COSMOS UC San Diego

California State Summer School for Mathematics and Science

UCSD Jacobs School of Engineering

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

Week 2 Newsletter

REMINDER!

Family Weekend is July 17th through July 19th. Students must be checked out by an adult specified on the Family Weekend Form between **6-9pm on Friday and must return between 2-5pm on Sunday.** Optionally, students can be checked out at 6pm on Friday and returned by 9pm that same evening or alternatively, 2pm on Sunday, returning by 5pm that day. We do not have the staff to accommodate individual schedules. **All students MUST be back to campus by 5pm on Sunday.** If you have any questions, please call our office at (858) 822-4361 or email: cosmos@ucsd.edu.

ADMISSIONS PRESENTATION

This coming Sunday, students and parents will be given the opportunity to attend a UCSD Admissions & IDEA Center presentation. The presentation will be conducted by Admissions at UCSD. It will begin with basic eligibility requirements for applying to UC colleges, followed by the presentation of statistics to provide students with a visual of the competitiveness of the applicant pool. It will conclude with a Q&A session. The presentation will be held this

Sunday, July 19th from 3-4pm at 107 Solis.

IN THIS ISSUE:

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
Phone: (858) 822-4361
After Hours: (858) 378-7312

DISCOVERY LECTURE SERIES

"Role of Phenology in Species Responses to Climate Change."

Dr. Elsa Cleland gave an interesting talk to the students on the role of phenology in species responses to climate change. She started off the lecture by telling us a little bit about herself and the path she took to becoming an Associate Professor in the Division of Biological Sciences at UC San Diego. Dr. Cleland has worked in a variety of states and countries all over the world in various conservation efforts. She illustrated how important it is to try many things and take advantage of all opportunities that can come your way.Research in the Cleland lab focuses on the intersection between plant community and ecosystem ecology, utilizing a combination of experimental, observational and data-synthesis techniques.

Dr. Cleland then went on to discuss how CA is a biodiversity hotspot. In fact, the CA floristic province is classified as one of the 10 most diverse places on the Earth by Conservation International. CA has over 2000 endemic species, meaning they are found nowhere else on Earth. Global changes, such as rising atmospheric CO_2 and Nitrogen deposition, are altering species composition as well as the availability of our resources. Dr. Cleland finds global change research to be compelling because it allows her and her lab to ask, and attempt to answer, fundamental questions about the functioning of plant communities and ecosystems, while contributing towards a greater understanding of pressing environmental problems. Dr. Cleland's lab documents changes in community structure, variation among species in performance, and species interactions. One of her labs current projects is evaluating the role of phenology in structuring native and invasive plant communities.

She ended her talk with giving the students tips on how to become an undergraduate researcher and what she, as a faculty running her own lab, would look for in an undergraduate researcher. She told the students how important foundation courses were as well and listed Biostatistics as one of the most important courses students should take before doing research. Students won't be able to make any sense of the data they have collected if they don't know how to analyze it. Furthermore, she discussed how important field work is in the field of Ecology and those who wanted to go into Ecology should organize their time accordingly so that they can routinely do field work. It is also important to be willing to learn from others, especially graduate students who have more experience.

CLUSTER EXPLORATION

Four professors from clusters 2, 3, 4, and 5 gave an intriguing look into the exciting science and engineering topics that our students are working on this summer! The students were captivated to learn about what their friends from other clusters have been doing with their days. Professor Raymond de Callafon discussed the creative clocks Cluster 2 has been building, as well as their plans for creating unique kinetic sculptures. Professor Robert "Skip" Pomeroy introduced everyone to UC San Diego's place in history as a hotbed for environmental research, and then discussed how Cluster 3 has been studying our environment from both marine biology and atmospheric science standpoints, culminating in six projects addressing current problems in environmental science. Professor Lelli van den Einde discussed the 'earth shaking' work they have been examining in Cluster 4, showing video clips of some of the students structures that have been built, as well as their destruction on their shake table. Finally, Professor Charles Tu (and COSMOS Director), illuminated the audience on the important light-related projects Cluster 5 is working on this year in the United Nations declared Year of Light and Light Technology, emphasizing light-based technologies as the driver of 21st century technology. Our students chatted eagerly after the talks had completed, eager to discuss the wide range of amazing science their peers are engaging in!

RESIDENTIAL LIFE

OMG! Who would believe we are already halfway through the program. You are going to love all the exciting stories your student will be sharing with you if you ask the right questions! Be sure to ask and listen regarding what they are learning in class, in lab, and on their field trips. Ask them which programs they participated in, about their suite time activities, and all the new people they have met. Anand and Yash will tell you to "lose yourself". Veronica would tell you how she "stepped up" one night. Amber would tell you that sand can be beautiful. Aditya would tell you how when at the beach you can leave things better than you found them. Lizbeth would tell you how smooth time in her suite can be. And the "410" musical group could share tips on how to get a crowd to listen to "10 bands" at one time. I am happy to share that beyond safety, academic excellence, and having fun, our other goal is to prepare students for life outside of the classroom typical of a college environment. Some years we have had difficulty getting student to put down the electronics and really socialize during the free time or the 90 minutes of required programming time. I am thrilled to share that you have done a superb job in teaching your student that it is not only important that they be knowledgeable about what happens in class, but that they also be skilled in socializing with other humans face to face outside of the classroom. This is a skill that can only be practiced by actually interacting with others and most of this year's group are aces.

In other news, some students are getting a bit of a sore throat so please help us in reminding your students to spend less of their meal times eating pizza and frozen treats and more of the time eating fruit and the salad bar. The biggest challenges currently are keeping everyone from excessive flirting, teaching everyone to use the 4-8 quiet free time productively, and getting them to actually go to sleep when they go to bed. However due to the continued overall positive behavior their boundaries around campus had been extended. Therefore they have been using some of their free time to go to the Geisel library which houses 3.2 million books, to window shop at the UCSD Bookstore which has everything from scotch tape to Dr. Seuss hats, or to visit our many recreational and art facilities within the shuttle loop of the UC San Diego main campus.

"Parent's Weekend" is this weekend, but don't be surprised if your student didn't want to stay initially and now does. Also don't be surprised if your student was originally planning on staying, but now needs the time away to decompress from being around people ALL of the time. For those who do stay we will be going to the movies together and afterwards some will go with RAs in small groups to places like the beach, shopping, running, and more. When everyone gets back by 5pm Sunday we will kick off week three with casino night, resume writing, a bonfire, and more. Thank you for loaning us your student. The pleasure has been ours.

CLUSTER 1: COMPUTERS IN EVERYDAY LIFE

Cluster 1: http://ucsdcosmoscluster1-2015.blogspot.com/

We ended last in the lab working on our Scribbler Dance projects. We quickly became engrossed in making our designs perfect but learned that they didn't always behave the way we thought they would. We discovered that the battery strength sometimes played a role in the execution as did the surface our Scribblers drove on. We learned to adapt and become comfortable with Python (the language we program our Scribblers with). We presented our final Dancing Scribbler Friday afternoon. Our demos can be found on our blog at ucsdcosmoscluster1-2015.blogspot.com. Congratulations to Guillermo and Izabella for having the best dance!

On Monday and Wednesday, we learned about image processing. We learned how programs like paint and Photoshop do some of their basic functionality like finding a color and changing it to another or clearing the screen. We discovered how to do some image processing functions in Python – which means we'll be able to do it with the Scribblers! Currently, we are trying to get our Scribbler to traverse a maze, identify the colors and if a vertical or horizontal line is present. We've learned that the cameras on our Scribblers don't always seem to present the exact color shade we expect and we had to adjust for that. Also, textures and shadows give off different shades of blue (for example), so we can't just use one single definition of blue. To get our Scribblers to recognize (and communicate appropriately) vertical and horizontal our code had to analyze the pixels and perform calculations.

Monday afternoon we finished up our RoboArt. We programmed our Scribblers to draw what we wanted on a large piece of paper. You can view the photos on our blog. Congratulations to Shamailah and Shreya for their awesome snowflake design!

On Wednesday afternoon, we took a field trip to ViaSat. Sonali shares her experience: "Our field trip began with an informative presentation about ViaSat and the projects they are currently working on. Nikolai Devereaux, our tour guide, showed us models of the new ViaSat-2 satellite that is supposed to be launched in 2016. The difference between the new satellite and the previous one, that is currently orbiting the Earth at "low earth orbit," is the internet speed is five times faster and double the capacity of people or devices that can be connected. After making deals with JetBlue, United Airlines, and just last week signing on Virgin America, ViaSat has wi-fi coverage over 95% of the United States. After learning about ViaSat's commercial programs and government/military projects, we saw the networking devices that connect all the flights of JetBlue on their server. Lastly, we were able to view the devices and modems that software, computer, and mechanical engineers are testing for their new project. In conclusion, we were exposed to so many types of engineering and how they all come together to create a network, which was very inspiring to us young engineers. "

At the end of the week, we'll start our Arduino labs and submit our ethics essay for the contest. It's been a busy, challenging and fun week!

CLUSTER 2: ENGINEERING DESIGN AND CONTROL OF KINETIC SCULPTURES

This second week newsletter begins with an exciting update to the end of week. Friday night cluster two earned a "silver medal" in the COSMOlympics with a fantastically choreographed and scripted musical montage (thanks Alejandra and Pollo!) What a great way to end an amazing first week.

Over the weekend, in addition to working on their ethics essays, students were tasked to form groups of four with an emphasis on creating diversity in each group. As a warm up to their kinetic sculpture project, and to get them thinking and acting like engineers, students spent the morning with an activity called "recursive water ballon drop with high speed photography". In layperson's terms, this means that students rapidly prototyped a container to protect a dropped water balloon, drop tested it from increasing heights, analyzed the ground impact with high speed video, and then used their analysis to redesign and improve the vehicle's performance. Students struggled with the concept "fail early to succeed sooner" as they struggled against limited time to do multiple iterations of their designs.

In the afternoon, students learned about the physics of a marble dropping vertically and also rolling down a ramp from Dr. de Callafon. Concepts of rotational and linear kinetic energy were used in analyzing the motions and predictions the speed of the marble as it drops. Students then went to the design studio to do a lab measure these motions with marble and track from their upcoming sculptures and compare their measurements to the theoretical values predicted by the derived motion equations. Following the lab and a short wrap-up discussion led by Dr. de Callafon, students had time to work on finishing their pendulum clocks and work on the clock analysis web pages.

Tuesday morning started with a great Discovery Lecture about plant adaptation to changing ecosystems by Dr. Elsa Cleland. After the lecture, we walked up to the lab and student groups gave their oral presentations on the water balloon drop exercise. Teams reflected on the success and failure of their ideas, the process of developing ideas, and analyzed their teamwork. The oral presentations were well done and students and faculty were able to give each team feedback that will help them to better prepare when they present their final projects in two and a half weeks.

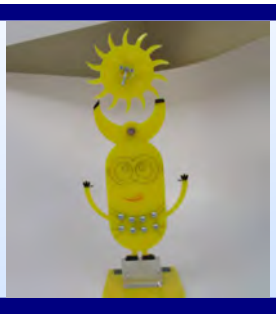
Tuesday afternoon students continued their study of physics of ball dropping by considering two dimensional trajectories. This information will help them program their sculptures later. To reinforce the ideas, they completed a lab in the design studio. Later, students finished up their clocks and worked on the timing analysis.

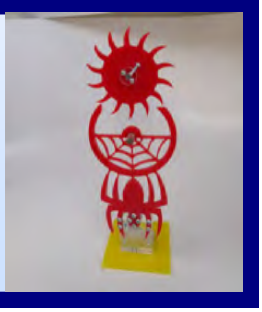
Wednesday morning, students were tasked to bring four sketched ideas each for their mini sculpture. The mini sculpture project is designed to get students focused on the critical aspect of design and control of the sculpture with a relatively simple structure. Dr. Delson discussed creativity and how to promote it among a team and his lecture included some interesting challenges that got students thinking laterally and "outside the box". Teams then used Pugh charts to objectively rank their ideas on a number of important criteria and choose one to use in their mini sculpture. Once the idea was chosen, students were able to dig into the massive collection of sculpture parts and began building.

Wednesday afternoon students learned about programming from Dr. de Callafon and then were able to practice their new skills by programming a simple back and forth robot that utilized one touch sensor and one sonar sensor. When they had accomplished that task, they were able to work on their clock analysis and web page.

Thursday morning we settled in for a cluster information session in which we learned about the cool things going on in other clusters but left still glad we were in cluster 2! The morning continued in the computer lab as students worked to finish their clock web pages. After lunch students learned more advanced programming and did another hands on activity where they programmed a machine to catch a ball in a small basket. The challenges keep increasing and students are meeting them!

Friday ended another week packed with new skills and accomplishments. Students really were able to dig into their mini sculpture and use their creativity, design methods, and teamwork to make functional, fanciful interactive structures.





CLUSTER 3: LIVING OCEANS AND GLOBAL CLIMATE CHANGE

Week 2 of COSMOS has been full of all types of excitement for Cluster 3! Besides our discussions of proper experimental design with complex environmental systems, we have also been engaging in deep discussions of ethical issues in science and continuing to explore various regions of our environment! We've all been having a great time so far, and I'm looking forward to more to come!

"On Wednesday, our first day of group projects, our cluster split into two groups, one going to Scripps Institute of Oceanography (SIO), while the other went to Dr. Pomeroy's lab. Students at SIO got to experiment with shrimp and barnacles, while students at the lab were exposed to the different instruments they would be using. For my group, we got to work closely with one of our graduate Teacher Assistants, Marissa, who

taught us about the FTIR instrument. This tool can help us determine the Global Warming Potential of different gases, and for fun, we used it to identify our thumb skin's surface composition! Overall, it has been an exciting beginning to our projects, and I cannot wait to begin working on it! " – *Rachel Tham*

"Friday at SIO, we went to the pier to measure the length of barnacles, and we each had to catch one shrimp or crab. After that, we each received a small lack crab in a bowl, and we had to fill it with either 100% salt water, 0 % salt water [100% fresh water], or 50% salt water, and 50 % fresh water. For the second half of the day, we went to Revelle College to receive a lecture about how to determine if something is a greenhouse gas from Professor 'Skip' Pomeroy." – *Sakshi Hegde*

"Monday was one of the most interesting days of COSMOS so far. We started off at SIO, where Dr. Lai was able to help teach us about phylogeny and phenetics by allowing us to observe different types of crabs, which included a full size Dungeness crab. We even got to dissect a crab to observe its organs and characteristics that allows it to survive in and out of water. Later that afternoon, we headed back to the lab where Skip lectured us on the formation of clouds. We did several fun labs to teach us about the effect aerosols have on cloud formation. Root beer made it all the better. " – *Cameron Nosrat*

"On Tuesday morning, we all walked down to our second Discovery Lecture

by Professor Elsa Cleland where we listened to her talk about her past experiences and studies. This lecture was interesting since it pertained to climate change, which made us a lot more intrigued, as the information related to what we're learning in our classes. In the afternoon, we went our respective ways to work on our final group projects, where we continued to explore and understand each of our own topics with the help of our Cluster Assistants. "– *Cindy Li*

"Wednesday, we went to SIO and learned about the fish that we will be dissecting next class. Then, we went to the pier and collected more barnacle samples for our study on their average size. Then, we went to the lab and listened to a lecture about aerosols before doing two labs relating to organic chemistry about secondary aerosol production the oxidation of organic molecules. Overall, the labs were challenging, but in the end they were very informative and helped us have a deeper understanding as to what goes on in our atmosphere." – *Ingrid Spielbauer*

CLUSTER 4: WHEN DISASTER STRIKES: EARTHQUAKE ENGINEERING

Our Cluster 4 Cosmopolitans continue to impress us with their superior work effort, problem solving strategies, and tremendously positive attitudes. Above all that, we find this group to be a very warm and friendly assembly of inquisitive young adults. Good job parents! Students were placed into one of eight project groups comprised of three students each, and on Monday they began to delineate the individual responsibilities required to carry out their mission, and to create organizational time charts.

The eight project groups each have their own unique characteristics and design challenges, not to mention time management hurdles. Yet, the students have bravely forged ahead, and soon will experience the realities of a three week deadline. The groups include 'soft story' structures, timber, masonry, concrete bridge columns, liquefaction, lightweight reinforced concrete aggregate, base isolation, and tuned mass dampers.

During the morning sessions, Lelli continues to explore various aspects of engineering design considerations with the students, preparing them to strike out on their own with idea development. Following approval of their designs, they began building and testing their models based upon the assigned structural type. Cluster Assistants James and JJ keep very busy advising and supporting our student groups during the afternoon project sessions. Almost all groups completed their models by Thursday and began testing the strength of their models Friday. They will be using the 'earthquake shake table', or another instrument specific to their structure during testing. Keen observations are necessary while testing for structural failure, and these notes are used in assessing the needs during the redesigning days to come.

In other news, our students were treated to a Discovery Lecture by Dr. Elsa Cleland on Tuesday. Her research has demonstrated that the timing of plant growth is a key indicator of species response to global change. We learned that ecosystems often respond in surprising, non-linear ways when exposed to multiple, simultaneous environmental changes such as global warming. It is powerful for the students to experience her passion towards such a vital environmental issue, and to understand that she successfully balances her research with her family priorities as well. On Thursday we are attending our first cluster exploration hour, where they are able to hear about the cool things other clusters are doing. The final exploration hour will be next week.

Thursday was spent soaking in the warm San Diego sun and learning about San Diego geology from Kevin. We trekked a short distance up Mt. Soledad and were inspired by the beauty of a 360 degree view. Box lunches were enjoyed on the beach at nearby La Jolla (tough job, isn't it!) before we journeyed to Torrey Pines State Reserve. Kevin led the students on a geologic scavenger hunt of sorts, all the while honing their GPS skills in the creation of a field trip map on Google Earth, to be shared with you soon. Before returning to campus, students relaxed on the beach and appreciated the amazing setting that UCSD students are so fortunate to experience.

Our student groups are functioning well thus far, and the process of building, testing, analyzing, and redesigning will continue into next week. Those families taking advantage of Parent Weekend will undoubtedly hear all about their successes and challenges over some home cooking. They look forward to sharing their final results and products with you in two more weeks. As always, please keep up with their endeavors by checking out our Cluster 4 Website and photo galleries.

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

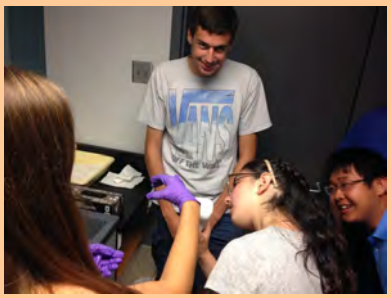
CLUSTER 5: FROM LASERS TO LCDS: LIGHT AT WORK

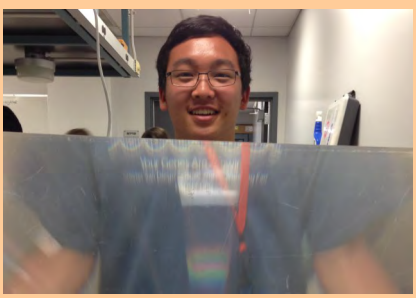
After placing third overall in the COSMOS Olympics, and spending the weekend relaxing at the world-famous San Diego Zoo and La Jolla Shores, cluster 5 was rested and ready to delve into optics and polarization in week two.

The invention and study of lenses has allowed our society to observe phenomena that would have otherwise gone unseen. From learning how both camera and glass lenses are made to the function of tunneling electron microscopes, students developed an understanding of the technology and theory behind the tools through both lecture and lab. By manipulating the focal length and object distance of images in lab, students were able to gather data then share their conclusions with the class while surviving the good-natured grilling of Principal Investigator Dr. Peter Ilynich and PhD candidates Rui Lau and Paulo Gabriel.

The students also were also able to visit Professor Zhaowei Liu's lab in the Department of Electrical & Computer Materials Science and Engineering Program Center for Magnetic Recording Research. The applications of the knowledge we have been studying is getting much more in depth and exciting for us all. The theory that is being applied in these labs has motivated us to develop a deeper understanding of the concepts. Going forward students will focus in on one of the workshop topics (PDMS lenses, holography, organic solar cells or spectrography) we have covered thus far and develop a two week in-depth study of a concept.

In addition to the rigorous lab and lecture curriculum, students have been working hard as they develop five-page essays outlining current ethical issues in the field of photonics. After independent study of the issue and a whole-cluster collaboration, students have decided to tackle issues as diverse as the use of high-powered lasers by the military, the extraction of rare-earth elements to manufacture LEDs and solar panels, and the regulation of lasers used in cosmetic surgery. Students will find out soon who among them will claim the $200 prize for best essay!





CLUSTER 6: BIODIESEL FROM RENEWABLE SOURCES

"Thursday was a great day for Cluster 6 students: the weather was perfect, the students were beginning their group projects, and class had been moved half an hour to start at 9:00 AM. Thursday was the first day to exhibit standard San Diego weather - it's perfectly warm and the sky was almost impossibly blue by the time students begin walking to class. Cluster 6 students had been divided into groups to research different uses and components of biofuel and its by-products; the groups were solketal, dioxane, algae, polyol, and particle emissions. While the polyol group went directly to the lab to begin their experiments, the other groups attended a stimulating lecture and review of chemistry given by Professor Pomeroy. Lunch was about as exciting as usual, and the grilled cheese sandwiches and "boy choy" were among the cluster's favorites. Then came the wonderful process of drying biodiesel in the lab, which provided an exercise in patience for the excited students and an opportunity to begin the group projects. After class and lab were over, the students of Cluster 6 practiced for the Cosmolympics competition to be taking place on Friday." - Bansi Parekh

"Friday, July 10th, was our third day producing biodiesel. Since the last step - drying out water from the biodiesel by heating it - was completed, we were finally able to see the final product we had been striving for for a whole week. Unfortunately, that was not the end; how are we going to ensure that the products came out are actually biodiesel? To check the purity of our biodiesel, we began a new project including many steps and analytical tests.

Cluster 6 was divided into five groups and guided to different tests for the analysis process. We tested - or planned to test - our biodiesel's density, water content, viscosity, cloud point, composition, glycerol percentage, flash point, percentage of pure biodiesel (using FTIR), and energy efficiency (using a bomb calorimeter). As each of the processes took about 45 minutes, we could not finish all the steps in one day. It was a good chance to learn how the properties of biodiesel can be tested, how the testing process works, and how the machine carries out the procedure" - Cindi Park

"Monday marked the start of our second week at COSMOS! After we had navigated our way there by ourselves for the first time, we began the day working in the lab. Dr. Pomeroy assigned each pair of lab partners to a station, where we would test different properties of our biofuel, alternating stations throughout the week. The types of properties that we tested for included Cetane Number, Energy Content, Flashpoint, Viscosity, Oxidative Stability, and Cloud Point. I began with testing the energy content, or heating value, of my biodiesel by using a bomb calorimeter. This test is performed to determine the thermal efficiency of the fuel. After lunch, we proceeded to our classroom where Dr. Pomeroy gave a lecture on the history and different implications of diesel and biodiesel. Next, Dr. Albizati continued with a lecture on the importance of science communication and information on the vastness of scientific literature." - Carly Rick

"Tuesday, after breakfast, our cluster went to a discovery lecture led by Professor Elsa Cleland. She specializes in plant ecology, and told us about her fascinating field studies that took her from the beautiful White Mountain Range to the semiarid deserts of Arizona. She focused on opportunities for undergraduate research and work in the field. Afterwards, we discussed the pros and cons of her presentation techniques and had some time to give constructive criticism on each other's ethics essay. Later, we went to work on our final group projects. My group, which focuses on aerosols, washed some biodiesel for future use and tested out the particle counter." – Christian Fong

"On Wednesday, our daily morning lecture was way different than what I had expected. Dr. Pomeroy welcomed us, as usual, yet he then began to lecture us about spectroscopy which basically covers the different wavelengths known to us such as light and microwaves. Anyways, what does the spectroscopy have to do with biodiesel? Well, he and Dr. Albizati later explained that we can tell how things are chemically composed based on how they react to these wavelengths. In other words, they could literally do incredible things such as find out how our biodiesel was composed or also see if your golden necklace was really gold or not." – Christian Mojica

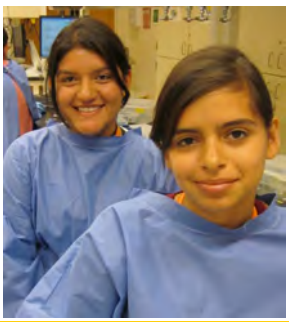
Cluster 6 has made great advances learning the background organic chemistry involved in making and testing their biodiesel. They have also begun organizing the projects that they will be working on over the duration of COSMOS and will be presenting the last day. Cluster 6 has also excelled with their after session activities, winning the COSMOS Olympics last Friday. We look forward to our field trip next week, and the activities that we are engaged in expanding our knowledge and experience.

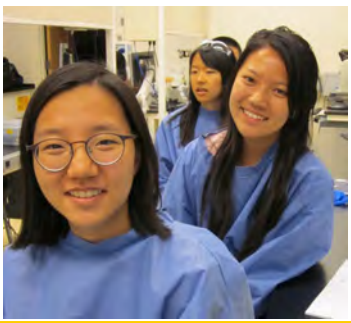
CLUSTER 7: BIOENGINEERING/MECHANICAL ENGINEERING: THE AMAZING RED BLOOD CELL

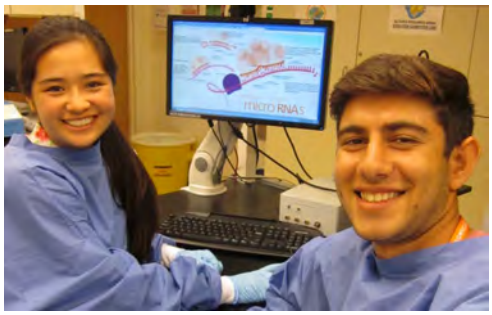
The focus of Cluster 7 during COSMOS 2015 week two were molecular and cell biology studies of red blood cells (RBCs). Purified RBC "ghost membranes" were analyzed in week two by the combined techniques of SDS-PAGE (to separate the mixture of proteins contained in membranes) and western blotting (for protein identification). Students discovered the immense power of western blotting in the identification and quantification of the protein actin. In western blotting, RBC membrane proteins were separated by electrophoresis and then transferred to a paper matrix that was first mixed with an antibody that only binds to the protein actin and then visualized using and second antibody and chemiluminescence. High quality western blot results were obtained by all lab groups in Cluster 7! By the end of the week students used the polymerase chain reaction (PCR) technique to convert small amounts of DNA into very large quantities.. The PCR-produced DNA was then analyzed using agarose gel electrophoresis to confirm the huge capacity of PCR to amplify targeted DNA. Finally students learned about a powerful method of gene silencing known as a "gene knock-out" (KO), a commonly used technique in bioengineering and biotechnology research labs. Students were able to analyze the presence or absence of a gene for the RBC membrane protein, E-Tmod from a KO mouse created in Dr. Vera's research laboratory. Using PCR, students could genotype the KO mouse and determine whether the mouse was completely lacking the E-Tmod gene compared to positive control levels found in normal mice.

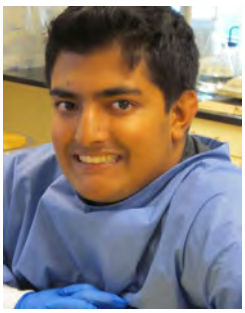
Students also measured oxygen transport by red blood cells using the technique of pulse oximetry, a fingertip method for monitoring a patient's oxygen saturation level. Students also explored Electrocardiography (ECG or EKG) which is the recording of the electrical activity of the heart. An ECG is used to measure the heart's electrical conduction system and displays the overall rhythm of the heart and weaknesses in different parts of the heart muscle. Students learned that a regular heart rate is between 60 and 100 beats per minute (bpm); less than 60 bpm is called bradycardia; more than 100 bpm is termed tachycardia. Students learned additional aspects of ECG including QRS patterns and P waves.

In the science communication portion of cluster 7, students continued to work on their independent bioethics essay. Cluster 7 also had its first field trip to the J. Craig Venter Institute (JCVI), and got a behind-the-scenes look at a dynamic biomedical research laboratory. Students learned about various projects at JCVI including the use of algae as a new source of oil and the global sampling of sea water for the identification of new species, complete with their genomic DNA sequences. Having achieved a sound foundation in RBC molecular and cell biology over the last two weeks, Cluster 7 students are now well poised to build and analyze RBC models using mechanical engineering principles that should provide further insight into the structure and function of the amazing red blood cell.









CLUSTER 8: TISSUE ENGINEERING AND REGENERATIVE MEDICINE

The end of the first week was GR8! We wrapped up the week with a tour of Sanford Consortium. Dr. Gaetani gave us an overview of the facility and then we were able to tour many labs and informative mini lectures from leading faculty. "The mission of the Sanford Consortium for Regenerative Medicine is to advance stem cell research through collaborative, multi-disciplinary interactions. Sanford Consortium researchers are applying the powers of stem cells to promote diagnoses, treatments, and cures for degenerative diseases and injuries." (http://www.sanfordconsortium.org/) After the tour we walked to the Glider Port and enjoyed our ocean view as we ate lunch. And then to wrap up the week, we had COSMOS Olympics. Our skit, cheer, skills in relay races and of course brain power (from all our homework) was outstanding. Even though we did not win we did GR8.

We began our second week in the lab where we learned how to use a microscope to view stained and unstained cells, how to use a hemocytometer to count cells, and how to thaw cells. As the week progressed we learned how to passage cells, to create collagen gels, and continued on our decellularization and were able to examine histology slides to check on our progress. Chris and Evan, our TA's have taken the lead and instruct us through pre and post lab instructions. They are excellent at making sure everything is explained so we understand and they take the time to ensure the labs run smoothly. As a result our decellularization process worked exceptionally well and we have successfully been growing cells in culture.

Our lectures and discussions by our distinguished faculty, Dr. Sah and Dr. Gaetani have expanded our knowledge about stem cells, biomaterials, biomechanics and commercialization in tissue engineering. As we increase our comprehension about tissue engineering we have many more questions and Dr. Sah and Dr. Gaetani are always eager to help us. This week was exciting as we spent time summarizing our lectures and discussing different project ideas so that next week we can begin our much anticipated projects.

We went on our second field trip to the J. Craig Venter Institute with Cluster 7. During our visit we were able to learn about their LEED Platinum award winning building and heard about the different projects that are under investigation such as the ability to induce diatoms to produce oil and the genome characterization of the microorganisms from all of the major bodies of water worldwide. Our entire group then went on a tour of the facility, seeing the research labs and the LEED certified building "that is built to save money and resources and have a positive impact on the health of occupants, while promoting renewable, clean energy" (http://www.usgbc.org/leed).

In the communications portion of the cluster we have had the opportunity to attend a Discovery Lecture from Dr. Cleland. She spoke to us about her previous global research opportunities and her current research that focuses on ecosystem responses to environmental change. Additionally, we have been discussing the ethical issues in Tissue Engineering and learned about the 'COSMOS Ethics in Science Essay Contest'. Each of us has done background research on our personally selected ethics topic, written a rough draft of our paper, and we all submitted our final drafts on Thursday. To end another Great week for Cluster 8 we will go on our third field trip to Organogenesis.

CLUSTER 9: MUSIC AND TECHNOLOGY

Should we let AI compose for us? That's the question of the week.

Thursday, Day 4 was a very nice and mellow day. We started with a belly full of fresh breakfast, and a decent amount of sleep, although no amount of sleep can fully satisfy any teenager. First, we headed to Center Hall to listen to a highly informative lecture on the library at UCSD. We learned about the catalogue, and how e-books could work better than tangible books.

We then learned about the various databases UCSD offers, and how to use them, all of which was very useful information.

Soon after, we stayed in Center Hall, but proceeded to one of the rooms in the upper floors, so that our class Teacher Fellow, Eric Burtson, could give us a brief lecture on sound and waves. We learned about waves and all the various harmonics. We learned about beat frequencies, and what makes a chord sound good.

Afterwards, we were assigned a biography presentation, in which we had to research a famous musician and present their life to the cluster.

We then made our way to lunch, and soon after, the Geisel Library where we worked on our ethics essay and biography assignments. It was an amazing library. The view from the sixth floor was fantastic, and the multitude of books was more than overwhelming. Finally, at 4:00, we headed back to our suites. Overall, it was an amazing day full of learning, and productive work time.

On Friday, instructor Colin started class with a demonstration of a robot powered by Raspberry Pi, a credit card sized computer, which played audio as it moved forward. Professor Shlomo continued with a lecture on Fourier transform and analysis, examining the composition of sound waves as a combination of sine and cosine waves. Later, students downloaded the Ableton software, which allowed us to overlay sound tracks, write drum beats, and record audio. The day concluded with an explanation of assigned homework, which introduced us to coding music in Python.

On Monday, we had our first experience of riding the shuttle to class. We learned about how music could be represented with geometry in Professor Dubnov's morning lecture. At the lab, some of our fellow classmates gave presentations on John Cage and Léon Theremin. We were fascinated to learn about Cage's 4 minutes and 33 seconds of silence, as well as Theremin's invention (called the theremin) which uses proximity sensors to play different pitches. A highlight of the day was guest Mike Gao's presentation on his app Polyplayground. Mike, a former graduate from UCSD and currently a well-known DJ, showed us how to play different chords just by touching a couple tiles on an iPad. We had lots of fun playing with the app! Tuesday started off with another Discovery Lecture, this time from Elsa Cleland, a professor of ecology and environmental change at UCSD. She talked to us about her findings about threats to biodiversity, as well as some advice and tips. After discussing our thoughts about the lecture in the classroom, we learned how to add waves together and draw the result. Before lunch, we reviewed Monday's lecture about Fourier series and timbre, which is what makes instruments sound different from one another, and used a PHET simulation to visualize adding waves. After eating lunch and talking about the app we saw on Monday, we had time to peer review our ethics essays, giving suggestions to others and editing our own writing.

Wednesday morning began with us returning to audacity to look deeper into different types of sound waves. We then went back to the labs to get another lesson in Python. We were finally able to create music with our code! After lunch, we had a guest speaker talk to us about her projects with computers that compose music! It told us a lot about certain "rules" music has that makes it enjoyable. Then it was back to the labs to start working with embedded electronics. We learned about a small computer called Raspberry Pi that we will get to use in our future projects. --Aditya, Melissa, Valerie, Jerry, Ian

COSMOlympics

1st: Cluster 6

2nd: Cluster 2

3rd: Cluster 5

Residential Activities


SAND ART


BOARD GAMES


MIXOLOGY


MASON JAR DECORATING


CHESS COMPETITION


PARFAIT MAKING


BEACH TRIP


JUST DANCE


SUITE TIME


Happy Birthday Alice & Michelle!

San Diego Zoo