
Jim Johnson
Avila University
Kansas City, MO
Several optical phenomena of the sort that could be explained in a conceptual physics course, or a first year course have been observed and documented in a backyard hot tub. Among them are the apparent colors of various objects when illuminated with various colored lights in the tub, apparent depth being less than the truth, and total internal reflection resulting in bright water if the lights are submerged. A few blurry photographs are interpreted.

Making Connections with Non-science Majors
Linda C. Kondrick, Ed.D
Assistant Professor of Physical Science
Arkansas Tech University

What do infrared astronomy and flush toilets and have in common? What do special relativity and women's corsets have in common? What do Sputnik I and the Hope Diamond have in common? They are each pairs of waypoints on parallel timelines. In 1800 Sir William Herschel detected infrared radiation the year before President Thomas Jefferson had the outdoor wooden privy demolished and installed two water closets in the White House. In 1905Albert Einstein published Special Relativity, the same year the S Bend Corset became popular. In 1957, the Soviet satellite Sputnik I was launched, and a year later the Hope Diamond was donated to the Smithsonian Institute of Natural History.
These events are samples from a semester project, Twice Upon a Time, designed to motivate and engage non-science majors in the study of the physical sciences. Students are required to research major events in two fields: a specific area of physical science or a related technology and any other topic of interest to the student. Twelve or more events are arranged on either side of a parallel timeline that covers at least a century. In a companion essay students explain the connections they have discovered between these disparate fields.

Physical Science Lab Quizzes: Results from Test Item Analysis
Wilson J. Gonzalez-Espada
Arkansas Tech University
(presented by Linda Kondrick)

Assessing students properly is a difficult task because mental constructs such as *knowledge* and *understanding* cannot be measured directly. Multiple choice items are a way to estimate student knowledge in a fast, inexpensive, and reliable way, assuming that the items are properly designed and validated. Test item analysis borrowed from large-scale test theory can reveal significant details about a classroom test, including technical flaws and errors of judgment made by the item writer, multiple interpretations of ambiguous items, poor distractors, and student misconceptions. The purpose of this paper is to introduce the concepts of item difficulty and discrimination in the context of the analysis of lab quizzes offered to more than 100 students enrolled in Introduction to Physical Science at Arkansas Tech University. It was found that most of the test items were easier than expected but with reasonable or high discrimination. However, several items were flagged as too easy and marginally discriminating and must be further analyzed for possible modification or deletion from the item pool.

Spherical Rare Earth Magnets in Introductory Physics
Al Adams
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In recent years physics instructors have been able to purchase powerful rare earth magnets shaped as spheres. These spherical rare earth magnets (SREMs) feature a high magnetic field at their surface (order of 104 Be, where Be is the magnetic field of the earth) and retain their magnetization well. Studies have shown that the 3/4-inch SREM can be modeled as a pure magnetic dipole with a magnetic moment on the order of 3.5 Ampere-m2, adequate for observing interaction with the earth's magnetic field. A series of observations and measurements with SREMs has been developed for use in introductory physics. These include rolling on flat non-metallic surfaces, rolling in inclined non-metallic channels, kinematics for a moving magnet near a second stationary magnet, falling SREM in metal pipes, measurement of force vs distance for two magnets and mathematical modeling of the data to yield predicted value for dipole-dipole interaction, and the use of SREMs in the Gauss Rifle in which a ferrous ball is launched with high velocity from a stationary magnet impacted by a slow-moving ferrous ball. All of these applications will be described and modeled in this presentation and their potential for illustrating fundamental concepts at the introductory level highlighted.

Energy Mental Models: From the World to the Classroom
Salomon F. Itza
University of the Ozarks

Monica Ramos
San Diego State University - Imperial Valley Campus

We investigate mental model(s) liberal studies majors, prospective elementary school teachers, may use for the energy concept in physics, in various contexts. Our research instruments are pre- and post-instruction surveys, and pre- and post- instruction interviews. We find that initially our students consider the concept of energy with the point of view of colloquial language and everyday experience. After instruction their responses consider several types of energy and the principle of conservation of energy. We present the questions, responses and analysis of the surveys results.

Online Support for New Physics Teachers*

Brian Adrian, Dean Zollman, and Scott Stevens+
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Teachers of physics can often lack the type of support they desperately need. The Physics Teaching Web Advisory (Pathway) is a dynamic digital library for physics teaching that is designed to offer such support. Carnegie Mellon University's synthetic interview technology provides the foundation for a system that allows physics teachers to ask questions of a virtual mentor and get video responses. A log of the questions asked of our system provides a rich database of information about just what types of support teachers are requesting. This talk will present a summary of the common types of questions teachers ask. Such information is valuable as we design support systems for physics teachers, both new and experienced. In addition, recent progress and developments will be discussed.

*Supported by NSF grant numbers DUE-0226157, DUE-0226219, ESI-0455772 & ESI-0455813
+Carnegie Mellon University

Transfer of Prior Reasoning in Understanding Positron Emission Tomography*

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We present college students' prior reasoning and transfer while understanding some of the physics of Positron Emission Tomography (PET). Interactive hands-on activities which serve as analogies to key aspects of the PET process were designed. Teaching interviews were then conducted to investigate the role of the activities in facilitating transfer. This study, which involved students enrolled in an algebra-based introductory level physics class, showed that the use of the analogies does indeed prompt the transfer of relevant physics ideas to PET contexts. In addition, the study showed that the students transfer their prior models that they have constructed through classical physics or everyday life while learning using the analogy activities. Some of the prior models that they transfer while learning in new contexts are inappropriate but very robust. We concluded that the hands-on activities, if they are introduced in the appropriate order, can be very effective in triggering appropriate use of prior reasoning and suppressing inappropriate ones.
* Supported by National Science Foundation grant 04-2675.

Probing and Improving Student Understanding of Common Electrical Devices*

Jacquelyn J. Haynicz, Peter R. Fletcher and N. Sanjay Rebello
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Educators have often attempted to motivate students' interest in science by demonstrating its connection to everyday life. This research focuses on whether exploring the topic of electricity within the context of common electrical devices would make learning more enjoyable and productive for introductory college students. In Phase I of the research, students were asked which electrical devices they found interesting and to explain the functioning of those devices. Students cite a wide variety of devices, focusing mainly on electronic devices and their usability. In Phase II, students' conceptions of the functioning of a blender were investigated and hands-on interactive demonstrations were introduced to help students to better understand the electromagnetic motor used in a blender. We describe students' progression through the demonstrations and the impact of the demonstrations on student understanding of the blender.

*Supported by National Science Foundation Grant REC-0133621 and Kansas State University Graduate School Summer Undergraduate Research Opportunity Program.

Some Preliminary Views on Students' Models of the Physics of the Eye*

Dyan Jones and Dean A. Zollman
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Students have their own ideas about how the human eye works. A research project has been designed to elicit student understanding of the human eye by asking them to respond to and evaluate a set of four different models of the eye. We will present an overview of the project including which models were used. Though the results are forthcoming, we will also present some interesting student responses.

*Supported by National Science Foundation grant DUE 04-27645.

Using Optical Analogies While Teaching Physics of X-rays and CAT Scans*

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Our Modern Miracle Medical Machines project is devoted to improving motivation and performance of pre-med students in their undergraduate Physics classes. Under its framework we designed hands-on lab activities involving optical analogies to teach the application of contemporary physics to medical imaging. On the basis of our previous research that included clinical interviews, we created activities using semi-transparent Lego blocks as analogs for understanding the image reconstruction process in CAT (computerized axial tomography). Teaching interviews have been conducted with health-related majors using these materials. Students had to determine the shape of an object constructed of Lego blocks and hidden within a closed box. Using LEDs (light-emitting diodes) and a photo detector the students attempted to learn the contents of the box. They also had access to another similar Lego arrangement which they were already free to open. Interviewees successfully transferred knowledge from their science and math classes (as well as from other sources) while completing activities, and expressed great interest in this endeavor. Improvements to the activities have been based on the students' feedback. *Supported by the National Science Foundation under grant DUE 04-2675.

Exploring the Studio Format in an Upper-Division Optics Course: A First Look*

Fran Mateycik and N. Sanjay Rebello
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Studio physics classrooms are most commonly used with introductory courses. The Kansas State University Physics Department intends to expand studio implementation to upper division classes, and elected to start with Optics I and II. Studio Optics was designed and completed over the spring of 2006. We chose to investigate how this method will perform with upper division physics majors. Twelve students were given two sessions of teaching interviews. The first interview focused on single slit diffraction. The second interview focused on Poisson's' Spot. The initial data sweep afforded us the opportunity to explore students' difficulties with the studio laboratory write-up as well as their conceptual understanding of the topics. We also gained insights students into the mindset with which students approached the studio laboratory activity.

*Supported in part by the National Science Foundation under grant number DUE 0511667.

Initiatives in Physics Education Research in India

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Learning patterns of students are influenced strongly by the prevailing structure of an education system and the socio cultural aspects. An understanding of the difficulties faced by students and the possible approach to help them learn effectively need to address the relevance of these issues. The education system in India is formatted in a significantly different pattern than in the USA. In this talk, a brief overview of the educational scenario in India will be presented. The similarities and differences that are relevant from the point of understanding of the student learning processes will be discussed. A status report on the PERG initiatives in India will be reported. The talk will then discuss our own work on the possible application of lateral thinking techniques to help students develop the skill of strategizing learning.

Bringing Physics Education Research Into Practice*

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Pathway is seeking to improve the quality of physics teaching by facilitating additional in-service and pre-service teacher training. The multiple features of Pathway make it suitable for different needs of users. The components of Pathway are Synthetic Interviews and the Informedia Digital Video Library. My contribution to Pathway is providing links to a collection of educational resources and literature.

Originally, in this study with teachers' questions, the achievements of research were collected and associated to the relevant questions. The primary focus was mechanics. The output is a collection of different kind of resources which were matched to teachers' questions.
These links will be displayed as part of the Synthetic Interview when a teacher submits a question to Pathway.

*Supported by the National Science Foundation under grants ESI-0455772 & ESI-0455813.

Using a Web-based Classroom Interaction System to Enhance Student Learning*

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We have developed and deployed a Web-based wireless classroom interaction system in a large-enrollment introductory physics lecture class that uses HP handheld computers (PDAs) to facilitate real-time two-way student interaction with the instructor. Our system is ahead of other "clicker" based systems that are primarily limited to multiple-choice responses. Our system allows for a variety of questions including short answer questions. It also allows for adaptive questioning and two-way communication that provides real-time feedback to the instructor. We will share results from student feedback as well as the impact of this technology on student learning. Comparisons to the more commonly used multiple-choice response systems will be discussed.

*Supported in part by HP Technology for Teaching Grant 2004.

Diversity Among ASMSA Students - A 3 Year Summary
Shane Thompson
Arkansas School for Mathematics, Sciences, and the Arts (ASMSA)
Aaron Bowen, ASMSA Class of 2004
Aja Hogan and Eddie d'Orsay, ASMSA Class of 2005
Tina Henderson, ASMSA Class of 2006

Each year approximately 100 students from all parts of Arkansas enroll in Physics classes at ASMSA. For 3 years these students have participated in research projects conducted by fellow students concerning diversity among the population. In particular, the FCI has been administered as a pretest and post test. A study was conducted in 2004 based on "home-school" size and FCI performance. A second study dealing with normalized gains and gender was completed in 2005. Finally, a current study using the EBAPS and FCI Pretest is discussed. EBAPS measures the "scientific sophistication" of the student. The results of these studies and other information about ASMSA students will be presented.

Utilizing Tablet PCs and wireless technology in teaching introductory physical science
Zdeslav Hrepic
(Physics Department, Fort Hays State University)
Hong Wang
(Director of Center for Teaching Excellence and Learning Technology, Fort Hays State University)
Dorothy Fulton
(Department of Special Education, Fort Hays State University)

I order to capitalize on educational opportunities provided by tablet PCs and wireless technology, in summer of 2006, FHSU faculty piloted use of DyKnow software application. In this paper we report on results of DyKnow usage in introductory, inquiry based Physical Science course for non-majors. DyKnow was consistently used to facilitate student engagement, collaboration and exchange of results during group investigations. The software also facilitated post-investigation discussions and provided several effective, nontraditional venues for student feedback and formative assessment.

IDEAS NEEDED! Undergraduate Research/Projects Assessment
Dr. Rudy Eichenberger
Physical Science and Technology Department, Southern Arkansas University

One of the problems in using undergraduate research and/or undergraduate engineering projects as a junior and/or senior project is finding researchable or constructable projects which are "doable" and meaningful. Allowing for the correct credit hours (quantity) for the project or research is another problem. Assessing the project or research for grade (quality) is another problem. We require a written

paper describing the literature search, project or research description and data collection, data analysis and conclusion. The author will share past experiences and accept new ideas.

POSTERS

Dr. Karen Williams and Victor Jacome
East Central University

Basic ultrasound imaging techniques using an ultrasonic echoscope interfaced to a PC, a 1 MHz transducer, a 4 MHz transducer, and acrylic blocks were used to determine several physical properties. Properties of the echo waves such as velocity, frequency, period and amplitude were measured to obtain various physical measurements of the objects being imaged. Measurements of the thickness of a polyacrylic block and the depth of holes in a phantom block were made using both the T(time)- mode and the D(depth)-mode. The depth of drilled holes in the phantom were determined from images formed from B(brightness)-mode and M (motion)-mode. Frequency calculations were made from the period and compared to frequency values obtained using fast Fourier transform methods. Echo amplitudes were measured for two different thicknesses of acrylic to determine the coefficient of attenuation for acrylic. All values measured by ultrasound imaging agreed quite well with their accepted values. In addition, the scanning ranges of each transducer were easily determined. The lower frequency transducer was more accurate in measuring greater depths and the higher frequency transducer was more accurate in determining shallow depths.

The Trouvelot Astronomical Prints at Emporia State University

DeWayne Backhus, Professor and Chair, Departments of Physical Sciences, and Elizabeth Fitch, Earth Science Graduate Teaching Assistant
Emporia State University

Emporia State University possesses ten historically significant astronomical prints from an original portfolio of 15 produced by the French immigrant Étienne Lêopold Trouvelot (1827-1895). At a time when astrophotography was in its infancy, Trouvelot created over 7,000 drawings between 1870 and 1881 using naked-eye and telescopic studies of celestial objects and astronomical phenomena. With the intent to reach a larger audience, 15 were selected to be recreated as chromolithographs for a portfolio produced and published in 1881 by Charles Scribner's Sons.

Trained in France as an artist, the application of his artistic skills to astronomical studies were not Trouvelot's first "dabbling" in science. His first efforts were with silkworm culturing and silk production (sericulture). Through a series of unfortunate events, Trouvelot became infamous as the individual responsible for the introduction and release of the gypsy moth in the United States. Turning from his "failed" pursuits in sericulture, Trouvelot followed a new path that brought him greater acclaim with his observations and renderings of astronomical objects and phenomena.

The history behind these prints and the existence of part of a set at Emporia State University remains somewhat of a mystery since we became aware of them in the late 1990s. The prints have spurred extensive research to determine more about É.L. Trouvelot, the astronomical prints, and the presence of ten of these prints at Emporia State University. The earliest indirect references to them are in Kansas State Normal publications between 1897 and 1901, from which we deduce an apparent connection with Thomas M. Iden, head of the physical sciences from 1897 to 1913. The ESU Trouvelot prints have been remounted with appropriate archival-quality materials, and framed for protection in ultraviolet protective Plexiglas®. Decisions regarding future plans with the prints are in a formative stage.

Note: The Trouvelot prints will be on display in the poster area.

Can Air Resistance Decrease a Pendulum's Period?

K. Grantham, J. L. Ballester and J. McGil
Physics Department, Emporia State University

The simple pendulum model presented to students in introductory physics courses has a simple formula for the period. However, the simple pendulum neglects several factors that can influence the period of the pendulum, such as the finite amplitude of the oscillations, air resistance and the rotational inertia of the pendulum bob. We will present the results of a numerical investigation of the effect of air resistance and pendulum bob inertia on the period, particularly when linear and quadratic velocity dependence for air resistance is combined with finite amplitude effects.

Optimization, Design and Testing of a Multiple Transducer Ceiling Mounted Sound System - An Engineering Physics Service Learning Project

Jonathan Gonzales (junior physics major) and Carl Rutledge, East Central University

The goal of this student summer research project was to provide a sound system for a large, irregularly shaped church dining hall which provided high quality, evenly distributed sound to all areas for a minimum cost. Four different brands of speakers were purchased and tested, first in the laboratory and then on site. Selection considerations included overall frequency response, angular dispersion, sensitivity, speech intelligibility, subjective sound quality and price. Following a site survey, geometric considerations determined speaker numbers and placement. After circuit design, wiring and installation, white noise sound intensity levels were determined to be uniform to within +/- 3 db throughout the dining hall. The First Baptist Church of Ada reimbursed the project for the cost of the speakers and provided the space and some installation materials and equipment. The project was supported by the National Science Foundation and OK-LSAMP.