

CEMaST NEWS

OF INTEREST TO STUDENTS/ TEACHERS:

Funds available to support
future teachers

Information on how to
become a single subject
teacher

Making Molecules Simula-
tion

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Cal Poly Pomona

CEMaST

Center for Excellence in Mathematics and Science Teaching

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SPRING 2016

Meet Our New Faculty!

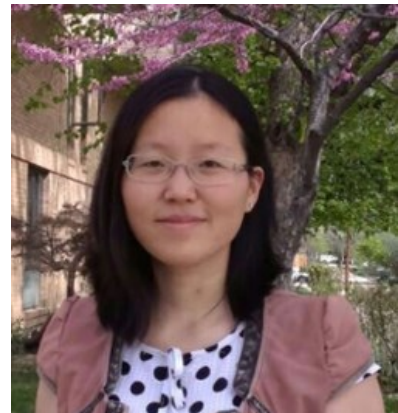
CEMaST is delighted to welcome two new faculty to the center. Both have been hired as joint appointments (with Math and Physics) and come with a strong commitment to education and impressive resumes. This brings the number of faculty in CEMaST to six and there are plans to expand the joint appointments to all of the departments in the College of Science.

Dr. Stacy Musgrave comes to Cal Poly from Arizona State University where she was a post-doctoral scholar working on Project Aspire. The project was led by Patrick Thompson and the goal was to create a diagnostic tool to characterize teachers' mathematical meanings for content ideas in the secondary curriculum. Before doing her postdoc she was a Presidential Fellow at the University of Georgia where she earned her PhD in Mathematics.



*Dr. Stacy Musgrave Dept. of Mathematics
and Statistics and CEMaST*

Dr. Qing Ryan comes to us from a post-doctoral position at the University of Colorado where she did research on course transformation of upper-division electrodynamics taught at the University. Her research involved investigating student difficulties, developing a conceptual assessment and curricular materials. She completed her PhD work in the Physics Education Research group at the University of Minnesota—Twin Cities. Dr. Ryan has a research background in investigating problem solving at both the introductory and upper-division level. Her research in introductory physics involves using web-based computer coaches to improve students' problem-solving skills. Her current research interest is focused on designing customizable computer coaches that could provide different levels of coaching to different students. She is also interested in studying student difficulties and designing research-based conceptual assessments in junior-level electrodynamics. Her current research seeks to characterize student difficulties with boundary conditions and complex exponentials.



*Dr. Qing Ryan Dept. of Physics and Astronomy
and CEMaST*



Interested in a Career in Teaching?

To become a math or science teacher in California you must obtain a Single Subject Teaching Credential. This credential authorizes public school teaching in a departmentalized classroom such as those in most middle schools or high schools. To obtain a Preliminary Credential the following requirements must be met:

- Bachelor's Degree or higher from an accredited university.
- Completion of a teacher preparation program (credential program, including student teaching)
- Meet the Basic Skills Requirement (CBEST exam)
- Demonstrate subject matter competency with the passage of California Subject Examinations for

Teachers (CSET or completion of an approved single subject program.

Cal Poly has an approved single subject program for mathematics and science as well as a credential program. For more information or for an advising appointment please contact CEMaST at cemast@cpp.edu.

MPWR
participants
are assigned to
peer-
mentoring
groups.

MPWR — Empowering Women in RUME

By Dr. Stacy Musgrave

The Mentoring and Partnerships for Women in RUME (MPWR) Seminar is a one-day meeting held the day before the annual Conference for RUME (Research in Undergraduate Mathematics Education). The primary goal of the seminar is to support women at all career stages and from all institution types from the RUME community. In the past three years, over 140 graduate students, postdocs, lecturers, assistant professors, associate professors, full professors, and other professionals have participated in the seminar and have overwhelmingly given positive feedback about their experience. During the day-long event, participants hear from and engage with panelists from within and beyond the RUME community,

participate in mini-workshops targeted at supporting professional or personal growth, and are assigned to peer-mentoring groups that are to provide support throughout the year.

In order to continue hosting this event, Dr. Jess Ellis (PI, Colorado State University) and Dr. Stacy Musgrave (Co-PI, Cal Poly Pomona) have secured a 3-year grant from the National Science Foundation (NSF) to sponsor the event and investigate the effect of providing such support to women in the RUME community. The next event will take place in San Diego, CA in late February 2017 and announcements to solicit applicants for the fourth MPWR Seminar will be posted this fall. For more information and to apply later this year, visit the website mpwr-seminar.com.



Scholarship Funds Available



Dr. Nicole Wickler has announced that scholarship funds are available for the 2016-17 academic year through the Math and Science Teacher Initiative (MSTI) Scholarship Program. The program’s objective is to support talented Science and Mathematics majors who might not have considered the teaching profession. Each MSTI Scholar can receive up to two years of scholarships, up to \$5,000 per year. MSTI Scholars are selected on the basis of academic achievement, under-representation and financial need. MSTI Scholarships are available to those seeking a single subject credential in Biology, Chemistry, Geology, Mathematics, and Physics. Scholarships will be awarded on a competitive

basis and there are minimum requirements for undergraduate students.

They include:

- a declared Cal Poly major in a Mathematics or Science discipline.
- at most two years and 96 units remaining to complete bachelor’s degree.
- an overall GPA of 3.0 with a preference given to those who have a GPA no lower than 3.0 in their major.
- Be a US citizen, national, or permanent resident alien.

There are also scholarships available for single subject mathematics or science graduate credential candidates. The deadline for the fall quarter is August 1, 2016. For more information and to apply please visit the website

<http://www.cpp.edu/~msti/msti-scholarship/index.shtml>

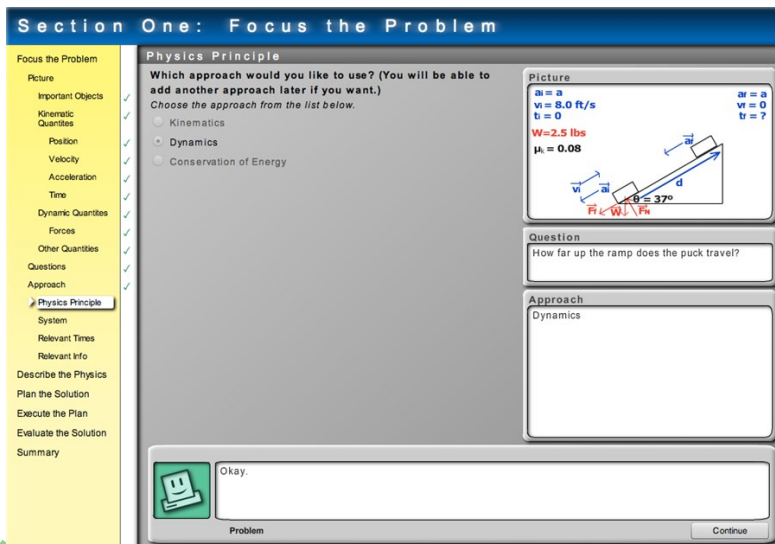
Physics Coaches Help Students!

Computer
Coaches
help
students
understand
physics

Dr. Qing Ryan joined Cal Poly in Fall 2015, holding a joint appointment between Physics and CEMaST. As a physics education researcher, she is interested in many aspects of improving teaching and learning physics, at both the college and K-12 level. Her current research interest involves developing web-based computer coaches to

help students solve physics problems (see screenshot below). She recently submitted a grant application to the National Science Foundation hoping to bring these physics coaches to schools in Pomona and surrounding districts in the future! John Santiago, an undergraduate physics major, is currently working with her on research-

ing the alignment of the computer coaches with NGSS (Next Generation Science Standards). She reports that she is having fun here at Cal Poly working with wonderful colleagues and students and is grateful for the support from CEMaST. She is looking forward to making contributions to physics teaching and learning at Cal Poly and in our local districts in the years to come.



Cal Poly student John Santiago

RESPECT CONTINUES



By Dr. Nicole Wickler

Coming into year three, the Reinvigorating Elementary Science through a Partnership with California Teachers (RESPECT) program continues to support Pomona Unified teachers in implementing science curriculum and pedagogies that will engage students in learning science content within the framework of the Next Generation Science Standards. The first cohort of

Teacher Leaders will begin working with peer teachers June 14-17 and 21-24; while June 13-17 and 20-24 the second cohort of teachers will be developing skills as Teacher Leaders. With support by a \$7.7 million dollar grant from the National Science Foundation to CEMaST, within the five year program nearly one third of Pomona Unified's elementary teachers and 7,500 of its students will benefit.

Pomona Unified Respect Teacher Leaders

CSET Preparation Science/Math

With support from MSTI funds CEMaST offers FREE CSET Preparation Workshops for science and math majors who are interested in obtaining their Foundational Level General Science Credential or their Foundational Level Mathematics Credential.

The Science CSET Preparation

for the CSET Science Subtest I and II (Tests 118 and 119) consists of online prep courses and is provided to Cal Poly students, and credentialed teachers who hold a multiple subject credential.

The CSET Preparation for CSET Mathematics Subtest I and II (Tests 110 & 111) are in

the form of summer workshops and are offered free of charge to Cal Poly students and credentialed teachers who are already working in a classroom. The workshops provide an intensive review of mathematics concepts and skills required for the CSET tests. For more information please visit the CEMaST website.

MSTI seeks to encourage talented Science and Mathematics majors who are considering secondary teaching.

Seminars Offered

CEMaST offers a seminar series for students to learn about teaching as a career and to promote innovative and effective teaching strategies. The seminar series begins with a fall reception and continues to meet during the academic year. Past seminars include teaching demonstrations from local teachers, K-12 classroom video analysis of teaching and learning, review of educational research papers, resume development, and interview techniques.



The MSTI Seminars support future teachers

Fedco Grant Program for Local Teachers!

The California Community Foundation awarded Cal Poly Pomona - CEMaST \$40,000 to distribute to local full-time K-12 public school teachers as FEDCO Classroom Enrichment Grants and to administer the program. Grants support hands-on, classroom, or field trip projects that “bring learning to life” and increase student academic achievement. Grants are designed to encourage experiential learning, enhance student understanding, and increase student achievement in relation to the curriculum standards in one of the core subject areas of language arts, social studies, mathematics or science.



The availability of FEDCO Classroom Enrichment Fund Grants was publicized via email, website postings, and paper fliers. Electronic and paper fliers advertised the availability of funds and indicated how the teachers could apply for the grants. Email messages with these fliers attached were sent to teachers, principals and superintendents in the eligible districts. Paper fliers were also sent to the schools and district offices. Notices were also posted on the Cal Poly Pomona CEMaST websites in the College of Science.

Teachers may apply for grants of up to \$500 or collaborate with other teachers in their school and submit a joint application of up to four teachers for a total of \$2000 maximum.



CEMaST received 77 applications this year from numerous local school districts! The application period was open from September 1, 2015 to October 15, 2015. In November 2015, the FEDCO Review Committee, which consisted of past winners, reviewed, discussed and rated the applications before making the final decisions on funding the proposals. CEMaST was able to fund 27 grants involving 88 teachers, 2,021 students in San Bernardino County, and 928 students in the eastern portion of Los Angeles County for a total of 2,949 students. The funds were distributed to the winning teachers in mid-December 2015. All funds must be expended by April 30, 2016 and grant winners are required to submit a two-page narrative report, including a summary of the students' accomplishments, and an expense report by May 16, 2016.

This year, twenty-three of the projects involved field trips off-campus, and four involved bringing the field trip experience to the school site. Several projects chose to visit Riley's Farm, the California Science Center, the Aquarium of the Pacific, and the Museum of Tolerance. Other field trip experiences that were brought to the school sites were: a mobile farm; a re-enactment of the Gold Rush Days, building rocket cars with the Science Education Center, and the Cabrillo Marine Museum mobile aquarium. Student education was enriched by activities and outings that would not have been possible without the FEDCO Classroom Enrichment Fund. The projects funded by the FEDCO grants allowed students to be involved in hands-on learning experiences that enriched their understanding of the subjects in ways that would not have been possible otherwise!

Making Molecules Simulation

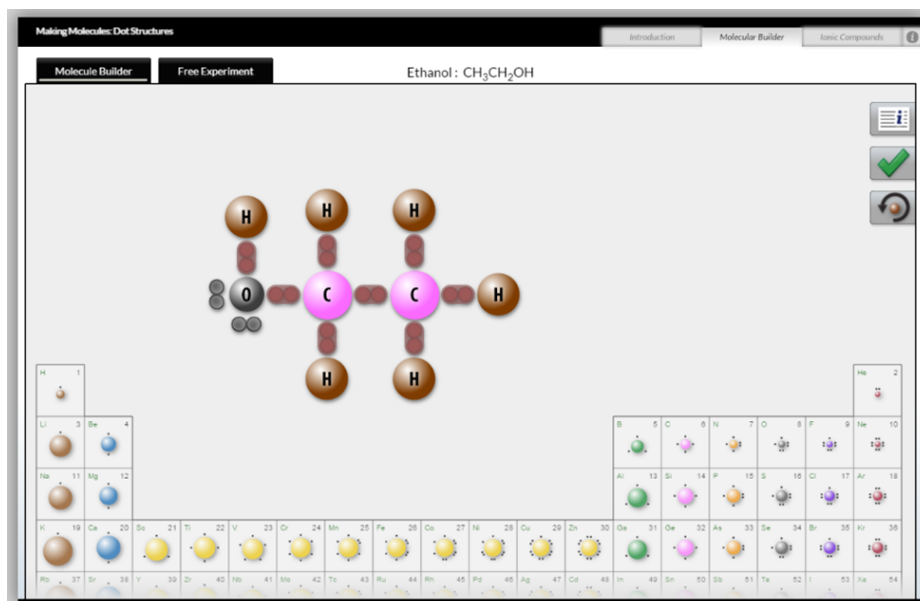
By Dr. Jodye Selco

Understanding how atoms bond together to make molecules is difficult because we cannot see the atoms. A new simulation (posted at <https://elearning.cpp.edu/learning-objects/making-molecules>) enables users to visualize unpaired electrons on different atoms and then connect them to form chemical bonds. Most molecules have all of their valence electrons (the outer most ones) paired with another electron; this simulation makes that visible.

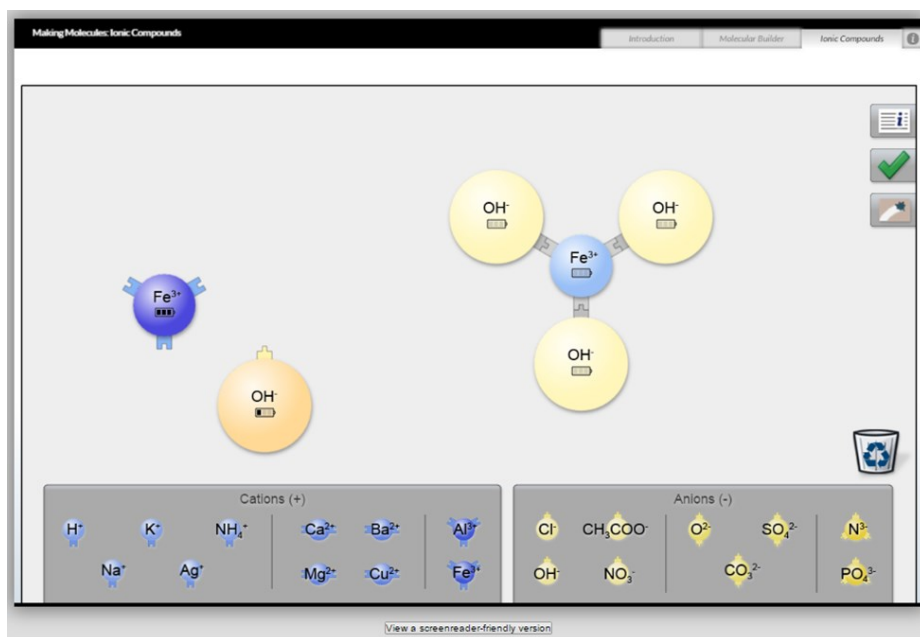
There are two work spaces for connecting electrons together to form chemical bonds: the “Molecule Builder” contains a short list of practice molecules and the “Free Experiment” allows the user to choose any of the active atoms on the pallet to construct molecules from.

This simulation also contains a space to construct ionic compounds to discover that these materials need to be electrically neutral. Each part of this simulation helps students visualize molecules and how they are constructed from atoms and/or ions.

Many thanks to the eLearning team: Richard Feldman, Pauline Muljana, and Tommy Gaston for their work on this simulation!



The Molecular Builder



The Ionic Compounds tab provides practice in forming ionic “compounds”

Jodye Selco is a Professor of Science Education (in the Center for Excellence in Mathematics and Science Teaching – CEMaST) and Chemistry at California State Polytechnic University Pomona. She is actively involved in research in physical chemistry as well as the teaching and learning of chemistry by all students. Professor Selco has been working with the teachers in Rialto Unified School District for many years.

California Mathematics and Science Partnership Grants Enter Final Year

Teachers are taking on leadership roles in the CaMSP

The California Mathematics and Science Partnership (CaMSP) grant program, administered by the Science, Technology, Engineering, and Mathematics Office in the California Department of Education (CDE), is dedicated to increasing the academic achievement of students in mathematics and science by enhancing the content knowledge and teaching skills for classroom teachers through professional learning activities.

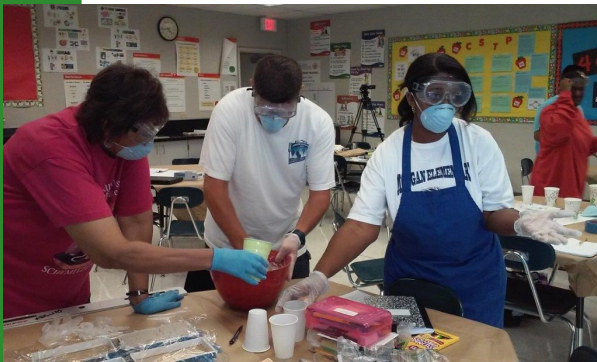
Faculty in CEMaST are supporting two California Mathematics and Science Partnership grants that are entering their third year and final year. The partnerships are in Rialto USD (science) and Hacienda La Puente USD (mathematics). Both projects have presented at the Learning Network in Sacramento.

Dr. Jodye Selco is the IHE lead for the CaMSP grant in Rialto R-iSMART (Rialto integrating Science Mathematics And Related Technologies). She is getting ready for the last year of the 3-year grant providing professional development

for third through eighth grade science teachers. This project has summer intensive institutes and 24 hours of follow up training. Dr. Selco is supporting teachers in STEM action research projects and the implementation of Project Based Learning and integrated lessons and curricula.



HLPUSD teachers at follow up



Rialto science teachers making cement bricks with different recipes to test strength and insulation abilities.

Dr. Laurie Riggs is the Co-PI for the Hacienda La Puente partnership and is working with both teachers and administrators in increasing content knowledge and supporting teachers in the Common Core State Standards in Mathematics. Dr. Paul Beardsley, faculty in CEMaST and Biology, will be joining the project's final year to support the third through fifth grade teachers with the connections to the Next Generation Science Standards (NGSS).

Teachers in the partnership are taking on leadership roles and sharing with other teachers at their sites what they have learned in the institutes and follow ups on effective use of technology in the classroom.

Teaching Evolution Using Human Examples: Free Curriculum Materials for AP Biology

By Dr. Paul Beardsley

The study of biological evolution is entering a golden age. With the recent development of genomic technologies, biologists can ask and answer questions that were completely unapproachable and maybe not even imagined a decade ago. For example, scientists have recently determined that the traces of humans and Neanderthals interbreeding can be found in the genomes of many people living today. They have also discovered that modern humans are evolving fascinating adaptations, such as some populations living in the Andes that have evolved to be more tolerant of arsenic.

As many teachers know firsthand, the excitement found among scientists for evolution's explanatory power is not shared by all students or the general public. A majority of Americans do not accept that biological evolution is the scientific theory that best explains the unity and diversity of living organisms. Why is this so? The most common answer is that many people believe that evolution conflicts with their religious beliefs. As a result, many teachers are hesitant to teach about evolution. But educational researchers have documented numerous other motivational and cognitive challenges that impede student learning about evolution. For example, many of the lessons designed for helping students learn about evolution focus on older examples of evolutionary discoveries using species that may be foreign or somewhat un-interesting to students. The excitement of new discoveries is often absent from these examples.

To address these issues, Principal Investigator Dr. Briana Pobiner at the Smithsonian Institution's National Museum of Natural History secured funding from the National Science Foundation through the *Teaching Evolution through Human Examples* project. This project gathered a coalition of scientists, teachers, and educators to develop four curriculum supplements for Advanced Placement Biology classes (each supplement includes 4-5 lessons and require approximately 1-2 weeks). Dr. Paul Beardsley, Associate Professor in CEMaST and the Department of Biological Sciences, was the curriculum developer for the project and the sole or lead author of the curriculum supplements.

Highlights of the four curriculum units are as follows.

Adaptation to Altitude: Students learn how to devise an experiment to test the difference between acclimation and adaptation; investigate how scientific arguments show support for natural selection in Tibetans; design an investigation using a simulation based on the Hardy-Weinberg principle to explore mechanisms of evolution; and devise a test for whether other groups of people have adapted to living at high altitudes.

Evolution of Human Skin Color

TEACHER GUIDE

Developed as a Part of the
Teaching Evolution through Human Examples Project



Evolution of Human Skin Color: Students examine evidence for the relationship between UV and melanin in other animals; investigate the genetic basis for constitutive skin color in humans; learn to test for natural selection in mouse fur color; investigate how interactions between UV and skin color in humans can affect fitness; and explore data on migrations and gene frequency to show convergent evolution of skin color.

Continued on page 9



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College of Science

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Teaching Evolution Continued from page 8

Malaria: Students examine evidence to compare four different explanations for why many malarial parasites are resistant to antimalarial drugs; investigate how scientific arguments using *G6PD* data show support for natural selection in humans; and apply their understanding to other alleles that have evolved in response to malaria.

What Does It Mean to be Human?: Using a strong nature of science component, students use different types of data to infer / interpret phylogenies among domains, within the vertebrates, and within primates while reflecting on how they answer the question “What do you think it means to be human?” students choose a characteristic that changed substantially in the human family tree to develop a scientific argument based on evidence for when the character evolved.

Importantly, the project team, led by Dr. Contance Bertka, also developed strategies and resources to support teachers in creating a comfortable classroom environment for learning and understanding evolution through acknowledgement and respect for students’ personal beliefs (the Cultural and Religious Sensitivity [CRS] Teaching Strategies Resource).

The curriculum supplements and CRS Resource are fully available for free from the Smithsonian Institution’s Human Origins Program website (<http://humanorigins.si.edu/education/teaching-evolution-through-human-examples>). Field tests of the materials across the country, including three teachers from southern California, over three years suggest that the approach of using human examples to teach evolution can be highly effective. The initial research also suggests that the approach of using classroom activities to help teachers acknowledge students’ personal beliefs may enhance the effectiveness of using human examples to teach evolution.

Further research on this project is yielding additional insights. For example, as a part of her CPP Master’s project, Lilian Shabani is examining the relationship between students’ overall motivation for learning biology and their acceptance and understanding of evolution. Lilian will be defending her thesis this summer and we are all eagerly awaiting her results!

To learn more about this project and resources for teaching evolution, contact Dr. Beardsley at pmbeardsley@cpp.edu

The CEMaST Newsletter Committee welcomes news from faculty, students and teachers. Please contact Dr. Laurie Riggs, lriggs@cpp.edu for information on how to be included in upcoming issues!