



# COSMOS UC San Diego

California State Summer School for Mathematics and Science 

A RESIDENTIAL ACADEMIC EXPERIENCE FOR TALENTED HIGH SCHOOL STUDENTS AT UC SAN DIEGO

## Week 3 Newsletter



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### MAILING ADDRESSES:

#### Please address REGULAR MAIL:

Student's FULL Name  
COSMOS @ UCSD  
ERC Conference Services Center  
9450 Gilman Drive  
La Jolla, CA 92092-0100

#### Please address PACKAGES:

Student's FULL Name  
COSMOS @ UCSD  
Jacobs Hall, Suite 1400  
9500 Gilman Drive #0429  
La Jolla, CA 92093-0429

### CONTACT INFORMATION:

COSMOS Office Hours:  
(during the summer program)  
Monday - Friday: 7:30am -  
4:30pm

Email: [cosmos@ucsd.edu](mailto:cosmos@ucsd.edu)  
Phone: (858) 822-4361  
After Hours: (858) 378-7312



# CLOSING DAY!

On Saturday, August 1st, students will present their final projects. Please plan to arrive at **8:30am to Warren Mall**. You will be escorted to your student's cluster project location where presentations will be from 9-10:15 am. Following the presentations will be the COSMOS Awards Ceremony at 10:30am. Students will be presented with their Completion Certificates and special awards. We encourage friends and family to come see all of the hard work that the student have been putting in during their month at COSMOS!

After the Awards Ceremony, we ask that families start heading back to the Eleanor Roosevelt College (ERC) residential halls to pick up their belongings and check-out. This means that all students should be packed prior to the Research Expo and have their keys and meal cards ready to be turned in. If your student has lost their key(s), it is a \$155 expense per set of keys and this must be paid at the time of check-out if not before. Broken keys are free to replace.

Families should park at the Gilman Parking structure near the Price Center. **Do not use the 9500 Gilman Dr. address in your navigation system-it will take you to our central mail processing!** Families can park in Gilman for the Research Expo and Awards Ceremony then drive to the Pangea Parking Structure to pick-up their student's belongings and check-out. All students **MUST** be checked out by 1pm.



# Closing Day Driving Directions



## Getting to GILMAN PARKING STRUCTURE

1. Exit La Jolla Village Drive from the I-5 S and head west to turn onto La Jolla Village Drive.
2. Turn right onto Villa La Jolla Drive.
3. Continue straight past Gilman Drive into Gilman Parking structure.

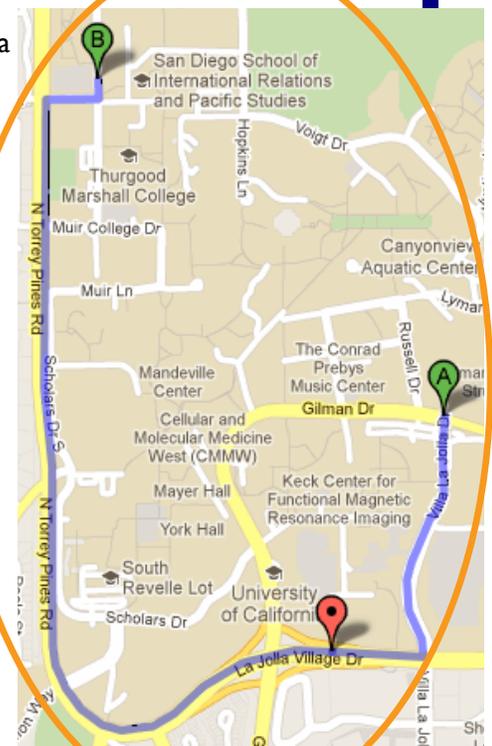
## (Walking) From GILMAN PARKING STRUCTURE to WARREN MALL

1. Head NORTH from the Gilman Parking Structure on Russell Lane. Look for COSMOS signs that will be along the way to Warren Mall from Gilman parking structure.
2. Continue Past Matthews Ln. Walk Straight.
3. Turn Left upon arriving in Warren Mall.
4. Closing Ceremony will take place in Warren Mall, directly in front of

## (Driving) From GILMAN PARKING STRUCTURE to PANGEA PARKING LOT

1. Head South on Villa La Jolla Drive.
2. Turn right onto La Jolla Village Drive
3. Continue straight onto N Torrey Pines Road.
4. Turn right onto Pangea Drive.
5. Pangea Parking lot will be on your left.

\*NOTE: Parking is free on weekends unless otherwise noted.



# DISCOVERY LECTURE SERIES

## “Enabling Chemical Discovery through the Lens of a Computational Microscope”



This week's discovery lecture starred Dr. Rommie Amaro. Dr. Amaro's presentation was titled "Enabling Chemical Discovery through the Lens of a Computational Microscope." She got her bachelor's degree in chemical engineering from the University of Illinois, where she also earned her PhD in chemistry. She currently teaches at UCSD while also running the Amaro Lab, which focuses on using computational methods to develop drugs to work against diseases such as cancer and influenza.

Throughout her lecture, it was evident that Dr. Amaro is extremely passionate about her research. Dr. Amaro emphasized the world of computation as a great area of study for all science students. Scientists can use computation to aid various types of scientific research in a variety of fields, such as mathematics, physics, and biology.

In her work, Dr. Amaro uses computing to determine the position of the atomic particles in proteins to understand the dynamics of cancer cells. Dr. Amaro described how the P53 protein, which normally causes damaged cells to destroy themselves, is mutated and allows damaged cells to proliferate and create tumors. Through computational methods, Dr. Amaro has discovered more P53 reactivation compounds in six months than all of the non-computational research in the past twenty years. By finding these reactivation sites, Dr. Amaro hopes to reactivate the P53 proteins in order to stop tumor growth. This could serve as an alternative to chemotherapy, especially in cancers that do not respond to chemotherapy. In addition to describing her research, Dr. Amaro also encouraged students to keep an open mind throughout their educational careers in order to find the work that truly inspires them. She discussed how the path we think we will take to our careers may not be the path we end up taking. What is most important, she discussed, is finding something they can be passionate about.



# WOMEN IN STEM

The Academic Enrichment session this week, titled Women In STEM, featured **Dr. Gabriele Wienhausen and Dr. Ebonee Williams.**

Dr. Wienhausen is the Faculty Director of the Teaching and Learning Commons at UCSD as well as Faculty within the Division of Biological. She received her Ph.D. from the Westfälische Wilhelms-Universität, Münster, Germany. She is also

currently the co-Principle Investigator of the Howard Hughes Undergraduate Science Enrichment Program. Dr. Ebonee Williams is the Director of the Gordon Engineering Leadership Center at UCSD. She earned her B.S. in Chemical Engineering from Brown University and her Ph.D. from the University of Washington. She also has a Masters in Industrial Business Management from the Lille Business School in France.

It was inspiring to see so many young ladies join the session and share their concerns as well as experiences with Dr. Williams and Dr. Wienhausen. Our students asked great questions, such as how to create a positive influence on their female peers so that they too could be encouraged to join STEM fields. They also asked questions about the lack of females in fields such as Physics and Mathematics and were challenged with coming up with solutions themselves on how to change those statistics. They were encouraged to find their true passion, whether it was science or engineering, and to create support systems for one another so that they could succeed. Both Dr. Wienhausen and Dr. Williams attribute much of their success to the support systems they had while going through challenging courses and issues they faced in the work force.



# RESIDENTIAL LIFE

There is so much we would like to share with you about your students lives and progress here at COSMOS. The number one lesson each student has been working on outside of class has been community building. We are happy to say that many students have shown great skill in communicating with their neighbors, when they see something is wrong they have said something and in some cases they have done something.

They have been helping keep each other accountable and honest with minimal gossip. With this skill in hand, they are destined to do far better in a university environment, assuming they keep working on these skills. Another lesson learned is that attending programs, events, and down-time outside of class is essential to a balanced academic life. At the College Success program the Admissions and College representatives stressed this important skill. It is not enough to write a good personal statement, but a successful college student also learns to fill their resume with more than just a good GPA and an internship. Involvement is key. This has been a driving force for the Resident Advisors to instill in the students and we believe they are beginning to embrace the wellness philosophy. So what have they been up to this past week? Students who did not go away during Family Weekend enjoyed a fun and rain filled trip to our local Town Square Cinema. They were also able to participate in a visit to Convoy Street, canvas painting, general down time, Just Dance, and hiding out from the unusual torrential downpour. Upon everyone's return there were a lot more things to do for the week including but not limited to: Casino night, ballroom/salsa dancing, healthy relationships, tie dye, ice blocking, and a bonfire at La Jolla Shores with s'mores and a beautiful sunset. During all of this we learned so much more about our residents. Bansi and Barbara make relationships with others a healthy priority. Vaishnavi could conduct henna for a living. Noah and Ashwin can take the lead on a dance floor with a smile. Jerry is more than a cube master, but also a composer. Cameron P. and Annabel D. will be showcasing their audition ready voices at the Talent Show. And some ladies of Latin America 110 could be professional beach jumpers. Needless to say, it was an action packed week. We must forewarn you that this last week is often a time when you will not hear much from your student. They are not only busy getting ready for their presentations and projects, but they are also already preparing to shed tears over leaving one another. Students will go to Avenida de la Playa, put on a Talent Show, attend a fun filled carnival, write a resume, have a yearbook party, and experience one last COSMOS dance, just to name a few events. Though UCSD COSMOS 2015 is coming to an end, there is a lot of fun in store to make the students' experiences as memorable and well balanced as possible.



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# CLUSTER 1: COMPUTERS IN EVERYDAY LIFE



**Cluster 1:** <http://ucsdcosmoscluster1-2015.blogspot.com/>

Last Friday, we had a guest speaker, Diba Mirza, who spoke to us about data compression. We knew it happened on our computers and other devices, but never quite knew how. She taught us about Huffman codes and how fewer bits are used to store information using that algorithm compared to non-compressed data.

On Monday, we learned about adding binary numbers using adders. As a cluster, we added two 19-bit binary numbers together. Each one of us was a digit and we used what we learned about sum and carry bits to accomplish the task. Did you know that all the following are true:  $1 + 1 = 0$ ,  $1 + 1 = 1$ ,  $1 + 1 = 2$  and  $1 + 1 = 10$ ? We did. And we know why. Later that morning, Sanjay Dasgupta guest spoke about algorithms and how they determine which ones are “good” (more efficient) or “bad” (less efficient). While there are thousands upon thousands of problems out there, most can be reduced down to a much smaller subset of algorithms. For example, the cartographer’s problem of color coding a map with the fewest number of colors while having neighboring countries have different colors is really a graph color problem. Another graph color problem is exam scheduling – using as few time slots as possible but not scheduling two exams for one person at the same time. In the afternoon, we continued to work on our musical instrument Arduino project. We became adept at circuits and got some new parts that we could include – like push buttons. You can see videos of us playing our instruments on our blog. The top musical instrument projects were made by Sheldon and Lizbeth, and Veronica and Matthew.

On Tuesday, we began working on our walking Arduino robot. Each team has a different idea on how to get theirs to move around the room. We can use Kinex, popsicle sticks, and zip ties. It’s been a challenge, but a lot of fun and one we are facing head-on. We’ll present our walking robots on Thursday.

Wednesday, Gert Lanckriet came in to speak to us about building a music search engine. We heard about the evolution of how suggestions are given in Pandora, iTunes music store, etc. Gert’s research is working on entering other terms in a search such as mellow, romantic, dance, saxophone, etc. His lab is also working on going “zero-click” so that your phone’s music player can know what to play based on your “mood”. For example, if you were working out, trying to go to sleep, on a date, it would play the appropriate music without you typing anything into the player. His lab has not only graduate and undergraduate students but he welcomes high school students to work on the research as well! Afterwards, our professor Ryan Kastner, shared some of the work that Explorers for Engineering (E4E) is doing. Ryan and Curt (our faculty) are also co-directors of E4E. Any misconception that computer scientists and engineers just sit in a lab in front of a computer was smashed when he shared with us their work which took them to places like nature reserves, Guatemala, and the Dominican Republic – just to name a few. They went to Guatemala to map out ancient Maya tombs and create 3-D models of it. They will soon 3-D print these models and share them.

Another fascinating project he shared was a “camera trap” to get pictures of animals in their natural habitat. There are challenges that they face in putting a camera out in the wild such as power. The devices can’t be plugged in and re-charging them frequently is unreasonable. The camera traps turn on when it “sees” an animal and continue to track its movements. In the afternoon, we got a chance to meet some of the students who are working on this research and see the technology first-hand.

We’ll finish off the week with a visit to CallT2 and start work on our final projects. It’s been a busy and challenging week. We’re going to make the best of the final week of COSMOS!



## CLUSTER 2: ENGINEERING DESIGN AND CONTROL OF KINETIC SCULPTURES

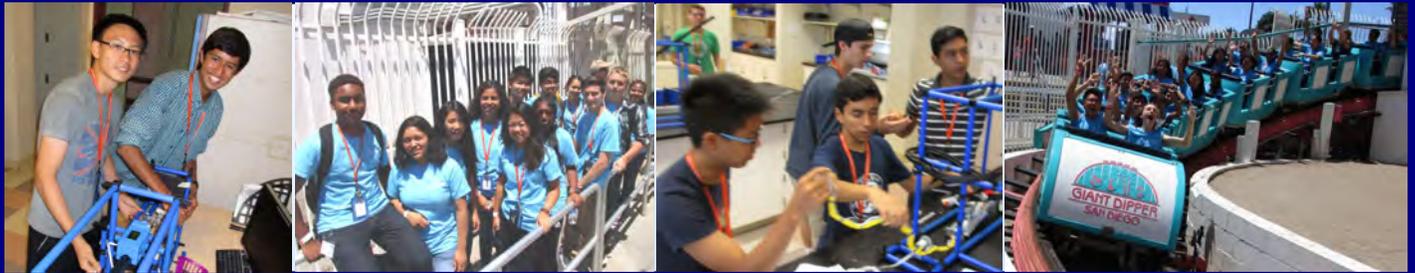
Students arrived after a (rainy) family weekend rested and ready to continue working on their mini sculptures. By the end of the week, each group will present their mini sculpture design to the group. These mini sculptures. Each presentation will focus on the conceptual design, risk reduction tests, prototyping, and various iterations that resulted in the final working machine.

Monday morning students were treated to a lecture on bearings by Dr. Delson. The tips he gave concern how to mechanically constrain motion made students think about how to best construct a linear slider

powered turbines to power generators, compressors, and pumps all over the world. It was remarkable how similar the turbine assembly process was to our clock assembly project. In addition, students saw how impressively clean and organized the work areas were considering each "package" is constructed from approximately 40,000 parts. The largest of these turbines costs approximately 30 million dollars and can be constructed in about one month. An interesting note is that the company's maintenance revenue has exceeded its yearly sales revenue.

After a brief lunch at Solar

are 95% done, they still are only half-way there. One of the groups also started 3-D printing a mini foosball table for people interacting with their sculpture to play. Other exciting design elements teams have designed and built so far include machines that sort balls by color, adjustable ramps with moving catch baskets, interconnecting gear mechanisms, a movable catapult, and dueling trampoline jumps. In the afternoon, Dr. de Callafon gave a brief talk on dynamic modeling and started the students working on modeling their mini sculptures in working model. You will see the results of these modeling sessions in the final presentations.



mechanism, build a jam free linkage, and to minimize wobble that can lead to inconsistency and early failure in a machine. With this new knowledge, students hit the design studio to continue working on their machines. At the end of the day, Dr. Delson walked around to consult with each group on their progress and plans to complete all of the requirements of the mini sculpture by Friday. With a day taken away due to our field trip, and given how fast time flies during COSMOS, it was not too early to consider the plan for completion.

Tuesday began with a fantastic Discovery Lecture from Dr. Amaro who is using computational methods to discover new drugs to fight a number of human diseases. Then we boarded a bus for an off-campus adventure. Our first stop was a company called Solar Turbines which makes large gas powered generators that power many industrial processes. Students learned how the company designs and builds medium sized gas

Turbines, we jumped back on the bus to head to Belmont Park, a small but fun packed amusement park located in Ocean Beach just north of San Diego harbor. With unlimited ride bands, students were able to experience some of the physics they have been learning about from Dr. de Callafon. Dr. Delson posed a thought-provoking question to the students: which car of a multicar roller coaster experiences the most acceleration? In order to answer this question, he distributed a number of cell phones with an accelerometer app on it which the students activated and then rode the coaster in one of the twelve rows. Unfortunately the phones were unable to sense any accelerations over 2g's. Next year we will bring 4g phones!

Wednesday we jumped right into the design studio to continue working on the sculptures. Teams added elevators to enable the machines to run in continuous loop mode. Students are starting to realize that sometimes when they think they

Thursday we were treated to another cluster exploration session in the morning which once again left us fascinated but yet STILL glad we had chosen the BEST cluster. After that, students learned about Design Thinking from their teacher fellow and then had some time in the design studio to work on their sculptures. The afternoon session was devoted to more work on fine tuning the mini sculptures in preparation for team presentations tomorrow.

After a week of brainstorming, designing, troubleshooting, testing and refining their mini sculptures, each group presented what they had learned in the process. Moving forward into the final week of COSMOS, these mini sculptures will form the foundation of students final project sculptures which will be presented to family and friends at the COSMOS Expo next weekend. This teacher fellow cannot wait to see how each group uses its creativity and skill to create an amazing final sculpture!



# CLUSTER 3: LIVING OCEANS AND GLOBAL CLIMATE CHANGE

It's hard to believe that we are already wrapping up week 3 of COSMOS! In the last week, students have completed writing an essay exploring ethical issues in climate and the environment, attended many fascinating lectures by our amazing professors, and worked hard on their individual research projects!



"It was interesting to see how the fish hatchery helped breed and release Sea Basses. We also saw the tags they put in the fish to track where they go and their survival rate." – Layly Roodsari



"On Friday, we visited the lagoon. There were small crabs and snails that lived in the mud, which differed in shape in comparison to the crabs and snails at the tidepools." – Emily M e i e r



"On Friday, our cluster headed

out to SIO, where Professor Lai (definitely one of the most interesting teachers I've ever had) held a short lecture. Afterwards, we went to the pier in La Jolla beach and we were all in for a surprise- dissecting a shark. Everyone was able to feel all the organs and flesh of the Mako shark. Overall, it was an amazing opportunity and experience, and I won't forget about all the shark blood over my hands. In the afternoon, cluster 3 was shown a video about algae and effects of climate change, along with a very informative lecture from Skip. It was an unforgettable day!" – Angela Liu



"We started off Monday morning by going down to SIO. As usual, Dr. Lai had a surprise for each of us – a cockroach (in a plastic box)! We learned more about evolution and the tetrapod. Later, we went to a nearby building that housed many sea creatures such as shrimp, sea urchins, fish, sharks, and clams. Our experience was definitely "hands-on" as we were able to touch starfish, sea cumpers, and more. In the afternoon at our climate change class, Professor Pomeroy gave us a brief lecture on ocean acid-



ification. We then did a lab on measuring the pH of a liquid that represented the marine buffer system. It was fascinating to watch the beaker turn from yellow (neutral) to basic (blue). Afterwards, we had a special guest lecturer who talked to us about conditions on Mars and the importance of isotopes in discovering more about a plant's history and predicting future conditions. She even brought in samples of a meteorite and soil from Mars for us to hold." – Angela Huang



"This Wednesday, the first thing we did was visit the Birch Aquarium at Scripps Institute of Oceanography. There were many marine animals including seahorses, jelly fishes, leopard sharks, and even a sea turtle! One specific exhibit focused on global climate change and global warming. Immediately after visiting the aquarium, we went back to the classroom and dissected mice and frogs and learned about their evolution. In the afternoon, we visited the California Center for Algae Biotechnology and learned about biodiesel energy where researchers harvest lipids from algae to produce energy. It was definitely one of the best field trips so far." – Amber Chau



# CLUSTER 4: WHEN DISASTER STRIKES: EARTHQUAKE ENGINEERING



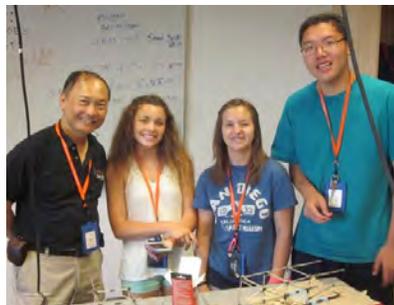
Clyde Tombaugh, discoverer of 'minor planet' Pluto, is quoted as saying "A person that is much interested in science is going to neglect their social life somewhat, but not completely, because that isn't healthy either." We needn't worry about our COSMopolitans neglecting their social lives, even though they were extremely busy this week with testing and retrofitting their structures. Our wonderful residence life advisors scheduled a bonfire, the talent show, and many other worthwhile distractions from their hard work in the Cluster 4 lab.

Week three is in the books, and their progress has been substantial. This week is typically a transitional week, as students returning from the fun and relaxation of parent's weekend awaken to the realities of deadlines, analysis, and the expectation of finishing in two more short weeks. They are actively involved with finishing seismic testing, redesigning and retrofitting, and final testing of their newly strengthened structures. It requires and teaches the importance of teamwork and time management to effectively and successfully conclude the structural engineering component of their assigned project. Compounding the frenzy of planning is the initial designing of their group's website, including the formalizing of their geophysical setting information and associated Powerpoint presentation. As Bob says, "There is no such thing as free time!"

Students embraced two trips out-

side of the lab this week. They enjoyed a tour of the campus Cal-Trans SRMD facility. You may enjoy reading more about it yourself at this link: <http://structures.ucsd.edu/node/62>. The Seismic Response Modification Devices are used to test structures such as highway bridge columns under earthquake stresses. On Thursday we bussed to the San Diego Office of Emergency Services, receiving a tour detailing the responsibilities of city personnel during fires, earthquakes, and other natural disasters. We residents of San Diego thoroughly appreciate the level of preparation detailed in order to successfully provide the vital services to citizens following such an event. The building itself has been fitted with base isolation devices, which the students saw from below ground level. The day concluded with an amazing tour of the Englekirk Center and the UCSD NEES shake table, a full scale earthquake shake table, capable of testing buildings as tall as seven stories. You may enjoy watching their testing videos at <http://nees.ucsd.edu/>. It was truly special to see and learn about such a world-class facility.

As week four approaches, students will give more thought to communication skills in order to best showcase their project results. This will involve further analysis of their eventual data and methodology, and brainstorming ways to best organize the details of their journey through cluster 4. We press on towards the completion of our projects, and producing some terrific posters and professional presentations for our cluster families to enjoy.



<https://sites.google.com/a/eng.ucsd.edu/ucsd-cosmos-cluster-4-2015>



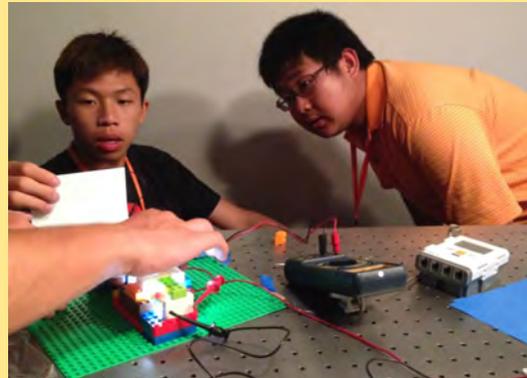
# CLUSTER 5: FROM LASERS TO LCDS: LIGHT AT WORK

After Parents' Weekend students returned to the COSMOS campus in Middle Earth with renewed enthusiasm for their cluster. We started off the week with a lecture from Dr. Tu about the evolution of the solar cells over the past 50 years. After lecture we returned to lab where student groups finalized their selections for their final projects.

Final projects will be in-depth investigations of spectrometry, dye-sensitized organic solar cells, optical communication and Faraday's Law. Spectrometry was chosen by two groups and both will be using their coding skills to enhance the efficacy of their design. Solar cells were chosen by two groups as well: one group is attempting to determine which organic compounds will most efficiently convert the sun's energy into power while the other is attempting to create a flexible dye-sensitized solar panel. The optical communication group is developing a method of communicating audio signals using laser and LED light. Our final group is trying to induce rotation of a polarized laser light though application of a magnetic field. Cluster members are feverishly working on their respective projects to ensure that they will be ready to share their exciting findings at the end of the COSMOS summer session.

On Tuesday there was an excellent Discovery Lecture by Dr. Rommie Aramo who is a computational biochemist at UCSD. Her lab is currently on the leading edge of research into protein structures in the cell and development of drugs to combat diseases like cancer, the flu, and trypanosomes.

We were also able to visit several optics labs in the Jacobs Engineering Building and were fortunate to hear about some of the interesting research and development that was occurring there.





# CLUSTER 6: BIODIESEL FROM RENEWABLE SOURCES



"On Thursday everyone began their day by walking to Center Hall where we would be having our Cluster Exploration lecture.

During the lecture the professors who lead the clusters gave a short lecture and updates on what their clusters were doing. The clusters that we learned about were clusters 2, 3, 4, and 5; this lecture provided insight on what our peers were doing in their groups and the projects they have come up with. After the lecture our cluster headed to one of the classes above Center Hall. In the class we discussed the lecture and spoke to the class about the topics of our ethic papers and were then given time to finish the papers.

After lunch the cluster headed down to the lab where we split up into groups to work on our final projects. It was during that time that we could catch up on work and further analyze our final project topics.

The day ended with several activities such as, playing Just Dance or Volleyball and making parfaits or going to a Positive Body Image speech."

- Irene Ramirez

"Friday marked the end of the second week at COSMOS and the beginning of parent's weekend! The morning of lectures began with Dr. Pomeroy's presentation on diesel engines and the mechanics

behind these large engines that power large trucks, trains, and oceanic vessels. Not only did we learn about the history of engines, from Rudolf Diesel's engine to Otto and Bosch's engine, we also learned about the construction and ways in which an engine operates. Learning about the 2 and 4 stroke engines, we further analyzed the common engine pressure and volume cycles (intake, compression, power, and exhaust) for a 4 stroke engine. Dr. Pomeroy finished his lecture by discussing the efficiency of the different types of engines and the advantages/drawbacks of the diesel engine. Next, it was Dr. Albizati's turn to lecture the enthusiastic cluster, which he began by going over a few of the organic chemistry functional groups. Dr. Albizati's lecture focused on energy and enthalpy that drive chemical reactions. He took us through the definition of energy,

heat, mechanisms, and energy transfer within reactions. The second half of Dr. Albizati's lecture was on enthalpy and heat of a reaction, involving a few mathematical concepts and equations. Finally, Dr. Albizati finished his lecture by testing our "chemical intuition" about enthalpy of combustion of different molecules. Now it was time for lunch over at 64 degrees and the much needed break after the morning of chemistry lectures. After lunch, each group of 2 lab partners broke up to continue testing our biodiesel products using different analytical chemistry methods. My lab partner and I went to the FAME station with the Teacher's Assistant, Morgan. In this station, we began by preparing

a diluted solution of our biodiesel and an organic solvent, pentane, in order to test the different compounds in our biodiesel by using a gas chromatograph electron ionization detector. This test took about 45 minutes, but at the end we had a nice chromatogram of the different components in our biodiesel. When 4:00 rolled around, we all cleaned up and went back to Eleanor Roosevelt

College dorms to see our parents for Parent's Weekend!

- Jamie Salinger

"After Family Weekend, we returned to class refreshed, whether we went home or not. We walked or took the bus to class, dodging puddles left by the weekend's unusually heavy rain. Once we had arrived, Dr. Pomeroy started off the day with a lecture on biomass and biofuels

that covered production of different fuels from different sources. Dr. Albizati followed by presenting chromatography, a process used to separate solutions. He covered both liquid chromatography, which utilizes a liquid solvent and solid stationary phase with different properties, and gas chromatography. After lunch, we proceeded to the laboratory to continue testing our biodiesel, checking its viscosity, composition, mass percentage glycerol, flash point, and cloud point to determine its quality. We began to better understand the properties of biodiesel."

-Jamie Geng

"We started off Tuesday morning with an interesting and fascinating Discovery Lecture put together by Rommie E. Anaro on *Enabling Chemical Discovery Through the Lens of a Computational Microscope*. Dr. Anaro elaborated on current methods of creating computational models of proteins, specifically p53, to better understand their structure and help discover new forms of cancer treatment. Her lecture

was followed by a session of Science Communication with Mr. Towler where we held a discussion about the pros and cons of Ms Anaro's presentation. We were also briefed on how to prepare for our own final presentations and the different components that should be included. For lunch, we ate at 64°.

I found it quite enjoyable and relaxing, being able to sit in one another's company and eat together as a Cluster.

After filling our bellies, we arrived at the lab and hit the ground running. Everyone was busy working on their final projects and carrying out experiments within their group for the rest of our time together."

- Joy Suh

"On Wednesday, we had our first Cluster field trip! All of us (along with Cluster 3) went to the Birch Aquarium and the Algae farm (Field Station) on the UCSD Campus! We started off in the Beat the Heat Special exhibit. There, we learned the hard facts and statistics about what we are doing by releasing billions of tons of Carbon Dioxide into the atmosphere. We also learned about aerosols, the pros and cons of the ways to control our Carbon Dioxide emissions, and what we can do about it. We then explored the other exhibits in the aquarium, from the exotic and endangered dragon fish, to humongous leopard shark. After finishing our visit, we drove back to the main UCSD campus to eat lunch. It was a real treat to eat with both of our cluster RA's, our Teacher Fellow Mr. Tim Towler, and Dr. "Skip" Pomeroy.

After lunch, we took the campus shuttle bus to the algae farm on the UCSD campus. There, we got a wonderful tour of the

farm from Mr. Dominic, and he thoroughly explained the processes about how algae is grown, what it can be used for, and how much energy can be produced from it. It was really interesting to see just how algae could be mass produced, and the possibilities of what algae can bring to our world."

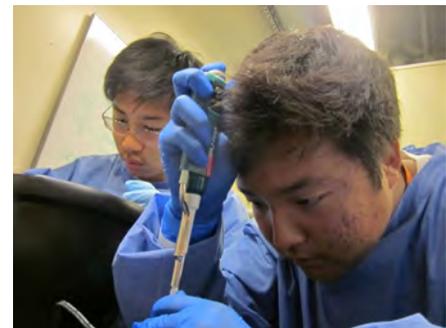
- Kevin Amemiya



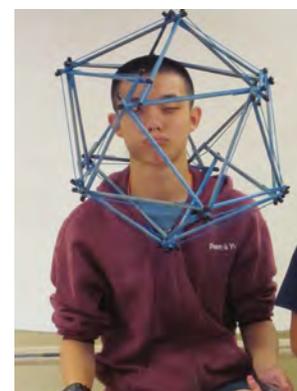
# CLUSTER 7: BIOENGINEERING/MECHANICAL ENGINEERING: THE AMAZING RED BLOOD CELL



The second half of Cluster 7 began with the introduction of tensegrity structures by professor Mauricio de Oliveira and teaching assistant Tamož Dunov. Tensegrity structures consist of elastic strings under tension that connect wooden sticks that are under floating compression in such a way that the sticks do not touch. The objective for week 3 was to develop an appreciation for tensegrity structures as models for the mechanical properties of red blood cells (RBCs). A tensegrity structure stabilizes itself mechanically based on the way tensional and compressive forces are distributed. The simplest tensegrity structures, called Snelson prisms, were constructed by students which led to the creation of some very interesting 3-D shapes (and fashion statements)! This was followed by mechanical engineering experiments to determine the forces associated with the tensegrity structures. Using Hooke's law ( $F = -k \Delta X$ ), students first experimentally determined the stiffness ( $k$ ) of various elastic materials (strings, bungee cords, etc) and then analyzed Force ( $F$ ) versus Load Displacement ( $\Delta X$ ) curves for a selected string. Students then used their knowledge of Hooke's law to determine the pretension characteristics in a 6 string / 3 rod Snelson prism. From these experiments Cluster 7 students are now poised to connect the value of tensegrity structures as models for RBC membrane shape and function.



With only one week to go in COSMOS 2015 students have been busy in developing their final projects but also in devising a novel approach to preventing/treating malaria in a class-wide collaborative essay. Cluster 7 final projects are somewhat unique in that students use their laboratory experience and data from weeks 1 and 2 to formulate a research *proposal* focusing on a novel hypothesis linked to red blood cells. Some of the tensegrity structures built during the last two weeks of COSMOS represent good models of normal versus atypical red blood cell shape and flexibility and as such are often included in Cluster 7 final project presentations that, amazingly, are just around the corner!



# CLUSTER 8: TISSUE ENGINEERING AND REGENERATIVE MEDICINE

Week two ended with a field trip to Organogenesis, a tissue engineering and regenerative medicine company which manufactures Dermagraft to help heal diabetic foot ulcers. We were able to see all aspects of the company in action, from research and development to manufacturing. Overall it was an incredible opportunity to observe first hand many techniques we have learned in the lab and to tour a company that manufactures a product developed by tissue engineers.

Week three began as our esteemed professor, Dr. Sah, introduced us to proper experimental design. After numerous discussions and considerable evaluation we were able to select our own project topics and thus we were ready to begin the planning phase of our work. After two days of researching, planning, brainstorming, and support from Dr. Sah, Dr. Gaetani and our Teaching Assistants, Evan Teng and Chris Yin, everyone was prepared to begin the much anticipated projects. Briefly the groups will be examining fibrillogenesis and gel formation, regulation of chondrocyte phenotype, regulation of bone growth, cardiac decellularized ECM and collagen hydrogels, liver decellularization, and the generation of microspheres. Accordingly, tissues are being processed, gels formed, cells cultured, and materials are being prepared and tested. After an intense week in the lab our projects are underway and we eagerly await the results in a few days.

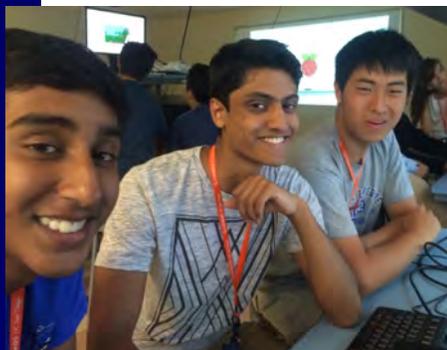
Dr. Amaro was our speaker for our Discovery Lecture this week. Her research utilizes computational methods to explore potential drug treatments for diseases such as influenza and cancer. She clearly demonstrated her research process using p53, a tumor suppressor gene and we

were fascinated by her molecular modeling which is accelerating drug discovery. In our communications course everyone has evaluated presentations, practiced presenting, reviewed abstracts and learned more about scientific writing. In Cluster Explorations, it was all about cluster pride, and we were definitely pleased to have their peers hear about what is going on in Cluster 8. Everyone is learning to manage their time, focus, and work together as a group of brilliant young scientific researchers. Cluster 8 continues to be 'GR8'.

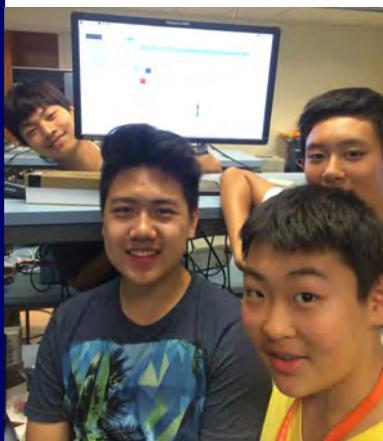


# CLUSTER 9: MUSIC AND TECHNOLOGY

Friday was Cluster 9 FIELD TRIP DAY!!! We took a bus to Qualcomm to learn more about the newest devel-



opments in technology. First, we went to the Game Developers Demonstration Room and learned about how the developers programmed the latest games with life-like graphics. We even took turns testing out the Oculus Rift, VR goggles!



After taking a lunch break, we visited the Qualcomm Circuit Factory and saw how circuits were made with amazing speed and accuracy. We then saw demos of the Snapdragon's latest

technologies, such as Voice Activation, Ultrasound Fingerprinting, and amazing 7.1 Surround Sound! Overall, this field trip was a very exciting day!

Week three of Cluster 9 started out with a bang! Literally! We spent our morning lecture time learning about the graphical programming language PureData, and its various controls and commands. We used PD to create a 3 oscillator synthesizer with a waveform analyzer. We also learned how to load and



control a .wav audio file with simple PD code. After a lunch at the Canyon Vista cafeteria, we went to the lab and continued working on PureData, this time with our Raspberry Pi Linux computers. Near the end of class, we brainstormed some ideas for the final project and started getting in our groups. We have some really cool ideas, and we can't wait to show them to everyone next week!

The science communica-



tions days saw us completing our ethics essays. Though most of these centered on the creativity-crushing effect of music piracy, papers ranged in topic, including permanent hearing loss from headphones and the questionable practice of cleaning up sub-par singing voices. We also started prepping for our project poster-display.

We spent much of yesterday in the lab, working with Joe, Colin, Shlomo, and Mauricio, who guided us through various approaches to make our projects awesome! --Kalen, Darius, Eric



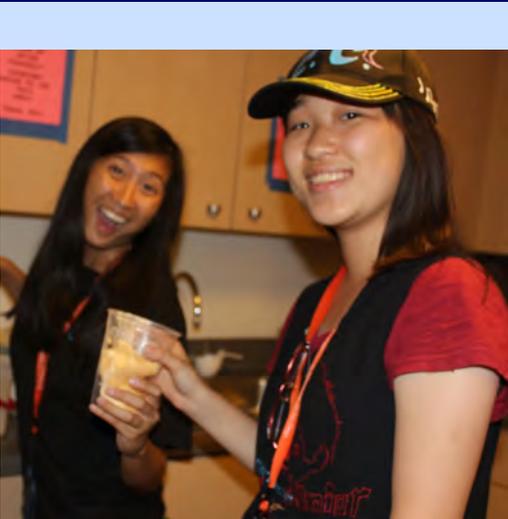


**Ballroom Dancing**  
**S'mores at the Shores**  
**Ice Blocking**





Crab Soccer  
Gingerbread  
Houses  
Henna  
Picture Frames  
Ice Cream



*Happy Birthdays!*

# CASINO NIGHT

