

ELEMENT

MATHEMATICS
2013

FRESNO STATE

SCIENCE
2013

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FRESNO STATE

**CHEMISTRY
STUDENT
HONORED WITH
PRESIDENT'S
MEDAL**

**PIECING
TOGETHER OUR
REGION'S PAST,
BONE BY BONE**

**METRO STUDENT
RESEARCH
PROGRAM**

**HANDS-ON
PSYCHOLOGY
RESEARCH**

**NATIONAL
MATHEMATICS
SUMMER
RESEARCH
PROGRAM**

**BUILDING A
FOUNDATION FOR
CANCER RESEARCH**

FRESNO STATE

College of Science and Mathematics

VOLUME 1 🐾 ISSUE 1 🐾 FALL 2013

INTRODUCING



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into a
Primary Care Profession



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PHARMACY

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DISCOVERY. DIVERSITY. DISTINCTION.

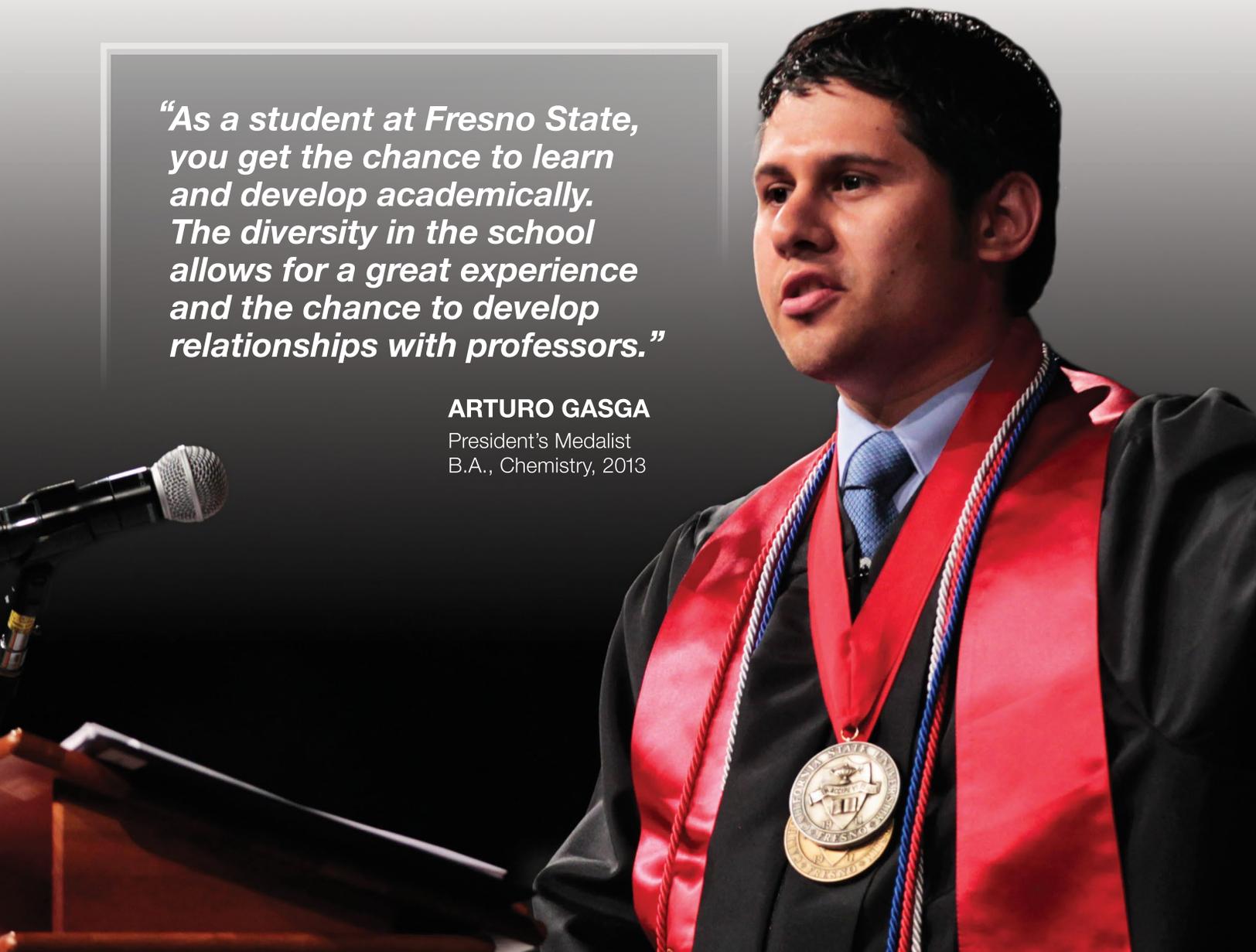
Since Fresno State was founded in 1911, thousands of Central California students — many who were the first in their families to attend college — have worked to discover solutions to some of society's most challenging issues related to water management, air quality, food and health.

From the Downing Planetarium and Museum to our Biotechnology master's program and the only undergraduate Biomedical Physics program in the nation, Fresno State is fostering discovery, diversity and distinction every day.

“As a student at Fresno State, you get the chance to learn and develop academically. The diversity in the school allows for a great experience and the chance to develop relationships with professors.”

ARTURO GASGA

President's Medalist
B.A., Chemistry, 2013



Welcome



SUSAN ELROD, PH.D., DEAN,
*COLLEGE OF SCIENCE
AND MATHEMATICS*

"We are proud of the opportunities that students have to work with our faculty, in the lab, the field or in the community to prepare them for careers, graduate school and professional programs beyond the classroom experiences they have in their majors."

Welcome to the inaugural issue of *Elements* magazine! On behalf of our family of students, faculty, staff, alumni and friends, I am pleased to launch this new publication. *Elements* will tell the success stories of our students, faculty, alumni and friends. Along the way, we also hope it will build a broader community, both internally and externally to the University, to demonstrate the impact we have on the San Joaquin Valley and the State of California. Fresno State's College of Science and Mathematics is one of the largest colleges on campus and the largest university science program from Northridge to Sacramento.

The College enrolls over 3700 undergraduate and graduate students in 21 bachelor's and master's level programs across the seven disciplines in our College - Biology, Chemistry, Computer Science, Earth & Environmental Sciences, Mathematics, Physics, and Psychology. In addition, we offer dozens of courses in general education and as support for other majors so we touch nearly every student at Fresno State. These programs are supported by a diverse and accomplished group of over 150 faculty members who are dedicated to high-quality teaching, research and service to the University and the Central Valley community. We are proud of the opportunities that students have to work with our faculty, in the lab, the field or in the community to prepare them for careers, graduate school and professional programs beyond the classroom experiences they have in their majors. This issue features many of the research opportunities our students have to work with faculty on theoretical as well as applied and regional problems.

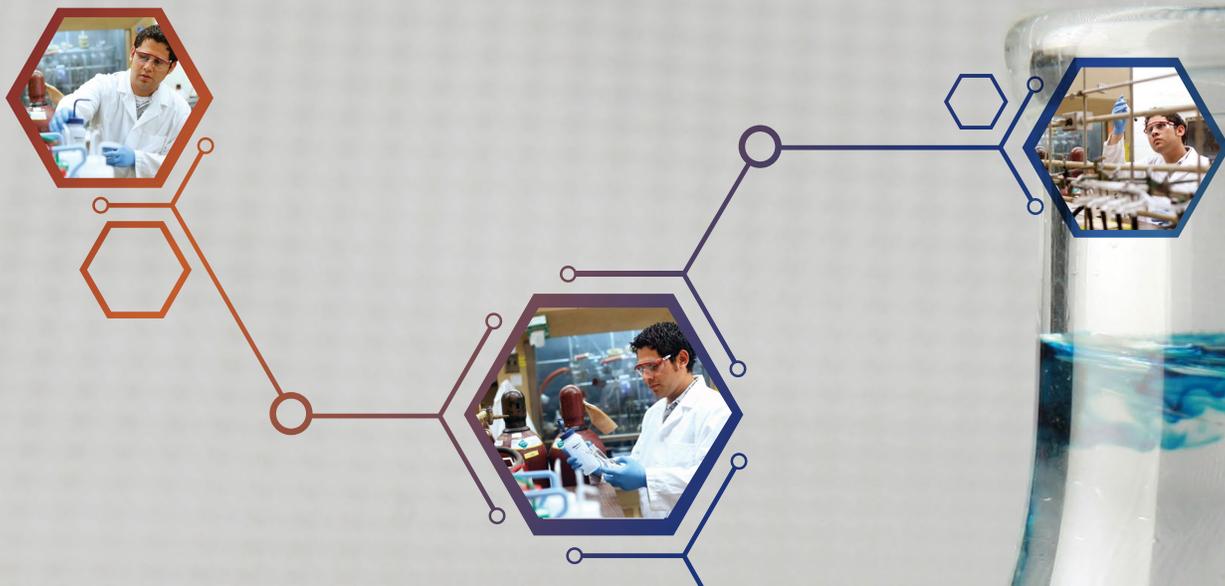
Elements will be published twice annually (Fall and Summer) and we are pleased to have sponsorships from California Health Sciences University, UCSF - Fresno, Children's Hospital Central California, Office of the President - California State University, Fresno, Decipher, Inc., Dr. Joan Otomo-Corgel and Mr. Richard Corgel, AEGIS Groundwater Consulting, Chevron, Kenneth D. Schmidt & Associates, and H. Markus & Margossian Printing. Our mission is enhanced by partnerships in support of our programs and we are grateful for this support.

As this publication evolves, I hope to see others join with us as partners to show the deep and diverse community that is dedicated to the College of Science and Mathematics in the region and across the state. This is just one of the many opportunities our alumni and friends have to support our work. We look forward to working with you on future endeavors and collaborations as the College moves forward.

Enjoy!

Susan Elrod, Ph.D.
Dean





Chemistry student

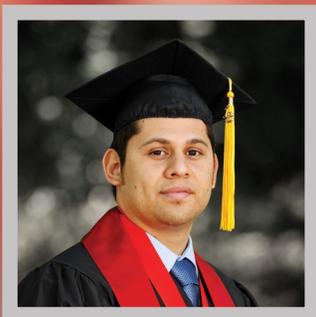
HONORED

with

President's Medal

BY KATHLEEN SCHOCK





Arturo Gasga

When Arturo Gasga arrived in the United States from a poor neighborhood in Mexico at age 15, his English vocabulary consisted of three words: yes, no and taxi. In May, the Chemistry major was named Fresno State's 2013 President's Medalist — the university's highest academic honor — at the 102nd Commencement ceremony at the Save Mart Center.

Each of the university's eight schools and colleges, along with the Division of Student Affairs, selected an undergraduate medalist and a graduate medalist based on academic excellence, community involvement and other achievements. Of this group, Gasga was chosen to receive the top undergraduate honor.

Gasga came to the U.S. for an education and, once established, brought his sister and parents as well. He still helps take care of his sister, who began as a Chemistry major at Fresno State in the fall.

"Arturo is an American success story and a wonderful example of Fresno State's mission of serving the underserved," says Dr. Susan Elrod, dean of the College of Science and Mathematics, who nominated Gasga for the honor. "We are very lucky to have such a fine young man as a student. He represents everything that makes Fresno State special."

Gasga has his sights set on medical school to fulfill his goal of becoming a physician and returning to the Central Valley as a bilingual primary care doctor.

He says he has wanted to be a doctor since he was seven years old: "After Hurricane Paulina struck Acapulco, Guerrero, I witnessed many family members and friends suffer from illnesses because they were not able to receive adequate health care. I want to work with the underserved and continue to motivate others to obtain higher education."

For the past two years, Gasga worked with Dr. Melissa Golden on the organic synthesis of BMAA, a compound that might be involved with ALS (Lou Gehrig's disease) and Alzheimer's disease. For this work, Gasga won an award from the American Chemical Society and presented at its national meeting.

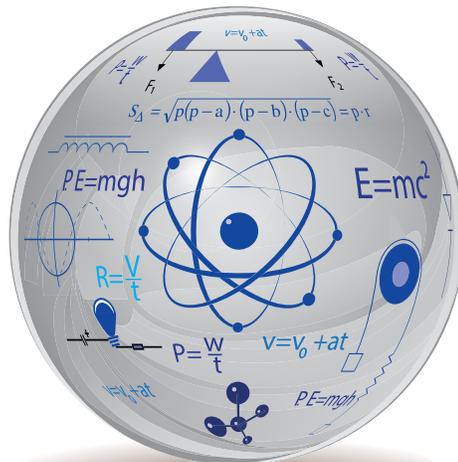
Gasga has served as a scribe in the emergency department at St. Agnes Medical Center and a volunteer screener for clinical research trials at UCSF Fresno and Community Regional Medical Center.





Biomedical Physics Program is nation's first for undergrads

BY LANNY LARSON



“ This program was always envisioned

AS A FEEDER PROGRAM FOR GRADUATE SCHOOLS ”

During his interview to join the faculty, Dr. Amir Huda proposed creating the nation's first undergraduate program in biomedical physics at Fresno State — a pipeline for his students directly to prestigious post-graduate schools.

He exceeded his own expectations when private industry, the military and government also began hiring program grads directly after Commencement.

It's a success story that began in 2000, when Huda was working at the University of California, Los Angeles and learned Fresno State's Department of Physics was recruiting for someone with a radiation physics background.

“I always thought there was a need for an undergraduate program in the United States in biomedical physics,” Huda says, “since the field had grown tremendously from its inception after World War II.”

So he pitched an undergraduate program in biomedical physics during his Fresno State interview.

In medical physics, principles and methods of physics are applied to diagnose, manage and treat a broad spectrum of human disease. Radiation, magnetic resonance imaging, radioisotopes and ultrasound are among technologies incorporated in the program.

Huda spent his first semester at Fresno State cultivating relationships with medical centers in Fresno and then applied for a National Institutes of Health grant, which was received in 2004.

To enhance courses he taught on campus, Huda offered students lab work at the Veterans Administration Medical Center in central Fresno. He also campaigned with university officials for his program to have official major status.

The request went through several committees and the Office of the President, and was approved in 2008.

“The Undergraduate Biomedical Physics Program is at the junction of complex anatomy-physiology and the sophistication of nuclear physics,” Huda explains, making partnerships essential to offer students current and relevant training.

Huda recruited adjunct professors Gopi Solaiappan, a physicist on the radiation oncology research team at Fresno's cCARE cancer treatment center, and Richard Dunia, chief medical physicist at the Fresno Cancer Center.

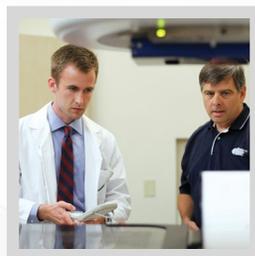
Off-campus partnerships have opened research opportunities beyond the undergraduate level. Says Huda, “Our graduate students in physics have also benefited from this collaboration and some master's theses have come out from the research.”

At the end of their junior year, Huda says, most students look for internships. They have been accepted at the University of Pennsylvania, University of Texas MD Anderson Cancer Center, University of Wisconsin, University of California, Davis, Long Beach Memorial Hospital and private medical physics consulting companies.

All program grads, he says, have been admitted to doctoral programs at prestigious institutions or hired straight out of Fresno State's program.

“This program was always envisioned as a feeder program for graduate schools,” Huda says, so he tells students to not expect to work right away after graduating. “However, several companies have employed our students and sent emails admiring the caliber of their work.”

Huda hopes Fresno State can add a faculty position to accommodate double the program's current 30 students by 2017. He is cultivating additional regional partnerships, believing they will continue to yield training that benefits students, the university and community.



“ The Undergraduate Biomedical Physics Program is at the junction of complex anatomy-physiology and the sophistication of nuclear physics ”





Building a foundation for Cancer research one cell at a time

BY LANNY LARSON

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Under the direction of biology professor Jason Bush, Fresno State students in the Cancer Biology Program are investigating:



Research is being performed on:

- Genetic markers that could allow earlier diagnosis and treatment of pancreatic cancer, which has a high death rate that Bush attributes to late detection.
- Whether exposure to pesticides is a factor in breast cancer among Latina farmworkers.
- Stem cells as building blocks of heart tissue.
- The effect of osteoporosis-treating bisphosphonates on late-stage cancer metastasis.
- Possible causes of slightly higher thyroid cancer rates in the region.

Through a high-power microscope appear the specimens that fire Jason Bush's scientific excitement: breast cancer cells waiting for tests, pancreatic cancer cells reacting to a drug and mouse stem cells that might be building blocks to tomorrow's health care.

A video of microscopic stem cells — cultivated in Bush's third-floor lab in the Science I building — shows twitching tissue, replicating a beating heart.

No question that Fresno State's key words — discovery, diversity, distinction — intersect at Bush, a Fresno State associate professor of biology whose advanced cancer research engages students and addresses critical San Joaquin Valley health care and research disparities for underserved populations.

Scientific investigation by Bush and his students enhances Fresno State's research stature, he says, promoting the university to organizations that fund more research and to potential faculty and students seeking research experience. Grants and contracts also pay for equipment upgrades and salaries, reducing reliance on philanthropy and tuition while connecting students with postgraduate and career opportunities.

The biomedical marvels are not final answers, but movement toward cancer prevention and treatment. Bush cautions, "We're not looking at something that will help right away. It's our job to do the research that will pay off eight, 10 years down the road."

The pace of research conflicts with most students' laser-like focus on completing a degree rapidly and moving into careers or postgraduate study. Research takes time.

The ideal research student already is interested in science, Bush says, and has the right mix of curiosity, logic, optimism, resourcefulness, passion, patience, teamwork and technique necessary to be a scientist. Bush pushes to get undergrads into his lab early in their campus tenure to maximize their research time and, perhaps, allow them to see the fruits of their labors.

"I ask a lot of the students before I let them join my lab," including a strong sense of personal responsibility, Bush says. "I tell them, when they're working with cells it's like taking care of babies. They can be really demanding. If you don't take care of them, what happens?"

"So whether it's 5 a.m. or midnight on a Saturday, they have to commit to doing what it takes to keep their work alive," says Bush, who gives his students 24/7 access.

Bush, a Fresno State faculty member since 2006, sets the work-ethic example by supervising 18 research students, teaching, seeking grants, collaborating with faculty colleagues and communicating findings as broadly and quickly as possible.

He helped attract a \$1.2 million grant from the National Cancer Institute for research and to create a Cancer Biology Program in collaboration with the Sanford-Burnham Medical Research Institute in La Jolla, where Bush was a post-doctoral fellow. Each summer Fresno State students travel to La Jolla to conduct research, learn techniques and gain an edge toward postgraduate study and careers.

Bush's integration of advanced research with community needs was recognized with a Promising New Faculty Award. He also was appointed to the California Carcinogen Identification Committee, which designates cancer-causing agents.

He is a passionate advocate for Fresno State creating a bigger research "footprint" and for research opportunities for minority students so they can transition to biomedical careers and serve as role models.

Bush believes Fresno State has built a solid foundation for research in the College of Science and Mathematics, with its Science Undergraduate/Research Experience Program offering internships with local labs and with development of the Jordan Research Center.

"Let's face it; a lot of people don't know who we are," Bush says. "We're not Harvard or Stanford, but we do the same things they do in research."

“We're not Harvard or Stanford, BUT WE DO THE SAME THINGS THEY DO IN RESEARCH.”

“So whether it's 5 a.m. or midnight on a Saturday, they have to commit to doing what it takes to keep their work alive.”

METRO Program

exposes students
of all backgrounds to

Science

BY EDDIE HUGHES



Nine undergraduate students tackled a wide range of research projects specific to the Valley this summer, from pesticide exposure and smog emissions to reintroducing salmon in the San Joaquin River.

The research is part of the Mentoring, Education, Teaching, Research and Outreach (METRO) Program at Fresno State. The Geosciences METRO Center is a collaborative effort between Fresno State, Fresno City College and Reedley College to increase awareness and interest in geosciences careers among minority and under-represented college students in the Central California region. The program provides community outreach, undergraduate mentoring and professional development.

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METRO

research opportunities



“The philosophy of the program is to provide research opportunities to all students,” said Dr. Alam Hasson, faculty

in the Department of Chemistry. “We make a concerted effort to recruit students from backgrounds that are traditionally underrepresented in science, technology, engineering and math. Many students don’t realize these research opportunities and careers even exist and a major goal is to change that.”

Undergraduates in the program work on various research projects in geology, environmental science, engineering, geography, chemistry and biology. Students gain hands-on experience while interacting daily with mentors who are respected in their fields.

“There has been a major transformation in the level of research in science and math in the 12 years that I have been at Fresno State,” Hasson said. “I can think of few other institutions where the quality of undergraduate research experience is so high.”

In total, 35 students worked in research labs this past summer. Historically, about 90 percent of participants are from underrepresented and minority groups, and all of the community college participants have eventually transferred to a four-year institution. Of the first 75 students in the program, more than 65 conference presentations and peer-reviewed journal articles were produced.

VISIT www.FresnoState.edu/csm/geosciencesmetro
for more information on Fresno State’s Geosciences METRO Center.



Highlights of this summer’s METRO Program research include:

29
Copper
63.546
Cu

“Cellular Thiols Protect Cyanobacteria from Environmental Stresses”

Student: Aramais Orkusyan (Fresno State)

Adviser: Dr. Mamta Rawat

Orkusyan measured cell growth for cyanobacteria, a blue-green bacteria that obtains energy through photosynthesis, in the presence of several environmental pollutants and UV light. His preliminary data indicated that cyanobacteria growth was inhibited in the presence of copper ions and hydrogen peroxide. Further, mutant strains, which produce lower levels of thiols, were more sensitive to pollutant exposure than the wild type, which provides information on how the cyanobacteria protect against environmental stresses.

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Hydrogen
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“Emissions of Smog Precursors from a California Dairy”

Students: Leanne Cheng and Joshua Jimenez

(Willow International Community College Center)

Adviser: Dr. Alam Hasson

Cheng and Jimenez deployed automated sensors to continuously measure greenhouse gas emissions from a dairy facility. They found large spikes in methane emissions during specific operations at the dairy. This may ultimately enable researchers to identify specific farm practices that can be modified to reduce greenhouse gas emissions.

47
Silver
107.8682
Ag

“Luminescence Intensity Effects of Polar Thiolate Ligands in Protecting Monolayers of Ag Nanoparticles”

Student: Phuong Ho (Fresno State)

Adviser: Dr. Jai-Pil Choi

Ho conducted experiments to investigate the surface-dependent properties of silver nanoparticles. She found that electronic absorption and electrochemistry of silver nanoparticles are strongly and consistently affected by changing the surface condition of silver nanoparticles. For this, the nanoparticle surface was treated with various ligand molecules, of which polarities are different, and the spectroscopic and electrochemical measurements were performed.

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Piecing together our region's past, bone by bone

BY EDDIE HUGHES

Paleontologists have walked closely behind large earth-moving scrapers for 20 years at the Fairmead Landfill in Madera County, anxiously searching the area to discover the next set of vertebrate remains. Their curiosity is frequently rewarded.

Dr. Robert Dundas, chair of Earth and Environmental Sciences at Fresno State, sat in his office in the Science II building on an August morning, explaining his ongoing research efforts and how a select group of students are involved. Most of the thrills of Dundas' job happen far away from that office — but it takes just one look around the room at the fossil models of saber-tooth cats and giant sloths to see where his passion lies.

On any given day, Dundas' students work in the nearby paleontology lab, carefully brushing, cleaning and preparing fossils unearthed at the landfill — mammoths, camels, horses, llamas, sloths, saber-tooth cats, jaguars and several reptilian and amphibian species.

“The most memorable moment I have had working in the lab was finding a mammoth bone, which we concluded was a mammoth femur. It was huge,” said Victor Valdivia, a senior from Orange Cove majoring in Psychology and Chicano Latin American Studies. “The thought of this bone being part of an enormous animal that lived here during the ice age is fascinating and rewarding.”

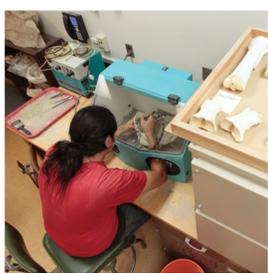
Fossils were first discovered at the site in 1993, when an equipment operator excavating a hole for garbage found a 500,000-year-old mammoth tusk. Thousands of specimens representing 72 species dating back to the Middle Pleistocene have been preserved from the site.



Dundas says sites of this age and size are extremely rare in the United States.



Dundas' students work in the nearby paleontology lab, carefully brushing, cleaning and preparing fossils unearthed at the landfill



“Only about three dozen digging sites of this age exist in the U.S. and this is one of the largest,” Dundas says. “The La Brea Tar Pits is the largest in the world, dating back 40,000 years. The Fairmead Landfill dates back to 750,000 years.”

So why do so many remains exist deep beneath the silt and clay at this particular site? Dundas has a theory. It is believed a large lake, known as the Turlock Lake Formation, encompassed the region hundreds of thousands of years ago. The Fairmead Landfill site lies at the eastern margin of where the lake used to be. Dundas says it makes sense a large number of animal remains would collect at the edge of this body of water.

Theories like this one are what Dundas and his research students try to validate each day as they analyze every bit of evidence from their findings and use their data to piece together a clearer understanding of prehistoric times.

Currently, Valdivia is conducting research on western pond turtles. “I look at the specimens of turtle fragments and try to determine everything I possibly can about the fossils; the type of turtle it was, how old it was, where it died, how it died and more.”

But before the research can get to that point, the fossils must be carefully prepared. It’s a delicate process that can be challenging to learn. “In the beginning, I was afraid I would damage the specimen and cause it to fracture or crumble,” says Yesenia Espino, a geology graduate student from Tranquility who now serves as lab supervisor.

The students collect data on the fossils, working to identify what they are and determine the color and type of the sediment. The fossils are then transported to a repository in Madera where they are catalogued, photographed and entered into a database.

The more complete specimens go on display at the 5,000-square-foot Fossil Discovery Center near Chowchilla.

Both Espino and Valdivia are among the many students who were exposed to research early in their undergraduate courses — taking advantage of the unique undergraduate research opportunities at Fresno State.

Espino has traveled around the country for various research conferences and presentations while working with multiple faculty and students.

“My curiosity to know about the past inspired me to do this type of research.”

continued on page 18...

"Every great advance in science has issued from a new audacity of imagination."

- John Dewey

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...continued from page 17



**Piecing
together our
region's past,
bone by bone**

Valdivia was first exposed to research in his introductory Biology class when he learned about the Mentoring, Education, Teaching, Research and Outreach (METRO) Program at Fresno State, intended to increase awareness and interest in geosciences among minority and under-represented college students in Central California.

"When I first heard about the METRO Program and the opportunity to conduct research, I thought I should check it out," Valdivia says, "not realizing that there was such a great deal of research going on here on campus. The research topics vary greatly."



Did you know?

Many of the most complete fossils discovered are on display at the Fossil Discovery Center in Chowchilla, overlooking the Fairmead Landfill site where the remains were unearthed. The area is one of the largest Middle Pleistocene fossil excavation sites in North America, and one of few sites with so many species present. The Fossil Discovery Center is located at 19450 Avenue 21 1/2 in Chowchilla.

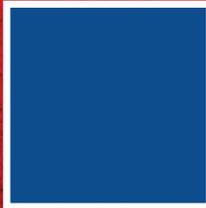
For more information, visit
www.maderamammoths.org.



FRESNO STATE

College of Science and Mathematics

Fresno State Homecoming 2013



Homecoming Tailgate!

Dean Susan Elrod and the faculty and staff of the College of Science and Mathematics held an alumni and friends tailgate party to celebrate Homecoming on October 19th! Over 100 people attended in a crowd that included Fresno State President Dr. Joseph I. Castro and his wife Mary Castro, Interim Provost Dr. Andrew Hoff and his wife Diana Hoff, and Vice President for Advancement Dr. Peter Smits.

Each of the seven departments set up an informative booth, conducted science experiments and demonstrations, and gave out college-themed items to the attendees. Special thanks to our sponsor Decipher Inc. for their participation and generous donation of a brand new tablet. Interim Provost Hoff chose the winning raffle ticket. Luckily enough, the young winner seeks to be a future student of the college!



Psychology research runs a wide gamut

When people learn Lorin Lachs is a psychology professor at Fresno State, they usually comment about dream analysis or therapy sessions, so he tells them, “There’s a lot more to psychology than the couch and fixing dysfunctional families.” Much more.

At Fresno State, psychological research involves high-tech equipment to investigate virtual reality and physiological response to different stimuli. But it also explores communication, comprehension and judgment, autism, human memory and more.

At Fresno State

BY LANNY LARSON

Psychology

Psychology
study of mind and
mental processes by e

HANDS-ON SCIENTIFIC RESEARCH

The university received a \$1.1 million grant from the U.S. Department of Education/Office of Special Education to improve services and outcomes for high-need children with disabilities. And a \$120,000 grant from the National Science Foundation will fund work in decision, risk and management sciences.

The hands-on scientific research techniques used in the program allow students to apply what they learn in classrooms, build self-confidence, produce results they share publicly and move toward a career in psychology.

Lainie Clemings, one of Lachs' students, made a significant mark before graduating in 2013 and moving into postgraduate work in the educational specialist in school psychology program.

Clemings' undergraduate research on the impact of classroom acoustics on primary students' reading fluency placed first in the 2013 student research competition throughout the California State University system.

Now, she says, "I plan to expand my research with Dr. Lachs on classroom acoustics into a thesis or project."

She has high praise for Lachs as a mentor. "His guidance was, and still is, very important to me ... He is an incredible professor and his advice is absolutely invaluable."

Lachs joined the faculty in 2002 after honing research skills at Indiana University, where he earned a Joint PhD in Psychology and Cognitive Science. At Fresno State, he has been the principal investigator of National Science Foundation and National Institutes of Health grants totaling more than \$381,000.

He has won Professor of the Year and Mentor of the Year awards and is the Psychology department's graduate adviser in addition to research leadership in psychoacoustics, virtual reality perception and group language understanding.

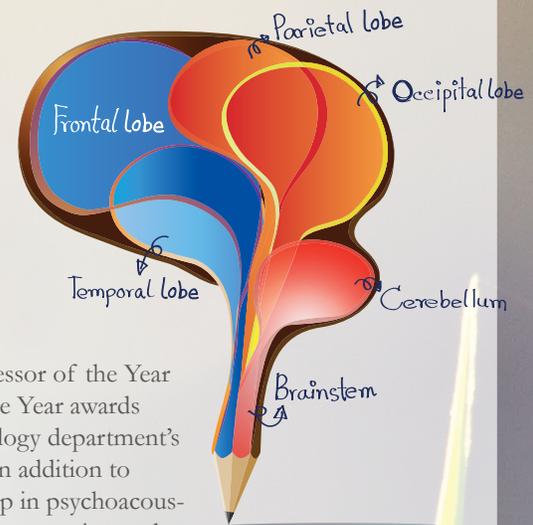
Lachs says research opportunities continue to expand in the department, which means more students are presenting at prestigious gatherings such as the Western Psychology Association's annual conference. Students get an opportunity to have their work evaluated publicly by peers and professionals and to make contact with prospective employers and post-graduate academic and research programs.

Clemings is grateful for her experience, saying, "I have always been interested in the relationship between psychology and education. One day, in Dr. Lachs' Sensation and Perception class, he discussed acoustics and how the ear processes sound. I thought back to elementary school and how hard it often was to hear the teacher over a noisy air conditioning system."

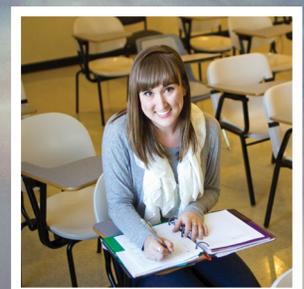
She and Lachs "bounced ideas around for the next few weeks and eventually decided to conduct an experiment that examined the relationship between classroom acoustics and first graders' reading fluency skills."

Clemings urges "students become as involved as possible" in College of Science and Mathematics programs.

"There is truly an incredible variety of research, grant, scholarship and volunteer opportunities that help you to make the most of your undergraduate career," Clemings says, "as well as faculty members and administrative staff that will guide you every step of the way."



students
become as
involved as
possible



Fresno State Mathematics

BY EDDIE HUGHES

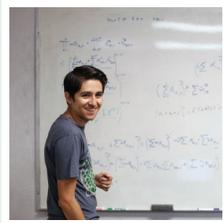
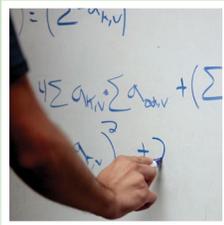
positions itself as a *leading*

Fresno State was the mathematics research hub this summer for eight undergraduate students from around the nation who are collaborating on problems related to the Algebraic Knot Theory and Zeros of Analytic Functions.

The eight students participating were selected from more than 350 applicants for the eight-week Research Experience for Undergraduates (REU) in Mathematics program, funded by the National Science Foundation. The students worked under faculty Dr. Carmen Caprau and Dr. Tamas Forgacs in hopes of having their research published in peer-reviewed journals.



undergraduate research program



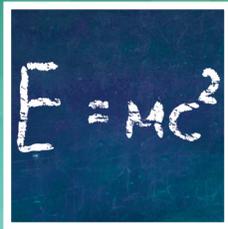
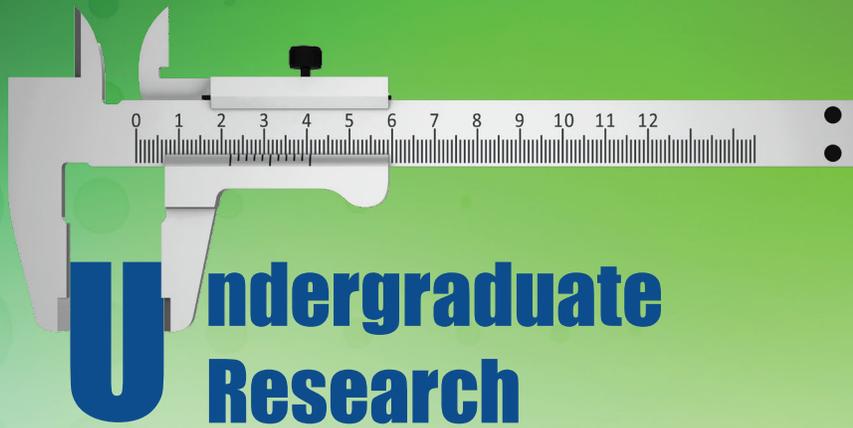
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Undergraduate Research



Dr. Oscar Vega

The students were split into groups, with some students focused on the mathematical theory of knots, which studies collections of tangled circles. Students were tasked with finding methods to distinguish these structures from one another. Other students collaborated on various

techniques used to determine the location of zeros of a special class of analytic functions. Recent approaches in this area of research have the potential to answer long-held questions in the field.

The students are preparing to present their work in January during a joint meeting of the Mathematical Association of America and the American Mathematical Society in Baltimore.

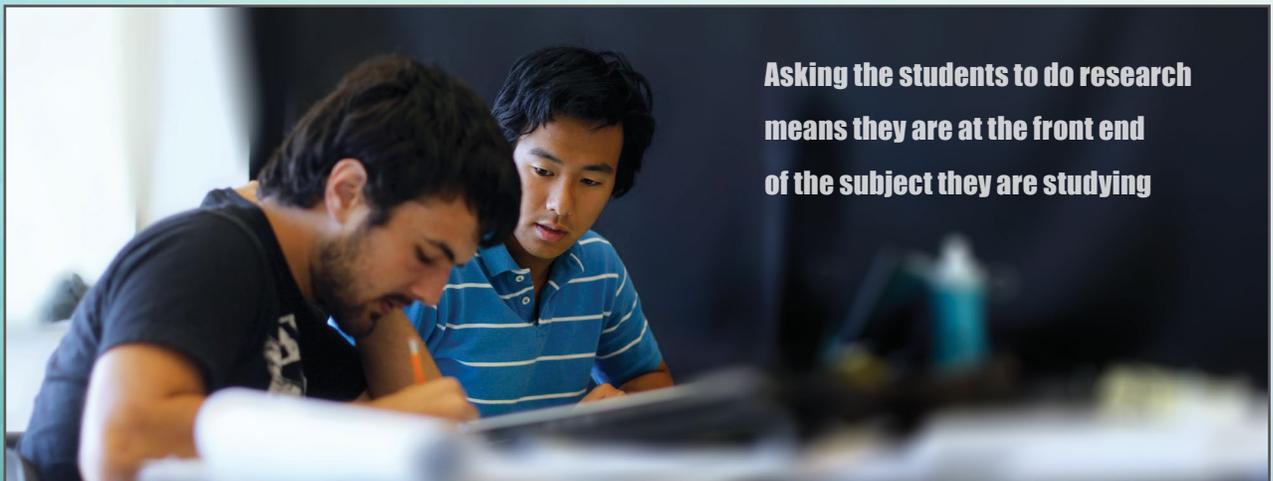
“The National Science Foundation-sponsored REU program is essential in our effort to position Fresno State and the Department of Mathematics on the national landscape of premier undergraduate institutions,” Forgacs says. “Fresno State and our participating faculty directly impact the preparation of future mathematicians and scientists.”

Unlike other sciences or engineering, math research is not done in a lab. Math students work at a board, discussing ideas with others while trying to find patterns and using software to generate examples.

“The problems students worked on this summer are fairly abstract, and students need some upper division courses in math to understand some of the topics connected to their work,” says Dr. Oscar Vega of the Department of Mathematics. “Asking the students to do research means they are at the front end of the subject they are studying, and the ideas that will eventually solve their problem come from the students themselves.”

The students in Caprau’s group investigating the theory of knots were Patrick Chu (Rice University), Alex Chichester (State University of New York at Geneseo), Danny Orton (California State University, Fullerton) and Tsutomu Okano (Carnegie Mellon University).

Forgacs’ group on zeros of analytic functions consisted of Fernando Quintino (Cal State Fullerton), James Haley III (University of Rochester), Rebecca Menke (Auburn University) and Carlee Simon (Davidson College).



Asking the students to do research means they are at the front end of the subject they are studying

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Harry Markus Jr., Graduate, Class of 1961



Check your answers here



What do you know?

The questions below are based on fundamental concepts in science that students frequently have trouble learning.

1 Which of the following kinds of cells perform basic functions such as making molecules for growth?

- a) Plant cells, but not animal cells.
- b) Animal cells, but not plant cells.
- c) Both plant cells and animal cells.
- d) Neither animal cells nor plant cells.

2 Why does liquid water take the shape of a cup it is poured into, but solid ice cubes do not?

- a) Because the molecules of liquid water are softer than the molecules of solid ice.
- b) Because the molecules of liquid water are smaller than the molecules of solid ice.
- c) Because the molecules of liquid water are moving but the molecules of solid ice are not.
- d) Because the molecules of liquid water can easily move past one another but the molecules of solid ice cannot.

3

Which of the following is TRUE about the boundaries between earth's plates?

- a) Boundaries can be anywhere in an ocean basin or a continent.
- b) Boundaries are always where ocean basins meet continents.
- c) Boundaries are always in the middle of ocean basins.
- d) Boundaries are not found in continents.

4

Some organisms, such as a chimpanzee and a human, have many similarities. Others, such as a zebra and a worm, have fewer similarities. What is TRUE about the ancestors of these organisms?

- a) Chimpanzees and humans share a common ancestor with each other, but zebras and worms do not share a common ancestor with each other.
- b) Chimpanzees and humans share a common ancestor with each other, and zebras and worms share a common ancestor with each other, but chimpanzees and humans do not share a common ancestor with zebras and worms.
- c) Because chimpanzees, humans, zebras, and worms are separate species, none of them shares a common ancestor with any other.
- d) Chimpanzees, humans, zebras, and worms all share an ancient common ancestor.

Questions from the American Association for the Advancement of Science Project 2061 initiative: www.project2061.org. For additional details, see NBC News story (April 7, 2011): www.nbcnews.com/science/science-quiz-hits-misconceptions-6C10403166.

You can find the answers to these questions on our website: www.fresnostate.edu/csm/news/csmmagazine.html



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