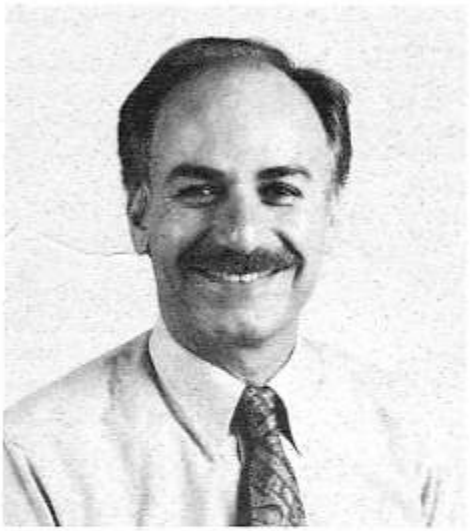
The PHYSICS MAJOR

SONOMA STATE UNIVERSITY DEPARTMENT OF PHYSICS AND ASTRONOMY
1996

#1 Again

For many years Sonoma State University has led the California State University system in the percentage of its undergraduates majoring in physics. In recent years the number of majors has declined, apparently in response to the well-publicized oversupply of Ph.D.'s in the sciences—even though there is still demand for those with bachelor's degrees in physics—but it turns out that the number of majors has declined everywhere.

The most recent figures available are for Fall 1994. Only 0.25% of the 259 thousand undergraduates at the twenty CSUs were physics majors, but at SSU the figure was 0.78%. The second highest was 0.46% at California State Polytechnic University, Pomona. Just four campuses—the Cal Polys at Pomona and San Luis Obispo, San Francisco State and San Diego State—had more physics majors than Sonoma State, which ranked sixteenth in overall undergraduate enrollment.



The Department's new Chair, Dr. Saeid Rahimi, has led the discussion of changes in the curriculum.

Curriculum Changes Discussed

The faculty of the SSU Department of Physics and Astronomy have been examining the Bachelor of Science program this year. Proposals have been made to put new emphasis on optics, electronics, computational physics, and health physics. In addition, the faculty are considering the addition of a 3+2 engineering program which would enable students to study at SSU for three years and then continue their studies elsewhere for two. They would receive a physics degree from SSU and an engineering degree from the other institution.

The optics and electronics concentration is a response to the growing number of employers in Sonoma County in photonics (including opto-electronics), fiber optics communications, lasers, detectors, and optical thin films. Dr. Saeid Rahimi, who not long ago spent a sabbatical at Hewlett-Packard working on diode lasers, is planning new courses, including laboratory courses, in lasers, fiber optics, and detectors. The theory and practical aspects of diode lasers will be emphasized in these courses. The current solid state and semiconductor physics courses will probably be combined into a semiconductor electronic devices course with a laboratory. It is hoped that these moves will increase the number of physics majors and will enable more graduates to find positions in the local area.

The computational physics orientation is aimed at providing students with advanced computational skills. Proposals are being discussed to reduce the analytical treatment in theoretical courses and to add more numerical work. In the fall Dr. Sam Greene's students in the analytical mechanics and quantum mechanics courses will use *Mathematica*, powerful computer software written by a physicist. A new course on computational physics is being designed to include more advanced numerical methods, including data analysis and statistics.

A new emphasis in health physics is being led by Dr. John Dunning, who is already including many health-related projects in the applied nuclear chemistry and physics courses, and is now thinking about a new X-ray course. Other faculty have introduced several health-related experiments in the introductory labs.

To make the proposed changes, of course, new equipment will be needed. The National Science Foundation is considering the scanning electron microscope proposal submitted by Dr. Dunning and other SSU faculty.

According to Professor Rahimi, "We are determined to include the best available elementary and advanced instruments in our laboratories."

The changes under consideration are not limited to courses. The faculty would like to make the department even friendlier and more accessible than it is now. Students are encouraged to voice their opinions and participate in the changes. Plans for construction of a new student room on the third floor of Darwin have been drawn up and will be implemented as soon as fund-raising efforts prove successful.

A New Emphasis in Nuclear Courses

John R. Dunning

Biochemical and medical tracers and health physics will be featured in the applied nuclear chemistry and physics courses in the fall of 1996. To help in the transition we have a new edition of the text, *Atoms, Radiation and Radiation Protection*, by James Turner of Oak Ridge National Laboratory. The laboratory part of the curriculum will include a tour of the nuclear medicine department at Santa Rosa Memorial Hospital and work with air sampling equipment. The famous Hot Hair and Hot Rat experiments will be retained.

Major upgrades are planned for the laboratory. We are trying to fund a new, larger germanium detector, a low-level counting chamber, and a computer-based multi-channel analyzer. The proposed system will have a factor of ten better minimum detection limit. This means we will be able to analyze air filter papers and some water samples directly. Using our in-house neutron source we will be able to detect milligram amounts of aluminum, arsenic, and twenty other elements. The Hot Hair Experiment uses Washington State University's reactor, and nanogram amounts of longer half-life elements should be detectable. Do you remember those gammas that did not fit the library we have? The software for the proposed new analyzer features a 40,000+ gamma ray library keyed to the Chart of the Nuclides.

Cominsky Probes Pulsars and Bursters

Dr. Lynn Cominsky's research activities expanded this year, as she received additional grants to work on data from the Japanese X-ray astronomy satellite *ASCA*, NASA's *Compton Gamma Ray Observatory*, and the newly-launched *Rossi X-Ray Timing Explorer*. The *Rossi* orbiting observatory features a large detecting area, which enables researchers to measure X-rays from binary systems, including pulsars and "bursters," over extremely short time intervals. Dr. Cominsky and her colleagues presented results from the *CGRO* work at both the January 1996 meeting of the American Astronomical Society (AAS) in San Antonio and the May 1996 meeting of the AAS High Energy Astrophysics Division (HEAD) in San Diego.

Dr. Cominsky also continued to work closely with the Stanford Particle Astrophysics group on simulating the science that is expected to result from the proposed *Gamma-ray Large Area Space Telescope* (*GLAST*). The *GLAST* proposal is continuing to attract attention, and it is hoped that funds will soon be available to construct a prototype of the instrument.

Perhaps the most unusual new activities for Dr. Cominsky this year involved dealing with the press. She was featured in three very brief news reports, aired one week apart, on Channel 4 KRON-TV, due to the efforts of Science Editor Brian Hackney. An initial taping of her comments about the newly discovered X-ray pulsing burster led to two additional interviews about Comet Hyakutake, even though she does not work on either of these objects. However, knowing nothing about these and similar subjects did not dissuade her from undertaking the role of press officer at the HEAD meeting in San Diego. There she ran two press conferences, one featuring discoveries made by the *Rossi XTE* of the fastest oscillations ever detected from neutron stars, and the other presenting new results on blazars, quasars with relativistic particle beams, which are believed to contain supermassive black holes at their cores. The fast oscillations news made the *Los Angeles Times*, as well as Charles Osgood's Files on CBS.

Dr. Cominsky is convinced that in this day of decreased government funding for science, it is very important to get the word out about the wonders of the universe, and she is enjoying playing the role of commentator in the hope of gaining more public support for astrophysical research.

Reunion Celebrates Landmark

As this newsletter goes to press the SSU Department of Physics and Astronomy is about to award its 300th bachelor's degree. Just as the 100th degree was the occasion for the Department's first reunion, in 1980, this event inspired another one, believed to be the fifth, held on campus May 10.

Graduates came from as far back in time as 1971—Jim Hill—and as far away in space as Utah—David Shoaf ('75). A new feature of this reunion was that a number of alumni sent contributions so that current seniors could attend free of charge. The result was a lot of networking among seniors, recent grads, and older grads, and a good time was had by all.

A fine dinner was arranged by School of Natural Sciences Development Officer Christina Richie-Gray and alumni Miriam Carolin ('82), Joan Murray-Wilbur ('83), and Mark Robinson ('93). After dinner those in attendance heard about the Department's history from its long-time chair, Dr. Duncan Poland, and watched slides of SSU over the years presented by Dr. Joe Tenn. They also browsed through the Department's archives—some half dozen large binders maintained for many years by Miriam Carolin.

The Physics Major
No. 21 May 1996

Published by
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Written by Rachel Burgio, Lynn Cominsky, John Dunning, Saeid Rahimi, Willie Rodriguez, Chris Rostel, Joe Tenn, Amy Weber, and Susan Webster

DON HERRIOTT ('72) is president and general manager of Roche Carolina, Inc., a company which develops new pharmaceuticals and the technology for making them.

JOHN PROUD ('73) teaches physics and mathematics at Punahou School in Honolulu, where he chairs the science department and is director of the school's Challenge Ropes Course. John earned his teaching credential at SSU and his M.Ed. at the University of Hawaii in 1984.

JOHN P. NORTON ('74) is business editor of the *Pueblo Chieftain* in Colorado.

Hurwitt Wins Research Position

She signs her electronic mail, "THE TREE HUGGER." Since long before she came to Sonoma State University from Berkeley High School, Siana Hurwitt has wanted to do something to help the environment. She started out majoring in environmental studies, but after a couple of years switched to physics for a stronger scientific background. An excellent student and the winner of two scholarships, Siana will spend the summer doing research in the physics department at Rensselaer Polytechnic Institute in Troy, New York. She declined a similar offer from the University of California, Santa Cruz. She says that her laboratory courses and working in the stockroom with Steve Anderson helped give her the confidence to apply to national summer programs. She has discussed the Rensselaer program with Mario Marckwordt ('94), who was a participant two summers ago, and she is looking forward to research that will make her an even stronger candidate for graduate programs in environmental engineering or science when she graduates in December.

The Physics of Toys

The conceptual physics laboratory, Physics 102, is a one-unit lab for non-science majors with previous or concurrent enrollment in the conceptual physics or astronomy courses. Students who are not science-oriented take it to satisfy a general education requirement. This fall they will investigate the physics of toys.

To support the new course Professor Saeid Rahimi was awarded one of nine academic innovation grants at SSU. The award provides him with both time and funds for supplies. According to Dr. Rahimi the course will be an important one for those students who will become elementary and high school teachers, and it will be an asset to parents and future parents who wish to teach some concepts of physics to their children through play.

The main purpose of the new course will be to induce interest and active participation in discussing physics principles among students not known for their interest in science.

Dr. Rahimi reports that the "equipment" for the lab will be chosen from hundreds of toys on the market. Most people, regardless of their age or level of intelligence, easily relate to toys. While some toys are easy to describe, the principles of operation of others are illusive even to technically and scientifically-oriented people. An attractive feature of this course is the fact that the students will play with toys while learning physics.

Students will connect abstract science concepts with enjoyment of the everyday physical world, and will learn that doing science is fun. Each week there will be twelve identical sets of equipment available for the class. Additionally, students will be encouraged to bring their own special toys that are relevant to the topics of any particular week for discussion and sharing.

Consider for example, the operation of the "perpetual spinning top" that can be found in novelty toy shops for about $20. The unit consists of a small metallic top that continues spinning on the top surface of a "black box" once set in motion. To the untrained eye, this is a truly amazing phenomenon. The top itself is made of a magnetic material. When set in motion, it induces an electric current in a coil inside the box. The coil is connected to the input of a transistor which switches on upon sensing the induced current. The newly established current in the transistor circuit will in turn create an oscillating magnetic field that interacts with the spinning magnet, thus forcing it to continue its motion.

It is expected that the majority of the students will not be able to explain the principle of operation of this toy on their own. However, after thinking about the problem for some time, they will be willing to find out about the solution to the puzzle and they will learn a little about electromagnetic induction, magnetic interactions, transistors and electronic circuits. They will take the boxes apart and learn about various components of the toy. The instructor will then demonstrate the same ideas with more traditional physics equipment.

Fifty Semesters of WPD

In Fall 1995 the SSU Department of Physics and Astronomy presented the 50th semester of the "What Physicists Do" public lecture series. Dr. Joe Tenn, who founded the series in 1971 and who has now directed it for 37 1/2 semesters, was presented with a plaque by Dean of Natural Sciences Anne Swanson. Dr. Lynn Cominsky, who has directed 8, received a framed certificate. The surprise presentation was organized by a few of the regular attendees from the community.

The fall speakers were what Dr. Tenn called "some of our favorites from the first 49 semesters." They included two members of the National Academy of Sciences—Professors Calvin Quate (Stanford) and Marvin Cohen (UC Berkeley)—and two best-selling authors—Paul Hewitt (*Conceptual Physics*) and Cliff Stoll (*The Cuckoo's Egg* and *Silicon Snake Oil*).

The spring series included two speakers on global warming—David Goldstein of the Natural Resources Defense Council, and Barbara Levi, an editor of *Physics Today*. Attendance was high for astronomers Virginia Trimble (UC Irvine) and Halton Arp (Max Planck Institute for Astrophysics), and it peaked at the last lecture, when Galileo Probe Project Scientist Richard Young presented some of the early results from the mission into the clouds of Jupiter.

Students and faculty from throughout SSU, and visitors from as far away as Eureka, enjoy the popular Monday afternoon lectures and the opportunity to meet the speakers, many of them very prominent scientists.

A Major Contribution

Jason Alexander ('92), an engineer at Lightwave Electronics in Mountain View, recently arranged for the donation of a number of diode lasers to the SSU Department of Physics and Astronomy. The lasers range in power from a few hundred milliwatts to more than a watt and in wavelength from visible to infrared. Some of the donated lasers have thermoelectric coolers built in, which will be quite useful in demonstrating diode laser properties.

After graduating from SSU, Jason earned a master's degree in physics at Indiana University–Purdue University at Indianapolis. He maintains a high level of interest in physics, higher education, and his alma mater. He has been advising Dr. Saeid Rahimi concerning gas, solid state, and diode lasers that are important in industry, and he gave an exciting guest lecture in the Lasers and Holography course, Physics 447, this spring. He has promised more involvement in the new optics programs currently being discussed. The Department wishes to thank Jason and Lightwave Electronics for more than $22,000 worth of equipment, and for his active interest in its present and future activities.

SPS Activities

Willie Rodriguez

The Society of Physics Students at Sonoma State University remained active during the past year, even with the large load of courses most members were taking. Fall semester president Susan Webster made sure that SPS did not disappear into the ether. SPS continued with fund-raising bake sales, toured the Stanford Linear Accelerator and partied at Dr. Cominsky's.

As spring semester president I sensed fund-raiser burnout among our members. As a result we decided to have a bit of fun with the money we had earned. SPS members were treated to pizza at Mary's and Cybelle's, and played pool at Buffalo Billiards' reserved VIP room. SPS also attended Great America's Physics Day, where we helped high school students with their experiments and questions. With this relaxing semester behind us, we will be back on course for the fall.

SPS Visits SLAC

Susan Webster

Last fall the SSU Society of Physics Students chapter visited the Stanford Linear Accelerator Center. Our first stop was *GLAST* (*Gamma Ray Large Area Space Telescope*), where our own Dr. Lynn Cominsky, a member of the *GLAST* team, gave a talk on high energy astrophysics with models of the telescope detectors.

Eric Weiss ('91) gave an exciting introduction to particle physics. Since leaving SSU Eric has been a graduate student at the University of Washington, and he is now doing high energy physics research at SLAC for his Ph.D. We were fortunate to have him as our guide. As we toured the site on a SLAC bus, Eric explained the old equipment on the grounds. He showed us the control center for the SLD (SLAC Large Detector) and explained how it detected Z particles.

The last part of the field trip was on the Stanford campus at the W.W. Hansen Experimental Physics Lab, where we saw work on *Gravity Probe B*. Under way for more than twenty years now, the project is still a few years away from launching the satellite that will test Einstein's General Theory of Relativity to unprecedented precision. We again had a lecture explaining the goals of the mission and how the probe was made. Then we were led in small groups to look at the areas where the different pieces of the probe were being made. From time to time throughout the day Stanford physics graduate student Mallory Roberts ('94) joined us and answered any questions we might have had.

The field trip was now finished, and Dr. Cominsky invited everyone to a party at her house. With a hot tub, food, nice music, and drinks, it was a perfect day.

On Being a Full-Time Worker and a Part-Time Student

W. Chris Rostel

Editor's note: Quite a few SSU physics majors have pursued their degrees while working full-time. The Class of '96 includes Bill Dover, Optoelectronics; Paul Bauer, Hewlett-Packard; Bill Oakes, Optical Coating Laboratory, Inc.; and Chris Rostel, Deposition Sciences, Inc.

As I wrote this I was distracted by wrapping up my senior design project, the overtime required by my work, and my teenage daughter, who insists my lifelong ambition is to find new ways to persecute her.

Enough with the whining and excuse making. I knew it would be tough 7 years ago when I embarked upon this journey now culminating in a B.S. in physics (while working full time and raising my young family). It all started innocently enough. I accepted a night position so that my children would not need day care while my wife returned to college to complete her BA and earn her teaching credential. Unfortunately, the people at my new job were all highly educated and skilled. I had a two year occupational degree that had served me well, but it did not take long for me to become dissatisfied with my education in their presence. I resolved to return to school when my wife completed her education.

Am I glad I did it? It has come at a great personal cost. My quality of life (no free time, no time for friends) is sorely missed. But it has enhanced my career. I now work as an engineer. The scientific foundation I have acquired has made me capable of understanding more than I had ever dreamed existed. Life is full of trade-offs. I believe that having put my personal life on hold will be well worthwhile in the long run. The quality of my life, intellectual and financial, will be enhanced by my education. But right now all I feel is tired. I am looking forward to getting back some of my personal life and free time. Maybe I will even watch an episode of "Seinfeld" and find out what everyone is talking about!

ROY SKINNER, JR. ('74) is the owner of a computer-based publishing business and a video production and distribution company in Douglas City, California.

RICHARD BROMAGEM ('75) is a field engineer for Mountain Computer Co., Scotts Valley.

MICHAEL W. McBRIDE ('75, physics & management) is regional sales manager for the eastern states for Balzers Process Systems, Inc. A past president of the SSU Alumni Association, he earned his M.A. at the American Graduate School of International Management in 1977.

Thank You, Donors

The SSU Department of Physics and Astronomy is grateful for the private donations which help it carry on its activities. For example, the Department's two public programs, the "What Physicists Do" public lecture series and Public Viewing Nights at the SSU Observatory, depend entirely on donations. Privately-funded scholarships support a small number of physics majors.

As the level of state support for public higher education continues to decline, the University has been urged to raise a whopping 10% of its budget privately.

Contributions to any of the Department's accounts may be sent to the Department, with a note designating the account(s) for which the donation is intended. Checks should be made out to the SSU Academic Foundation. Contributions are tax deductible to those who itemize. The following donors have contributed since last year's newsletter. We thank them all.

#63851 **PUBLIC PROGRAMS.** Richard & Iris Borg, Sea Ranch; Albert Brians, Penngrove; Ben & Zoe Burmester, Petaluma; Stephen & Elisabeth Bursch, Penngrove; Ruth Clary, Petaluma; Clover-Stornetta Farms, Petaluma; Dolores Dahm, Cotati; Carlin Davis, Sebastopol; Edward Davis, Healdsburg; Jay Davis, Livermore; Charles Daymond, Cotati; Mr. De Ferrari, San Rafael; Donald Farmer, Sebastopol; Dennis & Susan Fujita, Sebastopol; Joe & Shawna Gannon, Santa Rosa; David Gillett, Mendocino; Will Gipple, Novato; Dennis ('78) & Meredith Goodrow, Santa Rosa; John Hall ('80), Santa Rosa; Geraldine & Francis Halpern, Santa Rosa; Raymond & Betty Halpern, Kensington; James ('71) & Judith Hill, Sonoma; Marvin Hoffman, Oakland; William & Lucy Kortum, Petaluma; Robert & Dorothy Kuehnert, Vacaville; Suzan Lins, Novato; Ralph & Hilda Mansfield, Santa Rosa; Carl & Linda Marschall, Penngrove; Mr. & Mrs. Francis Marshall, Petaluma; Charles & Norma McKinney, Windsor; Mr. & Mrs. Bernard Meyers, Novato; R.P. & Bette Michaelis, Santa Rosa; Kitty Long Miles, Napa; Mike Miller, Glen Ellen; James & Laurie O'Hare, Glen Ellen; Mary Alice Parke, Sebastopol; Robert & Bertha Rains, Santa Rosa; Damon & Linda ('88) Rarey, Santa Rosa; Donald Rathjen, Pleasanton; Glen Ray, Santa Rosa; Gregory & Linda Rose, Sonoma; Julius Schindler, Novato; Michael D. Scrivner, Napa; Joseph & Jo-Ann Smith, SSU; Rex & Sally Thompson, San Anselmo; Michael Thuesen, Cotati; Miriam Tobin ('90), Sebastopol.

#63852 **PHYSICS & ASTRONOMY SUPPLIES.** Peter D. Bailey, Rohnert Park; David & Paula ('86) Bennett, Novato; Anthony Blume ('92), Santa Rosa; Lisa Christensen ('94), Portola Valley; Martha ('88) & Alex Hunt, Healdsburg; Valerie Leppert ('87), Sonoma; John Max, Healdsburg; Michael McBride ('75), Midlothian, VA; Lee Steele ('85), Mt. View; Robert Steele ('70), Santa Barbara; Trudy Tuttle Hart ('91), Santa Rosa; Yverdon Vineyards.

#63853 **SSU OBSERVATORY.** Claude Plymate ('81) & Teresa Bippert-Plymate ('84), Tucson, AZ.

#75960 **PHYSICS & ASTRONOMY SCHOLARSHIP.** (endowment) Philippe ('88) & Aludia Argouarch, Pacifica; David & Paula ('86) Bennett, Novato; Robert Bilodeau ('83) & State Farm Insurance; Lynn Cominsky & Garrett Jernigan, SSU; Duncan & Marion Poland, SSU.

#77020 **SCIENCE AT WORK** (endowment for "What Physicists Do" series). John Max, Healdsburg.

#78380 **JOSEPH S. TENN SCHOLARSHIP** (endowment). Susan Ivancic, San Rafael; Mark Robinson ('93), Cotati; Daniel & Gail Tenn, Calabasas.

#85960 **PHYSICS & ASTRONOMY SCHOLARSHIP** (current). Joe & Eileen Tenn, SSU.

We Play Detective with the Best

John R. Dunning

Do you remember using the X-ray powder diffraction system (XRD) in Physics 316? Well the analysis system for unknown compounds just got much better. State-of-the-art search and match software, trade named *Jade Plus*, has been funded by our campus Library and Information Technology Committee. The powder diffraction file of patterns to search for has been upgraded to include 62,000 different compounds. Through Dr. Edward Liston, the Philatelic Foundation in New York has funded a state-of-the-art PC to run these programs. The new 17-inch monitor and a lightning-fast 150 MHz Pentium arrived in April. They are a joy to use.

Greg Madruga has been comparing the ink on modern and 1903 era stamps using both the present XRD system and our X-ray fluorescence system. Amazingly, the ink forms sufficiently fine crystals on the stamp to analyze by simply laying the stamp on a sample holder. At present, our exposures of the stamps to X-rays are sufficiently short that no visible browning is observed. And, yes, there are significant differences in composition between modern and ninety-year-old stamps. Greg is working on a paper describing the details.

We propose to be even better.

Our NSF proposal is currently pending for a brand new Scanning Electron Microscope (SEM) with elemental analysis via detecting the X-rays. This involves five SSU departments and seven faculty directly. When installed, this instrumentation will provide surface elemental composition for all elements down to and including number five, boron. This information will be added to the above crystal structure determination to help identify the harder cases. Also the SEM provides a picture of the unknown sample. We all know a picture is worth 1000 words.

SCOTT C. ANDERSON ('78) is the producer of the LEGO project at Mindscape in Novato. He is the co-founder of Wild Duck, a computer graphics and educational software company in Rohnert Park which distributes his popular animation program, *Fantavision*.

DENNIS GOODROW ('78) is the lead programmer in the "Kids group" at Mindscape, where he works on the Lego project.

BRUCE ODEKIRK ('78) is Integrated Circuit Foundry manager at Sarif, Inc., an LCD imaging technology company in Vancouver, Washington. He earned his Ph.D. in applied physics at the Oregon Graduate Institute of Science & Technology in 1982.

ALBERT PLAMBECK ('78, physics and music) is a product marketing manager with KLA Instruments Corp. in San Jose. He has published on overlay metrology and the implementation of coherence probe microscopy.

STEPHAN R. CRANDALL ('82) develops software for Stratcom and lives in San Jose.

An Innovation in Teaching

After teaching only physics majors since 1986, this year Dr. Lynn Cominsky decided to try a new version of the algebra and trigonometry-based introductory physics sequence.

She was inspired by a new textbook, the result of over twenty years of research into physics education by the authors. The class features all hands-on experimentation in small groups and no lectures. It emphasizes thinking and explaining, rather than memorizing.

A Student's View — *Rachel Burgio*

Physics is closely tied to complex mathematics. Yet, because it is so universal, it is taken by students with majors as diverse as geology, kinesiology, and energy management. This year the SSU Department of Physics and Astronomy offered a new section of the general physics course that focused less on mathematics than the traditional one. Largely responsible for its creation is Dr. Lynn Cominsky.

The text is a hot-off-the-press publication from John Wiley & Sons, *Physics By Inquiry*, by Lillian McDermott and her colleagues at the University of Washington. It is separated into distinct modules: Properties of Matter, Heat and Temperature, Magnets, Electrical Currents, etc. Most exercises involve setting up and running numerous experiments.

The class environment is unique. With almost no lecturing, the classroom resembles a lively workshop. There is often tangible excitement in the air, as the students struggle together in a collaborative effort. A strange phenomenon not yet explained is that students can be found coming in early and staying late, as the three hour lab periods tend to stretch into four or five.

As a first year guinea pig, I think the course is a major success. I have learned to reason using mathematical relationships. This is accomplished by collecting data and then analyzing emerging patterns. This skill has already helped me wade through math problems in my other courses. Other skills refined by the course include attention to detail, accounting for the reasoning behind your conclusions, and clear presentation of data.

Over all, it is my opinion that this course trains students to think as scientists do. It takes a bold step away from the mass number crunching familiar to traditional physics courses. Making that sacrifice, its aim is to produce students who can critically assess a problem and develop sound solutions.

Making A Difference — *Amy Weber*

Physics 209/210 is the algebra and trigonometry-based course that many students outside of physics and mathematics are required to take. This year Dr. Lynn Cominsky decided to try an innovative teaching style, a physics class where the students are encouraged to think for themselves rather than memorize lectures. The new text emphasizes an experimental approach to learning. Very little time is spent lecturing; instead the students work in small groups performing small experiments and working through exercises.

Since the students work in small groups, a low student-teacher ratio is needed. The class was limited to 22 students, considerably fewer than in the traditional section, which, because it covers more material, is recommended for students preparing for the health professions. In addition, I was able to be a teaching assistant to Dr. Cominsky. I attended all class meetings, and during class I worked from group to group, answering questions and participating in discussions.

As a T.A. I have learned a great deal about myself and about teaching. The students helped me gain confidence in myself by realizing that I have something to offer: my knowledge and my willingness to help.

I also gained an increase in my appreciation for teachers. After grading and returning homework, I was responsible for discussions of the topics missed. I also led study sessions prior to exams. These sessions required me to prepare and deliver organized lectures. Teaching requires a great deal of practice and preparation. This was a tremendous learning experience for me and I enjoyed every day of it.

There are many things about this class that made it so innovative and exciting. The text, the teaching style, and the structure of the class were all new to me.

The text is broken into modules with each section containing experiments, examples, exercises, and problems. Students work in small groups as they do the experiments and exercises in each part of the module. For example, sections within the Electric Circuits module include "A Model for Electric Current," "Series and Parallel Networks," and "Multiple Batteries."

The arrangement of the text and the small groups allow the students to work at a comfortable pace. Experiments, demonstrations and small group discussions replace traditional lectures. I observed this approach to be successful in getting the students to think about the topics they were presented. For example, one of the first sections covered in the fall semester was "Principle of Balance," within the Properties of Matter module.

Here the students experimented with hanging masses from a peg board. They were led through a series of questions and experiments which would help them discover the principle of torque. A student had worked diligently throughout class. It was obvious how hard he was thinking about his experiments. When he discovered that torque equals force times distance he couldn't contain his excitement; he was proud of his accomplishment. He learned more by discovering it on his own than he would have if he had just read a chapter in a book.

My observation is that teaching is all about making a difference in someone's education. Many of the students began the semester fearful of physics, but they were very successful due to the hands-on, visual style of the class. This class is an excellent way of teaching physics so that students spend their time learning and not being frustrated. This class and Dr. Cominsky have allowed me to make a positive impact on the education of these students.

JIM PISANO ('82) is software engineering manager for INOVA Corp., a manufacturer of LED displays in Virginia. He was formerly a computer consultant for the psychology department at the University of Virginia.

DANIEL O'DONNELL ('83) is system administrator for a graphics local area network that produces on-air graphics for NBC network television.

STEPHANIE SNEDDEN ('83) is a graduate student and teaching and research assistant in astronomy at the University of Nebraska.

Public Viewing Nights Sparkle

Susan Webster

Fall 1995 may have been the best semester of all time for Public Viewing Nights at the SSU Observatory. The weather was beautifully clear, and we averaged about 50 people per viewing night. We answered questions on all kinds of astronomical subjects. We also had help from members of the Sonoma County Astronomical Society, who often bring out their own telescopes and set up next to the observatory. We looked at the Swan, Lagoon, Ring, and Dumbbell Nebulae, the Andromeda Galaxy, and Saturn. Only the December viewing was rained out.

In the spring we were not so fortunate. We were able to view the sky only in April and May. We looked at galaxies and the moon. The atmosphere was so clear we were able to see 6 or 7 satellites flying by. This was very exciting to the younger viewers present. I think this year was a good year for bringing together amateur and professional astronomers, especially with the arrival of Comet Hyakutake. It was good preparation for the Hale-Bopp Comet due in the spring of 1997.

A highlight of the spring semester was the Robert Ferguson lecture series. This series had well-known speakers Seth Shostak, Timothy Ferris, Alex Filippenko, and Joseph Silk. The series was a fund-raiser for the new observatory to be built by the Valley of the Moon Observatory Association at Sugarloaf Ridge State Park. The goal of the observatory is to create public access programs that will bring the wonders of astronomy to students and other members of the community.

TOMAS VERA ('84), a former naval officer, is laboratory services manager for an agricultural consulting firm in Fresno.

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