COSMOS UC San Diego

California State Summer School for Mathematics and Science

UC San Diego JACOBS SCHOOL OF ENGINEERING

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

Week 1 Newsletter

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COSMOS 2018 has begun!

Cosmos is here and what a week it has been! The students are settling in, making new friends and becoming familiar with the campus. This newsletter, the first of our weekly newsletters, will provide you with a glimpse into your students' lives over this past week.

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RECAP of OPENING DAY

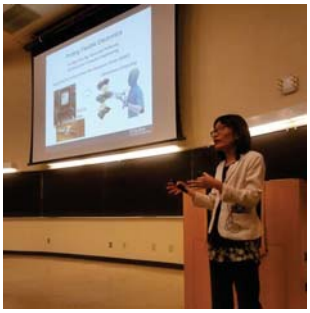
Two hundred and one students arrived on the UCSD campus for the greatly awaited COSMOS 2018 program to begin. Families and staff were found dispersed throughout the Eleanor Roosevelt College (ERC) as students moved into their suites, their home for the next month. The joyful music and friendly environment was very welcoming. All people present then walked to Peterson Hall for the Introduction presentation and Welcoming remarks. Students then split into their clusters and took a tour around campus led by the Residential Advisors. They then returned to ERC and said their good-byes to their families. The clusters had ice-breakers for the students to begin meeting each other, for they will be working and learning closely together throughout the program. Dinner was well-enjoyed at the college dining hall, Cafe Ventanas. After dinner, the rules and boundaries for the program were clearly explained. There were still plenty of activities left to do for the day. More ice-breakers were played by everyone together and others that involved friendly competition between the clusters. Eventually, everybody headed to their suites, where they finished moving in and met with the group of people with whom they will be living. Lights were out by 11:00pm, to ensure enough energy for the next day. This was only the beginning...

RESIDENTIAL LIFE

We are happy to inform you that your student is alive and well. The RAs have put on a variety of programs for your student this week. Programs have included Laundry 101, Basketball, Karaoke, DIY slime, Snow Cone Day, and Tie-dye, just to name a few. The students have also been hard at work preparing their cheers and choreographing their dances/skits for the annual COSMOlympics competition between clusters for Friday afternoon. I'm sure students will post videos of the event so be on the lookout for those. Safety has been our number one priority, and the students have been successful in creating a lively, energetic and safe community in a short period of time. All in all COSMOS has been off to a great start in and out of the classroom.

DISCOVERY LECTURE SERIES

Dr. Tina Ng, from UCSD's Electrical Engineering department, gave a fascinating lecture titled "Printed Flexible Electronics." Professor Ng received her Ph.D. in Physical Chemistry from Cornell University, where she worked with Professor John Marohn on (1) examining charge injection processes in organic semiconductors by electric force microscopy and (2) thermomagnetic fluctuations and hysteresis loops of sub-micron magnets for magnetic resonance force microscopy. Dr. Ng's current research focuses on plastic electronics patterned by inkjet printing instead of traditional photolithography. She began by speaking about ubiquitous computing, in which computing is made to be used everywhere on any available material, rather than just on a laptop or a desktop. Ubiquitous computing uses any device, any location, and any format possible to do computing. Dr. Ng also showed a brief video regarding how silicon wafers are made as well as the process used to form silicon crystals. Dr. Ng's conclusion was that silicon is fragile - the transition is to use plastic instead of silicon as it is more robust. The future of electronics will be found in new processing options and materials for next generation electronics. Dr. Ng next talked about amorphous versus crystalline materials, and indicated that crystalline materials are capable of faster speeds and are better for high speed electronics. Additionally, Dr. Ng discussed the development of prototypes that utilize short wavelength infrared sensors, using non visible light for early detection of cancers and other ailments that are apparent in blood vessel imaging. Another prototype in production is a glove to quantify spasticity, which is worn by a doctor for assessment of certain illnesses. Dr. Ng concluded her talk by reminding students that failure is a part of being a scientist, all successful scientists have many failures behind them - the most important thing is to keep trying!



FAMILY WEEKEND REMINDER

Family Weekend is July 20th through July 22nd. Students must be checked out by an adult specified on the Family Weekend Form between **5-9pm on Friday and must return between 2-5pm on Sunday.** Optionally, students can be checked out at 5pm on Friday and returned by 9pm that same evening or alternately, 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.** PLEASE speak with your child and let us know *by email* if their choice for the weekend has changed so we can staff appropriately. There are many students who will be staying on campus during the weekend and the RAs have a full schedule of activities and fun planned for those students. **If you have any questions, please call our office at (858) 822-4361 or email cosmos@ucsd.edu.**

Admissions Presentation: 7/22 @ 3pm. Parents welcome to attend!

CLUSTER 1: COMPUTERS IN EVERYDAY LIFE

Cluster 1

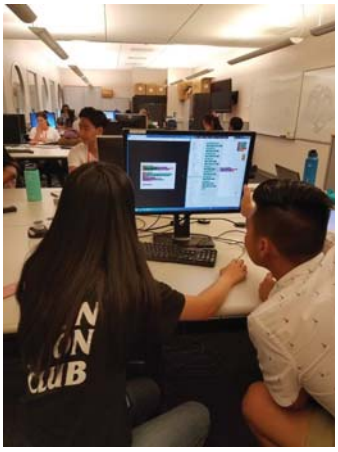
On Day 1 of COSMOS, Cluster 1 had not only gotten a glimpse of what was in store for the next four weeks, but created an Android app! During this first week, we began to learn AppInventor. It is a scripting language with a graphical interface which allowed us to put together our simple app in a matter of hours. AppInventor allows us to develop applications for Android based devices, like cell phones. Some of our first applications for the Android phone included making a Whack-a-Mole game. Next we worked on our own unique app with our partner. If we wanted to, we could put our apps up for sale in the Android Market! We were paired up in teams and made a group app which we we'll present on Thursday afternoon to the cluster. In about three days, we had created an app and could see what other features we still had to work on.

On Wednesday, we began to learn about Python! It's a powerful language that is fast, friendly and easy to learn. In fact, our first lesson in programming on variables, controls, methods and functions resulted in us being able to read the Python code and correctly concluding what it would do. After our lesson, we had a guest speaker. Julian McAuley talked about his work in data mining. The field of data science is growing! There is so much data that is gathered today that can help guide us in things we do every day and to help us as a society. In the field of data science/mining, they build models to "help us understand data in order to gain insights and predictions". For example, recommender systems are made to predict a rating a person will give on a product. This will allow a system to be built which will recommend products that people are interested in and gain insight on how opinions are influenced by gender, age and location. Some areas which use it today are social networks (such as trying to predict whether two users might be friends), advertising and medical informatics.

Thursday we heard a presentation from the Science and Engineering librarian that will help us do our research for our upcoming work. In the afternoon, we'll finish up our apps and present our work to our cluster. The presentations will be available on our blog - http://ucsdcosmoscluster1-2018.blogspot.com/. Our first presentation to the cluster will be Thursday afternoon to share what each group did for their original app.

Friday will learn about image processing. In lab, we'll begin programming in Python to take pictures and process the images.

Videos of our app presentations and photos will be posted this weekend on our blog



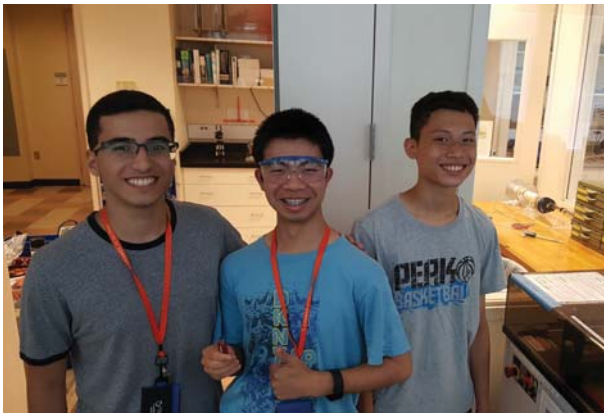
CLUSTER 2: ENGINEERING DESIGN AND CONTROL OF KINETIC SCULPTURES

The first day of COSMOS consisted of the necessary lab safety trainings. Students were given detailed instructions on how to handle potentially harmful chemicals and equipment. After their lab training students were split into their clusters and met with their professors. Professors Nate Delson and Veronica Eliasson gave students an overview of the four week long schedule. Students were then given a short presentation on their first project, the Clock Project.

All COSMOS students attended a short one hour seminar on flexible electronics by a UCSD professor. Subsequently, Cluster 2 students met in their assigned computer lab where Mr. Octavio Ortiz gave a short lecture on the physics of pendulums and presented students with two different models of analysis, which are taught to sophomore level college students. In the afternoon Michael Bagherpour, a mechanical engineering graduate student, presented a tutorial on Autodesk Inventor. Inventor is a Computer Aided Design software that engineers use to draw three dimensional shapes. They also began fabrication of their pendulum clocks in the engineering shop.

On day 3, students continued where they left off. They started designing their pendulum clocks using the CAD software. They dealt with all the intricacies of learning a new tool while also personalizing their pendulum clocks. After lunch, students received a short tutorial by Professor Delson on Working Model 2D, a simulation software that will allow students to predict the timing of their pendulum clocks. The objective is that students use various forms of analysis to predict the timing of their clocks before they actually fabricate it and test it. Sara Tran and Marc Hansen, mechanical engineering undergraduate students, assisted students with the design and fabrication of their clocks. Some students were able to laser cut their clocks before the end of the day.

On Thursday and Friday students continued with the design, fabrication and modeling of their pendulum clocks. The week has given students as close an experience to what engineers do in their professional lives. It has also allowed students to learn a variety of engineering tools and software that are commonly used in the industry.



CLUSTER 3: LIVING OCEANS AND GLOBAL CLIMATE

Cluster 3 has gotten their feet wet and started swimming through Week 1. Our first week has been full of introduction to laboratory procedures, our projects and understanding climate change. Cluster 3 is honored to work under the guidance of Dr. Skip Pomeroy on atmospheric chemistry and aerosols as well as Dr. Ngai Chin Lai with oceanography. Below are student comments as they dive deep into the program:

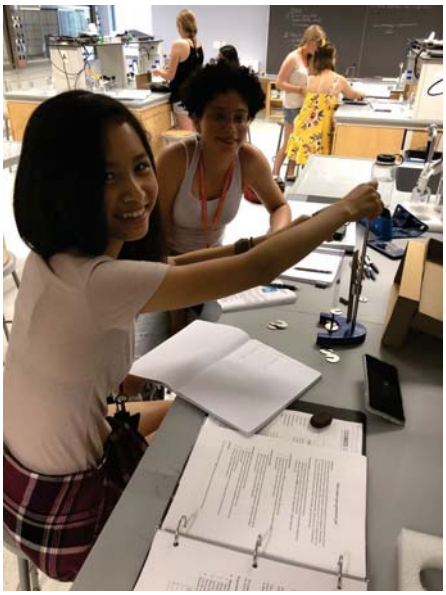
"On our first day, we got to tour the pelagic invertebrate and fish collections at the Scripps Institute of Oceanography after meeting Doctor Lai. Then, we came back to UCSD to hear an interesting lecture from Doctor Pomeroy regarding the physics and chemistry behind climate change science. Overall it was a great introduction to COSMOS"- Mira K

"On Tuesday, we attended a discovery lecture on flexible electronics, and what the possibilities are with them, followed by science communications, where we began work on our essays on ethics. After lunch, we broke into groups and picked topics for our final projects, and then viewed the movie, "Merchants of Doubt."- Emily I

"On Wednesday morning, we went down to the Scripps Institute of Oceanography to have a lesson with Dr. Lai and explore the tide pools on the beach. As we walked down the pier we were able to see many marine animals from the area. Then, Dr. Pomeroy gave us a lecture on the albedo of different places on Earth, and what that means for the atmosphere." - Emilie O

"On Thursday we learned how to access the library resources. Then we worked on our essays and finished our labs. We ended the day with project time where we got to start our projects."- Justin D.

On Friday we will be visiting the Birch Aquarium where we will be evaluating evolutionary relationships between different type of aquatic organisms. Stay tuned next week to hear more!



CLUSTER 4: WHEN DISASTER STRIKES: EARTHQUAKE ENGINEERING

We are off and running and sweating here at COSMOS 2018! Literally sweating, as nature has introduced some rare subtropical humidity into the normally mild San Diego climate. No matter; it serves to enhance the actual efforts that our students are exerting as they attack the engaging challenges of week one. And this group looks up to the challenges! They showed perseverance and determination as they were introduced to processes involved in designing, testing, and analyzing structures. Their hard work and smiles can be viewed in pictures and videos which will soon be uploaded to our Cluster 4 Google Site.

Our Cosmopolitans have displayed promptness, daily preparation, and inquisitive attitudes. Their initial activity was designing and building a K'Nex structure, and then testing it on the 'shake table'. After an introduction to structural design by faculty lecturer and lead instructor Lelli and Jacqui (a practicing structural engineer), ingenuity and thought lead to their construction ideas, most of which withstood simulated seismic energy testing while some failed. Several 'back to the drawing board' moments served to further motivate students. Yes, they are beginning to think like engineers!

The next challenge they faced, and mastered, was truss analysis. It took some concentration, but they made sense out of the vector analysis and trigonometry as they applied their new skill set to designing a truss bridge. Our awesome cluster assistants, Rad (a PhD student) and Alan (undergraduate) patiently double checked the students' calculations and guided them to a deeper understanding of this sophomore level information. Again we made predictions, slowly increased the applied load to each truss bridge, and compared the results at the failure point to the student's predictions.

Bob provided information and discussion on their major cluster 4 projects and also a physics review lecture. They will soon begin writing their ethics essays, as they consider the real life implications of properly designed human occupied structures. They are provided with some case studies, and Lelli, Jacqui, and the cluster assistants will elaborate further during lecture.

The week concluded with the testing of metal 'coupons' for tensile strength and behavior. We crunched numbers and formulas using Excel, quantified the differences between aluminum, steel, and brass, then graphically displayed the data. A Friday tour will give the students a taste of the unique facilities at UCSD, and current engineering research that's underway. Soon they will be placed into one of eight assigned groups of three, and this cadre will design, build, test, redesign, and collect data on a specific structural type or building material. This will be their focus for the remaining three weeks. More about this, their major project, during the next newsletter.

It is our pleasure to work with your terrific students at COSMOS this summer. We sincerely mean that it is a highlight of our year! Cluster 4 rocks!

CLUSTER 5: FROM LASERS TO LCDS: LIGHT AT WORK

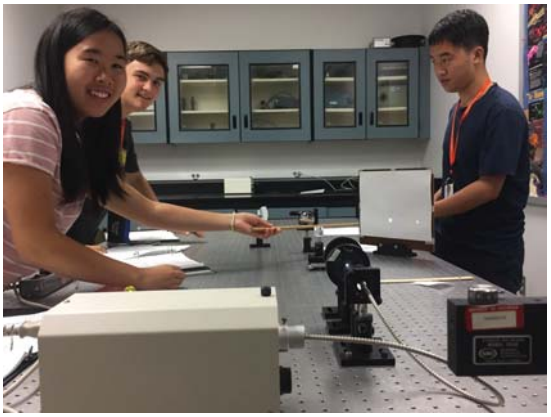
After an eventful Opening Day and introduction to COSMOS, our first day as a group in Cluster 5 began with an interesting Laboratory Safety Training session where we learned about proper eye protection when working with lasers. With many types of lasers that operate at different wavelengths, it is very important to use protective glasses that correspond to the proper wavelengths to ensure safety. Immediately after the safety training, we were able to get started with a lecture from Dr. Charles Tu on some of the amazing ways light contributes to technological advancement in communications, energy production, health and biomedical applications, and nearly every aspect of science and life in general. After lunch, we went to the Photonics Lab in the Jacobs Engineering Building to learn about light refraction, prisms, and Snell's Law from Dr. Peter Ilinykh. Students then had the chance to conduct a lab with a Helium-Neon (HeNe) laser and a prism to verify Snell's Law experimentally and find the critical angle of the prism.

On Tuesday, our day began with an amazingly interesting guest lecture from Dr. Tina Ng on flexible electronics, OLEDs, biomedical applications like mechanoreceptors in prosthetic limbs that can transmit feeling to neurons, and many other advanced applications of electrical engineering technology. After a look at our Science Communications curriculum and lunch, we tackled another lab with Dr. Ilinykh, this time involving prism refraction and diffraction grating spectrometry. Students took data to calculate the resolving power of the prism and the line spacing of the diffraction grating.

On Wednesday, the day started with an in-depth lecture from Dr. Tu on semi-conductor physics, n- and p-type doping, quantum numbers and energy levels, LEDs, and refraction and diffraction of light. Our laboratory work on this day involved a fun mini-project on mobile spectrometers. Each student had the opportunity to build their own spectrometer out of cardstock and a piece of a compact disc (CD) to use as the diffraction grating. Students took data using their mobile phone and uploaded the spectra to a great website called Spectral Workbench in order to analyze the data in detail. Students even got to take their spectrometer with them to keep.

On Thursday, students got some helpful training on how to utilize the vast library resources online at UCSD before continuing work on their Ethics Essays. Students chose their topics and started researching relevant sources. In the afternoon lab session, students worked with LEDs and analyzed different wavelengths of light through various methods. It is becoming very evident that nearly every aspect of physics and engineering that relate to optics will be addressed throughout our lecture and lab sessions, and students will continue learning a lot!

We will be sure to keep you updated on Friday's happenings in the next newsletter. Please know that your students are learning, growing, and enjoying the beautiful (and occasionally sweltering) San Diego weather!



CLUSTER 6: BIODIESEL FROM RENEWABLE SOURCES

Cluster 6 is off to a great start with 19 students. Dr. Pomeroy, Dr. Watson as Faculty, Trevor, Karen and Emily as Cluster Assistants, Garo and Ashley as Resident Advisors, and Mr. Towler as the Teacher Fellow are all looking forward to an exciting and informative month.

On Sunday, July 8th, students began COSMOS by checking into their dorms and attending orientation with parents. After orientation, students met with their clusters for the first time and introduced themselves with icebreaker games. Students concluded the day by spending time with their suitemates and RA. - Aaron L.

On Monday, the students learned about lab safety; had their first lecture with Dr. Robert "Skip" Pomeroy; and converted vegetable oil into biofuel! They first learned about transesterification then translated their new knowledge into a lab experiment.- Alyssa H.

On Tuesday morning, we listened to a guest lecture from an associate professor of electrical and computing engineering on flexible computers and their applications. In the afternoon, we chose group project topics and watched a short documentary on science ethics called "Merchants of Doubt." -Bavan R.

COSMOS Cluster 6 students started Wednesday with a two hour lecture by professor Skip Pomeroy on alternative energy and organic chemistry (converting vegetable oil into biodiesel). After lunch, the students headed to the laboratory to create more biodiesel and wash/dry Monday's biodiesel to remove impurities. - Brian F.

Thursday we solidified our ethics essay ideas and learned about how to reference credible sources using the UCSD library system. It was very cool to see the thousands of primary and secondary sources available to students at COSMOS. - Daniel K.

We'll finish Thursday by meeting in project groups and beginning work on our group projects.

CLUSTER 7: SYNTHETIC BIOLOGY

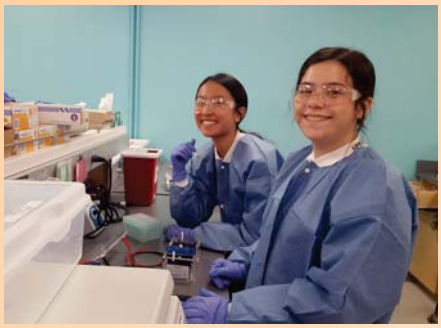
Cluster 7 started off bold and strong. We began the week with a few presentations on safety precautions and procedures, library resources, and our first discovery lecture from Dr. Tina Ng on Printable Electronics. It was fascinating. We also walked, a LOT! The students from Cluster 7 are really getting to know the UCSD campus! They walked all over campus on Monday. Tuesday they also walked quite a lot around campus. The weather has been treating us fairly well, with clouds decreasing the heat on Tuesday and Wednesday.

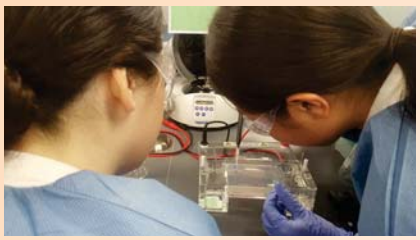
Each week the students spend Monday, Wednesday, and Friday with Dr. Vera and Dr. de Oliveira in lecture and lab. The lab has two fantastic TAs, Kritin and Jacob who are bioengineering majors. The lab manager Ana is also on hand during lab to help us out. Trudy, the teacher fellow, also helps out in lab. Students have lots of support as they are learning to use the tools of biotechnology.

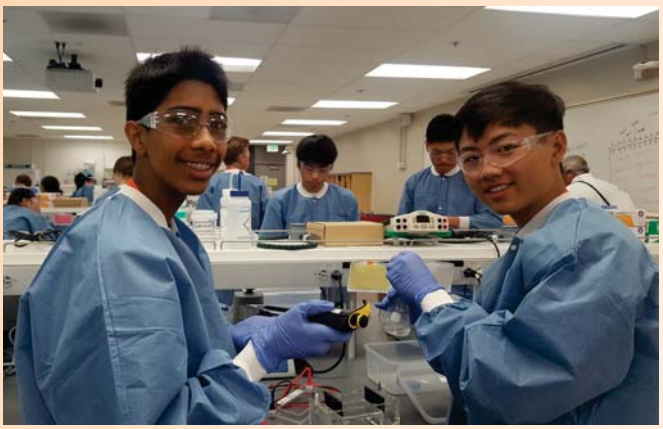
On Tuesday and Thursday, students spend time in Science Communications with Trudy working on their Ethics Essay and science communication skills. Each student is creating an essay on an ethical issue related to Synthetic Biology. They will present to our class on this and we will discuss these issues in both the lab and in SciComm class.

Our first lab experience was spent learning how to use the micropipette and an introduction to Synthetic Biology. During our second day of labs, we used gel electrophoresis to separate DNA into bands on agarose gels. In our third lab, on Friday, we will be using restriction enzymes to digest DNA and checking our results using electrophoresis.

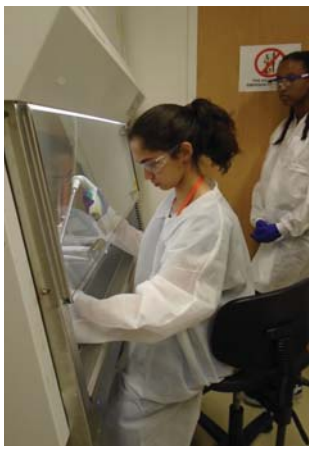
Dr. de Oliveira also taught the students about logic tables and how to create a circuit using Boolean logic on Wednesday. Students used circuit boards with various switches and logic to light up LEDs. We will be using this logic next week to build biological circuits with living organisms! This is very exciting new stuff and a really different way to think about how living things work! Everyone is enjoying their time at COSMOS and doing exceptionally well!







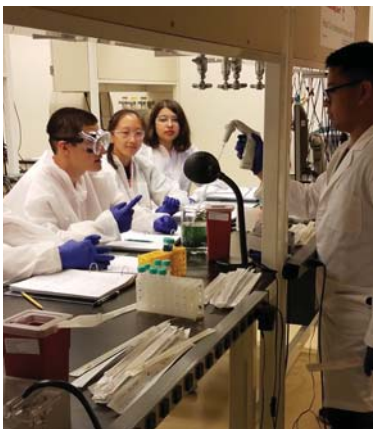
CLUSTER 8: TISSUE ENGINEERING AND REGENERATIVE MEDICINE



It was a bright, HOT day in July, and the clocks were striking 1:00pm… COSMOS 2018 began. After getting moved in we had time to take a tour of UCSD with our RA, Alison, met some new friends, and settle in! Early Monday morning we enjoyed our breakfast at Café V, fortunately it was a little cooler than Sunday! We then went to our general safety meeting and then a second safety meeting specific to bioengineering, as safety is the top priority.

After a short break, we met one of our professors, Dr. Gaetani, who is a Visiting Scholar at Sanford Consortium for Regenerative Medicine, UCSD, studying better therapies to prevent the development of heart failure after myocardial infarction (MI). He gave us an introduction to Tissue Engineering and Regenerative Medicine, specifically how tissue engineering began, how it has advanced by the practice of combining scaffolds, cells, and biological molecules to form functional tissues, and how these products have helped heal individuals with damaged tissues and organs.

Our afternoon started when we met our other professor, Dr. Sah, who is a Bioengineering Professor at UCSD studying cartilage repair and tissue engineering, specifically the relationship between biomechanical function, metabolism, composition, and structure of cartilage during growth, aging, degeneration (osteoarthritis), repair, and regeneration. He introduced us to the techniques and details of cell culture so we would be prepared when we start our own cell cultures. After lecture and discussion we were introduced to our first three skills labs by our Cluster Assistants (CA). Our returning CA's are Erica Gacasan, who is currently a graduate student in Bioengineering studying under Dr. Sah, and Nathan Ng who will be starting his Master's of Science in Bioengineering at UCSD this fall. Our new CA's are Julian Kosacki, who will be a bioengineering graduate student this fall and Kurt Walsh, who will be starting his Master's program at UCSD this fall.



Tuesday morning began with a Discovery Lecture from Dr. Ng, who spoke to us about her research involving the development of biomedical devices for spasticity assessment and plastic electronics, including bendable cellular devices! After lecture, it was off to a library presentation where we learned what resources are available to us here at UCSD and the skills we need to be a more effective researchers. We then debriefed in Science Communications, where we discussed what components make a GR8 scientific presentation and learned about our ethics paper that we will be researching, developing and writing over the next two weeks.

As the week progressed we finished our first six skills labs, we mastered how to pipette using serological and micro pipettes, made and pH'd solutions, performed serial and simple dilutions, used sterile technique to make media for our cells to grow in next week, and learned how to use a spectrophotometer. In the classroom, Dr. Sah acquainted us the variable characteristics of tissues and organs and how these variables create challenges in tissue engineering. Dr. Gaetani expanded our knowledge about characterization of tissue and elaborated on various methods and purposes of microscopy in the laboratory.

On Friday night we will have a Journal Club, learn about bioreactors and biomechanics, finish our post labs and compete in COSMOS Olympics! Stay tuned for more about these in next weeks' newsletter.

We have had an incredible start because of collaborative efforts and the magnificent minds in the GR8 Cluster 8!

CLUSTER 9: MUSIC AND TECHNOLOGY

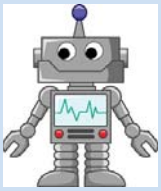
COSMOS cluster 9 got off to a rousing start with dazzling displays of technology and artistry. In the first three days, cluster 9 students were exposed to a variety of musical and technological tools. Dr. Oliveira gave an overview of the nature of soundwaves and introduced students to a sound recording and analysis software package called Audacity. Audacity generates sounds or takes sound inputs and allows the user to analyze these. Audacity also serves as a simple mixing system with which musicians can overlay multiple recording tracks. An even more challenging software package, called Pure Data that was developed at UCSD, was taught to the cluster on Wednesday by PhD candidate and Teaching Assistant Kevin Haywood. Pure Data is a drag and drop sound synthesis system that allows students to create increasing complex sound synthesizing and processing combinations. Newly matriculated PhD in Music and Teaching Assistant Colin Zyskowski gave an overview of Arduinos, Raspberry Pi, and other microcontrollers that cluster 9 students will use in creating their capstone projects. During the Tuesday session, Teacher Fellow Jeff Mellinger led students through a few Audacity projects. During the Wednesday session students were introduced to UCSD's state-of-the art recording facility. The session was highlighted by performances from Hannah H., A.J. S., Grady F., Sam N., Isaiah C., Sarina S., and Erin T. In addition, a number of students experimented with instruments from Dr. Oliveira's homeland, Brazil.

Grady F. (Trumpet) and A.J. S.(guitar) perform a duet of Jack Johnson's *Belle*

Hannah H. performed a 12-minute solo of Beethoven's Sonata No. 21 from memory

Sam N., Erin T. and Sarina S. perform Alicia Keys' *If I Ain't Got You*

CLUSTER 10: ROBOT INVENTORS



Cluster 10 is facing their first challenge - the battle of the bots!

Day 1: Today students met the faculty in charge of their cluster and learned about this history of robotics and had an introduction (from our amazing faculty Curt Schurgers and Nick Gravish) to python and raspberry pi. With this knowledge in hand, in the afternoon students began building their first robot of the cluster, which involved assembling a laser cut chassis, wiring and programming their raspberry pi, and wiring their wheel motors.

Day 2: Students began today with their first Discovery Lecture, which was very relevant to robotics, combining engineering design and research with biomedical applications. Students were then challenged by their science communication teacher Johnnie Lyman to design a unique robot and consider its ethical challenges during their science communication course. They were also introduced to the format of digital portfolios, which they will use to present their work for this cluster.

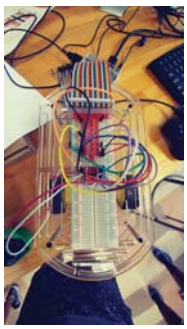
Day 3: Today began with 3-D design in SolidWorks. Using the design of their chassis, they began designing their robots in 3-D and adding new elements for battle. We also trained all of the students to use the laser cutter in the design studio, so they can now design and create their own parts. Students worked hard on their battle designs all afternoon to prepare for Friday's competition!

Day 4: Final prep day! This morning students learned how to use the university's library to its fullest extent, gathering resources for their essays and learning how to cite sources. Students then continued development of their ethics essays and digital portfolios before heading to final robot battle preparation in the afternoon. Check out next week's newsletter for battle results!

"Seeing a laser cutter in real life for the first time took my breath away and I couldn't look away from the machine." - Olivia

"I enjoyed working with the ps3" - Alvyn (students used the ps3 controllers for their robots)

"I had an exciting time coding a music player into our robot." - Drake



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