



# 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 3 Newsletter



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# CLOSING DAY!

On Saturday, August 4th, students will present their final projects. Please plan to arrive at **8:30am to Warren Mall**. You will be escorted to your student's cluster project location where presentations will be from 9-10:15 am. Following the presentations will be the COSMOS Awards Ceremony at 10:30am at the Price Center Ballroom. Students will be presented with their Completion Certificates and special awards. We encourage friends and family to come see all of the hard work that the student have been putting in during their month at COSMOS!

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

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



# Closing Day Driving Directions



## Getting to GILMAN PARKING STRUCTURE

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

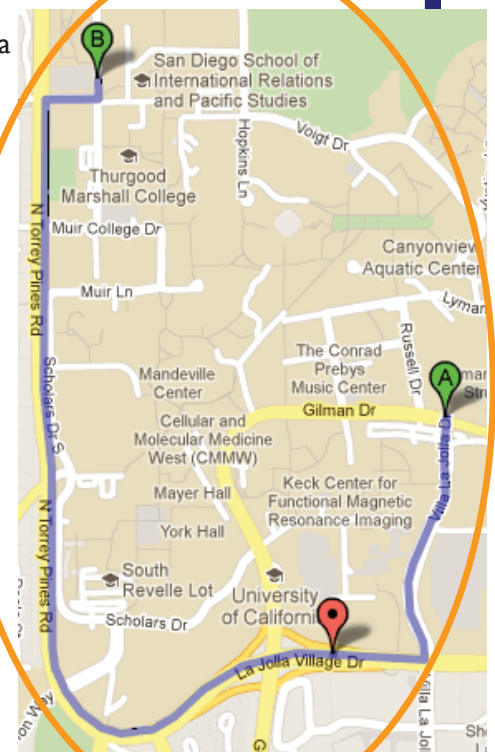
## (Walking) From GILMAN PARKING STRUCTURE to WARREN MALL

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

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

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

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





# DISCOVERY LECTURE SERIES

Dr. Terrence Sejnowski gave a great lecture titled "The Deep Learning Revolution: Artificial Intelligence Meets Human Intelligence" for our third lecture of the Discovery Lecture series. Dr. Sejnowski is the Francis Crick Professor at The Salk Institute for Biological Studies where he directs the Computational Neurobiology Laboratory and is the Director of the Crick-Jacobs Center for Theoretical and Computational Biology. His research in neural networks and computational neuroscience has been pioneering. He has turned to computer modeling techniques to try to encapsulate what we know about the brain as well as to test hypotheses on how brain cells process, sort and store information. While other scientists have focused on mapping the physical arrangement of neurons (tracing which cells connect to which), Sejnowski is interested in a more functional map of the brain, one that looks at how sets of cells are involved in processes—from filtering what we see to recalling memories. To collect data on brain function, Sejnowski records the electrical activity of select sets of cells, as well as analyzes thin slices of autopsied brains. He uses that information to create and refine computational models on how the brain stores information for different activities. Through these models, he gets a better understanding of what information different cell types encode, what molecules are needed and how signals move throughout the brain. At the same time, he learns how diseases such as schizophrenia or Parkinson's might alter these patterns.

Dr. Sejnowski began by asking the question, "Who was Carl Sagan?" and talked about how Sagan made a huge impact on our study of the cosmos and beyond. Next, Dr. Sejnowski talked about the concept of artificial intelligence and began by discussing the most difficult problem: how to make machines "see" and distinguish what they are seeing. A particular fact that was highlighted is that synapses in the brain are "plastic," meaning they can change and reform. The human brain can store a vast amount of information - scientists estimate up to a petabyte - which is  $2^{50}$  bytes; 1024 terabytes, or a million gigabytes. Humans are able to categorize the images they see into the smallest subcategories. Scientists are working on how to make a computer do the same thing. Dr. Sejnowski concluded his lecture by discussing the possible future of computers, including the concept of a personal tutor assigned to every child at birth, which would be customized specifically to their unique learning and emotional needs. This would lead to maximizing human potential to learn and to eventually invent the future that awaits us!



## RESIDENTIAL LIFE

Three weeks down...one more week to go. Week 3 was another week of exciting programs. We started the week off by having our annual Casino Night in collaboration with one of our teacher fellows. The students had an amazing time! We also had a panel of women in the STEM field who spent an hour sharing their experiences and answering questions. In addition, the RAs put on a variety of programs including Capture the Flag, DIY slime making, a bonfire, and a Trivia night. This weekend we will be our last full weekend at COSMOS. We have a carnival and a dance planned for the students so they're last weekend will be a blast!



# WOMEN IN STEM

COSMOS students had an opportunity to attend an excellent panel discussion titled Women in STEM. Our panelists were:

Pamela Cosman, Ph.D., a Professor of Electrical and Computer Engineering at the University of California, San Diego. Pamela joined UCSD in July of 1995. Prior to that, she was a Visiting Assistant Professor of Electrical Engineering at the University of Minnesota, and a postdoctoral fellow and lecturer in Electrical Engineering at Stanford University. She received her Ph.D. from Stanford University in 1993 and my B.S.E.E. from the California Institute of Technology in 1987. At UCSD, she was the Director of the Center for Wireless Communications from 2006 to 2008, and the Associate Dean for Students of the Jacobs School of Engineering from 2013 to 2016. She is also affiliated with the California Institute for Telecommunications and Information Technology. Dr. Cosman does research on image and video compression, wireless communications, and image and video processing.

Elaine G. Tanaka, MD is an Assistant Clinical Professor, Non-Salaried in the Department of Surgery at UC San Diego. Her specialization is in Breast Care and she teaches residents and medical students. She created the Breast Program at the VA Hospital (MDBrST) and is an advocate for Women's Health. She serves on the steering committee for Critical Gender Studies at UC San Diego. She is volunteer faculty advisor for multiple UC San Diego undergraduate and medical student groups (APAMSA, MediCamp, AMWA). She founded the San Diego Chapter of the UCSD Medical Alumni Association, and the Nonprofit Compassion Breast.

Jacqueline L. Le received her B.S. and M.S. in Structural Engineering from UC San Diego. She has been a part of a large variety of projects ranging from retrofitting underground large diameter pipes and analyzing carbon composite airplane panel damage from hail ice impact, to remodeling historic museums and designing new hospitals and hotels. Le currently works at KPFF Consulting in San Diego as a structural engineer. Some local San Diego projects she has been a part of include the San Dieguito Riverpark Classroom, Kaiser Hospital, and Sharp Grossmont Hospital. Le is excited about learning, teaching, and solving real-life, as well as engineering, problems. Le has guest lectured at NewSchool of Architecture and UC San Diego.

Elaine Chien attended COSMOS the summer of 2014 and was part of Cluster 1: Computers in Everyday Life. This summer, Elaine is in San Diego interning at Qualcomm (which she actually visited for the first time during a COSMOS field trip). Elaine is a rising junior at UC Berkeley studying computer science. At Berkeley she's involved with the Data Science Education Program and develops course curriculum for professors who want to integrate their non traditionally technical courses with computing and statistics.

Christina Aguila is a UCSD graduate who received her Chemical Engineering bachelor's in 2016 and master's in 2017. As a student, she was heavily involved in STEM outreach. She served as the Outreach Chair for Society of Women Engineers (SWE) and Assistant Program Coordinator of a STEM program for 5th and 6th-grade girls. Christina was also the head teaching assistant for Global TIES, a project-based course in humanitarian engineering. In the past, she has worked in nanotechnology and algae bioenergy research. She currently works at Ajinomoto Althea as a pharmaceutical manufacturing assistant.

These five panelists shared their journey as Women in STEM and answered questions about their work experiences and career tracks from the student audience. It was a great opportunity for students to gain insight and understanding about the success strategies employed by these successful Women in STEM!



# CLUSTER 1: COMPUTERS IN EVERYDAY LIFE



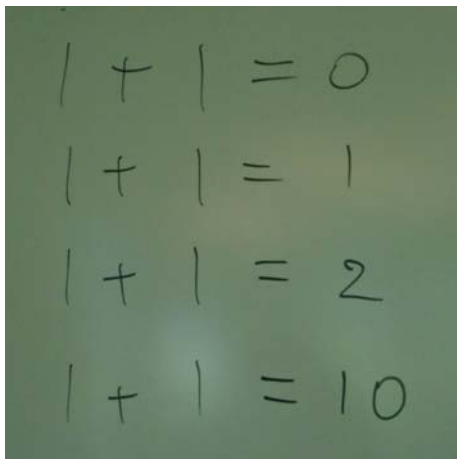
Late last week, we saw a demo of an apple piano. A mini piano Curt made from actual APPLES. This was our intro into circuits and Arduinos. Then in lab, we got to begin working with tutorials so we can learn how to wire and program our circuits in C using push buttons, speakers, temperature sensors and servos to name a few. It was exciting to see our circuits working!

On Monday, we began learning about Boolean logic, gates and DeMorgan's Law. We were challenged to create the logic for trying to escape campus given constraints such as two roads out, a booby trapped scooter and Shirley trying to catch us. Then we learned about picobots – simulated robots that are programmed using state machines. It can only sense things directly to the north, east, west and south. Therefore it's coded by sequences which identify where it can and cannot move in those four directions. We got an opportunity to program the picobots through various mazes.

In lab, we began working on our project this week – creating a musical instrument using an Arduino.

Wednesday morning started with some students from the Explorers for Engineering (E4E) lab. They spoke about their projects and their journey. Curt is one of the directors for E4E. One of the project we learned about was monitoring the health of mangrove trees from above. The students gave us great insight to their experience and projects and offered some useful advice! Then we learned about adders and made our cluster into a 20-bit adder!

We also learned that:



To find out why, watch the video on our blog!

On Thursday, we'll present our musical instrument Arduino project. Videos and demos will be uploaded by the weekend! Then on Friday we'll officially begin working on our final projects

Congratulations to Kristen and Ishaan for being recognized as the Faculty Choice winner for their image processing





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

During week 3 the students worked on their mini sculptures. The goal of this project is to work out the most difficult aspects of the final kinetic sculpture: combining sensor, motors and design an automated control system. Some students used their skills in CAD and the Lasercam to cut out acrylic parts for their sculptures. Others 3D printed their parts. To get the sculpture to be controlled, servos were controlled with a Lego NXT programmed in RobotC.

On Monday Dr. de Callafon lectured on the design process and on the physics of motion in the sculpture. Students had worked on ideas for their sculpture over the weekend and brought them into the Design Studio for prototyping. In the afternoon they drew aspects of their sculptures in Working Model 2D and modeled the physics. The focus on Tuesday was on the science communication. Our cluster teacher Mr. Ortiz revised the group websites with the students and how to organize the various materials on the mini kinetic sculpture on the website.

On Wednesday Dr. de Callafon gave a lecture covering the general aspects of control and how to use flow charts and multi-tasking programming to implement automated control algorithms.

On Thursday both Dr. Eliasson and Dr. de Callafon guided students on a tour of the Structural and Material Engineering (SME) and Mechanical and Aerospace Engineering (MAE) labs. Students get to see a life size shaker table for a structural experiments at SME a wind tunnel and various other control experimental apparatus at MAE.

The rest of the week students were hard at work on the mini sculptures. They learned more about the design process and how to refine their ideas. A key lesson was remembering that they could give up a component that wasn't working and replace it with another component that would perform the same task. On Friday students presented the results of their mini sculptures and started their final project, the kinetic sculpture.







## CLUSTER 3: LIVING OCEANS AND GLOBAL CLIMATE CHANGE

Greetings from Cluster 3! Our third week has flown by quicker than we could have imagined. We are currently designing our presentations for our projects and working hard to prepare for our talks next week! This week we will be applying our knowledge of global climate change to ocean acidification. Here are some insights to our busy week:

"Last Friday, our cluster went down to Scripps institution of Oceanography to witness a fish dissection with Dr. Lai. He brought us down to the pier to watch him dissect three different fish and discuss their underlying characteristics for survival. Lai incorporated different tunas I personally didn't recognize, a feeling shared with other people in my cluster shared." Suli V.



"On Monday, we had lectures with both Professor Lai and Pomeroy. In the morning, we went down to Scripps to learn about analogous structures and convergent evolution with Prof. Lai. Then we got our gloves dirty and dissected a shark to identify organs like the heart and the gallbladder. After lunch, we went up to NSB to learn about molecular orbitals and radical interaction with pi bonds with Prof. Skip. For the lab, we reacted the aromatic compounds in an orange peel with ozone to see how secondary aerosols form. We also played with molecular models to see the reac-

tion mechanism of secondary aerosols." - James C

"On Tuesday, we went to Peterson Hall and listened to a lecture about artificial intelligence. In the afternoon, my group went down to Scripps Institute of Oceanography and worked with Sarah and Dr. Lai to finalize our data for our project." -- Ashley C



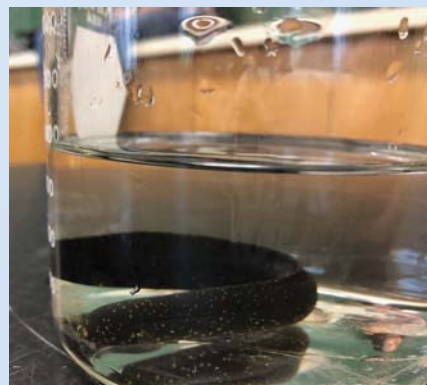
"On Wednesday, we went to Scripps and dissected a rat in order to make comparisons of the swell shark dissection. We then went to the Natural Science Building and made a coulometers, a device to determine electron charge. In the afternoon, Cosmos spent late afternoon at La Jolla Shores beach."-- Ximena V



"On Thursday, we went to cluster exploration in the morning where professors from other clusters shared with us what their cluster did and are going to do within these 4 weeks. Through these presentations, we were able to have a better understanding of the other clusters. After cluster exploration, we had science communication

where we had time to get into our project groups to work on our final project. Further on in the day, Cluster 3 split up into project groups where some went to SIO and others stayed in NSB to continue working on our final project with help from the professors, the teacher fellow, and also the teacher assistants." -- Claire C

We can't wait to see you next week to present our projects to faculty, families, and friends!





# CLUSTER 4: WHEN DISASTER STRIKES: EARTHQUAKE ENGINEERING

Cluster 4 is in high gear! As we conclude an exciting week three of COSMOS 2018, our eight project groups are moving forward with structure testing as efficiently as possible with the knowledge that their poster presentation is just around the corner. They continued to refine the retrofitting on their structures, with the hope that additional testing and analysis provide data showing that they have successfully mitigated the potentially damaging seismic vibrations. Our cluster students also participated in many other exciting activities during the week such as cluster exploration, field trips, and the weekly Discovery Lecture.

Our student's progress has been substantial. This week is typically a transitional week, as students returning from the fun and relaxation of parent's weekend awaken to the realities of deadlines, analysis, and the expectation of finishing in two more short weeks. They are actively involved with finishing seismic testing, redesigning and retrofitting, and final testing of their newly strengthened structures. It requires and teaches the importance of teamwork and time management to effectively and successfully conclude the structural engineering component of their assigned project.

We also enjoyed several ventures out of our lab this week. We began by touring the campus CalTrans SRMD facility. You may enjoy reading more about it at this link: <https://structures.ucsd.edu/research/laboratory-listing/srmd>. The Seismic Response Modification Devices are used to test structures such as highway bridge columns under earthquake stresses. Later we bussed to the San Diego Emergency Services office, receiving a tour detailing the responsibilities of personnel during fires, earthquakes, and other disasters. The building itself has been fitted with base isolation devices, which the students saw from below ground level. The afternoon concluded with an amazing tour of the Englekirk Center and the UCSD NEES shake table, a full scale earthquake shake table capable of testing structures up to seven stories tall. It is located approximately eight miles northeast of the UCSD campus. Students heard about the history of the table, watched videos of past testing, and then went underground to see the actuators and systems that operate the table. You may enjoy watching their testing videos at this link: <http://nees.ucsd.edu/>. It was truly special to see and learn about such a world-class facility.

We press on towards the completion of our projects, and the eventual production of some terrific posters and professional presentations. Students are also receiving instruction in effective communication of their findings. The students look forward to showing off their hard work to you next week!





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

COSMOS 2018 is already 75% complete (!) and students are truly getting involved in some deep and interesting science. On Friday last week, students had the chance to learn about quantum cascade lasers (QCLs), quantum dots, LCDs, polarization of light, and holography from Dr. Tu at the morning lecture. In the afternoon, students created their own holograms using the principles of interference and the physics they learned in the morning. Many students also had the opportunity to go home or leave UCSD with their family for the Family Weekend – hopefully everyone enjoyed that time together!

On Monday this week, the morning began with some further in-depth discussion about holography and LCDs, as well as the photoelectric effect and the process of photolithography. Dr. Tu then took us on a tour of UCSD's Nano3 Laboratory Facility, so students could see inside the various clean rooms (through the windows) where photolithography and other semiconductor processing techniques are implemented. The afternoon session consisted of our much-anticipated field trip to Daylight Solutions. The wonderful staff organized four rotating mini-tours of their facility so students could see their QCL infrared microscope (used to advance cutting-edge cancer-detection), CAD software techniques, fiber-optic cable development, and a great discussion with one of the company's founders about optics, astronomy, and spectroscopy. It was a truly great trip!



On Tuesday, our Discovery Lecture consisted of an engaging talk from Dr. Terrence Sejnowski on Deep Learning, neural networks, and artificial intelligence. Dr. Sejnowski made interesting connections between physics, biology, and computer science that kept students very intrigued. Next, at our Science Communication session, students learned more about ultraviolet optics and how different the world looks in the UV. In the afternoon lab session, students formed their groups for their final cluster projects and started preliminary work and planning.

Wednesday began with another great lecture from Dr. Tu on CCDs and CMOS detectors, followed by a great lab demo with Dr. Janet Pan on optical scattering and rainbows. In the afternoon, students continued their initial stage of work on their projects and developed plans for completing their work by the middle of Week 4 in order to be prepared for their presentations at the end of the COSMOS program. We won't give anything away just yet, but student groups have

come up with some very innovative and interesting ideas for investigating scientific phenomena in the world of optics and photonics – it is sure to be fun!



On Thursday, the morning began with the second Cluster Exploration session where students had the chance to see what the rest of the clusters have been working on over the past three weeks. This was followed by a Science Communications session where students examined a peer-reviewed journal article in order to model their own project presentation for clarity, succinctness, and ease of understanding for the audience. In the afternoon, groups continued to make progress on their projects in the lab, as we quickly get closer and closer to the end of the program!

Friday's happenings will be detailed in the final newsletter, and we look forward to see all the families at the Research Expo and Awards Ceremony!







# CLUSTER 6: BIODIESEL FROM RENEWABLE SOURCES

During week 3, the focus of Cluster 6 is to work on data collection for our projects and to continue the analysis of our biodiesel.

On Friday, July 20th, Cluster 6 began the day by analyzing their biodiesel in the lab, followed by a lecture from Dr. Pomeroy on the benefits of algae. After class, students were able to leave for the family weekend. – Lauren G.

On Monday, the 23rd, Dr. Pomeroy gave a lecture on creating soft and rigid foams. In the afternoon, the cluster got into their lab groups and performed more analytical tests on their biodiesel..- Maxim H.

Students attended a Discovery Lecture Tuesday morning by Dr. Terrence Sejnowski, a renowned computational neuroscientist. Students received an overview of artificial intelligence and how it can be designed to mirror the human mind. After leaving the lecture hall, Cluster 6 visited Bonner Hall to read some posters put to-

gether by immunobiology researchers at UCSD. The cluster split up into project groups for the afternoon and began working on their final presentations. - Parnika K.

On Wednesday the 25th, cluster 6 students received a lecture from Dr. Pomeroy on Karl Fischer titration and gas chromatography. In the afternoon, students continued to test the properties of their biodiesel to make sure the biodiesel is up to standards. - Philippe W.

On Thursday, Cluster Six students started with Cluster Exploration in Peterson Hall, where several cluster leaders talked about what they study with their students. Shortly after we headed Towards the Natural Science Building for Science Communication. After lunch we headed towards York Hall to work on our final projects with our respective groups. - Ricardo O.



# CLUSTER 7: SYNTHETIC BIOLOGY

Thursday, July 19th Cluster 7 went to the [J. Craig Venter Institute](#) (JCVI). What a great experience! Students were well prepared to make the most of the visit. Students heard about the work of Dr. Sheuermann, Dr. Tran and Dr. Glass (Leader of the Synthetic Biology Division). Dr. Sheuermann, Director of the La Jolla JCVI, told us he had never heard such great questions from students!

Here is a photo of the students in front of J. Craig Venter's office facing gorgeous La Jolla Shores (Dr. Venter was there, but was being taped for a TV show).



Friday, the students transformed bacteria to make them glow. After students finished their work to transform and plate the bacteria, they had did an activity which looked at gene drive and malaria.

Students spent this week doing additional experiments with bacteria that smell like banana, and growing glowing bacteria! They also presented their final projects to the professors and received feedback and advice on how to improve their projects.

Today, Thursday July 26, students are touring Illumina. This company is the leader in gene sequencing technology and students will be seeing where gene sequencers are developed, made and used. Companies like 23 and me and Ancestry.com use Illumina to sequence DNA from their customers. It was a very busy and exciting week of learning and discovery!



Here's what the students had to say:

We learned about the mechanism in which malaria works, both within humans and mosquitoes. By reading case studies, we were able to see how complex the issue of gene drive is by looking at how it would affect a community in Kenya socially, economically, and politically. As a group, we shared our own recommended stance on this issue and defended our proposals to our peers. Throughout the afternoon, we gained valuable research and science communication skills, as well as become more prepared to look at the ethical implications that might come with using synthetic biology to solve real-world problems. ~Airol



We began the day by looking at the results of the pGLO lab, in which we used DNA from a fluorescent Jellyfish to make e. Coli glow under UV light. Most groups saw their bacteria grow and fluorescence, which proved that we had successfully transformed the bacteria! Next we previewed the Eau That Smell lab that we'll be performing for the rest of the week in which we make e. Coli smell like bananas. We watched a video of MIT students explaining the experiment and stopped to discuss the purpose and procedure. After lunch, we proposed our ideas for final projects to the class and shared our plans. Groups are doing everything from making e. Coli turn different colors to making yogurt that glows under UV light. We spent the rest of the afternoon preparing for our next two labs, the purification of the green fluorescent protein from the pGLO lab and Eau That Smell, which will begin the rest of our hectic week. It was a fun-packed day full of learning and science! ~ Lea and Julia





# CLUSTER 8: TISSUE ENGINEERING AND REGENERATIVE MEDICINE

Our second week ended with a day of project planning, presenting for feedback, and research. Our esteemed professors, Dr. Sah and Dr. Gaetani answered our copious questions and our CA's, Erica, Julian, Kurt and Nathan assisted us with every step. As we began week three each project group was able to develop a title, summarize background information, propose an experimental approach with an aim, hypothesis and study design, plan laboratory methods, and select proper research analysis.



Week three began with an amazing field trip to Sanford Consortium for Regenerative Medicine, a research center whose mission is 'to advance stem cell research through collaborative, multi-disciplinary interactions...to promote diagnoses, treatments, and cures for degenerative diseases and injuries.' Dr. Gaetani guided us on an extensive tour concluding with a poster presentation given by some of the graduate students in his lab. Our morning ended with lunch at the Torrey Pines Glider Port overlooking the beach.



Dr. Sejnowski was our speaker for the Discovery Lecture this week. He discussed his pioneering research in neural networks and proposed what we have to look forward to in our lifetimes as far as advances in computational neuroscience. In Cluster Explorations, it was all about cluster pride, as Dr. Sah presented Cluster Eights undertakings to all of COSMOS. Dr. Sah definitely impressed everyone when he gave brief glimpse into the 'GR8' projects underway! In science

communications, we began to present our ethics topics within cluster, worked on creating posters, power points, and papers to document our projects and prepared for our upcoming presentations.

Everyone was prepared to execute the much anticipated projects. Briefly, three groups will be studying Cartilage Tissue Engineering: Aaron, Dina and Leela are investigating the Effect of Chondrocyte Density on Cartilage ECM Production in Compressed Collagen, Sean and Raman are studying the Effect of FBS and Oxygen Tensions on Epiphyseal Cartilage Growth and Differentiation, and Eden, Jeanne, and Mark are



looking at the Effect of FGF-2 on Proliferation of Articular Cartilage Cells. The other three groups will be focusing on Cardiac Regenerative Medicine: Anika, Constance, and Joyita are evaluating the Effects of Cardiac-Derived ECM Hydrogels on the Viability of Fibroblasts Undergoing Oxidative Stress, Caroline, Connie and Ethan are assessing the Effect of Cardiac ECM on the Spheroid Size, Proliferation, and Metabolic Activity of Cardiac Progenitor Cells, and AJ, Brandon and Shawn are investigating Laminin's Influence on CPSS' Proliferation and Differentiation in cECM. The week has been intense in the lab as tissues are being processed, gels formed, cells cultured, and materials are being prepared and tested. Cluster 8 continues to be 'GR8' as we have mastered the required expertise to plan and execute our projects.





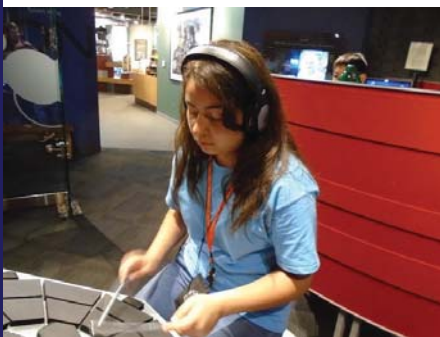
# CLUSTER 9: MUSIC AND TECHNOLOGY

This week's lectures and essays give way to brainstorming, creativity, and collaboration as the Cluster 9 team members formed groups of three and began work on their capstone projects. Essays explored an ethical issue related to sound, related technology, or the music industry. The essays submitted by the Cluster 9 students were of high quality. A number of essays were forwarded to the COSMOS administrators to be considered for COSMOS awards that will be presented at the closing ceremony. Teacher Fellow, Jeff Mellinger, selected the three for intramural awards. The essays selected for further judgement were those by Hannah H., Allison Z., and Tasmin K.

Python, though a relatively new computer language is rapidly gaining popularity for its ease of use.



The week included a visit to the Museum of Making Music sponsored by the National Association of Music Merchants. The cluster was treated to a tour of the facility which included a number of antique instruments as well as displays of various eras of American music dating to the 19<sup>th</sup> century. The visit was capped by an address from NAMM President Joe Lamond.



Among the most popular technologies used by Cluster 9 students are Pure Data, Arduinos, and the Python computer language. Pure Data is a visual programming language that provides users with the capability to create a wide array of musical sounds and general sound effects. As one of the first systems presented to the cluster, several of the groups are using this program extensively in their projects. Of the microcontroller systems available, the most readily comprehensible is the Arduino. While an Arduino does not have digital signal processing capability useful in producing audio sound it has many uses as a general-purpose control of automated functions. The functionality of Arduinos is enhanced when it is connected to external cir-



Students will be devoting some extra hours over the next week to complete their projects for the August 4 presentation.





# CLUSTER 10: ROBOT INVENTORS



Recap: Week 2 ended with the solving of a maze! Using the visual processing techniques they had learned in lecture earlier in the week, robots had to navigate autonomously using only colored flags as guides. Robots maneuvered their way through the maze successfully and the winner was the fastest to solve the maze!

Day 1: Students began the week learning about bio-inspired robots, including robots that resemble ants, cockroaches, bees, birds, and dogs. A postdoc in Dr. Gravish's lab shared her research with the students, and students were challenged to think about what motions animals do particularly well. Both Dr. Gravish and Dr. Schurgers shared their own research and what inspired it, helping the students understand the larger scope of what is possible in robotics. In the afternoon, students began their walking robot challenge - without using motors or wheels, their robot must walk at least 10 feet faster than all others!

Day 2: The day began with the Discovery Lecture by Dr. Terrence Sejnowski, who studies computational neurobiology. This lecture was particularly relevant to our cluster as it focused on machine learning, particularly around neural networks and how they can help us understand deep learning in machines. Students worked on developing their digital portfolios, CAD design, and answered some questions about how and why science should be communicated to the public. In the afternoon, work continued on walking robots.

Day 3: Today began with a final lecture on actuators from Dr. Gravish. We then moved to the lab to continue walking robot design for the remainder of the day. Students were challenged to determine their final project partners, and brainstorm final project ideas - they must build a working robot of their choice!

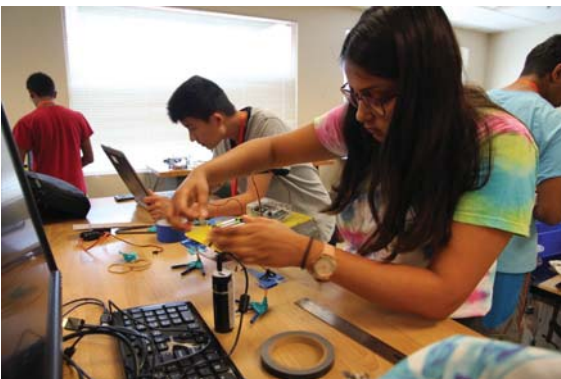
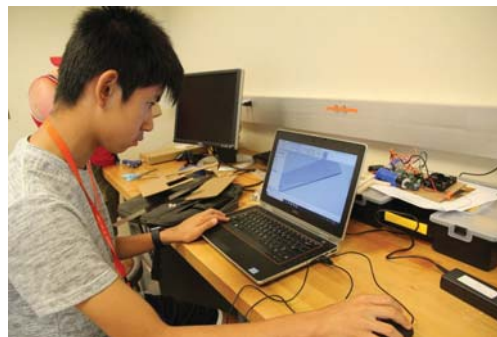
Day 4: Our cluster was part of today's Cluster Exploration session! Students also heard about oceanography, biofuel design, kinetic sculptures, and tissue engineering. They then had one hour to prepare a 2-minute pitch for their final project, which was presented to our professors and teacher fellow for final approval. All students are now ready to move forward with their final projects after tomorrow morning's walking robot competition!

"I look forward to hopefully seeing our 'crab-bot' flip around" - Walter

"We were excited to create an elegantly simple, yet effective, robot." Paymon

"We innovated this idea of developing a flipping robot (that was copied by many other teams!)" - Jim

"It was fun connecting servos and using them to produce more than one axis of motion" - Saisaran





# CASINO NIGHT





