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 4 Newsletter

CLOSING DAY AND BEYOND….

The four weeks of COSMOS seem to have flown by this summer. Faculty, residential life staff and office staff have worked hard all year to provide a unique opportunity for students to grow and excel both academically and socially. Over half of our students this summer will be entering their senior year of high school this fall and will have a much better idea of what's ahead as they complete their college applications. Hopefully some of our students from this summer will return to UCSD for their college experience. If you do, stop by our office and say hi! Many of our cluster assistants and residential life advisors were COSMOS students within the last two to three years and are now undergraduates at UCSD. For most of these COSMOS alum, their time at COSMOS remains a special memory and time, one that they are excited to give back to. Perhaps that will be you!

COSMOS ALUMNI

Yes…that's YOU!!!

Now that you're a COSMOS Alum, please stay in touch and check the following sites regularly for information about alumni events and internships, and to stay connected with your friends from COSMOS:

(COSMOS Webpage) http://www.jacobsschool.ucsd.edu/cosmos/alumni/
(COSMOS 2014) https://www.facebook.com/groups/230727677119749/
(COSMOS Alumni) https://www.facebook.com/pages/COSMOS-Alumni/10669972725

Continue to support COSMOS by donating!

Please visit: http://cosmos-ucop.ucdavis.edu/

COSMOS RECRUITMENT

COSMOS alum are our best ambassadors. If you would like to help promote the COSMOS program in your area, contact us at the information provided below:

Contact Information

COSMOS Office Hours:
Monday - Friday: 8am - 4:30pm
Email: cosmos@ucsd.edu
Fax: (858) 822-3903

In this issue:

DISCOVERY LECTURE SERIES

Dr. Olivia Graeve presented the last in our series of Discovery Lectures. Her lecture began with her biographical information. She grew up the oldest of five children in Tijuana, raised by a single mother after her father left the family when she was six years old. Her memories include being extremely poor, but always being in private school, and playing in the dirt, which was her favorite past time. She now plays with powders in the lab, but her second passion is gardening. Dr. Graeve began noticing the position of race and women in society as an undergraduate at UCSD. She spoke to the students about compassion as they move forward in their lives and careers, and highlighted two people she admires, Cesar Chavez and Eleanor Roosevelt. This portion of her talk covered the lack of representation of marginalized groups in engineering fields and that she is working towards helping to change the numbers. Shifting gears, she spoke about dust, dirt and the Periodic Table, stating that the table is concise and easy to understand. She encouraged students to put the table on the wall at the foot of their bed to start each day perfectly. The groans from the students were audible! Her research is energy related, either storage or producing energy itself. In her lab, elements are mixed to make new materials, with her specialty being ceramics. The hope is to find a new ceramic-electronic fuel source that can be recharged and can't be depleted. Her lab has fun exploring and mixing chemicals, often resulting in explosions, and culminating back to the dust and dirt she finds fascinating. She stressed the importance of her research given that she believes climate change is the biggest challenge facing us today, including lack of water and environmental degradation. Renewable, efficient energy sources are critically important. Dr. Graeve ended her lecture by giving students her words of wisdom as they enter college. She shared several insights and finished by saying that education moves groups into power positions. As the students move forward in their academic pursuits and careers, they need to be proactive, express themselves, find role models and mentors, network and connect, and keep their childhood friends. Her lecture certainly gave the students several things to think about.

CONGRATULATIONS...

...to our Ethics Essay Awardees

and Gordon Engineering Leadership Center High School Fellows.

RESIDENTIAL LIFE

The contrast of smiles and laughter with hugs and tears during the last days of programming as students ready themselves to depart from their journey here at COSMOS leaves us also with

a mixture of emotions at Residential life. From a staff standpoint, these four weeks of sports, dancing, crafts, art, movies, and more has left each and every student with new friends, new experiences, and new knowledge on how to maintain a balanced and healthy life.

Of course, we had to end with a bang during Week 4. Over the weekend, students enjoyed a trip to Knott's Berry Farm. There was

also a talent show, Tie-Dyeing, a movie night, as well as a last dance. Although all of COSMOS was extremely busy trying to finish and perfect their final projects and presentations during the week, there were still plenty of activities to help them balance out all that hard work. Students enjoyed a gender fishbowl activity, a resume and interview workshop, and a water balloon fight with a twist.

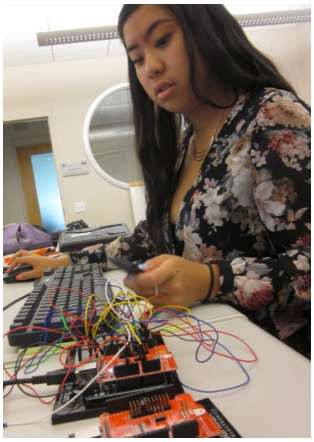
We finally had a fun playing Gotcha, we had a visit from Grace Bagunu, who shared her expertise on networking skills, and suite time expanded in a variety of ways. The Talent Show was amazing with dance performances, a saxophone, trumpet, singers, and more smiles than could be contained in a two hour show. We also had the last of the birthday parties, last run, and last meal. Each time the word "last" was used, sighs could be heard abounding.

All in all, fun was had, hugs were abundant and wonderful memories were created. We hope as students move on from COSMOS that they will look back fondly on their time at Eleanor Roosevelt College. They clearly will recall the amazing lessons learned in the classroom and we

hope we have given them a positive insight as to what their college experience can be outside of the classroom. Thank you for parents for entrusting your children in our care and thank you students for participating, growing, and living with us. We had a great month with you!

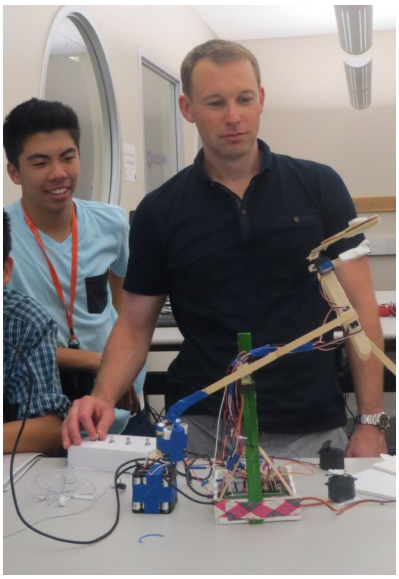
CLUSTER 1: COMPUTERS IN EVERYDAY LIFE

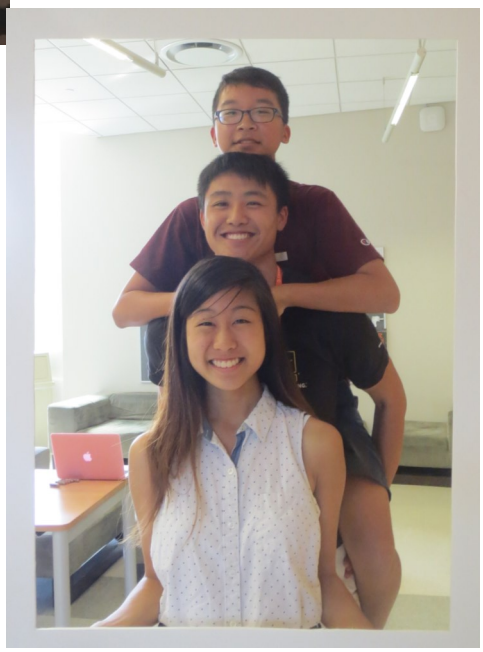
A lot happened at the end of last week. Last Thursday, we spent more time working with Arduinos to get a walking robot built using servos. By the end of Friday, we had varying levels of success – moving fast/slow or it moves through air!



The majority of this week, we focused on our final projects. We got to propose our own final project and get it approved. It had to involve AppInventor, Scribbler Robots or Arduinos. After many hours of hard work and some laughs at the weird things our programs would do, we are just about done with many of the milestones in our projects. A couple groups are working with AppInventor to implement ideas from needs they saw around them.

One team decided to work solely with the Scribbler Robot implementing image processing. Two groups took on the challenge to use both Scribblers and Arduinos together! They used sensors on both technologies to interact with each other. Two groups have taken on the challenge of working with just Arduinos – using sensors, and photoresistors and potentiometers. There are many ways to apply the engineering and science from our final projects to larger robots. Some of us hope to continue to work on our projects after COSMOS and submit it to a science competition this coming school year, such as a science fair. We look forward to sharing our projects with everyone on closing day. Our faculty was thoroughly impressed with our projects and it was difficult for them to select the Gordon Leadership Award winners for our cluster. The videos of our final presentations will be available on our blog.



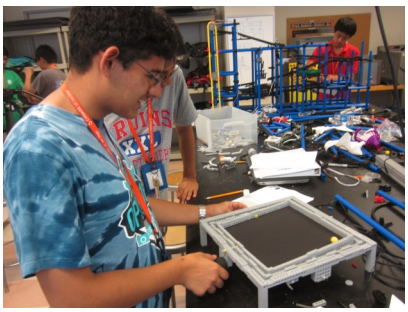


We would really like to thank all those that helped make our cluster and COSMOS experience one we'll never forget. From faculty (Professor Ryan Kastner and Professor Curt Schurgers) to our TAs (Kriss and Riley) to our RAs (Kristy and Khalid), you helped us learn a lot and have a great time in the process! You can view our pictures on our Cluster's Blog (UCSD COSMOS Cluster 1 2014) http://ucsdcosmoscluster1-2014.blogspot.com/ to see all the fun we had in class and on field trips!

CLUSTER 2: ENGINEERING DESIGN AND CONTROL OF

Things have been very busy during this 4th week of COSMOS: Cluster 2! We started the week off with a lecture from Dr. Delson on presentation skills. With all of the great things we've learned about engineering during the else few weeks, it was nice to see how engineers can present their work to an audience (parents or future clients). From then on, we worked on our final kinetic sculptures, the computer models, and our presentations. Students started to feel the stress of getting everything done with the remaining time!

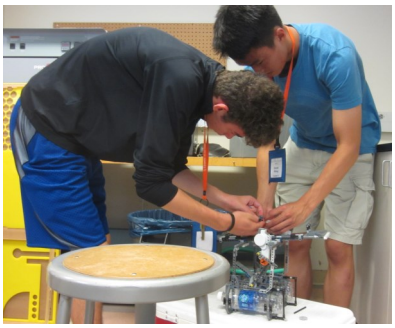
On Tuesday, we began the day with the final Discovery Lecture with Dr. Olivia Graeve and her



research on nanoparticles (or "dirt" as she called it). Her lecture began with her addressing the lack of diversity in engineering on both ethnic and gender lines. While the students would have preferred to hear more about her actual research, this topics did fuel a lively discussion afterwards during our Science Communication time that followed.

After the discovery lecture, we went to work on our posters and presentations in the computer lab. We went over Dr. Delson's advice from his lecture and compared the many speakers we have heard from over the last few weeks with COSMOS.

On Wednesday and Thursday, we have largely been working on our final projects: both the kinetic sculptures themselves and the presentation that accompanies it. One group has created a pitching machine device to launch marbles through the sculpture. Another group has used the 3D printer to create track pieces which allow the marbles to split up on various tracks. A third group has created a double loop-d-loop where the balls are timed to meet in the loops. The fourth group has part of their project floating in a tub of water (water and electrical components… what can go wrong?). The fifth and sixth groups have a Ferris wheel and speed randomizer respectively. All in all, the groups have been working tirelessly to put their sculptures and presentations together. These sculptures are amazing and you won't be disappointed by the student's final presentations.



CLUSTER 3: LIVING OCEANS AND GLOBAL CLIMATE CHANGE

Our final week at COSMOS concludes four weeks of adventures of science. From SIO to the Main Campus at UCSD. From the Birch Aquarium to the Hubbs Marine Hatchery. From the Chemistry Lab to the Pier and Tidepools, we have had many fantastic experiences.

Thursday after the Cluster Information Lecture, we went to our morning Science Discovery session, and Mr. T taught us about expressing error in our projects, to help us finish them and prepare for the presentations next week. In the afternoon, our cluster split up and went to SIO or to the NSB to work on data collection for our projects.
- Alex W.

Friday at NSB, we met Sherry Seethaler, acclaimed author of *Lies, Damned Lies, and Science*. After studying Dr. Seethaler's book for our impending geoengineering debates, her lecture served as a benevolent validation of our hard work. After walking back to ERC for lunch, we went down to SIO, Ritter Hall, where Dr. Lai passed out dissection papers - we knew that the room would start smelling promptly. Five minutes later, we each had a squid, shrimp, huge fish, and a mouse and were given the simple directions "DISSECT" via the blackboard. My partner Kalvin and I were lucky enough to have been given an especially large squid, so we started with that. An hour later, we had dissected all but the mouse, as it "hit close to home" for some of us. Kalvin and I quickly got over the mammal aspect of the mouse and tore into the project - literally. After our dissections, Dr. Lai helped us use our observations of structure to create a cladogram. We finished the day fishing from the end of Scripps Pier, a new experience for most of our cluster. Good day. A little ripe, but good.
- Kate M.

Monday, we went back to SIO, where Dr. Lai lectured on Polar Ecology and osmoregulation. We also went to the Scripps Pier to do water sampling from depths, dissolved oxygen testing, turbidity measurements and examine the part of the flume that we had cleared. After that, we had lunch at Scripps and enjoyed the beachside view. Finishing lunch, we headed to Ritter Hall to examine various types of living primitive fish and amphibians. After the hands-on experience, Dr. Lai began the second part of his lecture about "Dead Zones and Ocean Acidification." After the second part of his lecture, we headed out for a last visit to the beach to enjoy the rest of the day and splash in the water.
- Kalvin L.

The last couple of days, everyone is rushing to finish any data collecting so that they can finish their final project. On Tuesday, everyone started off their day with the discovery lecture from Prof. Olivia Graeve on material science. After, it was just a busy day for everyone. Our groups of different project topics met at NSB and SIO to make any finishing touches for our final project research. Graphs, data tables, charts, and procedures were all challenging areas that we encountered to put together our final projects. PowerPoints are coming together, and we are all excited to present what we have been researching for the past 3 weeks!
-Ben L.

On Wednesday, we were fortunate enough to see the beautiful ocean view from SIO one last time. There, Dr. Francesca Malfatti introduced us to the massive world of marine microbial biogeochemistry. She explained how anthropogenic impacts on the environment even effect the smallest of organisms. Afterwards, we were able to visit her laboratory and see the kind of work she and her colleagues do... and the incredibly expensive technology they use! In the afternoon, we had our GeoEngineering debates.
-Tania M.

One the last day, all five of our groups worked diligently in the morning during our Science Communications class and all throughout the afternoon at NSB. I saw all the groups practicing their speeches and finalizing their presentations as Saturday's final presentation is fast approaching. There are only two more days of COSMOS and we are all in the final stretch to the end!
- Brendon N.

All the students in Cluster 3 have done a fantastic job researching their topics, conducting their data collection and analyzing their data. Their project presentations look great and I'm very proud of the accomplishments of all our cluster's participants. We appreciate all the hard work of the Cluster Faculty and Cluster Assistants in helping our student's flourish.
- Mr. Towler

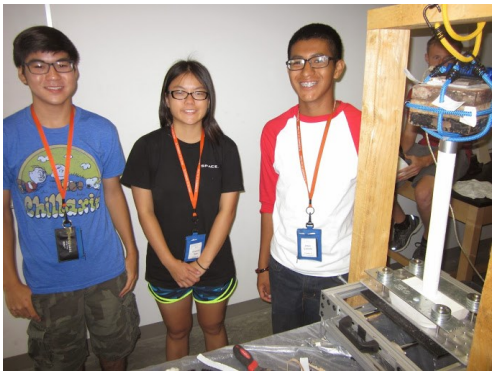
CLUSTER 4: WHEN DISASTER STRIKES: EARTHQUAKE ENGINEERING

The awesome students of mighty Cluster 4 concluded a productive week with their amazing presentations showcasing all of their hard work and dedicated efforts!

Many students have mentioned their appreciation of the richness of the COSMOS experience as project groups edited and finalized their posters. We look forward to showcasing the posters and models to parents and families on Saturday, and the exciting awards ceremony.

Another captivating Discovery Lecture earlier this week got us off to a great start. Students also engaged in a question and answer period about college life with our cluster graduate assistants. Then it was last-minute testing of structures and analysis of data. This lengthy process involves huddling with the instructors and teaching assistants, group brainstorming, followed by further huddling and more brainstorming. Actually it is the raw scientific process of personal growth! Not always pretty, but the final result for our Cosmopolitans is the precious self-knowledge of discovery. They 'did' science, and now possess the confidence to lead their future high school science lab groups to superstardom!

Following the testing and analysis phase, our students went to work on outlining exactly how to communicate their results to the public, or in our case, our friends in Cluster 5. They created an electronic poster formatted on PowerPoint, and are extremely excited to show it off and explain it to you on Saturday. They



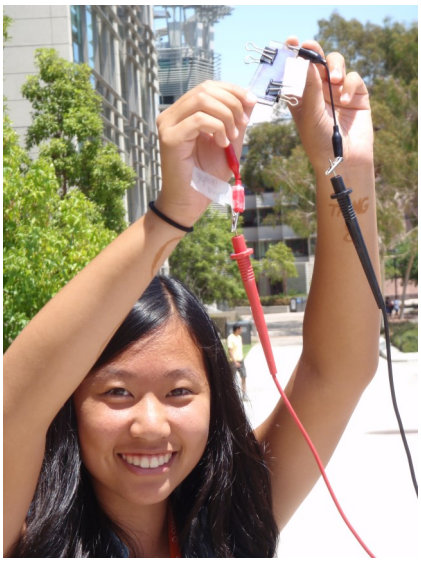
followed professional research presentation guidelines, and included abstracts, objectives, procedures, conclusions, and their data both tabled and graphic. Then it was time to produce several slides for the bulk of their presentation. This process took approximately eight hours of class time in the computer lab, and their results were wonderful.

In four short weeks, our students proceeded from project idea, to objective and testing, and analysis and conclusion. Finally, they presented their findings, and were encouraged to continue their research in the context of a science fair competition. All this while experiencing college life in the dorms, in the dining halls, in the lecture halls and labs, and across this beautiful campus with kindred spirits from all over the state. COSMOS is a one-of-a-kind opportunity for personal growth, for a unique exposure to the STEM fields, for a chance to interact with undergrads and graduate assistants, and bond with their instructors in a welcoming environment. Your kids are so fortunate, and we thank you for allowing and encouraging them to experience COSMOS!

CLUSTER 5: FROM LASERS TO LCDS: LIGHT AT WORK

Our final week has come to an end, but it was filled with excitement and learning. The week started with a field trip to Cymer. Cymer is the world's leading producer of tiny lasers that are used to create computer chips. We were able to see their research and manufacturing facilities and their numerous clean rooms while learning the practical applications of many of the concepts we had been learning in class.

We also heard from some different guest speakers talking about their research and projects. From Microfluidics, Camera Lenses, to optical implants and nano-lasers, we were able to see numerous applications of lasers in our daily lives and future technologies. These were great at showing the practical applications and theoretical applications of how light is the way of the future.



This week was also a busy week as students completed their projects and presentations. Classes were spent gathering data and putting the finishing touches on the many projects. Our projects ranges from organic dye solar cells, PDMS lenses, Holographic Images, to a laser keyboard. These projects were amazing and as Cluster Advisors, we are very proud of the work that they did.

This group was one of the tightest groups/ cluster on campus and we had a lot of fun and even learned a tremendous amount during the way. Cluster 5, thank you for allowing us on your journey of knowledge towards the light. Cluster 5, what an awesome time together.

CLUSTER 6: BIODIESEL FROM RENEWABLE SOURCES

Time is flying and students are working hard! This last week has really brought students together working on their various research projects. Students are now very comfortable on campus and can get where they need to go like a seasoned veteran. Student's are finishing off their project presentations and practicing their communication skills.

Team Algae has completed their algae testing and collected their final data points. They conducted a phone interview with Sapphire Energy's Dr. McBride, a specialist on algae crop protection. One last enrichment activity will be to visit a different UCSD lab to learn about algae specific oil extraction.

Team Dioxane spent time completing their dioxane from glycerol reactions to include: heating and washing. After the processing, they ran their product through the GC/MS to observe results. They are specifically interested to see if their processing temperature affects their isomer ratios.

Team Polyol has spent the last few days analyzing their new batch of polyol on the FTIR. They are completing their project by creating forms and making an item out of the polyol foam that will have a practical application for consumers.

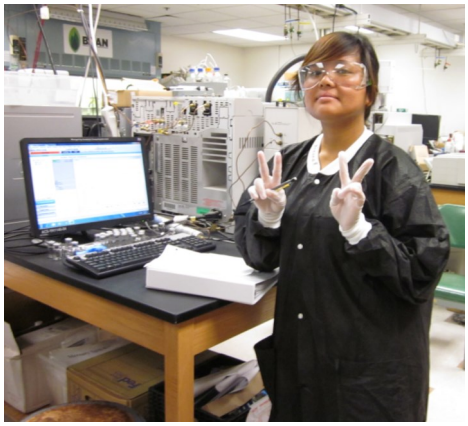
Team Rancimat has spent their days completing the entire structure of their rancimat, including the electrical system, an insulator system, and an air/water pump. They have begun testing various biodiesels and assembling their information into their presentation.

Team Soketal has tested 5 different blends of gasoline and fuel additives. Testing includes bomb calorimetry- to measure energy content, density, flash-point, and viscosity. Their data has been incorporated into their presentations and they are finishing up with that as well.

The students were asked to pick one thing that they felt was a very positive outcome of Cosmos. Some of the replies are as follows: *Getting to work with professional/specialized lab equipment. (9 students commented)*

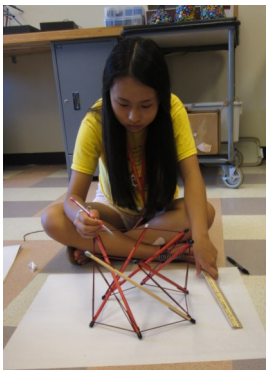
The chance to live in a college community - living in dorms, with roommates, meeting new people with similar interests (6 students) Knott's Berry Farm! Cosmolympics! Working in the greenhouse. Being able to experience what I learned in school at a research scale. The opportunity to learn about STEM in a real university setting, also appreciate the support from professors, teachers, and RA's.

The students of Cluster 6 are bright, dedicated, and polite people. They have formed great friendships while learning valuable engineering skills. Throughout the month students have really gained a good understanding of alternative energy sources and utilization for transportation. They've learned to think logically and dig deeper to find the true science behind green energy. Cosmos has certainly allowed these fantastic students to make academic and social connections that will last for years to come.



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

The final week for cluster 7 was a busy one with students completing their COSMOS final projects while also learning new engineering concepts that apply to tensegrity structures. Mauricio and Talesa continued to develop the concept of tensegrity structures and students learned how to construct more complicated "tensegrity plates" (featured in several final projects). Cluster 7 then began to explore the engineering principles of feedback and control using an electric motor equipped with a potentiometer and interfaced to an ARDUINO computer control program. Students performed numerous experiments to learn how a motor responds to variable voltages (control) and how the motor speed (feedback) is used to regulate voltage changes. Motor dynamics, gain, time constants and other parameters were assessed in experiments that culminated in graphical analysis of motor velocity versus time in Excel scatter plots. These investigations were an excellent exposure to the types of engineering analyses that can be applied to tensegrity structures that can serve as models of red blood cell morphology and function.



Students finished their final project powerpoints by Wednesday followed by presentation to Cluster 7. After further refinement the projects were presented to Cluster 8 for additional feedback leading to final refinement for Saturday's closing day presentation to family and friends. The last week also included the final Discovery Lecture given by Professor Olivia Graeve who presented an interesting talk on nanomaterials engineering and also closed with some words of wisdom for prospective first year university students!

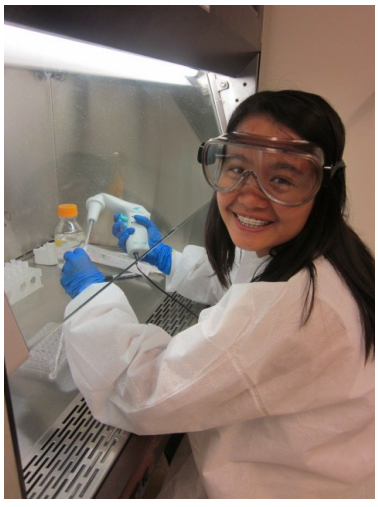
As we reach the conclusion of COSMOS 2014, Cluster 7 students wish to thank Dr. Mauricio de Oliveira and Dr. Carlos Vera, and Cluster 7 Cluster Assistants Anusha Pasumarthi and Talesa Bleything for all their efforts in guiding a detailed exploration of bioengineering and mechanical engineering principles and their application to studies of the amazing red blood cell. Thanks also to all COSMOS staff with a particularly big shout-out to cluster 7 RA's Baldeep and Daniel. It was a truly great academic and residential experience at UCSD this summer for all Cluster 7 students!

CLUSTER 8: TISSUE ENGINEERING AND REGENERATIVE MEDICINE

We are hard at work finishing up our projects! Group A are our counting experts and can be found spending their time at the microscope. Group B are using cartilage discs and growth factors in the BSC. Group C and D have amazing skills with the cartilage discs and bending apparatuses. They were able to build their apparatuses in the BSC under extremely sterile conditions. Great job everyone!! Group E and F are our gel experts and have perfected the art of picture taking to capture the results of their experiments. Congratulations to all our groups for perservering through the intense last weeks of COSMOS 2014!!

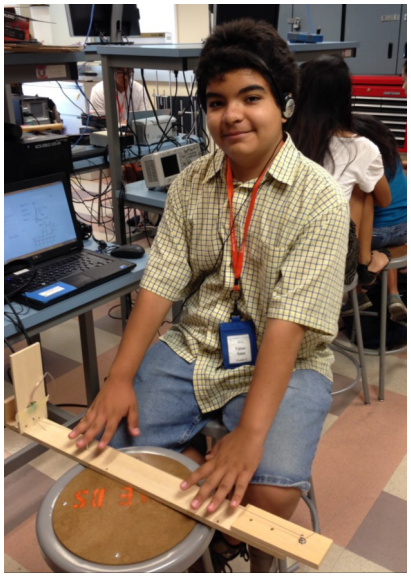
As we end another UCSD COSMOS adventure, I would like to thank my students for all their hard work and enthusiasm. Your take charge attitude made these graduate level projects a success and completely one of a kind. When you return to your respective schools, I hope you will continue the drive, energy, and determination that I saw this summer to your 2014 classes. What you experienced here will undoubtedly change you for the better. Spread the word about COSMOS and encourage others to find their STEM side!!

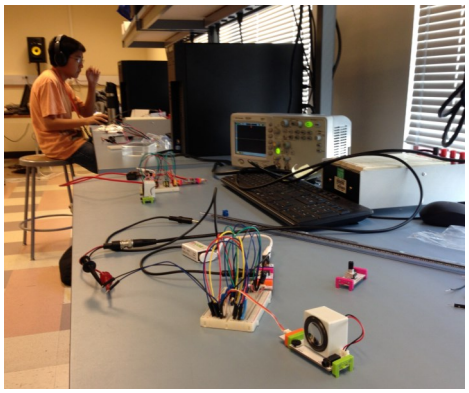
A deep and everlasting appreciation goes out to our two astonishing professors, Dr. Robert Sah and Mrs. Barbara Schumacher. We will miss Dr. Sah's unique facial expressions and Mrs. Schumacher's passion for microscopy!! We can't thank our two cluster assistants Aimee Raleigh and Sankha Ghatak enough for helping us get through the introductory labs and intense experiments. In addition, Liz Bird, Albert Chen, and Van Wong assisted us with making collagen gels, mechanical testing, and fluorescence microscopy. Lastly, we give a huge shout out to the best resident advisors in the world, Austin Hsu and Jenny Kaehms. Each and every one of you has made COSMOS UCSD 2014 a memorable and life changing event.



CLUSTER 9: Music & Technology

Week 4 of Cluster 9 has been less about content and more focused on pushing students to work on their projects. Our professors introduced the class to sampling and aliasing in order to give the students more content knowledge and before finishing the projects. The first step of getting a physical sound into the computer is translating airwaves into electrical signals. In order to use a computer to synthesize or edit sound, we need to digitize sounds, or in other words to represent continuous waveforms as a series of numbers. This is called sampling and it has specific rule to it - for instance, how often or at what rate should we sample the signal? And how many bits are needed to represent effectively the sound? The first step in creating a digital audio signal is to convert or capture the numerical representation from a continuous signal, such as an electric signal that comes from a microphone. We call this continuous signal analog, to distinguish it from numeric or digital. So the first step in digital audio system is a converter commonly called A/D or Analog to Digital converter. We have seen adc~ and dac~ in Pd already. The simplest way to think about it is so called `sample-and-hold' method. The sample-and-hold circuit captures, or samples, the instantaneous voltage of an analog audio signal and holds its value until the A/D converts it into a binary number. Professor Mauricio de Oliveira and Professor Shlomo Dubnov wanted to let groups pursue their passion for each project so groups were arranged by interest and idea. We have groups composing their own song, building instruments, creating vocals for their own song, and developing music generators. We are excited about the projects and can't wait to see each group present their idea!





Fun Photos...