



FAMILY NEWSLETTER

The Newsletter for Families of COSMOS Participants – Monday, July 27, 2009

Dear COSMOS Families and Friends,

It is hard to believe we've completed our third week of COSMOS and we are now headed in to our last week of final projects, speakers, outings and socials.

Our Distinguished Lecture Series featured Dr. Henry I. Miller, Fellow, Hoover Institution, Stanford University. Dr. Miller discussed the use of "designer genes", also referred to as "genetic modification", in agriculture and food production, and its impact on public health and environmental safety.

This week we call the Distinguished Lecture event Mathfest. This event is co-sponsored by the Math department. We will be hosting Dr. David Perry, Cryptologist from the National Security Agency. His talk is titled *The Coming of the Enigma*.

Saturday was the last weekend outing and we went to San Francisco to explore the Piers along Embarcadero and take a Bay Cruise. We sailed under the Golden Gate Bridge and around Alcatraz (also referred to as "The Rock"). Students also visited China Town and Ghirardelli Square. The weather was cool, but a nice break from the hot temperatures of Davis. It was a lot of fun.

Now, for an update on Closing Day. Students will be given direction from their RAs about returning keys and cleaning their rooms. Here is some important information for you:

- 8:30-9:30 Parents/Guardians arrive at Castilian Hall South to move their student out of dorm. Students will not be able to return to the dorm so please do not forget anything.
- 9:30-10:45 Parents/Guardians and students arrive at the Activities and Recreation Center (ARC) for project viewing and buffet breakfast. *Please do not arrive before 9:30 as there will be no admittance until then.*
- 10:45-11:45 Closing ceremony in the ARC Ballroom. ***Only two guests per student are allowed in the Ballroom.*** Additional family members and guests must wait in the ARC lobby or on the patio. We apologize in advance for the inconvenience.

If you have any questions, please email Emily Murdock at ejmurdock@ucdavis.edu.

And now onto the cluster reports...

Cluster 1

Cluster one has learned a lot of new laboratory techniques since last week, but there is even more to be done! We have been watching our modified plant viruses spread throughout our tobacco plants. Although the viruses are not attacking our plants as vigorously as we predicted, we do have a few positive control plants that are giving us some great visuals to track the spread of the virus. We have also been waiting for our transformed colonies of E.coli with modified proteins to grow this week. Additionally, we began an



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experiment to test various food products for genes that identify them as genetically modified. Early next week, we will be performing an assay to test our “hairy roots” to make sure that they are transgenic. We will also be doing a western blot, running an RNA gel, and purifying protein. Additionally, we are expecting to receive our DNA sequences back from the sequencing facility here at UC Davis, so there is certainly still much to look forward to!

As we mentioned in week one, our students are definitely learning that patience plays a key role in scientific experimentation. The cluster one students have truly been experiencing what Paul, Adam, and LeAnn like to say is “science in real life” in which not every one of their experiments have gone according to plan. This truly is invaluable experience, as the students themselves have been able to troubleshoot the procedures and use their analytical skills to come up with answers and solutions. I cannot think of a more authentic laboratory experience!

Our outing to the Joint Genome Institute was very informative. We were able to learn the basics of Sanger sequencing as well as the fairly new technologies of 454 and illumine sequencing, which are much faster in comparison. The rest of our time has been spent time working on our final projects. Most of us cannot believe that COSMOS is almost over!

Cluster 2

Wow, what a week of scientific experience and fun we have enjoyed! Early in the week we constructed optical chambers to hold solutions of the two chiral forms of tartaric acid, and used polarizing filters with our lasers to measure the opposite optical rotations of the plane of polarization of the two forms. That was cool, but only a tune up to the main event...the trip to Los Alamos National Labs!

Wednesday morning we got up around 3 AM (yikes!) to bus over to Sacramento Metro Airport and catch our flight to Albuquerque via Salt Lake City. Sparks, our bus driver, picked us up in Albuquerque and toured us through beautiful Santa Fe on the way to Los Alamos. Our early start got us to Los Alamos in time for Georgia, our Los Alamos tour guide, to take us on a walking tour of the historical sites where the Manhattan project produced the atomic bomb. We saw the houses where Chadwick (discoverer of the neutron) and J. Robert Oppenheimer lived at that time on “bathtub row” among other things. Sparks got us to the Mexican restaurant and back in time to collapse at the hotel and try to catch up on our sleep before visiting the labs.

Thursday morning we began with a visit to the Bradbury Museum to learn more about the mission of the Los Alamos National Labs (LANL), to maintain safe, secure, and reliable nuclear deterrent for our nation, and we took a group photo next to the mockups of Little Boy and Fat Man, the bombs dropped on Hiroshima and Nagasaki. Then LANL employees Kelly and Adrian escorted us through security to the Los Alamos Neutron Science Center (LANSCE) where Kevin Jones conducted us through the facility. There we learned the science behind how scientists there accelerate either hydrogen or hydride ions down a quarter mile accelerator to smash them into a tungsten target, spalling off a lot of neutrons. We visited one of the many laboratory buildings that radially surround the tungsten target, and that then use the “hot” (fast) or “cold” (slow) neutrons to investigate the characteristics of all kinds of materials.



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LANL is actually a large number of separate buildings scattered around the Parajito Plateau, so our next stop was another 20 or 30 minute bus drive to the National High Magnetic Field Lab. John Singleton, a scientist renowned for his recent work producing electromagnetic effects that propagate faster than the speed of light, conducted us around the parts of the large facility, culminating with the device producing the world's strongest magnetic field at 100 tesla. Every time the device is used it explodes the copper coil carrying the current, but without damaging the sample material that is being tested. We got back to the hotel by 5:30 PM, and walked to a restaurant that put together a table for the 28 of us!

Friday morning we checked out of the hotel and Georgia rejoined us to tell us about the geological and social history of the region as we rode the bus over to nearby Bandelier National Monument. Georgia led us on a more than 3 mile walking tour of ruins left by the Ancestral Pueblo (called incorrectly Anasazi) people. Twenty of us crammed into one small chamber on the cliff, large enough for only 3 or 4 comfortably. It was a 140 foot vertical climb up ladders and stairs to the large Kiva on one cliff, but even the most acrophobic among us faced her fears and courageously made it up and down. Our route back to the airport took us through a lot of beautiful parts of New Mexico, including the grassy Valles Caldera, but eventually we climbed aboard our Delta jet and retraced our flight to Salt Lake and Sacramento.

The COSMOS staff, professors, RAs, TA, and Teacher Fellow agreed that this group of Cluster 2 students are the best behaved ever, and were exemplary in the quality of questions that they posed for the scientists in the labs they visited, and in their conduct and attention, reflecting honor on the program as a whole. And they are a remarkably fun and funny group of young people. Parents, you should be proud of them.

Cluster 3

This week our cluster began applying its concepts and understanding of mathematics to the physical and realistic practice of engineering. A new professor, Professor Horsley arrived and began to teach us about beams and their bending capacities. He further instructed us about the use of various materials, sensors, and actuators in real world engineering applications, reminding us that things don't work ideally.

On Monday, we constructed basic DC motors comprised of batteries, copper wires, and neodymium magnets. Three passionate students: James, Rohan, and Pradeep (Deep) constructed a *beastly* motor that spun at 111 revolutions per second.

On Tuesday, our cluster was given Hydrogen fuel rockets and air pressurized airplanes. The hydrogen was produced and pressurized via electrolysis and propelled by this source alone instead of the more commonly utilized gunpowder combustion and water pressure. The planes exemplified the abstract concepts of lift and drag for the class to provide a better comprehension of aerodynamics.

On Thursday, the cluster made a trip to the Hydrogen Fuel Cell partnership in Sacramento, sponsored by numerous competing car companies, providing an optimistic, unifying perspective of alternative energy. We rode in the hydrogen fuel cell powered cars and learned about the complications of incorporating alternative energy into mainstream use. In the afternoon we performed a lab, with Professor Horsley, which



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demonstrated how mechanical engineers measured the strengths and properties of various materials using sensors constructed out of resistors.

Professor Horsley also taught us about his research, which pertains to mechanical, moving parts on the microscopic scale, used in M.E.M.S. (Micro Electro Mechanical Systems). Many everyday electronic devices, such as airbag sensors in cars and accelerometers in I-Phones use this technology.

A graduate student, Andrew, provided a thorough insight into the concepts behind our modern day understanding of aerodynamics.

Cluster 4

Unfortunately not available.

Cluster 5 – *written by Cluster 5 student, Rushikesh Joshi*

During the third week of our stay at COSMOS, we began to focus all of our attention on our respective final projects for the robotics course. This week was much more intensive for the robotics course, with labs occurring almost every day.

With all the tasks and programs assigned project construction began at full speed in the robotics course. Project ideas vary widely, and all us are working very hard to complete the projects. All the creative and challenging ideas are fabulous! Professor Dad-Del also gave lectures on gear ratios and different programs that he anticipated would benefit us when programming and building our final projects.

Meanwhile in the writings and communications course, our Teacher Fellow, Alexander Coward introduced us to the idea of an “abstract” paper. An abstract is a small research paper that summarizes the objective, purpose, conclusions, etc...of a project or experiment. To enter into the Intel ISEF Science Fair, students are required to write an abstract on a topic they select.

In the computational biophysics course, we continued to delve deeper into the topic of random walkers. However, Professor Scalettar took the programs a step further by introducing a code that would predict the probability of a random walker hitting a specific target. We also completed a progress report which was a series of tasks, and submitted papers to Professor Singh and Scalettar so they could evaluate how much knowledge we are grasping. The Professors also began to stress the importance of commenting codes, and gave a series of lectures on that topic.

On Wednesday, the distinguished lecturer Dr. Henry I. Miller gave all COSMOS students a fascinating talk about biotechnology and gene splicing, as well as of the importance of biotechnology in the world.

Cluster 6

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Cluster 7

After wrapping up veterinary medicine last week, Cluster 7 students spent week 3 becoming more familiar with human medicine. On Monday, we spent most of the day at the UC Davis School of Medicine, where we were able to perform simulations of laparoscopic surgeries (parents: this is one time where your student's video game skills actually do pay off), cardiac catheter insertions (including balloon pumps!), and treatment of emergency room victims in the Center for Virtual Care. Students were also able to practice their "doctoring" skills by practicing gathering patient histories on one another using scripts. Guest speakers, including the Associate Dean, the Admissions Director, and two current second-year medical students, shared their med school stories and experiences with us.

On Tuesday, students watched a fascinating video documenting the lives of several Harvard medical students and all the trials and tribulations that accompany med school. That afternoon, the veterinary TAs presented students with a wide array of plastinated animals so students could view organs and entire body systems in a gross anatomy lab, including a fetal pig with a cleft chin abnormality!

On Wednesday, students got the plague...in an interactive lecture given by Dr. LeFebvre. Later during the week, the vet TAs quizzed our students on their anatomy lab knowledge by having them quiz each other! Each student group of 4 was given an organ, asked to create two truths and a lie about it, and then ask the other student groups to figure out the truth. Since this is a summer camp, we spent that afternoon having a water balloon fight...science-style! Using large red and blue balloons to represent oxygenation and deoxygenation respectively, students had to walk through a simulated circulatory system while avoiding bombardment by "free radicals" (small water balloons hurled at them by the teacher fellows and vet TAs).

To culminate the week, we saw a fascinating video on bacteriophage viruses being used to cure bacterial infections. Students have been busily working on their body projects, finishing up their cameo lectures and research papers, and finalizing their science fair proposals. It's been a great week and we can't believe there's only one week left!

Cluster 8

Week three for Cluster 8 was really great. On Tuesday, we left Davis at 7:30 a.m. enroute to Incline Village and the Tahoe Environmental Research Center (TERC). The purpose of our visit was to get a firsthand look at chemistry as it is performed in an analytical lab. After spending two weeks dealing primarily with computational chemistry, it was nice for the students to do some hands-on work in an analytical setting. While at TERC, students were first given a tour of the facility and a short presentation detailing what is done at both TERC and in the chemistry lab. TERC's role is to do analysis of water and other things that are taken from and around Lake Tahoe. The project was originally created to determine the various factors responsible for the decrease in clarity of the lake. During their lab experience, students analyzed samples from various sites to determine the amount of soluble phosphorous in these samples. After finishing at TERC we stopped for a brief visit at the lake where students were able to get their feet wet before heading back to UCD.



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After a couple more labs dealing with computational chemistry, students attended SYLICCO, an all day Symposium on Learning and Industry targeting Computational Chemistry Opportunities, where they heard presentations from experts in the field of computational chemistry. The symposium allowed students the opportunity to listen to and ask questions of professionals currently doing research in the field as well as a representative of Amgen who described the process of drug discovery in the pharmaceutical industry. At the end of the symposium, students got to speak with graduate students who were presenting their own posters describing the work currently being done in labs at UCD and CSU, Sacramento.

The absolute highlight of the week was the 10 meter high bubble explosion Dr. Toby Allen created as he demonstrated a spontaneous reaction using hot water, bubbles and liquid nitrogen. It was the most entertaining thing any of us had seen in the previous three weeks!

Cluster 9

Cluster 9 had another very busy week. Students continued to learn about gravity; this week they learned about gravitational lensing and black holes and the Schwarzschild radius and other neat stuff. They also learned more about light and spectra classification and H-R diagrams, seasons, moon phases, and tidal forces, and more about how to analyze data. Jim Bosch from the UCD Physics department taught students how to program in Python, then they wrote programs to speed up the analysis of data collected from various stars and star clusters. It was amazing how much students were able to accomplish using Python and various other analytical programs on the laptops.

Students were fortunate to have two guest lecturers from the UCD Physics department. Dr. Matt Richter talked to students about his research using data collected mostly from the infrared part of the spectrum. He spoke about what he learns from IR spectra, as well as some of the instruments he uses such as EXES, and SOFIA -- a telescope mounted on 747 airplane which flies at 40,000 feet. He talked about the TMT (Thirty Meter Telescope) project proposal which he is hoping gets funded and built soon. Professor David Wittman spoke to us about his cosmology research using sky surveys. He talked about the difference between sky surveys and more typical observations, and how the equipment required for sky surveys is different from typical telescopes. He spoke about detecting asteroids, dark matter, dark energy, gravitational lensing and the LSST (Large Synoptic Survey Telescope) – a telescope which could produce huge amounts of data and survey half the sky.

Many hours this week were spent working on final projects. First, students downloaded data. Then they had to reduce, align and often combine the data. Then there were all kinds of analyses to perform, depending on the project. And then, students began writing their papers. Wow -- what a wonderfully busy week at COSMOS!

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As always, if you have questions or concerns, you are welcome to contact us at the COSMOS Office at cosmos@ucdavis.edu or by calling (530) 754-7326.

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