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

**In this issue:**



## CLOSING DAY AND BEYOND…

The four weeks of COSMOS seem to have flown by this summer. Faculty, teacher fellows, cluster assistants, 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 back regularly for information about alumni events and internships:
http://www.jacobsschool.ucsd.edu/cosmos/alumni.shtml

**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 cosmos@ucsd.edu.

# DISCOVERY LECTURE SERIES

The final discovery lecture was given by Dr. Adam Burgasser of the physics department at UC San Diego. He and his team at the Center for Astrophysics and Space Sciences recently played a role in the discovery of a new planetary system, named TRAPPIST-1, of seven Earth-sized planets around a single star. The discovery set new records for the greatest number of both Earth-sized planets and habitable zone planets around a single star outside our solar system.

Dr. Burgasser's talk was titled "TRAPPIST-1: Discovery of Seven Earth Like Stars Around a Star." He started his fascinating talk by discussing astrobiology, the study of life in the universe. He then went on to talk about the methods for finding exoplanets. It was only less than 10 years ago that astronomers have began to capture images of other planetary systems around stars. The techniques he went over were radial velocity techniques, coronagraphy, and the transit method.

Over 3,000 exoplanets have been found around other stars using the transit method, in which a planet passing between us and its host star blocks a small portion of the starlight, producing a subtle but periodic dimming pattern. TRAPPIST-1 was actually found using the transit method. Multiple transits for this star were detected with the TRAPPIST (TRAnsiting Planets and PlanetesImals Small Telescope) telescope, and their timings indicate the presence of three planets with orbit periods between 1.5 days and 73 days. These short orbits are likely to be in or around the habitable zone of the star, a zone in which liquid water could potentially exist on the planets' surfaces. Evidence that this is the case will have to wait until the 2018 launch of the James Webb Space Telescope, which will have the capability of measuring the chemical composition of these planets' atmospheres.


Dr. Burgasser ended his talk by making sure that each student was able to receive special glasses to view the solar eclipse on August 21, 2017.

# RESIDENTIAL LIFE

We are practically done with COSMOS! 4 weeks flew by! This week was filled with events. In addition to our regular week of programs that included Dodgeball, Ice Cream Making, Tie-Dyeing, and College Q & A, we had a dance, carnival, and a talent show. Everyone got dressed up for the dance and danced their troubles away. The talent show consisted of 20 incredible acts that ranged from singing to a comedy act. Lastly, we had a carnival where the big raffle prize was pie-ing our Faculty Director, Charles Tu. The lucky winner was Kai Jin from Cluster 2! I'm sure there are videos floating around somewhere. We're sad to say goodbye to these amazing and intelligent kids, but we look forward to seeing how they will change the world!


To see more photos from COSMOS 2017, click **HERE!**

# WEEK FOUR

# CLUSTER 1: COMPUTERS IN EVERYDAY LIFE

A lot happened at the end of last week. Last Thursday, we spent more time working with Arduinos for our alarm clock project. By the end of Friday, we had many different kinds of clocks including: one that would pour water on you, a cuckoo clock and ones that you have to chase to turn off!

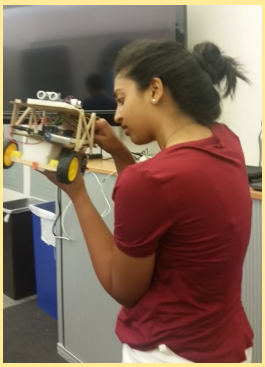
Last Friday learned about computer architecture including registers, MUXs, memory and ALUs. Then we had our last guest lecture from Manmohan Chandraker about computer vision. There are lots of applications of computer vision since images are everywhere – such as autonomous driving, games, smart homes, factory automation and more! It helps us investigate scientific problems like how animals recognize objects and how newborn babies respond to faces.

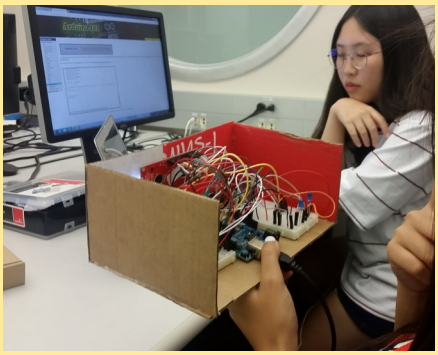
The majority of this week, we focused on our final projects. We got to propose our own final project and get it approved. It had to involve AppInventor, Raspberry Pis or Arduinos. After many hours of hard work and some laughs at the weird things our programs would do, we are just about done with many of the milestones in our projects. One project involves using an Arduino to turn pages for you! Another created their own unique "fit bit" type device and accompanying mobile app.

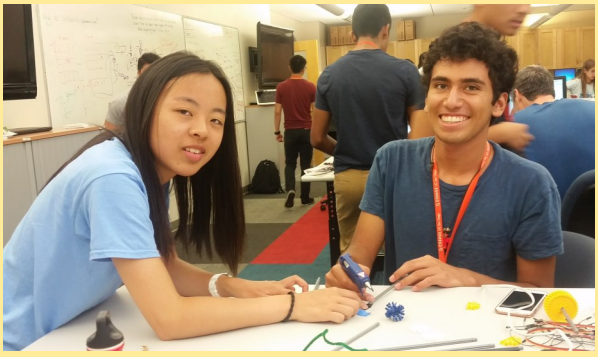
Some teams will be using their mobile phones (with an app they created) to control their Ardinos with various sensors and many servos! We have projects that are autonomous driving robots, one that will identify coins and calculate the total value of them, security systems, robots that will draw what is written on a phone and another that will track your movements and draw it on the screen, just to name a few! Students are using components on several technologies to interact with each other. 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 or Science Talent Search. These projects have a lot of work and heart in them and having great potential to do well in research project competitions. 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 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 Curt Schurgers and Professor Leo Porter) to our TAs (Matthew Kohanfars and Ravi Patel) to our RAs (Jen and Ruben), 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 2017) http://ucsdcosmoscluster1-2017.blogspot.com/ to see all the fun we had in class and on field trips!

From the author: Thank you to my bright, appreciative and overall wonderful students in Cluster 1. You made my "vacation" fun and energizing! Keep up your curiosity and drive for excellence. I know you will go far in your journeys! Your Teacher Fellow, Shirley Miranda







# CLUSTER 2: ENGINEERING DESIGN AND CONTROL OF KINETIC SCULPTURES

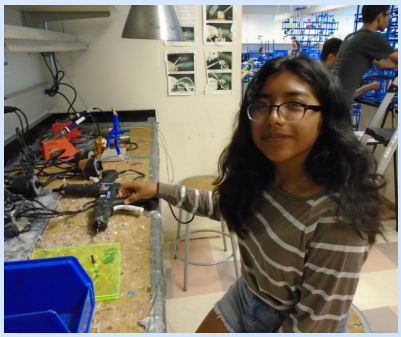
Week 4 of COSMOS was intense for Cluster 2 as they worked to finish their kinetic sculptures.

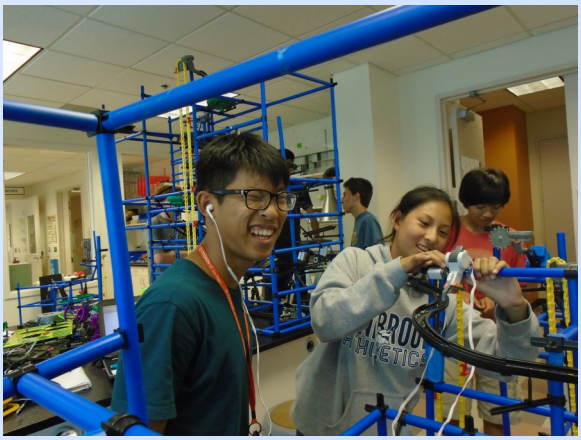
Monday was spent on the final sculptures, incorporating ideas from last week's mini sculptures. Students used their skills in CAD, fabrication, and programming to build their projects bringing together what they learned over the month at COSMOS.

On Tuesday there was an amazing discovery lecture on the search for exoplanets that could harbor life. Professor Adam Burgasser explained the latest techniques used by astronomers utilize to find these planets and infer their size, density, and orbit.

Also on Tuesday was the Cluster 2 field trip. Cluster 2 visited Solar Turbines and saw some of the most advanced manufacturing techniques in the world. 3D metal printing, machining, and laser drilling were the highlights. After the facility tour, Solar employees gave a panel presentation on their careers. In the afternoon we visited Spectral Imaging and toured the facility seeing a small employee owned company. Students got the opportunity to ask the engineers there about careers and engineering education.

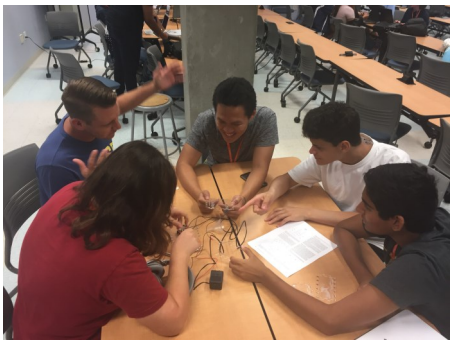
Wednesday was spent on the sculptures. Thursday students continued on the sculptures and worked on the final poster and website. Friday the cluster presented their projects to Cluster 9 in the morning. In the afternoon the design studio was spruced up for the final project presentation to parents on Saturday.



# CLUSTER 3: LIVING OCEANS AND GLOBAL CLIMATE CHANGE

It's hard to believe that we are just a few days from the end of COSMOS. I am very proud of Cluster 3's progress over the past few weeks. Many of us started the program with a limited knowledge of oceanography and atmospheric chemistry. We have been able to absorb a lot of knowledge from our amazing faculty and TA's. Now, we each are experts in our projects!

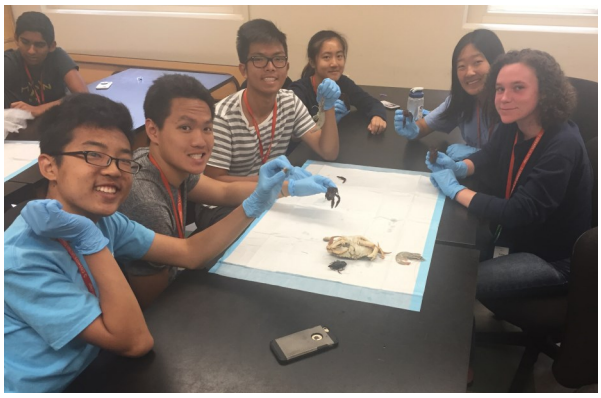


This past Monday we spent the morning down at Scripps Institute of Oceanography with Dr. Lai. Dr. Lai introduced us to the concept of taxonomy and classification by running us through several cladograms. Dr. Lai brought out several live specimen during his talk with us, including lungfish, turtles and mice that certainly added some excitement to the classroom environment. After lunch, we headed to the Natural Science Building where Joey taught us how to use Excel to organize scientific data.-- Shannon Z

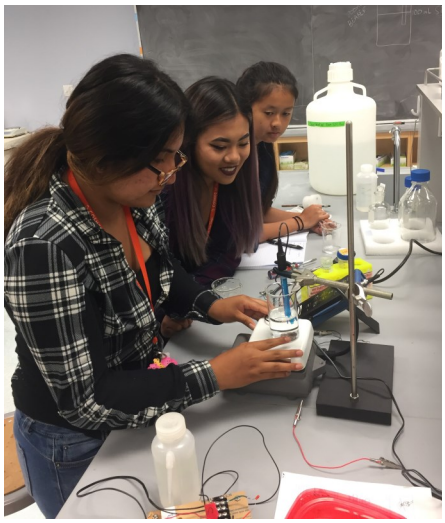
On Tuesday, we had our last Discovery Lecture with the astrophysicist Adam Burgasser regarding TRAPPIST-1 planets. It was extremely intriguing as he dived into the methods astronomers use to discover new planets. We then had our Science Communications class and worked on our final projects. My group finished analyzing our data and writing our abstract. -Yuwen W

On Wednesday, we spent our last day at Scripps in a lecture with Dr. Lai. However, the lecture was cut short so we could examine the tide pools and go swimming one more time before the end of COSMOS. Though there weren't many animals at the tide pools today, the head-high surf more than made up for it. Everyone in the cluster is busy putting the finishing touches on our projects, which are due in less than 48 hours. --Ian W

On Thursday we spent time running through our presentations and perfecting them in time for our due date. We added our final touches in order to be ready to present them to Cluster 6. In addition, we made final decisions amongst our group about how our presentation would be executed and what each person would be in charge of explaining. Overall, my group finished working on our project and are looking forward to presenting on Saturday.-- Jazlyn V



On Friday, we will be adding the finishing touches to our presentations and presenting to Cluster 6. We will see you tomorrow for presentations in the Red Shoe Room at Price Center!



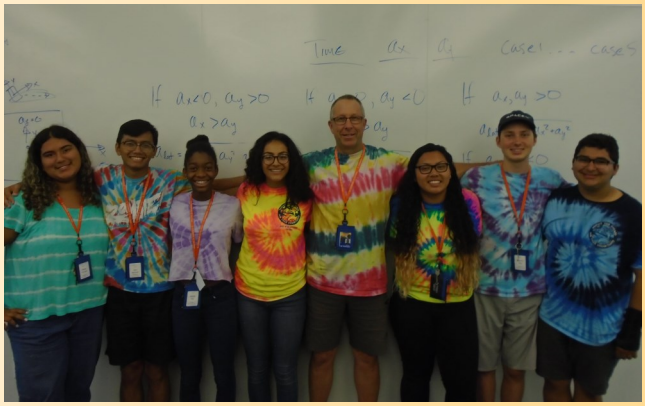
# CLUSTER 4: WHEN DISASTER STRIKES: EARTHQUAKE ENGINEERING

With COSMOS Opening Day as a distant memory four weeks ago, our talented Cluster 4 students march toward their eagerly anticipated research expo on Friday. Having met poster content deadlines including abstract creation, elaboration of their geophysical setting, and data analysis, our eight project groups look forward to showing their families what hard work can yield.

The week began with some final testing of their structures on the somewhat tired shake table. It has performed well after some intense usage for four weeks. Tuesday brought a fascinating Discovery Lecture with Dr. Adam Burgasser of UC San Diego's Center for Astrophysics and Spaces Sciences. His team recently played a role in the discovery of a new planetary system, named TRAPPIST-1, containing seven Earth-sized planets orbiting a single star. Such experiences are such a highlight of COSMOS, and it was interesting hearing our students discuss their excitement and their stimulating questions about what this discovery means to humanity and scientific knowledge.

Wednesday and Thursday were spent finishing, editing, and polishing their posters and presentations. It is not a simple task to communicate your experimental processes, your data, and your analysis, especially to an audience unfamiliar with structural engineering. Rehearsals have paid dividends, and our groups feel the confidence that accompanies proper practice. To lighten the busy mood, students played a lively 'Engineering Jeopardy' game, improvised a ping pong court, and participated in a question and answer with an engineering undergraduate.

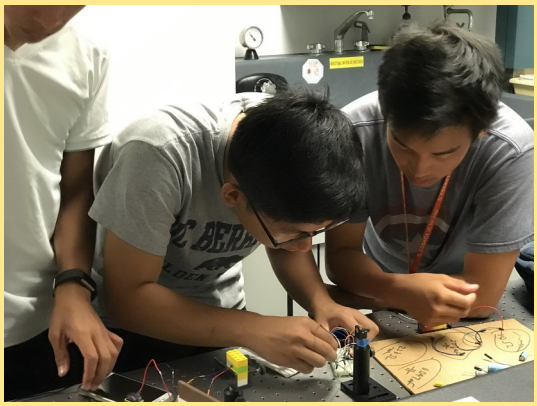
So the conclusion of COSMOS 2017 is here, and our students have expressed their thoughtfulness by thanking our cluster staff members. They gave an ovation to lead instructor Adel upon his final lecture, and similarly let cluster assistants Brandon and Allen know how much their help was appreciated. We have enjoyed the students as well, and look forward to hearing of their applications of COSMOS skills in their future high school and college careers. This was a warm, insightful, and friendly group. We wish them all the best!



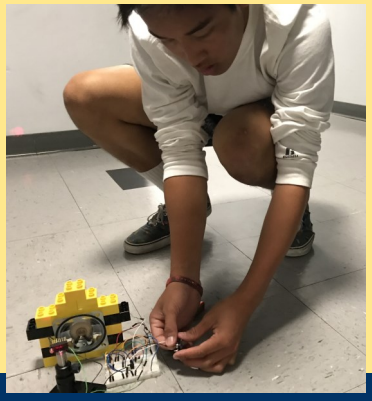
# CLUSTER 5: FROM LASERS TO LCDS: LIGHT AT WORK

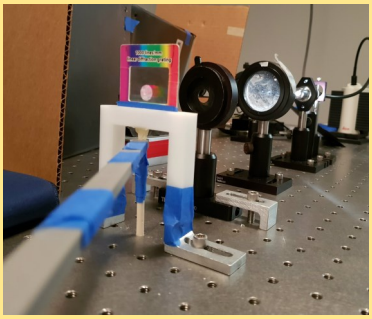
As our month-long COSMOS adventure approaches its end, the students of Cluster 5 continue to diligently work both in class, increasing our knowledge of photonics, and in the lab on our final projects. Each group of 3-5 students is finalizing their studies and constructions, with every day bringing about joyous screams as groups make new scientific discoveries or complete the creation of devices and instruments they had been developing. In addition to the projects that Cluster 5 has been working on, we've also seen another discovery lecture, this time from Dr. Adam Burgasser, on Astrophysics and Space Sciences and the discovery of the planetary system TRAPPIST-1. Even towards the end of the program, we continue to study and learn new topics in optics and other STEM fields.

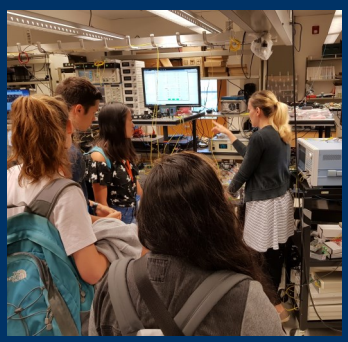
Outside of the classroom, we have also been able to gain new experiences related to the college and student lifestyle. On July 26th, we learned more about the other clusters here at COSMOS from their professors at the second part of the Cluster Exploration Session. Over the weekend, all the COSMOS students participated in a volunteer activity; either Feeding America, Beach Clean-up, or Gardening. Giving us a wonderful opportunity to give back to our community and make a positive impact on the world. We also had a carnival put on by the RAs where we were able to play games and win raffle tickets! At dusk, there was a formal dance for all the students. On Monday, COSMOS got a chance to show off our talents outside of STEM applications with the talent show, featuring music, poetry, and comedy acts.

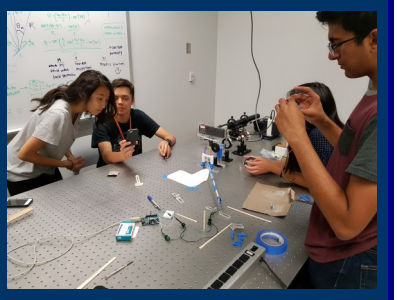


Though COSMOS is almost over, we will never forget the memories we made here or the things we learned during this exciting journey we shared together.
-Josh G







# CLUSTER 6: BIODIESEL FROM RENEWABLE SOURCES

Week 4, Cluster 6 has finished working on analyzing our Biodiesel and have completed the certificates of analysis. All of our project groups have completed their final projects and have been working on their presentation posters and their final presentations. We have had a great week together learning the chemistry associated with producing Biodiesel and the associated analytical chemistry involved in testing it. We look forward to presenting to all our family members on Saturday. Mr. Towler

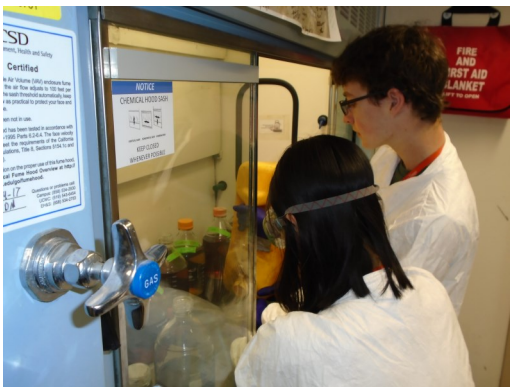
"In today's programming, we did Social Justice. It's really interesting because this was something we cannot learn from science. We discussed about some hot-debated topic such as racial discrimination and difference between sex and gender. This activity was really meaningful and educational because it taught me how to respect the others." -Yuhan S.

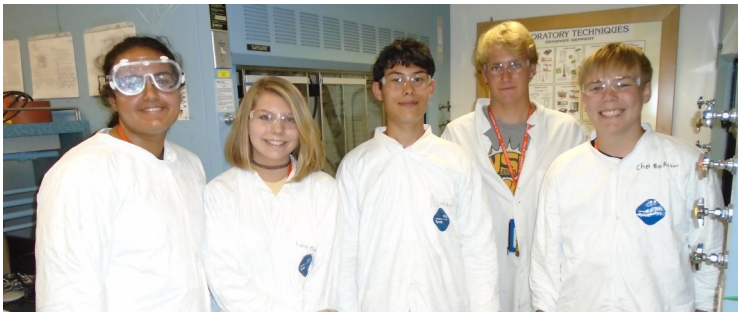
"Let's run, not walk, to the finish line." Andrew S."

We heard our last discovery lecture which focused on possible life on other planets. In the lab, we are wrapping up on our final projects, meanwhile everyone else is hard at work with their final project power points." Kathy T.

"On Wednesday, we spent the day working on the presentations and posters for our group projects. My group finished our poster and began to rehearse for our presentation." Athena T.

"Hello good food, bye-bye million-dollar lab equipment." Elizabeth W.



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

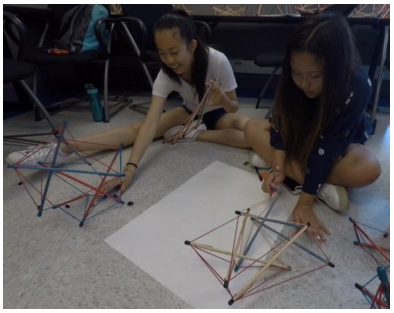
How can it be the end of COSMOS? How did a month fly-by so quickly? What I can say is that all of the students in Cluster 7 are extremely intelligent, outrageously talented, and are some of the kindest and caring students I've had a chance to work with. All 18 students worked hard and helped to create an environment that enabled learning and...a lot of fun! Thank you for being such excellent students, and I wish you all the best of luck in your future endeavors. -Your Teacher Fellow, Lindsey

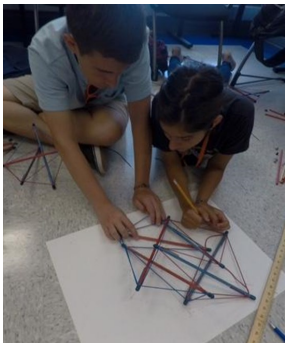
The students will share what we've been up to!

"Cluster 7 continued learning about the fundamentals of tensegrity structures and their applications in everyday life. Today the students returned to the engineering lab and spent all morning building tensegrity structures using triangular, quadratic and hexagonal bases. Cluster 7 then used protractors to calculate the average angle of rotation of these structures. Professor de Oliveira then showed us how to combine these constructions into larger formations such as pillars and tubes. Students learned that these are the only stable configurations to build reasonable large-scale structures from. After lunch, students then learned about feedback mechanisms in mechanical and biological systems. Students used Python to fix errors in the movement of their MIP robots. Professor de Oliveira then explained how similar systems function in bodies, such as in maintaining optimal temperature." -Zach and Karen

"During Tuesday's field trip, Cluster 7 students visited Illumina, a DNA sequencing research institute. At Illumina, Cluster 7 students saw different highly-specialized machines including a robot that can load PCR gels tens of times faster than an average person and sequencers that can sort through 20 genomes in 40 hours. They also got to play around at one of Illumina's training labs, using equipment like micropipettes, magnetic beads, platform shakers, and even one of the sequencers. In addition to having experienced lab work at Illumina, the students also got to talk to some employees, two of whom were COSMOS alumni, about their work, education, and experiences. After coming back from Illumina, the students collaborated to work on their final presentations." -Aaron & Stacy

"As the end of COSMOS is coming near, Cluster 7 was rushing to finish their final projects. During the morning, Professor De Oliveira introduced us to a final tensegrity structure we were asked to build. The rest of the time was allotted to work on our final projects. Today, we mainly focused on building tensegrity models as a visual aid for our projects. Our structures ranged in variety, from models of stents to large scale models of cells used in multiple processes. Luckily, many of us managed to build successful models that we hope will make our projects more interesting." -Sakhi & Amrita





# CLUSTER 8: TISSUE ENGINEERING AND REGENERATIVE MEDICINE

At the end of last week we visited Do Ho Suh's *Fallen Star* which is a house perched at an angle off the edge of the main Jacobs School of Engineering building. It shows Suh's perception of society and our surroundings. We all agreed that our visit was a fun break to take from our projects!

Week 4 began and ended with an immense amount of challenging work. It was overwhelming to us just how much planning and preparing was necessary to complete our projects and how much thinking was required to problem solve and analyze our data. As the week progressed all of the data was collected as our projects were completed, posters were created, power points put together, and our research paper ultimately finalized. Each group worked with a professor and TA in order to complete their projects. In the end we expertly presented our projects to our cluster, cluster 7, and on Saturday we will give professional poster presentations to our families and friends.

In our last Discovery Lecture, Dr. Adam Burgasser presented his recent research in astronomy and the discovery of the new planetary system, TRAPPIST-1, which contains seven Earth-sized planets around a single star, begging the question, 'are we alone?'. Our cluster thought that his presentation was, "enlightening and thought-provoking…definitely the best speaker this summer".

As COSMOS 2017 comes to a close, it is inspiring to see what everyone has accomplished. We have become proficient in our lab skills, refined our technical writing, and developed and implemented our leading edge projects. We all want to extend a gigantic thank you to our GR8 Professors, Dr.Sah and Dr. Gaetani, our extraordinary Teaching Assistant's, Erica Cacasan, Rebecca Drake, Marisa Keller and Nathan Ng, and to the best Resident Hall Advisor, Michael Hidayat.

**What I will always remember about COSMOS 2017 is…**

… learning Italian with Dr. Gaetani and forming three dimensional spheroids with cardiac progenitor cells. **Julie**

… struggling to clean the back of the hood. **Sandhya**

…the food. **Nathan**

…the many friends that I've made and the feel of ethanol dripping down my gloves. **Robin**

…my amazing roommate and the incredibly entertaining Cosmolympics and talent show. **Areli**

…the amazing people that I have gotten to know and all the experiences we've shared. **Alex**

…is wiping down the hood and my gloves with 70% ethanol and the late hours in the lab with the best project group ever. **Katie**

…how much fun learning can be when you're doing something you love with the best kinds of people. **Erin**

…is the time I stayed up until two to finish my ethics paper. (Shh don't tell Michael) **Tyler**

…the prestigious faculty, amazing teacher fellows, immensely supportive teaching assistants, and fellow students. **Priscilla**

…seeing everyone's faces every morning, all smiling despite our exhaustion. **Andrew**

…the passionate, dedicated, and inspiring people who help me to become who I aspire to be. **Victoria**

…the feeling of being around my amazing friends, who are all smarter and more talented than me, and just feeling inspired. **Sydney**

…the amazing fieldtrip to Advanced Biomatrix and listening to Maroon 5 on the bus there with Torry. **Sophie**

…the regret of not bringing long socks because the ones at the bookstore were so expensive. **Simran**

…the most genuine opportunity to experience interactions—social, academic, unique, and novel—that I have never had the opportunity of appreciating before. **Jennifer**

… the people here. I have met so many unforgettable people and I will forever be touched by all the memories I have made. **Lauren**

…the pleasure of spraying things with 70% ethanol, wonderful residential experience, and the amazing people I've met. **Trancy**

**Cluster 8 has had a Gr8 summer at COSMOS!**

# CLUSTER 9: MUSIC AND TECHNOLOGY

UCSD COSMOS is in the home stretch and students in cluster 9 have been immersed in their capstone projects for the past ten days. Professors Oliveira and Dubnov along with grad students Colin and Kevin have been providing technical expertise with a 5-to-1 student to instructor ratio. Much of the learning, however, has been autodidactic with students scouring the internet for resources and information to aid them in their work.

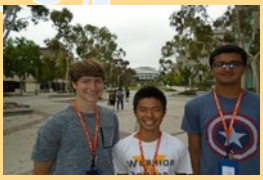
Project in progress are:

**Saachi, Rochelle, and Kaylee**: Creation of a musical harmony based on a user provided input melody using Pure Data audio software and Python.

**Laryn, Johnny, and Derek**: Creation of a glove that produces percussion sounds based on the position of the hand using accelerometers and pressure sensors connected to an Arduino.

**John, Mark and Eric**: Use of neural networks in applying style transfer used for images to the synthesis of sound using Python and Pure Data.

**Ashley, Sihyun, and Elena**: Comparison of the accuracy of a musical performance against sheet music with dynamic time warping using MuseScore and the Python Music21 library.



**Bhargav, Ryan, Ike**: AI melody creation using probabilities based on input chord changes using Pure Data, Python, and Arduino.

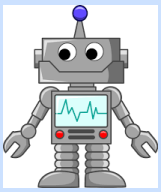
**Sam, Jun, and Nick:** Instrument tuner and synthesizer activated by voice recognition using Google voice recognition API and Python speech analysis.

**Tejal, Emily, Maria**: Software that receives a musical input and uses piezoelectric sensors to produce a percussion sound.

The cluster took an afternoon off last week to visit the Museum of Making Music in Carlsbad. The Museum is sponsored by the National Association of Music Manufacturers, a trade organization the promotes the sale of musical instruments. The group spent several hours viewing and playing several unique and antique instruments. The tour guide Barbara led the group through a history of twentieth century American music. NAMM president Joe Lamond spoke with group for half an hour and spent another half hour answering questions.

The past four weeks have been a whirlwind of information. Students have gained exposure, and in many cases proficiency, in hardware such as Raspberry Pi, Arduino, electronic circuits, and sensors, as well as software systems including the Python computer language and music dedicated software such as Pure Data, MuseScore, and Music21. Cluster 9 members are looking forward to concluding their projects and presenting to parents this Saturday.

# CLUSTER 10: ROBOT INVENTORS

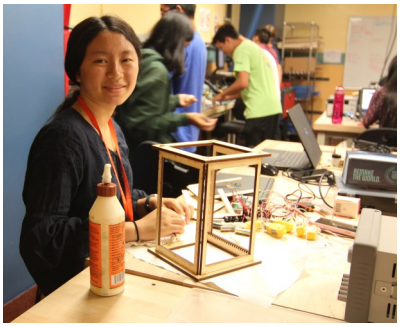


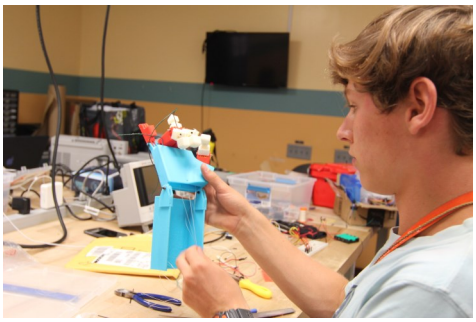
Cluster 10 has had an amazing final week here at COSMOS! Students are all working in pairs to create their own robot. These are designed fully by the students, and they will demonstrate them on Saturday for the families to see. Robots range widely in what they can do and how they are programmed. We cannot wait for you to see them in person!

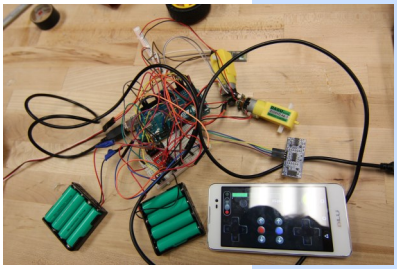
Our field trip to General Atomics last week was fantastic. Students toured their facilities in Poway (the company's headquarters), and they also spoke with engineers, designers, and managers there as part of a career panel. Students had the chance to ask many questions and see different systems and parts designed at General Atomics.

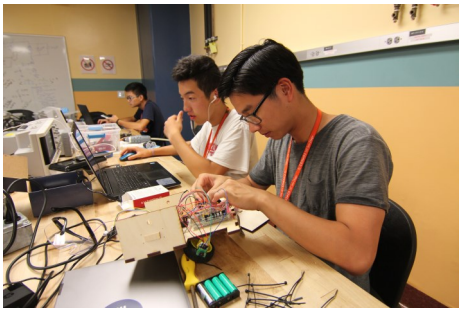
Last week wrapped up with a battle of the walking robots, with the fastest robot being the winner. Many different styles of robots were created and everyone achieved at least some walking motion! Students also finalized their robot designs for this week and have begun programming and development.

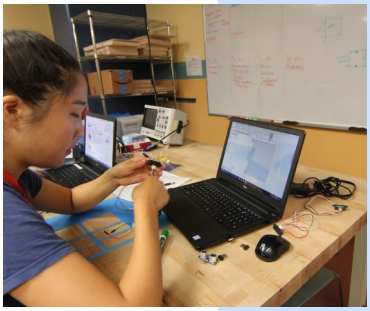
Overall, this has been a fantastic cluster - the students have worked very hard, challenged themselves, developed teamwork, and designed and programmed several robots! Curt, Mike, and Johnnie (along with the TAs) are very proud of the work the students have done, and of the skills they have developed. As the first ever UCSD COSMOS Cluster 10, thank you!

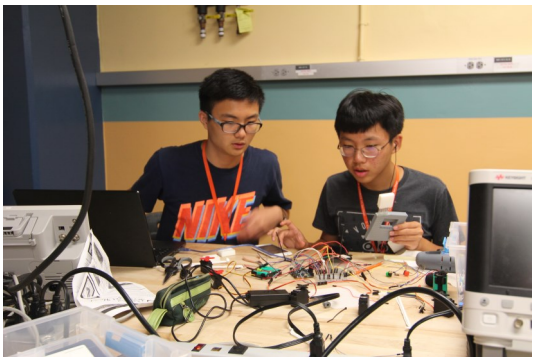













# CONGRATULATIONS!!!

## ….To Ethics Essay Awardees

## …. and Gordon Engineering Leadership Center High School Fellows.

Cluster 1

Cluster 2

Cluster 3

Cluster 4

Cluster 5

Cluster 6

Cluster 7

Cluster 8

Cluster 9

Cluster 10

## ….And Dr. Joseph Watson Awardees

# COSMOS 2017

CLUSTER 1

CLUSTER 2

CLUSTER 3

CLUSTER 4

CLUSTER 5

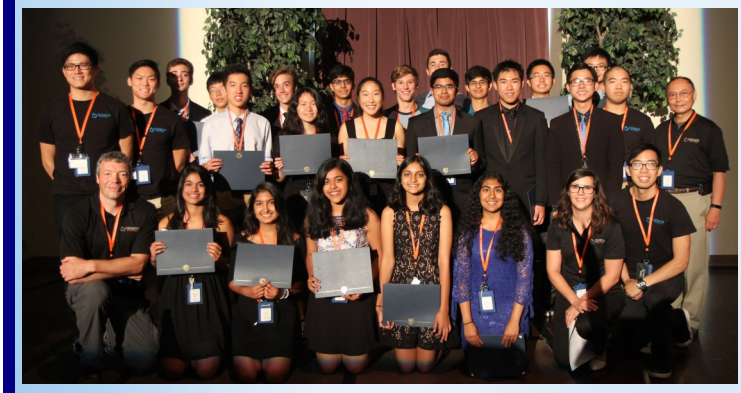
CLUSTER 6

# CLOSING CEREMONY

CLUSTER 7

CLUSTER 8

CLUSTER 9



CLUSTER 10


Teacher Fellows