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 2 Newsletter

UC ADMISSIONS PRESENTATION

On Tuesday night, the Office of Admissions at UC San Diego gave a presentation to the students on the basic eligibility requirements for applying to UC colleges and a visual of the competitiveness of the applicant pool. Following the presentation, there was a student panel conducted by the College Ambassadors, who are current undergrads at UC San Diego. The students had the opportunity to ask various questions about the campus and how to make themselves more competitive applicants. After the panel, the students walked over to Sun God lawn where they were split into 12 smaller groups lead by their regional Admission Officers, where they asked more questions, ranging from how can I make myself a more competitive applicant, to what classes they should take to better prepare for college. It was a successful event and we hope all the students would consider applying to UC San Diego.

IN THIS ISSUE:

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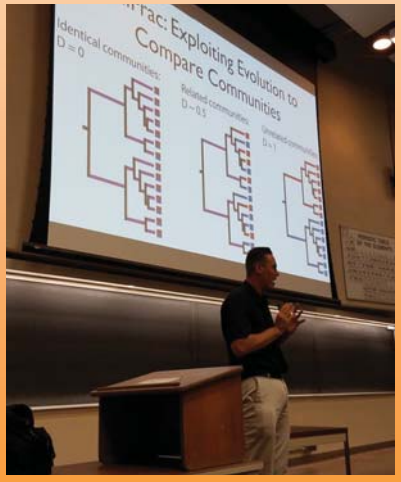
DISCOVERY LECTURE SERIES

COSMOS Students had their second Discovery Lecture this morning with Dr. Rob Knight, Professor of Pediatrics, Bioengineering, and Computer Science at UC San Diego. He began the lecture by talking a bit about the astounding amount of bacteria, not only on the planet, but also on the human body alone. 39 trillion bacterial cells live on the human body, making us pri-marily bacterial beings, rather than human beings.

Dr. Knight then shifted to discussing how it has become less and less expensive to determine your personal microbiome in your guts to try to learn more about your physical health. Similarly, it has become easier and less expensive to identify bacteria that exists in common places, such as on a cell phone or in a hospital room. Microbiology connects humans to the planet and Dr. Knight is connected to the Microbiome Project which, due to increase in technology is able to obtain quick results in sequencing human microbiomes.



Dr. Knight also spoke about how satellite data can be used to track microbiomes as they move through tides in order to track soil bacteria across the planet, with the goal of finding the "good" bacteria. His research also looks at skin samples as a model of microbacteria, as certain bacteria is found on specific places on the body. Dr Knight is trying to find out what function it is performing for the human, as a lot of bacteria is actually helpful to the host. Modern humans are depleting their microbiomes by moving away from the hunter/gatherer period and into the modern age. Research is moving in the direction of being able to identify more and more aspects of a healthy diet, to increase the good bacteria which will prevent many illnesses. What a fascinating area of research!

CLUSTER EXPLORATION

Professors from Clusters 1, 2, 3, 6, and 11 gave great summaries of the various projects and research topics that COSMOS students are engaged in. This gave students an idea of the variety of research going on at COSMOS and on the campus. We started off with Professor Curt Schurgers from UCSD's Department of Electrical and Computer Engineering, who showed us how COSMOS students are learning about coding and making their own apps in Cluster 1. Curt then spoke about Cluster 10, as he is also the faculty instructor for that cluster as well. Cluster 10 students are learning about all the different types of robots and how to build them from the ground up. Next we had Professor Raymond de Callafon, who discussed the topics Cluster 2 students are learning, such as making their own clocks as their first project and the progression in the coming weeks to building entire mechanical structures. Dr. Skip Pomeroy, instructor for Clusters 3 and 6, spoke about the impacts of climate change that Cluster 3 students study, and the many uses of natural products to build and to create new means of energy for the future.. Finally, Professor Jack Silberman spoke about Cluster 11, where students are learning to construct nearly every part of a self driving car.

Next week, students will hear from Clusters 4, 5, 7, 8, and 9!

RESIDENTIAL LIFE

This past week flew by fast for the COSMOS staff because we had an exciting and eventful weekend with the students. Last Friday, all of the COSMOS students participated in our annual COSMOlympics event. It was so much fun to see the students' various talents from playing instruments to watching them do gymnastics. They definitely brought in their own personalities to their performance skits. Cluster 10 are this year's COSMOlympics winners! Yay! This weekend we had the opportunity to travel with the students to the San Diego Zoo which is the most visited zoo in the United States. Students got to explore the place with their cluster groups as well as with their COSMOS friends. On Sunday, we all headed to La Jolla Shores Beach to hang out, relax, and soak up the sun! Students got in the water, some stayed behind in the grassy area to play card games, and others hung out with their peers. All in all, we had fun this weekend and ended the evening with s'mores at the shores! Throughout the week students were able to attend different programs such as Admissions Night, Karaoke Fun, Just Dance Party, Mason Jar making, Ice Cream Social, and Movie Night. This upcoming weekend is Family weekend and we are halfway through the program! While some students will go home for the weekend, the remainder of the students will have the opportunity to attend ice skating or bowling and Casino night. After the first week of awkward hellos and getting to know new people, your student has acclimated to the new environment and is making friends throughout the COSMOS Program.

COSMOS Advisory Board

visits the UC San Diego Campus

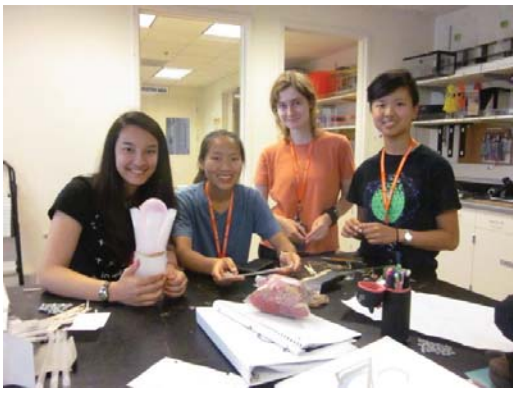
CLUSTER 1: COMPUTERS IN EVERYDAY LIFE

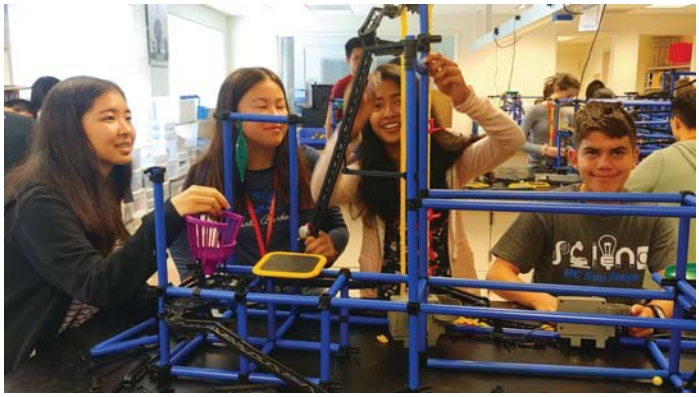
An update to Week 1's adventures can be found on our blog ucsd-cosmoscluster2-2018.blogspot.com. Demos of our labs, presentations, and photos and videos from Week 1 and COSMOlympics are now available. To see who was recognized with the Faculty's Choice and People's Choice awards check out our blog! Last Friday, we learned about Python and image processing. We learned how programs like paint and Photoshop do some of their basic functionality like finding a color and changing it to another or clearing the screen. We discovered how to do some image processing functions in Python. In lab, we began to work on creating our own unique image processing on photos – including using a green screen to superimpose ourselves into pictures with code. Then we began to work on tutorials for filters on images to do some basic image processing.

On Monday, Geoff Voelker was our guest speaker. Professor Voelker teaches operating systems and software systems courses. His research is on multiplayer network games. We had the opportunity to learn about what happens behind the scenes in massive multiplayer network games. For example, when you play these games, you are actually playing a game in the past (around 50 ms in the past) and there are several different ways for the system to handle lag times, predictions and interpolations so that it behaves as we expect. Afterwards, we learned about binary numbers and why we care about "base 2." We learned a little about encryption and the space on hard drives. Then we played "Around the World": converting binary to decimal, and Annie won "Around the World: Binary." After our Discovery Lecture on Tuesday about microbiomes, we got a chance to peer edit our ethics essay. It's due this week and the top COSMOS essays will be announced at the closing ceremony! Wish us luck! In the afternoon, we had our field trip to Sony Playstation. Our hosts True and Jessica are software engineers and Playstation Systems Architects and UCSD alumni. We got to learn a lot about Sony Playstation as a company, visit different departments and talk with many of its employees. It was a fun and invaluable experience! On Wednesday, we spent the day working in the lab on our image processing projects. We're excited to show off our work to our cluster and faculty on Thursday afternoon. You'll f ind the projects and presentations on our blog by this weekend. On Thursday afternoon, we'll learn about electronics, and on Friday we'll begin work on Arduinos!

CLUSTER 2: ENGINEERING DESIGN AND CONTROL OF KINETIC SCULPTURES

After a busy first week were students worked tirelessly on their clock projects, it was time for them to get in teams and start their first team project. Students formed their teams based on different areas of diversity. They considered cultural backgrounds, gender, skills, personality, and artistic vs. technical inclination. Professor Eliasson gave a lecture on Monday morning introducing the water balloon challenge, which is a kinetic sculpture project that provided an opportunity to learn systematic approaches in a design process, and learn how to work in a team. Students then worked in their groups to come up with the best design that will keep a water balloon from breaking after dropping it from various heights towards a bed of nails. They used Pugh charts to analyze the communication between the team members, as well as analyzing the advantages and disadvantages of each of their designs. On Tuesday, all COSMOS students attended a discovery lecture about Microbiomes in Human and Environmental Health by Dr. Rob Knight, who is the founding director of the Center for Microbiome Innovation and Professor of Pediatrics and Computer Science and Engineering at UCSD. Our students went back to the classroom, and each team presented to the rest of the cluster the process they went through as they worked on the balloon challenge. They discussed how they built, tested, documented, and redesigned the structures. Students had their first physics lecture on Wednesday. They learned about Dynamics of moving objects in Kinetic Sculpture, which was an introduction to their next challenge. They had to design and control Mini Sculptures and use at least 1 sensor, 1 actuator, 1 user input, then automate it. On Thursday and Friday, students had programming lectures and had to work on two challenges, the ping pong and the ball catch programming challenges.



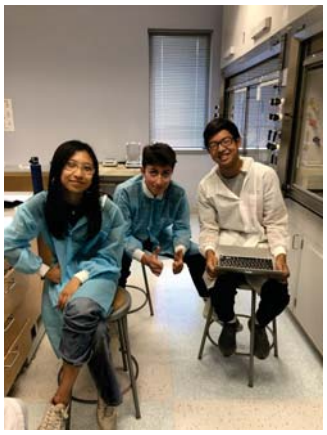


CLUSTER 3: LIVING OCEANS AND GLOBAL CLIMATE CHANGE

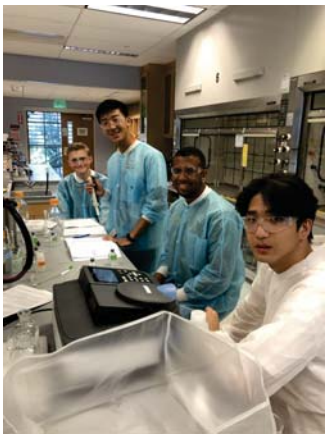
Hello from Cluster 3! We can't believe that the program is halfway over already. We have started on our projects, written our ethics essays and learned to navigate the campus. Here is what we have done since last time you've heard from us:

"We started last Friday with video lectures by Dr. Molina and Dr. Burney, where we learned about global warming and food security. We watched Merchants of Doubt, a sad movie about climate skeptics. After lunch, we enjoyed an afternoon at the Scripps beach. After exploring the tide pools with Dr. Lai, we got to play around in the water." Akshay P.

"On Monday 7/15, we participated in a lectured by Dr. Skip Pomeroy on greenhouse gases and learned how their specific molecular structures cause them to react differently to various wavelengths of light radiation. In the afternoon, we used reduction-oxidation reactions to determine the percentage of O2 in a sample of seawater and, under the instruction of George Anderson, performed the procedure using samples of seawater, H2SO4, NaS2O3, and starch." Vijay D.



"On Tuesday morning, all the clusters gathered at the Warren Lecture Hall for a Discovery Lecture by Rob Knight, who works in the fields of engineering, bioengineering, computer science, and pediatrics. He explained his work on the topic of "Microbiomes in Human and Environmental Health". His research connected the use of viruses and bacteria and the patterns of the seasons and wind cycles and how this information can together show and help predict where these pathogens will spread. Afterwards, we worked on our ethics essays until lunch, and then split up into our final projects groups. Cluster Three has groups working with aerosols, salinity, phosphates, silicates, and nitrates and connecting these topics to global climate change and how it affects our living oceans!" Anna N.



"For Cluster 3, Wednesday was a day packed with amazing experiences and the opportunity to see first hand the work directly related to the cluster's interests. The day started off with a long trek made worthwhile by the destination- the biological field station where students could witness the growth of algae as a source of renewable energy. Next, the students took a bus to the waveflume where students observed the fluctuations of the water and the explanations of the fascinating experiments taking place within. After lunch, the bus drove to the Hubbs Hatchery to see the location of white sea bass fertilization, maturation, tagging, and eventual release. Lastly, the aquafarm demonstrated the growth of millions of pounds of protein and the innovative technology used to farm mussels. The day ended with a movie night and the daily suite activities." Catherine D.

"On Thursday, professors presented lectures during Cluster Discovery. We gained insight as to what goes on the world of our fellow clusters, allowing us to explore what the clusters are learning about within their focuses. I especially enjoyed looking into the projects Robotic Inventors are working on along with my cluster's (cluster 3) future lab experiments." Christine D We look forward to sharing our experiences with parents this weekend!

CLUSTER 4: WHEN DISASTER STRIKES: EARTHQUAKE ENGINEERING

Week two started out as lovely as a day on the beach, and it was! Cluster 4 traveled to Torrey Pines State Reserve to observe the unique geology of the area. Learning about types and rates of rock formations, uplift, erosion made us ready for a little fun in the sun. We traveled from the rocky cliffs to the sandy shore for a little liquefaction in action demonstration. After a stop at the Visitor Center it was time to head back to UCSD campus.

Our instructor Rad taught the cluster about the structure of Earth and the types of waves caused by earthquakes. This background will prove useful in understanding the way the ground beneath the engineering projects might react to seismic activity. We received real seismogram data and analyzed the various peaks and different ways and time it takes for energy to be transmitted. Then we were able to calculate and determine the epicenter of the earthquake on inflatable globes.

Soil samples had to be collected in order to characterize properties. This is important to know when building on top of ground that may be unstable of prone to issues. It was easy enough to find sand, but seemingly difficult to find clay. After drying and further analysis, we discussed the building challenges for engineers that each sample presented.

Oh lollipop, lollipop! Learning about natural frequency is sweet! Jacqui helped us calculate the natural frequency and oscillations of various weighted rods. While the math calculations were challenging, it taught the importance of unit consistency and dimensional analysis.

Phase 1 testing groups presented their findings and handed over their lessons learned and projects to the newly formed phase 2 groups. With the information and discoveries from phase 1 hopefully the phase 2 testing will go smoothly. Regardless, we know it will be an exciting week ahead!

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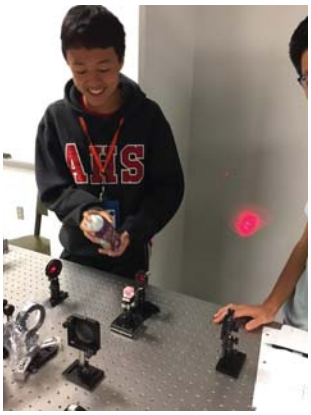
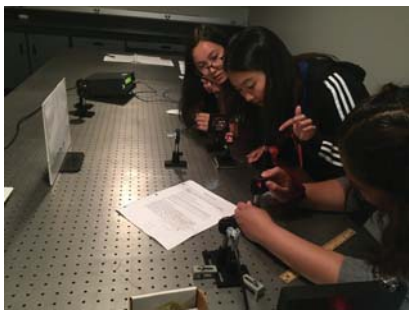
CLUSTER 5: PHOTONICS: LIGHT-BASED TECHNOLOGIES IN EVERYDAY LIFE

Somehow, we are already finishing up our second week of COSMOS! It sure is going fast, but that's what happens when you're having fun! Students in Cluster 5 are really settling in and getting comfortable with the morning lectures and afternoon labs, while still finding time to work on their Ethics Essays and have fun with their fellow COSMO-nauts. ;)



During the lectures with Dr. Charles Tu and Dr. Saharnaz Bagdadchi, students have been exploring some really interesting and high level physics and engineering topics. Just some of the topics include how semiconductor physics allows for LEDs, laser diodes, photodetectors, and solar cells, and how all of these ideas relate to fundamental geometric optics and enhance our technological society. Additionally, students saw some great optics demonstrations on chromatic and spherical aberrations from Dr. Janet Pan, with lights and lasers.

In the lab, students created their own solar cells using conductive glass plates, titanium dioxide, and berry juice as a dye to see which group could get the most current to flow from their cell. Also, they experimented with polarization, fiber optics, and interferometry as they started brainstorming and planning their Final Projects.



During the week, we were treated to a great Discovery Lecture by Dr. Rob Knight on how the Microbiome interacts with human and environmental health. Additionally, Eric Takeuchi from Daylight Solutions stopped by to explain the work his company is doing with Quantum Cascade Laser technology. On Monday next week, we will take a field trip to Daylight Solutions and tour their amazing facility!

Another busy week full of interesting, exciting, and fun science! Here's what some of the students have to say about their experience with COSMOS so far:

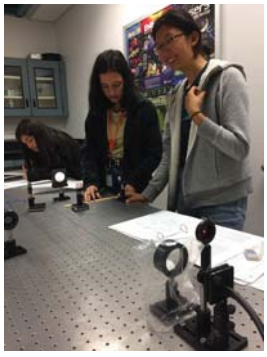
"Being able to work in a team on the labs every afternoon taught me a lot about photonics. It was great experiencing the concepts we learned in class while also collaborating with my teammates." - Joy L.

"I'm looking forward to making fun sounds with the holes in the tables everyday. And eating more mango popsicles :)" - Phoebe W.

"Working in a professional lab is very exciting and our experiments have opened up my interest in photonics! It is also really fun getting to know people in my cluster and making inside jokes with them." - Anne S.

"The best part of COSMOS would have to be interacting with the people here. I especially enjoy my suite time where I am able to just have a blast with the people in my hall playing games or just sharing stories."- Kevin C.

"I finally get to assimilate into this family two weeks into the program. Being a member in COSMOS encouraged me to step out of my tiny group to meet all the awesome individuals who enjoy the same principles as I do. I feel lucky to be part of this group." -Steven H.



CLUSTER 6: BIODIESEL FROM RENEWABLE SOURCES

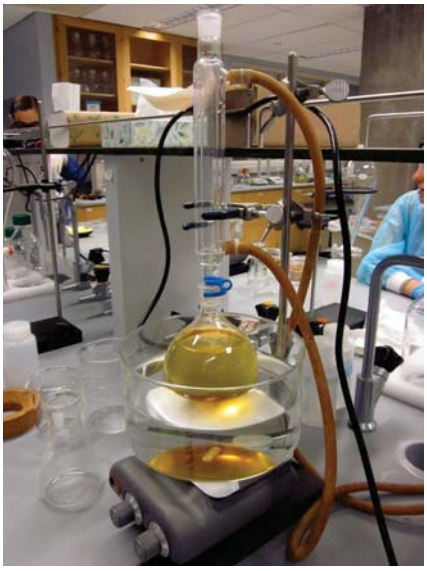
"Friday, we watched several recorded lectures and a documentary, Merchants of Doubt. After that, we went to the lab in York Hall and measured the water content in our biodiesel. Since all of us passed the test, we finished early and were able to visit the UCSD bookstore." Austin Yang

"On Monday, we continued our analysis of biodiesel. Every lab group was assigned a station to work in, and my partner and I worked with Dr. Watson in finding the cloud point and viscosity of our biodiesel. In the afternoon, we listened to Dr. Pomeroy's lecture of fossil fuels and diesel engines, which was an interesting experience." Cassidy Cheng

"Since it was a Tuesday, we had a Discovery Lecture by Dr. Rob Knight on the topic of microbes, such as the importance these microorganisms have on our health. Afterward, Cluster 6 went to the lab in order to resume our work on the individual group projects we had chosen. We were also given a presentation about the UCSD Application System and were given the opportunity to speak to the admissions officers about any questions we had." Daniel Kim

"On Wednesday, July 17, we traveled to four places on a day-long field trip alongside cluster 3: an on-campus algae farm, the wave flume at the Scripps Institute of Oceanography, the Hubbs Research White Sea Bass hatchery, and Carlsbad Aquafarm. During the trip, various professors and researchers explained their equipment and processes to us- we were even able to interact with graduate students and a news crew at the wave flume. We ate lunch with stunning ocean-side views and concluded the day by watching Black Panther in Warren Lecture Hall." Ella Nghiem

"Thursday started out with a cluster discovery session in which professors from 6 of the 11 clusters gave presentations to the entire COSMOS body to give a sneak peak into their projects. The discovery session will conclude next week where the remaining 5 of 11 clusters will present. The rest of the day was dedicated to project groups in which students returned to the York lab to continue analyzing their respective chemical reactions." Evan Bian



CLUSTER 7: SYNTHETIC BIOLOGY

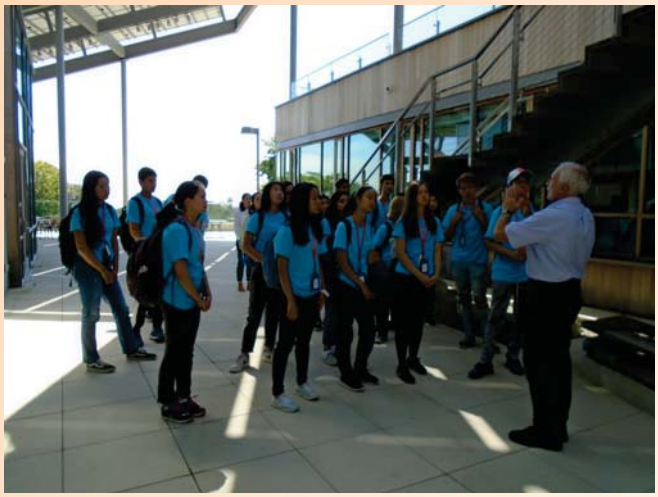
Students in Cluster 7 have been really busy learning about how to program living cells to make things like glowing green proteins and banana and mint smells. They have also been working on how to model genetic circuits using electrical boards, lights, resistors, inverters, and logic gates. They will be using Boolean logic to build their models, and programming their cells to do cool and novel things.They also visited the J. Craig Venter Institute to see where the first synthetic organism was created! It's been a really exciting week!

My first two weeks at cosmos have been amazing! Unlike my typical classes, I have been able to learn things that I genuinely want to learn under great professors. Earlier this week we had the privilege to go to the J. Craig Venter institute where we met with a variety of scientist outlining several innovations in the field of synthetic biology allowing us to see the possible uses of the ever growing field of science. ~Jose

"So far my time spent here has been very informative and interactive! I have learned so much from our Professors Dr. Vera and Dr. de Oliveira, fellow teacher Ms. Trudy, and from my hard working peers in the matter of 2 weeks. This week we had the opportunity to go to J. Craig Venter Institute (JCVI) and learn about their current research: to find a more effective and efficient way to treat type 1 diabetic patients. Overall, it has been a great experience so far and I can't wait for what the next 2 weeks await for us!" - Heidy C.

"I have had a blast during Week Two of the COSMOS program! Throughout the week we conducted two main labs: inserted the pGLO gene into bacteria that will result (hopefully) in the bacteria glowing green, and the Eau That Smell lab, in which we introduced a plasmid into E. Coli to have the bacteria smell like bananas at certain stages of growth. For me, working in a lab as nice as the one in Tata Hall, and using all the fancy equipment is amazing (it was really inspiring to see some of the same equipment, such as pipettes, being used in the Venter Institute too)! I can't wait for the weeks to come! - Kyra F.

Cosmos has been a really amazing experience so far and I have met so many talented, like-minded students. One of my favorite parts of the program is working in the labs with equipment I would never use in my high school. Recently, we grew E.Coli bacteria that contained plasmid DNA which we introduced into the bacteria. We also have amazing teacher assistants that attend UCSD and help us on our labs. Austin A



CLUSTER 8: TISSUE ENGINEERING AND REGENERATIVE MEDICINE

Our second week of COSMOS has been a busy and exciting one. We began with project introductions with Dr. Sah and Dr. Gaetani and have spent more time during the week researching our projects, developing our aims, designing our experiments, and creating study designs. We went on our first field trip to Advanced Biomatrix, a local company that makes innovative 3D matrix products for tissue culture, cell assays, and cell proliferation. They gave us a tour of the facility, an overview of their company, and answered all of our questions from how the business began, to what was involved in manufacturing and production, and the purposes of their various products.

In Science Communications we attended a Discovery Lecture from Dr. Knight, who spoke to us about the evolution of biomolecules and genomes in different ecosystems, have completed our ethics essays, and began to learn how to present our data. In the lab, under the guidance of our Cluster Assistance, Arya, Steven and Swetha, we have completed and mastered all of our lab skills and are now able to thaw, grow and passage cells, use a hemocytometer to count cells, make collagen gels, and use a microscope to examine our, stained and unstained, cells and tissues.

Friday we will visit Gilead, a local company whose vision is, “To advance therapeutics against life-threatening diseases worldwide”.

This week was GR8 because I learned ……

…the importance of ethical consideration in every field of science. Esha

...how to count cells. Jenny

…how advanced science has gotten and how we are on our way to being able to print organs. Kaylin

…how to perform sterile technique. Luke

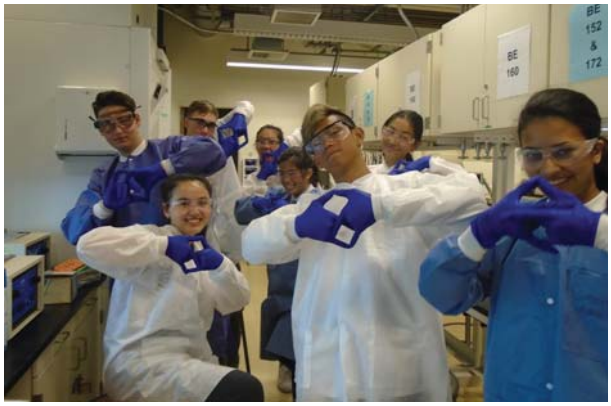
…how to use a microscope. Michael

…the power of friendship. Mitchell ps-Hi mom.

…about the importance of microbiomes and their prevalence in the human. Shreya

…how a biotech company operates with only five people. Smera

Next week will be GR8 as we will begin our much anticipated projects.

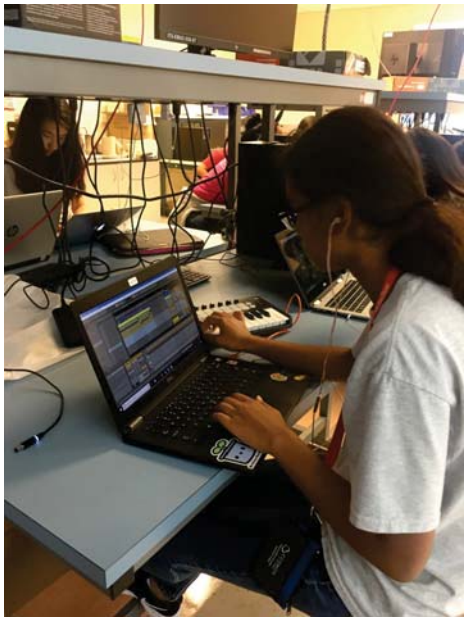


CLUSTER 9: MUSIC AND TECHNOLOGY

Even though it is only Week 2, we have already been introduced to a plethora of audio tools and resources. For example, we learned the basics of Pure Data, an interactive coding environment with powerful audio capabilities. We used tables in Pure Data to display values in a MIDI-like format and play the corresponding pitches with oscillators. Another program we have been experimenting with is Audacity, a digital audio editor, which can be used to manipulate audio files in a variety of ways.

In addition to learning how to use these programs, we had the opportunity to explore some facilities inside the Conrad Prebys Music Center. Specifically, we visited the Experimental Theater, a room with cutting-edge sound technology that allows the audience to experience different audio effects through the use of recording devices and speakers placed throughout the room. We also visited the Conrad Prebys Concert Hall, which was designed to project sound throughout the hall without the use of speakers.

Our professors also gave us the opportunity to record our COSMOlympics song in a recording studio. We then created our own samples that we will be able to use in our own productions. We're excited to integrate what we have learned into our projects over the next two weeks!



CLUSTER 10: ROBOT INVENTORS

Day 6: The students met professor Nick Gravish this week, and the cluster is now in new teams for a new challenge - navigating a maze using a camera operated through a raspberry pi. Nick introduced design to the students and they got to try out CAD to prepare for next week's competition.

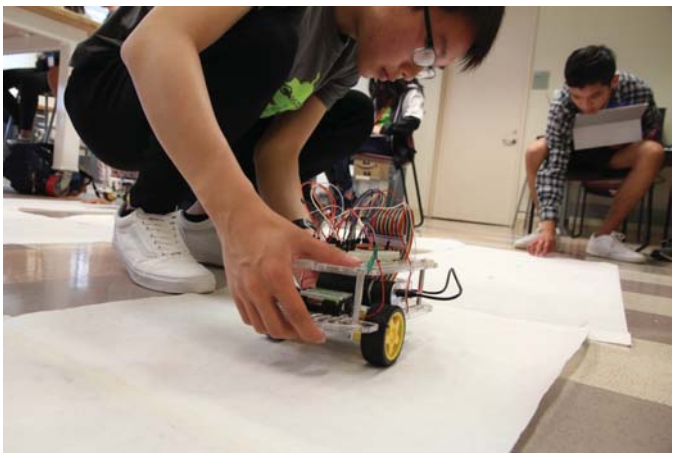
Day 7: Students began the day with the second discovery lecture, this time by Dr. Rob Knight who works with an incredible mix of human genetics and computational power to create giant datasets to help us understand how our microbiota affect our world. Students then worked on their ethics essays before moving to the lab for the afternoon to continue programming their maze navigation.

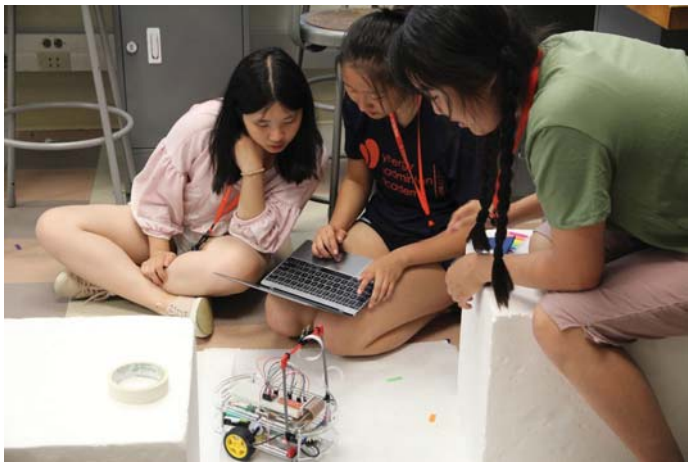
Day 8: Today began with Curt teaching the students about electronics and how different electronic components work. He also introduced different types of sensors and how they work so students can prepare for their final projects. After working on their ethics essay drafts once more, we moved back to the lab to continue the maze navigation challenge!

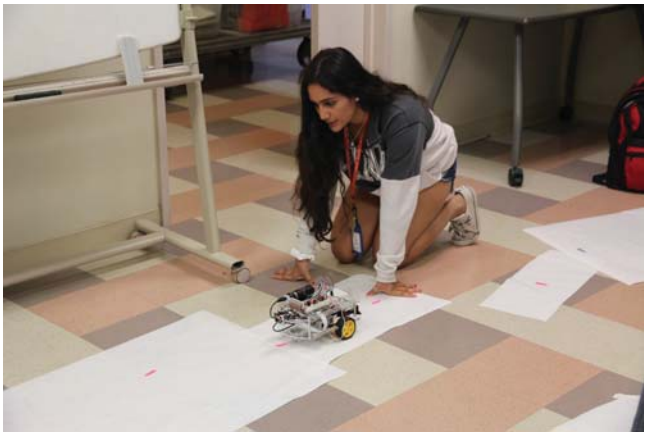
Day 9: Cluster exploration sessions started our day, so students got to learn about what many of the other clusters are doing and a bit of the science behind them. We went to the lab to show students their final maze and allow for code adjustments for battle Friday morning. This afternoon we had a field trip to General Atomics (no photos allowed inside unfortunately!), touring their drone facility as well as meeting with employees to find out about how they got into engineering and related fields.

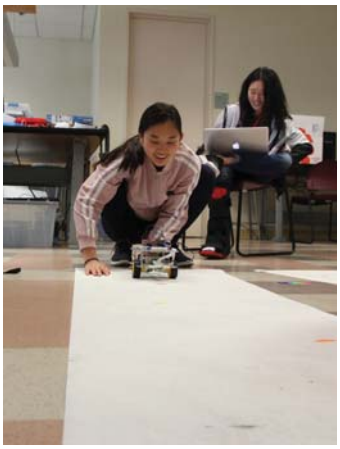
Day 10: Competition Day! Today began with students navigating the maze autonomously using their robot's visual systems. They also learned more CAD today to prepare for their walking robot challenge for next week, and were also introduced to their final project constraints so they can begin to prepare!

Congratulations to our Week 1 competition winners: Naama and Stefan!









CLUSTER 11: INTRO TO AUTONOMOUS VEHICLES

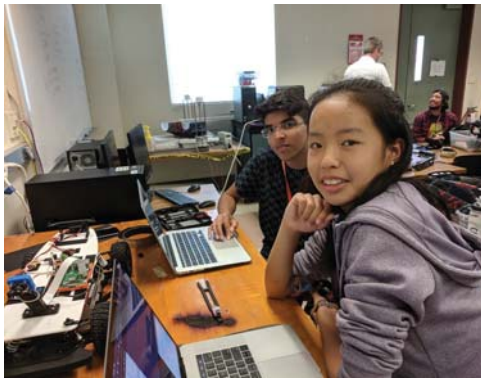
The week began with more work on electronics. Students had previously loaded the software needed for the project on their laptops and the Raspberry Pi, the small computer used to control the car. Students also got to see a self-driving wheelchair, another project that Cluster 11 leader Jack Silberman is involved with. We got to meet the UCSD undergraduate students working on the project and they talked about some of the engineering challenges of the project and how they have overcome them. The wheelchair uses computer vision similar to the RC cars Cluster 11 is working on. The wheelchair project students also discussed some of their experiences at UCSD with Cluster 11 students.

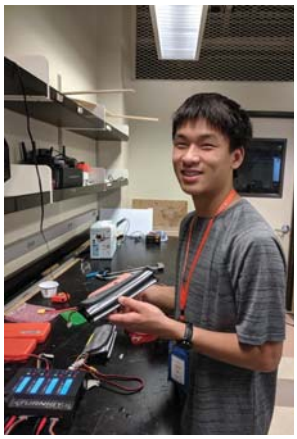
The students continued building the car, connecting all of the electronics needed. The car had to be converted from the default radio controller to be under the control of the Raspberry Pi computer. Students drive the car using a PS3 video game controller that uses Bluetooth to communicate with the Pi. The camera was connected to the Raspberry Pi so that the path driven by the human driver can be recorded by the Pi and then uploaded to be processed by the AI. The data on how to drive the car is then sent by the AI to the Raspberry Pi and the car can drive itself.

Tuesday started with the Discovery lecture by Professor Rob Knight on the human microbiome. After that, students returned to the engineering building to charge batteries and power up their cars for the first time. Some groups were able to drive their cars using the PS3 controllers. They were surprised by how fast the cars are and how difficult it is to drive them. Students had to adjust the acceleration and steering control the make the car more controllable so that the car could be trained properly. The rest of the afternoon was spent on driving practice.

On Wednesday, the rest of the groups were able to drive their car for the first time. The outdoor track was refurbished with orange tape to designate the center divider. The AI is capable of seeing color so the car will stay to one side of the solid white line and to the other side of the dotted orange line. Students were able to save data of their driving and then let the AI train using this data. In the afternoon the students learned how to connect to the supercomputer center to process their data faster. They practiced training the car by having the AI follow the movements of a person standing in front of the camera or even a metronome on a screen. In this way, the concept could be proven without having all the cars on the track at once.

Thursday's morning lecture was cluster exploration. Here students learn about the kinds of projects that the other clusters work on. After that, more training and letting the AI drive the cars rounded out the week.





COSMOlympics

Cluster 1


Cluster 2


Cluster 3


Cluster 4


Cluster 5

COSMOlympics


Cluster 6


Cluster 7


Cluster 8


Cluster 9


Cluster 10

COSMOlympics

Cluster 11

WINNERS:

1st :Cluster 10

2nd: Cluster 9

3rd: Cluster 3

San Diego Zoo