The Natural Science Edition

AN ACADEMIC BULLETIN FOR ALUMNI, FRIENDS,

STUDENTS, FACULTY, AND STAFF

SEAVER COLLEGE,
PEPPERDINE UNIVERSITY

SPRING 2001

SCAN Seaver College Academic News

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- Social Science

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A MESSAGE FROM THE DEAN

It is with pleasure that I introduce the new Seaver College Academic News (SCAN) bulletin. Each issue will highlight an academic division or special program of the college. SCAN will be used to honor faculty and student achievements, to inform outside professionals of work being done at Pepperdine, to interest prospective students, to keep alumni up to date, and to record academic projects for permanent library reference. Copies are available in print form and through the world wide web at www.pepperdine.edu.

The Natural Science Division is highlighted in this issue. Included are some faculty research notes, news regarding the division, and career updates from alumni. For future issues you are invited to submit information and ideas for consideration. We hope you enjoy this new bulletin.

W. David Baird
Dean of Seaver College

CENTERS and SPECIAL PROGRAMS
- Bible Lectures
- Career Development Center
- Center for the Family
- Dean's Lecture Series
- Great Books Colloquium
- International Programs
- Institute for the Study of Asian Culture
- Service Learning
- Summer Undergraduate Research in Biology (SURB)
- The Volunteer Center
- Washington, D.C., Internship Program
- Writing Center

KECK SCIENCE CENTER ABOUT TO OPEN

Excitement is growing as the new four-story, 33,000-square-foot Keck Science Center nears completion. Named after its principal benefactor, the W. M. Keck Foundation, the facility contains state-of-the-art classrooms and laboratories for the 470 students and 35 full-time professors in the Natural Science Division. Despite limited space in the current Rockwell Academic Center, the division has earned national recognition for pacesetting research with undergraduates in the areas of biology, chemistry, mathematics, computer science, sports medicine, and nutritional science.

According to division chair **Dr. Carolyn Vos Strache**, "The science programs will offer both majors and nonmajors an outstanding place to learn science. One of our educational goals is to teach students to see the world through the eyes of different disciplines. Using the scientific method to evaluate information and data is an important skill for all graduates. This new facility and the outstanding teaching faculty will provide students with an understanding of the methods and processes of scientific inquiry."

The center contains dedicated discipline-specific teaching and research labs, multimedia classrooms, computer and instrumentation rooms, dissection rooms, a lecture hall, offices, and conference rooms. Special features like the marine biology lab with aquarium facilities allows instruction to extend offsite to the natural wilderness that surrounds the 830-acre Malibu campus. In the last five years professors and their students in natural science have published forty-two articles in major scientific journals and eighty-seven abstracts for presentation at academic conferences. Pepperdine is noted for such research, and the Keck Science Center enhances "discovery-based" experimentation among students by providing a complete array of tools to pursue both collaborative and independent research.

TWO WORLDS BETWEEN THE TIDES

The intertidal zone, the area between the high tide and the low tide, is the ever-changing domain of **Dr. Karen Martin**, professor of biology, and serves as an aquatic classroom. Numerous organisms occupy this narrow strip of ecologically fascinating habitat, from algae and flowering plants to hardy invertebrates and cryptic vertebrates. They are exposed to the "two worlds" of life in the water and on the land as the tides ebb and flow. The interface between marine and terrestrial ecosystems living here is among the most demanding, diverse, and productive. At extreme high tide, Martin and her students spend late nights on the beach watching grunion lay eggs, then return at dawn to explore tidepools when the water is low.

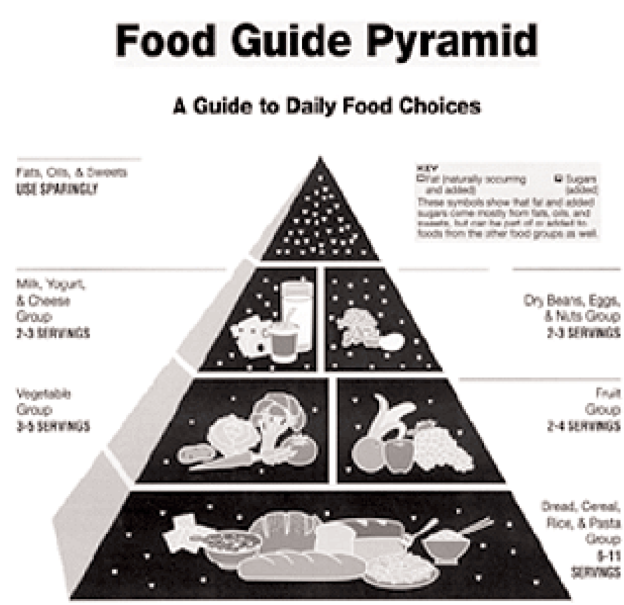
With the Pacific Ocean located just off the Pepperdine campus, students can form hypotheses in the field then bring back specimens to test these theories in the science lab. Projects have, among other things, measured metabolism in grunion fish eggs, timed the duration of beach emergence in spawning grunion, compared respiration in water and air in several species of intertidal fishes, and examined the process of hatching in grunion eggs. The students work in collaboration with Martin, and their combined work has been published in journals such as Marine Biology, Physiological Zoology, American Zoologist, and Environmental Biology of Fishes. They have presented their research at international scientific meetings around the country.

Martin teaches marine biology, physiology, and zoology at Seaver College. In addition to teaching, she has co-organized several symposia for a number of different societies on topics such as "Ecology of Intertidal Fishes" (American Society of Ichthyologists and Herpetologists), "Amniote Origins" (International Congress of Vertebrate Morphology), "Aquatic Organisms, Terrestrial Eggs" (American Society of Zoologists), and "Science and the Entertainment Media"(Southern California Academy of Sciences). Her book, Intertidal Fishes, was a collaborative effort involving an international team of scientists and brings together much information that was not previously available. The text covers ecology, behavior, physiology, systematics, biogeography, and fossil history. It includes a list of all intertidal fish families from around the world and a review of field and laboratory methods for studying them. Just as tidepool inhabitants experience two very different worlds, Martin's students have the advantage of working in the two worlds of classroom study and field research.

VEGETARIANISM FOR CARNIVORES: A NEW APPROACH TO A VEGETARIAN LIFESTYLE

Can you eat meat and still be a vegetarian? Perhaps. From Pythagoras to Pritikin, vegetarianism has been practiced for centuries for a wide variety of reasons. **Dr. June Payne Palacio**, Flora L. Thornton Professor of Nutritional Science, notes that there are just as many types of vegetarian diets as there are reasons for the practice. These may be grouped into eight categories: 1) Omnivores; 2) "Far," Partial, Part-Time, Pseudo; 3) Ovo, Lacto, Pollo, Pesco; 4) Lacto-Ovo; 5) Vegan, Pure, Strict, Total; 6) Macrobiotic and Zen Macrobiotic; 7) Fruitarian; and 8) Almost Vegetarian – Mediterranean. Although most vegetarian diets are nutritionally adequate, some are not. Careful planning is essential to avoid nutrient deficiencies brought on by the elimination of an entire food group from the diet.

Adopting a vegetarian lifestyle means: including a minimum of five servings of a variety of fruits and vegetables each day; choosing whole, unrefined foods; avoiding fatty, highly sweetened, and highly refined foods; avoiding unhealthy lifestyle choices such as tobacco, excess alcohol, stress, and sun exposure; exercising regularly; and getting adequate rest and seeking medical treatment when needed. Appropriately planned vegetarian diets are healthful, are nutritionally adequate, and provide health benefits in the prevention and treatment of certain diseases.



NATURAL SCIENCE FACULTY

B. Carol Adjemian,
Professor of Mathematics
Jay L. Brewster,
Associate Professor of Biology
Mark R. Coodey,
Assistant Professor of Mathematics
Bradley E. Cupp,
Instructor of Computer Science
Stephen Davis,
Distinguished Professor of Biology
Michael Feltner,
Professor of Sports Medicine
Jane A. Ganske,
Professor of Chemistry
David B. Green,
Professor of Chemistry
Don L. Hancock,
Professor of Mathematics
Susan Helm,
Associate Professor of Nutritional Science
Kevin M. Iga,
Assistant Professor of Mathematics
Jeffrey L. Jasperse,
Assistant Professor of Sports Medicine
Lee B. Kats,
Professor of Biology
Terence M. Kite,
Associate Professor of Physics
Holden S. MacRae,
Professor of Sports Medicine
Priscilla MacRae,
Professor of Physical Education and Sports Medicine
Randall Maddox,
Associate Professor of Mathematics
Karen Martin,
Professor of Biology
Patrick McGaha,
Assistant Professor of Physical Education
Douglas R. Mulford,
Assistant Professor of Chemistry
Laurie Nelson,
Associate Professor of Sports Medicine
June Payne Palacio,
Flora L. Thornton Professor of Nutritional Science
Donna Nofziger Plank,
Assistant Professor of Biology
William B. Phillips,
Professor of Physics, Dean of International Programs
Leland E. Rogers,
Associate Professor of Mathematics
Donald Thompson,
Associate Dean, Professor of Mathematics
Thomas L. Vandergon,
Associate Professor of Biology
Carolyn Vos Strache,
Division Chair, Professor of Physical Education
J. Stanley Warford,
Professor of Computer Science
James B. White,
Professor of Chemistry

Wildfires: Out of the Ashes

Each time that fires threaten Southern California, it is difficult to see the ecological benefits of having brush (chaparral) on hillsides around our homes, or to fully appreciate wildfire as a natural process in the ecosystem. According to **Dr. Stephen Davis**, distinguished professor of biology, we who choose to live along the urban-wilderness interface also choose to live with recurrent wildfire. We must not only respect the destructive capacity of wildfires and be prepared for such events; we must also learn to appreciate the important benefits of such fire.

Many indigenous species of plants are "fire dependent"–their seeds do not germinate and they do not thrive without fire. Some seeds only germinate after detecting smoke from burning wood. Many species vigorously resprout after shoots are consumed by flames. From an environmental perspective, local ecosystems are not "destroyed" by fire but require fire for renewal and rejuvenation. Wildfire increases plant vigor, promotes recycling of nutrient resources, increases biodiversity, reduces the numbers of exotic (weed) species, and favors productivity.

Although native plants expose nearby structures to wildfire, they provide numerous services to humans at low cost. Native plants deter soil erosion, increase slope stability, return soil water to the atmosphere, provide cover and food for wild animals, are aesthetically pleasing, offer recreational activities, and yet require no irrigation, clipping, or fertilizer. Davis' students study natural plant resources utilizing examples found in the Santa Monica Mountains and coastal regions near the Malibu campus. They examine problems of environmental and natural degradation and identify possible solutions for wise management practices, formulated through the scientific principles of plant ecology. Field trips include local habitats (barrier beach, coastal marsh, coastal dune, coastal bluff, riparian, coastal strand and chaparral plant communities), where research hypotheses can be formulated and later tested in controlled environments in the campus greenhouse or laboratory. The results of these independent and joint ventures are often published in professional journals. One such example is the "Impact of Water Relations on the Nodulation Frequency of Post-fire Seedlings of Ceanothus spp. Growing in the Santa Monica Mountains of Southern California," published in Physiologia Plantarum, in collaboration with students S. Diane Pratt and A. S. Konopka. Professor Davis believes that the study of plant physiological ecology is demanding but also exciting. The frequent wildfires in Southern California, although challenging, are especially conducive to studying the natural processes of the ecosystem, both destructive and ultimately rejuvenating.

Mathematics–An Infinite Intercultural Experience

Mathematicians are indeed a unique group of people. They have a distinctive way of looking at the world and reflecting on what they see. For example, they have their own brand of humor, laughing heartily at incongruities, juxtapositions, and extrapolations that leave some others smiling out of mere politeness. Also, the mathematician's choice of language, shaped by his or her training, often reveals a slavish attention to precision that sometimes seems fussy to others. Mathematics is a discipline that teaches a certain type of thinking and communicating. **Dr. Randall Maddox**, professor of mathematics, has written about these interesting observations. He goes beyond teaching basic principles and suggests innovative and compelling reasons why studying mathematics can enhance and change our lives. The following excerpts from the preface of his book

Mathematical Thinking and Writing: A Transition to Abstract Mathematics, are intriguing:

You are at the entrance into a new kingdom where an unfamiliar language is spoken. Welcome to the gates of that kingdom. You are here to learn the language, to be exposed to the culture, and to be trained to explore the territory on your own. It is a kingdom where the inhabitants tolerate nothing less than impeccably clear and accurate communication, where you say precisely what you mean or nothing at all. You needn't speak loudly, only clearly. Body language is irrelevant. No matter how wildly you wave your hands or how sincerely you look into the eyes of another, you add nothing to the value of what you say.

When you first begin to communicate with the precision so characteristic of mathematics, it might feel a little stifling, as if some persnickety person is forcing you to use his words to express the things you see clearly with your own mind's eye. Be patient. Your own personal style will shine through soon enough. In time you'll see how adaptation to the culture of mathematics and its style of communicating shape you as your thinking, writing, and critical analysis skills become more developed and polished.

Consider a beginning student of the piano. Music is one of the most creative disciplines, and our piano student has been listening to Chopin for some time. She knows she has a true ear and intuition for music. However, she must begin at the piano by playing scales over and over again. These repetitive tasks familiarize her with the structure of music as an art form, and actually nurture and expand her capacity to express herself in original and creative ways through music. She learns this truth: The aesthetic elements of music cannot be fully realized until the technical skills developed by rote exercises have been mastered and can be relegated to the subconscious.

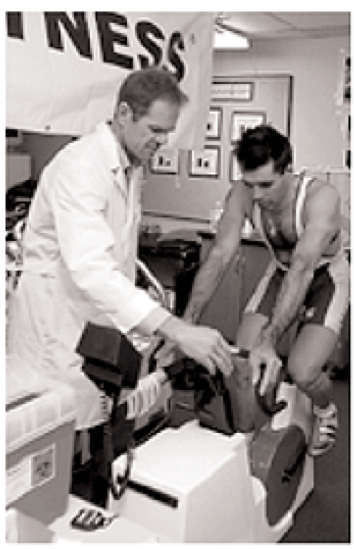
Your first steps into mathematics are a lot like those for our pianist. You're going to be introduced to the building blocks of mathematical structure, then practice on the precision required to communicate mathematics correctly. The drills you perform in this practice will help you see mathematics as a discipline more clearly and equip you to appreciate its beauty. These skills will impact the way you organize and present your thoughts in everything from English composition papers to late-night bull sessions in the dormitory. Think of this as an intercultural trip through the mathematical kingdom on a bicycle built for n. The purposes of the trip are:

- To familiarize you with the territory;
- To train and equip you to explore it on your own;
- To give you some panoramic views of the countryside;
- To teach you to communicate with the inhabitants;
- To help you begin to carve out your own niche.

If you're willing to do the work, I promise you'll enjoy the trip. You'll need help pedaling at first, and occasionally when the hills are steep. But you'll come back a different person, with a different view of the world because of a new part of it that has begun to feel like home. Whatever your major, what is important is not what you'll do with mathematics but what mathematics will do with you.

Fine Tuning the Human Engine of Racing Cyclists

The sport of competitive road cycling is physiologically demanding, even though the majority of road events are completed at submaximal exercise intensities. Although optimizing riding position and cycling equipment can result in substantial increases in performance, the greatest increases are achieved by changing physiological parameters through training. The engine or physiological makeup of the cyclist plays a major role. Physiologists and coaches can use laboratory testing to determine current performance levels and modify training regimens. Although useful, laboratory testing is not a magical tool for predicting performance. Test results must only be used with a sound understanding of their limitations. The ultimate performance of any athlete or team is the result of several interdependent factors, only one of which is physiological function.



Recently more than two dozen competitive cyclists, from the internationally renowned Mercury Cycling Team, underwent physiological pre-season testing at Pepperdine's Sports Exercise Physiology Lab, under the direction of **Dr. Holden MacRae**, professor of sports medicine. Fourteen of the cyclists were based in the USA, and nine were based in Europe. The testing protocol was based on that used by the Mapei Professional Cycling Team (Italy). Cyclists performed a step-incremental exercise test on a LODE cycle ergometer, beginning at 150W (100W in some cases), with a step increase of 30W/minute (25W/minute in some cases), to attain a target wattage of 5.3W/kg body mass. Once the target wattage was achieved, the cyclists rode for fifteen minutes with blood samples for lactate being taken at five different timepoints.

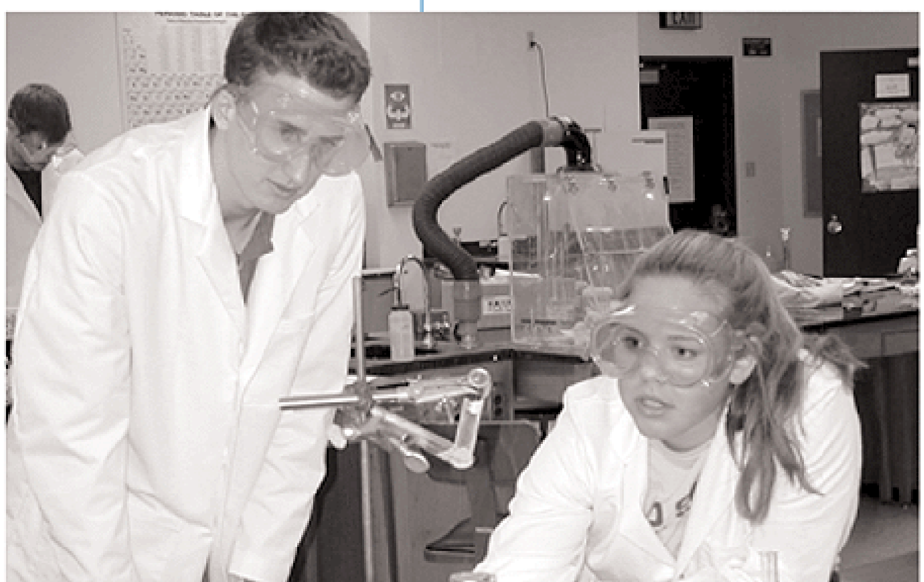
It was estimated that Chris Boardman, the one-hour world record holder, was able to sustain more than 95 percent of his maximum heart rate throughout his record one-hour cycling ride with an average power output of 6.4 W/kg body mass. MacRae determined that the cyclists tested in his lab were riding at around 80 to 82 percent of their peak sustained power output during the fifteen minute performance test (5.3 W/kg). Pepperdine was chosen as the site for the physiological cycling tests because of its state-of-the-art facilities. The results will be used to refine each athlete's training regimen to ensure greater success in competition.

The Color of Chemistry

Many compounds involving transition metals are highly colored. Depending upon the molecules or ions bonded to a particular metal, the resulting compounds, even for the same metal, can be many different colors of the rainbow. These color differences provide information about the interactions of the bonding molecules or ions with the central metal atom. Over the past summer, **Dr. Douglas Mulford**, assistant professor of chemistry, and student **Arianne Jansma** (a senior chemistry major) developed a new laboratory exercise to help students understand the origins of these colors and what information the colors provide about the molecules.

The Spectrochemical Series laboratory experiment can be tailored for use at the high school through college level. The experiment was piloted with predominantly freshman general chemistry honors students at Pepperdine University. In one study on octahedral cobalt complexes, water, acetone, ammonia, and four other molecules or ions were used as ligands. Each complex has a different color that was observed and quantitatively measured using UV-visible spectroscopy. Students were able to use the spectrochemical data gathered with the spectrophotometer to determine the wavelength of maximum absorption of each complex and thereby arrange the ligands into a spectrochemical series. The spectrochemical series orders different ligands based on their degree of interaction with the central metal atom. Compounds and their colors that were observed in this experiment included pink $[Co(H_2O)_6]^{3+}$, orange $[Co(en)_3]^{3+}$; yellow $[Co(NH_3)_6]^{3+}$; pale yellow $[Co(1,10\text{-phenanthroline})_3]^{3+}$; dark blue $[Co(NCO)_6]^{3-}$; and violet $[Co(NCS)_6]^{3-}$. Crystal field theory helps explain the different colors observed. In general, visible absorptive coloration arises when photons of the correct energy are absorbed and excite molecules from low energy electronic states to higher energy electronic states (electron jumping). Thus, transitions between electronic states are responsible for the majority of the colors seen. For the transition metal complexes studied, the ligand's interactions with the metal affects the magnitude of the gap between the low and high energy states, thereby affecting the energy (and color) of the photons absorbed.

The development of this laboratory project used classic scientific procedures to gauge the efficacy of the spectrochemical series experiment. Pre and post-tests



were administered as well as one-on-one student interviews. Preliminary results indicated that student understanding of transition metal complexes and their bonding was greatly facilitated through the process. Though these syntheses are well known, many previously reported laboratory methods were lengthy and difficult to perform within the constraints of a limited laboratory setting. The authors developed this time efficient process to explain complex chemical properties with visually colorful indicators.

Career News from Natural Science Alumni

Deborah Dean Boyer, M.D. (1987, biology/psychology), Physician, Internal Medicine/Pediatrics, Brentwood, TN
Christopher Eitzer, D.D.S. (1994, biology), Orthodontics and Pediatric Dentistry Resident, UCLA, CA
Stephanie L. Fabritius, Ph.D. (1981, biology), Department Head, Biology, Southwestern University, TX
Jeffrey M. Lundeen, M.D. (1985, biology), Orthopedic Surgeon, Santa Maria, CA
Chantil F. Ruud, D.V.M. (1993, biology), Veterinarian, North Shore Animal Hospital, Racine, WI
Dwayne D. Simmons, Ph.D. (1980, biology), Professor of Neurophysiology, Washington University, MO
Brian W. Goorjian (1976, physical education), Head Basketball Coach, Victoria Titans NBL, Australia
Andrea L. Hevener, Ph.D. (1990, sports medicine), Medical Research and Faculty, UC San Diego, CA
Lisa M. Linert, M.S. (1986, sports medicine), Senior Vascular Technologist, Stanford Medical Center, CA
Steven J. Smith (1977, physical education), Minor League Infield Instructor, Milwaukee Brewers, WI
Jim Smoot (1979, physical education), Head Volleyball Coach and Instructor, Westmont College, CA
Ben B. Yaspelkis, Ph.D. (1988, sports medicine), Assistant Professor, Cal State University, Northridge, CA
Carla Anson-Gottardi (1990, nutritional science), Registered Dietitian, Placerville Hospital, CA
Stephanie A. Gillenberg (1985, nutrition, food science), Nutrition Assistant, Santa Clarita Schools, CA
Darcey L. Lawler (1991, nutritional science), Pharmacist, CVS Pharmacy, Kennisaw, GA
Barney Paul Caton, Ph.D. (1989, chemistry), Weed Ecologist, Intl. Rice Research Institute, Philippines
Leighton K. Ford, M.B.A. (1990, chemistry), Environmental Engineer, Sandia National Laboratories, NM
Jeannette F. Holtzman (1999, chemistry), Air Quality Associate Scientist, PCR, Santa Monica, CA
David C. Coffey, Ph.D. (1985, math), Assistant Professor of Mathematics, Grand Valley State University, MI
Allen Denver (1989, math/CS), Software Design Engineer Lead, Visual Studio, Microsoft Corp., WA
Steven S. Dimse, M.D. (1980, math), Assistant Professor of Medicine, University of Miami, FL
Timothy B. Jang, M.D. (1995, math/biochemistry), Emergency Medicine Resident, St. Louis, MO
Kimberly J. Presser, Ph.D. (1993, math), Assistant Professor of Mathematics, Shippensburg University, PA

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