

SACS/AAPT Fall Meeting Program
22-23 OCTOBER 1999
At the COLLEGE OF CHARLESTON

An Evening of Physics Fun With Dick and Rae

Can Active Physics be Used to Increase the Number of Physics Teachers in High Schools

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Active Physics can be used in high schools that do not presently have a physics program. The teacher who takes the method class can introduce the students to the joys and appreciation of physics. As the teacher becomes better acquainted with our field, they see the need to develop more classes of physics, which requires the teacher to take more courses and workshops in physics, and wha-la! Another physics teacher is created.

Period Doubling Route to Chaos in a Root-finding Algorithm

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Kepler's equation is one of the oldest and most important examples from nature of a transcendental equation. For a specified time, corresponding to a mean anomaly; one may solve the equation to obtain the position of a satellite moving in an elliptical orbit about the earth, or a planet about the sun. Typically, the solution to Kepler's equation is obtained by Newton's root finding technique. A faster convergence to the desired root can be realized with a higher order method known by the name Chebychev, if the starting value for the algorithm is judiciously chosen. For a carelessly chosen initial value, convergence may never occur. Moreover, if the mean anomaly slowly increases between iterations, it is possible for spurious results involving bifurcation to occur. An example of such non-physical results will be provided, which demonstrate the classic period doubling route to chaos.

An Urgent Need: Find Ways to Test for "Real World" Student Knowledge

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The Physics Education Community was shocked into action when they saw the low performance of their students on the Mechanics Diagnostics Test and other similar tests. Published articles report how physics classes have been changed to improve scores on such test. Although this is substantial progress, these tests are just "symbols on paper", and need to be complimented with tests that involve "real world" hardware and events. It stands to reason that we should test for the actual skills and abilities that we expect our students to have when they finish our classes. Teachers urgently need to know if their students are able to APPLY what they have learned to appropriately selected real events and circumstances of their everyday world. In a "review for final exam" session, I asked my introductory physics students to complete a simple exercise that required application of their knowledge of Optics and Snell's Law to what they saw with their own eyes concerning rays of light passing through a glass fish aquarium. The students were completely unable to even start working, and what is worse seemed to have no desire or ability to go forward by team work and/or any form of trial-and-error exploration. Gradually, I have discovered teaching techniques that have considerably improved student overall understanding of the phenomenon of light and optics, and student performance on the "aquarium exercise" shows improved results.

Experiment in Active Learning

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Undergraduate education has undergone a paradigm shift during the last two decades. Educators are showing more concerns about students' learning. New pedagogies such as Cooperative Learning, Collaborative Learning, Problem-based Learning, Project-based Learning, Inquiry-based Learning, Case-based Learning, Research-based Learning, Situation-based Learning, Context-based Learning, Service Learning and Active Learning have been introduced in an arena of higher education. Savannah State University had a faculty development workshop entitled "Active Learning" during the academic year 1998-1999. I experimented with these teaching strategies after the workshop and the challenges and outcomes of an application of Active Learning pedagogy in general physics classes are discussed.

Wanted: Women in Science and Engineering: A Mentoring Approach

Rosalie A. Richards and Jesulon Gibbs, Department of Chemistry, Spelman College, 350 Spelman Lane, Atlanta, GA 30314, (404) 215-7842, rrichard@spelman.edu

Attracting and retaining women in physical science majors requires special attention. At Spelman College, a Program in Physical Sciences, PIP, was created to address this issue. On selecting pre- and post-freshwomen Physics and Astronomy majors, we have focused on two areas: (a) scientific and critical thinking, and (b) mentoring. The goal of the mentoring program is to develop desirable personal attributes among students that would foster positive experiences during their academic pursuits and assist in advancing their prospective careers. In this paper, we present preliminary findings regarding this approach. Financial support furnished by the Office of Naval Research (ONR)

Statistical Modeling of Sea Breezes

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A sea breeze can occur when air over the coastal land is warmer than the air overlying the coastal waters. This temperature gradient creates a density gradient that in turn creates a driving force favoring onshore airflow at low levels along the coast. This is called a sea breeze and it creates a distinct phenomenon, which can interact with surrounding large-scale weather systems in several ways. The factors that cause this sea breeze to form are generally known, but each geographic area must determine the characteristics and related values for these factors to forecast its own coastal weather. This has been found to be feasible, using a spreadsheet program on a desktop computer. Input data included coastal ocean surface temperature, inland wind data and temperatures 10 m above ground level, and time of day. Coastal wind data was used as the indicator of sea-breeze flow. The existing National Weather Service sensor for measuring ocean temperature at Charleston, South Carolina was found to be inadequate for analysis and prediction of sea breezes. A portable weather station was installed at the Folly Beach Fishing Pier on Folly Island, South Carolina to provide better data. The factors that lead to sea breeze initiation were studied and quantified using weather data from June 1998, including data from the Folly Beach Fishing Pier station. A sea-breeze index was determined for the coastal South Carolina area near Charleston. This index is the ratio of the squared synoptic-wind cross-coast velocity component to the difference in temperature between the inland air and the ocean surface temperature (U^2/T). Using this index and other values determined by that study, several increasingly complex statistical models, based on decision trees with statistical weighting factors, were developed. These models were tested using weather data from 1998, July through October, and the best models were shown to provide improved forecasting, with skill scores in excess of 30 % over climatology, making them useful predictive models.

The Banjo: A Drum With Strings: Some Physics and Some Merriment

Terri McMurray, Winston-Salem/Forsyth County School System, Winston-Salem, NC 27101, (336) 727-8181, mcmurrayte@netscape.net

Terri McMurray will discuss and demonstrate some physics associated with a truly American instrument: the banjo. The portion of the presentation guaranteed to stimulate your aural receptors will be when Terri is joined by her husband, Paul Brown, to demonstrate auditory aspects of the banjo, accompanied with fiddle, guitar and song. Terri and Paul live in Winston-Salem, NC. Terri teaches AP Physics and AP Statistics for the Winston-Salem/Forsyth County School System. Paul was, until recently, the Program Director at their local NPR station, WFDD. He currently does free-lance production and recording for NPR as well as state and local production for arts councils and organizations. Terri and Paul met through their music and continue to perform nationally.

Development of an Online Interactive Chaotic Pendulum

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A chaotic pendulum, which can be remotely controlled through the internet, is being developed at Mercer University. The pendulum is a commercially available device which has been modified to allow a remote user to adjust the driving frequency. For some driving frequencies the motion is periodic, while at other frequencies chaotic behavior is observed. Using a standard web browser, real time graphs of position and velocity as a function of time may be viewed. The phase space trajectory (velocity as a function of position) and a Poincare section may also be viewed. A graphical interface allows the user to interactively alter the driving frequency, and observe the resulting behavior of the pendulum. Data can be downloaded to the user for future analysis. We expect this pendulum to provide a valuable teaching resource. A unique feature is that data is from a "live" experiment and not generated by a simulation.

Teaching Introductory Physics Using Video Analysis Software

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Several video analysis programs are available that allow you to collect position and time data from digital video clips. We have used these programs with our students and would like to share our experiences. In this presentation, we will show the three different programs we have tried and the teaching strategies we have used.

Using the "Starry Night" simulation software for pre-lab activities in astronomy

Ntungwa Maasha, Coastal Georgia Community College, Brunswick GA, 31525. (912) 262-0458, Maasha@bc9000.bc.peachnet.edu

This talk will highlight the use of the "Starry Night" space simulator in the classroom to illustrate basic concepts about space in preparation for, or as an alternative to, viewing the night sky. I shall also note the experience of some students with its use.

Astronomy on cloudy nights: Computer-based instruction

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At the College of Charleston, we have set up a room with a dozen MacIntosh computers which we have used in our Astronomy laboratory course for the past four years. We have acquired four computer programs (Voyager, Star Probe, SimEarth and Moonsticken) which can be used to present basic concepts covered in our Astronomy lecture course. Specifically, three-hour courses of study have been developed which demonstrate Kepler's laws, the seasons, spectral analysis and classification of stars, plotting stars on the HR diagram, stellar evolution, stellar interiors, Hubble's law, the structure of the Milky Way, and planetary evolution. The structure of these labs will be discussed, as well as the problems and some potential solutions encountered during their development.

Surface Charges and Feedback in Simple Circuits

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Interest in the surface charges on circuits, and their utility in the conceptual understanding of circuit behavior, has recently increased. Papers and textbooks have discussed surface charges either with qualitative diagrams or analytic results for very special geometries. Here, I present the results of numerical calculations showing the surface charges on several simple resistor-capacitor circuits. Surface charges are seen to guide the motion of charges and create the appropriate electric potential and Poynting vectors for the circuit, and hence are an important factor in the teaching of circuit theory.

The 1999 International Young Physicists Tournament.

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The IYPT was held in Vienna Austria this year. The USA sent its first team from the North Carolina School of Science and Mathematics, led by Hugh Haskell and Chuck Britton. Seventeen counties participated. The questions for the tournament will be discussed. I went as a juror, and the judging system will be critiqued.

A Way to Improve Student Attitude About Learning, an Update

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This talk will be an update on recent developments concerning my use of the book *Zen and the Art of Motorcycle Maintenance* by Robert Pirsig, as a demonstrably successful way to improve student attitude about learning, education, and life. Written in a manner that is accessible and maintains interest, *Zen and the Art of Motorcycle Maintenance*, covers science, philosophy, scientific trouble shooting, problem solving, the process of scientific discovery, building the structure of science, and more..... all of which supports the mission and message of a physics class. This book shows the reader how it is necessary to thoughtfully combine science and humanities and personal values in a university education. Pirsig points out how proper learning is often prevented in present day universities. The role of the "flash of insight" and metaphor is shown to be fundamental to human thinking and learning. The book forces the student to think a great deal about themselves, their values, and why they are at an institution of higher education. Some members of the audience will remember my SACS-AAPT talk in March of 97 at the USC-Aiken Campus. Since that time there have been communications from my campus administration that have forced a great deal of soul searching, which will be shared with the audience.

Some Preliminary Results on Reviewing the Physical Science in Middle School Science Texts

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Have you ever wondered where your students get some of the ideas that they have?
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Can Jane and Johnny Learn Science?

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Many curriculum reforms are underway in Chemistry and Physics with the sole purpose of enhancing the understanding of physico-chemical principles among students and to improve their performance in course work. Most of these efforts concentrate on developing (or employing) various pedagogical approaches to deliver a similar content as before. As part of the Program in Physical Sciences (PIPS) at Spelman College, we have adopted a different approach to accomplish similar objectives as other groups. The main feature of our approach is to use the pedagogy to first demonstrate to participants (freshmen) the science and scientific process involved in the material, which is presented in the textbooks. The implementation strategy, the material utilized, evaluation process, and preliminary data will be discussed. The initial observations lead us to conclude that the "students are neither dumb, nor different; but have been taught differently."

Inculcation of Basic Principles in Physical Sciences: A Scientific Approach

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Scientists usually propose working models for natural phenomena which constantly change as the power of observations or the interpretations improve. Despite the wealth of such scientific literature, an average student considers the discipline of science as a collection of non-related facts. With the aim of teaching the scientific process and of experiencing the joy in practicing science, an instructional module entitled "atoms and molecules" has been developed. Thoughts about atoms and molecules are explored with a view to exposing students to a global and historically comprehensive picture of scientific principles. The module, offered as an enrichment summer activity for pre-freshmen (Program in Physical Sciences (PIPS)), includes interactive sessions and a daily laboratory component. After one offering, our initial observations suggest that this comprehensive approach has generated sufficient interest and enthusiasm among students. The organization of the module, the students' response, and some indicators of success will be discussed.

Model-building for active, constructive problem solving

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Using Stella modeling software we will present several examples of dynamical systems, normally studied in first year physics classes, designed to increase student knowledge and understanding of computer modeling and simulation. When structured carefully, the activities can lead to the development of a deeper understanding of the fundamental concepts, as well as more effective problem-solving skills. Stella is a dynamic modeling system in which the user can build models by creating a relational diagram and then assigning values and functions. Stella will produce output in numerical, graphic or meter form. We will show how you can rapidly customize existing models to meet your specific needs in order to illustrate concepts and principles in lectures.

Wave Function as a Two Dimensional Vector in Quantum Mechanics

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Complex numbers have the interpretation of vectors that rotate in the complex plane. This interpretation can be extended to represent complex numbers as two dimensional vectors using standard vector notation, thereby eliminating the imaginary number (i). Schroedinger's time independent and time dependent equations are rewritten in this new notation to interpret the quantum wave function as a vector that rotates about and at a 90 degree angle to its momentum vector as it travels through space.

Physics and Toys for Teachers (Workshop)

Ray Turner, Clemson University, Department of Physics, Clemson, SC 29634-0978 (864) 656-5321, traymon@clemson.edu

This hands-on workshop is designed for teachers at all levels in search of fun physics demonstrations, lab experiments, and interactive materials for their students through the use of ordinary children's toys. A variety of toys will be demonstrated, and the physical principles related to these toys will be discussed. The workshop leader has found that toys can be utilized in both qualitative and quantitative investigations at all grade levels from kindergarten through college by varying the sophistication of the analysis, and these same toys can also be used for informal presentations to public groups of all ages, whether children or adults. Physics can be fun not only for students and others, but also for the teacher. By using toys, physics can be fun for everyone!