

COSMOS UC San Diego

California State Summer School for Mathematics and Science

₹UCSD | School of Jacobs | Engineering

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

Week 1 Newsletter

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COSMOS 2017 has begun!

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

CONTACT INFORMATION

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(during the summer program)

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RECAP of OPENING DAY

Two hundred and five students arrived on the UCSD campus for the greatly awaited COSMOS 2017 program to begin. Families and staff were found dispersed throughout the Eleanor Roosevelt College (ERC) as students moved into their suites, their home for the next month. The joyful music and friendly environment was very welcoming. All people present then walked to Solis Hall for the Introduction presentation and Welcoming remarks. Students then split into their clusters and took a tour around campus led by the Residential Advisors. They then returned to ERC and said their good-byes to their families. The clusters had ice-breakers for the students to begin meeting each other, for they will be working and learning closely together throughout the program. Dinner was well-enjoyed at the college dining hall, Cafe Ventanas. After dinner, the rules and boundaries for the program were



clearly explained. There were still plenty of activities left to do for the day. More ice-breakers were played by everyone together and others that involved friendly competition between the clusters. Eventually, everybody headed to their suites, where they finished moving in and met with the group of people with whom they will be living. Lights were out by I I:00pm, to ensure enough energy for the next day. This was only the beginning...

RESIDENTIAL LIFE

e are happy to inform you that your student is alive and well. The RAs have put on a variety of programs for your student this week. Programs have included Laundry 101, college trivia, volleyball, Just Dance, canvas painting, and origami, just to name a few. The students have also been hard at work preparing their cheers and choreographing their dances/skits for the annual COSMOlympics competition between clusters for Friday afternoon. I'm sure students will post videos of the event so be on the lookout for those. On a different note, we are thrilled to report that despite having 205 teenagers, there have been no major injuries. *knock on wood* Though safety has been our number one priority, the students have been successful in creating a lively and energetic community in a short period of time. All in all COSMOS has been off to a great start in and out of the classroom.



DISCOVERY LECTURE SERIES

Dr. Alice Yu presented the first Discovery Lecture of the summer with a lecture titled "The ABC's of Translational Medicine". She obtained her Medical Degree in 1968 from National Taiwan University. She then continued her studies in the United States, where she obtained a Masters Degree from Yale and a PhD from the University of Chicago, both in immunology and microbiology. Dr. Yu's lab is currently involved in a highly successful Phase III clinical trial for the immunotherapy of neuroblastoma. Her research is also focused on understanding the molecular characterization of tumor suppressor genes in the childhood cancers neuroblastoma and leukemia, and exploiting these discoveries in clinical trials.

Dr. Yu defined translational medicine and proceeded to inform the students about how important it was in modern medicine. Many advancements in treatments of various cancers have been made possible due to translational medicine. Dr. Yu also described the drug discovery process from preclinical studies to clinical studies, which can take anywhere from 10 to 20 years. She described the differences between the four phases of clinical trials and how the costs increase as drugs enter each phase. It takes about \$2.5 Billion to deliver a new drug. Dr. Yu also described how important it was to protect people who participate in clinical trials. The concept of informed consent is very important. Every clinical trial must follow the Helsinki Declaration, a set of ethical principles regarding human experimentation developed by the World Medical Association. Dr. Yu ended her talk by going over a couple of examples of treatments used to treat various forms of cancer and leukemia that were made possible through translational medicine.





amily Weekend is July 21nd through July 23th. Students must be checked out by an adult specified on the Family Weekend Form between **5-9pm** on Friday and must return between 2-5pm on Sunday. Optionally, students can be checked out at 5pm on Friday and returned by 9pm that same evening or alternately, 2pm on Sunday, returning by 5pm that day. We do not have the staff to accommodate individual schedules. All students MUST be back to campus by 5pm on Sunday. PLEASE speak with your child and let us know by email if their choice for the weekend has changed so we can staff appropriately. There are many students who will be staying on campus during the weekend and the RAs have a full schedule of activities and fun

planned for those students. If you have any questions, please call our office at (858) 822-4361 or email

cosmos@ucsd.edu.

Admissions Presentation: 7/23 @ 3pm. Parents welcome to attend!

CLUSTER 1: COMPUTERS IN EVERYDAY LIFE

Cluster 1

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

On Wednesday, we began to learn about Python! It's a powerful language that is fast, friendly and easy to learn. In fact, our first

lesson in programming on variables, controls, methods and functions resulted in us being able to read the Engineering librarian that will help Python code and correctly concluding what it would do. After our lesson, we had a guest speaker. Sanjoy Dasgupta, whose field is Artificial Intelligence, spoke to us about "Learning Without Supervision". It was inspired by early childhood development and how babies learn about the world around them. Hierarchical clustering is done once attributes are assigned to an item to determine "what" it is. For example, with animals, some attributes could be: furry, stripes, tail, swims, hops, desert, and plains. A zebra would be assigned a 1 (true) or 0 (false) if the attribute is true for it and an overall value would be computed. Hierarchical clustering would group "like" animals together. Machines would then be able to learn the types of animals based on what it "sees". During lab, we finished up working on our apps and continued to discover the possibilities and limitations of working on a mobile platform.

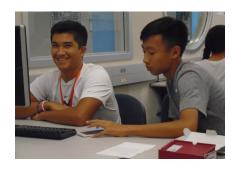
Thursday we heard a presentation from the Science and us do our research for our upcoming work. In the afternoon, we'll finish up our apps and present our work to our cluster. The presentations will be available on our blog http://ucsdcosmoscluster1 2017.blogspot.com/. Our first presentation to the cluster will Thursday afternoon to share what each group did for their original app.

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

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







CLUSTER 2: ENGINEERING DESIGN AND CONTROL OF

KINETIC SCULPTURES

Cluster 2 started week 1 of COSMOS with safety training. Students met the Cluster TA's Marika, Marshall, and Robert. Dr. de Callafon introduced the projects students will be working on this summer. Dr. Delson taught a lesson on clocks to introduce the first project, making a clock. We had a pizza party for lunch on Monday. After the pizza party the Cluster viewed the pendulum clock built by UCSD engineering students on campus. We then went to the Design Studio for instruction on safety and how to use the equipment. The Cluster then learned Autodesk inventor a Computer Aided Design program. Students used CAD to draw the escapement wheel and

On Tuesday we had the Discovery Lecture by Dr. Alice Yu on Translational Medicine. We then learned the physics of pendulums and spent time on CAD for the clock. Tuesday afternoon was spent in the Design Studio and on CAD.

pendulum for their clocks.

Wednesday Dr de Callafon introduced students to the Working Model 2D software. This program lets the students simulate their clock tions. Cluster 2 Website pendulums and later their final pro-

jects. Students learned about physical and computer models and became familiar with the powerful software program. Students have also learned about the physics of pendulums and how to predict the period of a pendulum using MathCAD

TA Marika focused on helping students with Working Model 2D. Robert assisted students with CAD and Marshall worked with students in the Design Studio. Students learned to use the Lasercamm to cut their pendulums from a sheet of acrylic. The first pendulums took shape and were tested for timing.

On Thursday all the clusters learned how to do research in the library. Cluster 2 then learned how to predict the timing of the clock using two different physics models. Calculations were performed with the help of the CAD program and MathCAD, an engineering math program. Students also started on their clock report webpages.

On Friday students spent extra time in the lab finishing the clock and comparing the clock's timing to their mathematical predic-









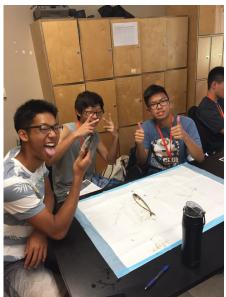




CLUSTER 3: LIVING OCEANS AND GLOBAL CLIMATE



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

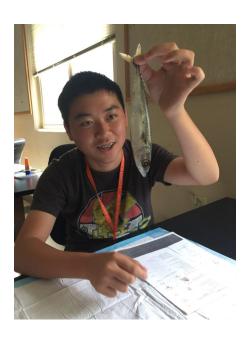


Day 1: "On day one we were introduced to the world of biology and chemistry. We handled shrimp, crabs, and sea anemones." - Lynette W.

Day 2: "Challenging lectures, fantastic meals, and exciting sports activities are all on my growing list of positives, a trend that I'm sure will occur for the rest of the COSMOS program."

- Alphonse O.

Day 3: "After engaging in a lesson regarding fish identification, we were allowed to spend time at the beach and bond as a cluster". -Ben A.









If Yoda wandered in to our cluster four workspace during this first week of COSMOS, no doubt he would have observed that the force is indeed with us. Forces, loads, moments, trusses, and perhaps some tension (and compression) were in the room as well. Our tenacious students were exposed to some sophomore and junior level engineering concepts during lecture, definitely challenging them at times, but they emerged with a feeling of accomplishment and curiosity.

Principal instructor Adel provided the bulk of the engineering lectures, and facilitated the activities along with cluster assistant and graduate student Brandon and undergraduate cluster assistant Allen. Students initially began a group team building activity involving the designing and building of a K'Nex structure, and then testing it on the shake table. The complication was that they were judged on a performance index for their structure, requiring their design to account for the costs of the pieces. We had some rewards for the winning group, which seemed to inspire the other groups in the subsequent activities.

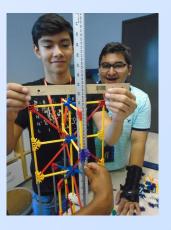
On day 2 they were fortunate to learn the basics of truss analysis. Students may have suggested I used the term 'endured' instead of 'fortunate', but when the dust settled they really did have a deeper appreciation for the usefulness of mathematics in engineering. After designing their own trusses, a load was applied to the point of failure, and the students analyzed the performance.

Further testing and analysis was conducted on several different types of metal 'coupons' as students considered tensile stress and strain, and capacity and demand. Your students will happily explain these concepts to you sometime!

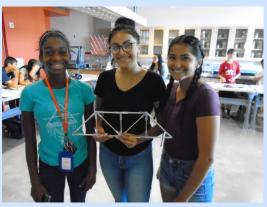
On Friday students were placed into one of eight project groups: timber structures, masonry structures, reinforced concrete columns, liquefaction, slope stability, tuned mass dampers, base isolators, or soft story structures. Next week we will hit the beach at Torrey Pines State Park for some geological appreciation and time in the sun before designing and building prototype project structures.













CLUSTER 5: FROM LASERS TO LCDS: LIGHT AT WORK













Cluster 5 started with a lecture on lab procedures and eye safety. We were surprised to learn that using lasers period for Cosmos Cluster 5. After discussing lab safety and requires lenses fitted with special lenses that shield specific wavelengths. We learned about the different strengths of lasers and their effects on humans as well. Afterward the cluster attended a lecture by Professor Charles Tu about the basics of light and energy. After lunch at Canyon Vista Restaurant, where they served a steaming bowl of ramen, we walked to the photonics lab in the basement of the Jacobs Engineering building and learned about total internal reflection and Snell's Law with Dr. Peter Ilinykh. -Lucy S & Adam Cooper

Tuesday morning we attended our first Discovery Lecture called the ABC of Translational Medicine which was given by Dr. Alice Yu. Next the cluster had a Science Communications session with Teacher Fellow Adam Cooper. We brainstormed ethical issues in the field of optics and photonics for our ethics essays. After lunch, we attended our photonics labs, hosted by Dr. Peter, assisted by Mr. Rui La and Mr. Sushant Kumar. We experimented with prisms and gratings in order to calculate the angles of diffraction. Annie explained her steps for calculating the resolving power of the prism in a way that was clear and understandable to the other students. Ronak presented his findings about the resolving power of the prism. He explained that he qualitatively confirmed his calculations using observations from the experiment. - Lucy S. and Adam Cooper

The past week has been an exciting introductory schedules, we have embarked on our journey of light. Although it has only been a few days, we have learned about many different properties of electromagnetic waves, and the physics involved in these properties. We have learned about the behavior of various particles in p and n type semiconductors, and about the physics of combining the two semiconductors to form solar cells and light-emitting diodes. We have continued into refraction and diffraction, and their applications in splitting light. As we look to the future, we see forever more intriguing labs, lectures, and projects. —Matthew M.

On the social side of Cluster 5, this past week has been fantastic. After extensive personal introductions and "icebreakers", both within our cluster and throughout Cosmos, our cluster has become exceptionally well acquainted. At the time of writing, we are preparing for our Cosmolympics presentation. Every individual seems uniquely talented, and our script attempts to utilize the artistic, musical, and humorous talents of our cluster. We have become particularly friendly, and at meal times, we often eat together, by choice. It appears that we are beginning to acquire the reputation of an extremely bright, enthusiastic, and companionable cluster. -Matthew M.

CLUSTER 6: BIODIESEL FROM RENEWABLE SOURCES

Week 1, the focus of Cluster 6 was to make Biodiesel. We have made Biodiesel from Soy Bean Oil, using the process or transesterification, washed the impurities from the product, and dried the Biodiesel to remove water. All our cluster are doing well, and got a good reaction. Next week we'll start the analytical tests to certify our Biodiesel. Mr. Towler

"In just one day, I have become phenomenal friends with my suite mates and cluster mates. Our 2 hour ice breakers games sparked excitement in me for the next 2 pretty cool. My group's project deals with lowering the weeks." Jenna C.

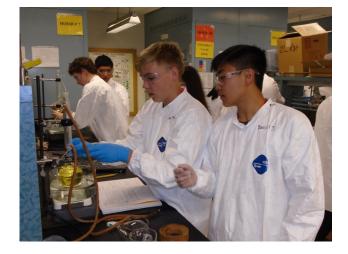
ters first sat through a Lab Safety Training. Cluster 6 went into the lab for the first time and was able to get right into creating biodiesel out of vegetable oil and methoxide." Andrea F.

"I woke up tired, but overcame that to take an active role in the lab. After class, Mafia was my favorite part, the bonding let me feel right at home." Truman F.

"After adding water to the biodiesel and washing out the impurities, we needed to evaporate the water out of it. We learned about why this eliminated the risk of microbes and allowed the biodiesel to burn hotter and faster, creating less emissions." Anusikha H.

"Today we started on our final projects, which was melting point of biodiesels by adding acetals, which are "Today was the first day of classes in which all clus- waste products from the original biodiesel synthesis process." Daniel J.









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



Wow...what a week! Cluster 7 started the week with a few presentations on safety precautions and procedures, library resources, and our first discovery lecture from Dr. Alice Yu on Translational Medicine. Each week the students spend Monday, Wednesday, and Friday with Dr. Vera in lecture and lab and on Tuesday and Thursday, students spend time in Science Communications working on lab analysis questions and their Ethics Essay. Each student will discuss a Bioethical issue concerning Bioengineering. Students have chosen topics ranging from GMO's we see in everyday life now to Cryonics, which has a potential to be possible in the far future. Everyone is enjoying their time at COSMOS and doing an exceptional job! Here is what the students have to say:

Lab Day 1: "Today was our first day of COSMOS!!! Surprisingly, we managed to all meet at 8 AM on time in front of the cafeteria. Thanks to the cluster RA's Isaac and Lizzie, we made our way to the first lecture of the day: lab safety. While slightly drab, the lab safety lecture is pertinent to our safety at COSMOS. We then attended a secondary lab safety lecture specifically for Cluster 7 and 8. After a morning of safety instructions, we were to embark on our journey of bioengineering! We were introduced to our teacher fellow Lindsey Carlyle and professor Dr. Carlos Vera. Dr. Vera introduced himself to us as well as his expectations of our academic performance. We then introduced ourselves to the class, with a brief description of what we believe in. Some common answers were access to higher education, helping others, and hard work paying off. We were also informed about the schedule of our cluster: how lectures and labs were paired, as well as the division between bioengineering and mechanical engineering within the cluster. PIZZA! We left the classroom around 12 and had pizza for lunch with cluster 8. Lunch was relaxing, and from there we attended our first official lecture and lab. The lecture was about the red blood cell (RBC), and we also learned about their functions and red blood cells diseases such as sickle cell anemia! Afterward, we went down to the lab and put on our safety equipment: gloves, glasses, and lab coat. Then, we did the first lab of two which dealt with pipette handling. The second lab was more of a group experiment regarding genetic transformations with LB agar plates. This lab was done in preparation for the pGLO lab coming in the future. Although the labs were intricate, we eventually figured it out and learned a lot of cool things!" - Ria & Renee

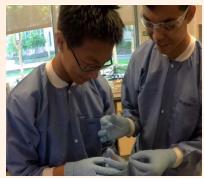
Lab Day 2: "Wednesday was a very packed day for cluster 7. We had three labs in a day. For one lab, students made a blood smear and got a closer look under the microscope with the help of our student lab TA who also was an COSMOS UCSD alumni. Students stained the cow blood after to take even a closer look and were able to identify the different types of blood cells like the White and Red Blood Cells and the platelets. In the second lab, students were given an unknown solution, and they were asked to determine the osmolarity of the solution based on the morphology of erythrocytes. And finally in our last lab, students prepared LB agar plates to grow E-coli for their pGLO transformation experiment that we will have on Friday."











CLUSTER 8: TISSUE ENGINEERING AND REGENERATIVE MEDICINE

A short time ago, on a campus not so far away, COSMOS begins... Sunday night we had time to meet everyone in our Cluster, our RA's and our suite mates, and time to finish moving in. Monday morning arrived quickly as we enjoyed our breakfast at Café V and went to our safety meetings, one general meeting, and one specific to bioengineering, after all safety is our top priority. Then it was off to meet one of our two professors, Dr. Gaetani, a research scientist at Sanford Consortium, who gave us an introduction to Tissue Engineering and Regenerative Medicine, specifically how tissue engineering began, how it has developed by the practice of combining scaffolds, cells, and biological molecules to form functional tissues, and how these tissues have helped with wound healing and even the formation of functional organs such as a bladder. Completing our morning, we had an opportunity to meet our returning TA's Becky and Erica, both graduate students in Dr. Sah's lab, and our new TA's Marisa, a recent graduate from UCSD who is currently pursuing her Masters' and Nathan who is entering his fourth year of undergraduate work at UCSD. For lunch we enjoyed a pizza party near the bear and this was a GR8 break before we proceeded back to our lecture/discussion/brainstorming room to meet our other professor, Dr. Sah, a bioengineering professor at UCSD. He introduced us to the history, techniques and details of cell culture so that we will be prepared when we start our own cell cultures next week. As we finished our first day of class, we had the opportunity to learn to pipette and discuss the labs for Tuesday.

Tuesday morning began with a Discovery Lecture from Dr. Yu, who spoke to us about her 20 years of work developing antibody therapy. After lecture, it was off to a library presentation where we learned the skills we need to be a more effective researchers. We then debriefed in Science Communications and heard about our ethics paper that we will be researching, developing and writing over the next two weeks. As Science Communications continued this week we discussed what components make up a GR8 presentation and began to discuss how to write like a scientist.

Lab time continued during the week and we have now mastered how to pipette using serological pipettes and micro pipettes, make and pH a solution, do serial and simple dilutions, use a spectrophotometer, and use sterile technique to make media. We have taken time to evaluate graphs, learn to graph using excel and how to use statistics such as standard deviation to examine the validity of our data. Next week we will learn cell culture and begin growing cultures on our own In lecture we have continued to expand our knowledge about Tissue Engineering from Dr. Sah as we learned about the variable characteristics of tissues and organs, how these differences create challenges in tissue engineering, and what techniques researchers use to conquer these obstacles. Dr. Gaetani has taught us more about characterization of tissue and elaborated on various methods and purposes of microscopy in the laboratory.

Finally, on Thursday we took our first field trip to the Sanford Consortium where we toured a wide variety of labs, learned about the robust collaborative research, and enjoyed a poster session from graduate students. Lunch was perfect at the glider port, overlooking the ocean! On Friday night we will compete in COSMOS Olympics. Stay tuned for more about both of these in next weeks' newsletter.

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













CLUSTER 9: MUSIC AND TECHNOLOGY

COSMOS cluster 9 got off to a rousing start with dazzling displays of technology and artistry. In the first three days, cluster 9 students were exposed to a variety of musical and technological tools. Dr. Oliveira gave an overview of the nature of soundwaves and introduced students to a sound recording and analysis software package called Audacity. Audacity generates sounds or takes sound inputs and allows the user to analyze these. Audacity also serves as a simple mixing system with which musicians can overlay multiple recording tracks. An even more challenging software package, called Pure Data that was developed at UCSD, was taught to the cluster on Wednesday by Teaching Assistant Kevin Haywood. Pure Data is a drag and drop sound synthesis system that allows students to create increasing complex sound synthesizing and processing combinations. Teaching Assistant Colin Zyskowski gave an overview of Arduinos, Raspberry Pi, and other microcontrollers that cluster 9 students will use in creating their capstone projects. During the Tuesday session, Teacher Fellow Jeff Mellinger led students through a few Audacity projects. During the Wednesday session students were instructed in the art of concert conducting by Dr. Dubnov. The session was highlighted by a group improvisation performance. Among those leading the improvisation were Nick P. and Mark E. on guitar, Sam L. and Emily K. on violin, Rochelle T. on Clarinet, Ryan W. on Trumpet, Saachi K. on the cajon box, and Ike T. on keyboard. In addition, a number of students experimented with instruments from Dr. Oliveira's homeland, Brazil.









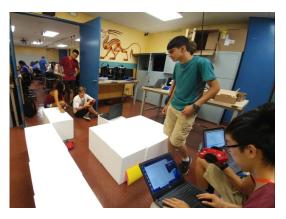
CLUSTER 10: ROBOT INVENTORS



Cluster 10 is off and running this week with a set of programming and design challenges. Students have been tasked with using a "scribbler" robot to design an image on a piece of paper. The robot has a pen in the center, and using their coding skills (students are learning Python), they must guide their robot to a creative picture design. The drawings were fantastic, and students presented challenges they faced in the design and implementation process.

Once students were comfortable programming their scribblers, they were introduced to image processing, and are currently working on programming optical systems to guide their scribbler through a maze. The shape of the final maze will be created on their competition day, so their scribbler must be able to navigate an unknown path. Alternatively, students can take on the challenge of showing their robot a single image, and letting it self-navigate through a maze based on that image. The fastest robot wins!

In the mornings, students have spent time learning from their amazing professors, Dr. Schurgers and Dr. Yip, about programming in Python, image processing, the history of robotics, and how to use SolidWorks to design their own 3-D printed parts. Additionally, students are learning from their teacher fellow, Johnnie Lyman, about ethical challenges in robotics and how to communicate information effectively with a broad audience. Students have gathered and presented data on one another, created a quick pitch for a novel robot design, and are writing for an essay contest on ethics in science in engineering around the topic of robotics. Overall, they are working hard and meeting the challenges!









COSMOS Style















Closing Day Information—Aug 5th, 2017

- Parents should plan to be on campus at 8:30am and meet at the Warren Mall in front of <u>Jacobs Hall</u>
- Parents will be escorted to the classrooms where presentations will be held
- Presentations will begin promptly at 9am
- The awards ceremony and closing ceremony will begin at approximately 10:15am and end at 11:45am in the <u>PC Ballroom</u>
- Students must checkout of the dorms between 11:45am—
 1:00pm in front of the dorms at Eleanor Roosevelt College
- Please Park in the <u>Gilman Parking Structure</u> and follow the signs to the Warren Mall. Parking is free on the weekends.

Parent Information

Several parents have requested access to other parent contact information to see if there is interest in creating carpools for parent weekend or closing day. Please follow the link and add your information if you would like to share your contact info with fellow COSMOS parents. Parents are responsible for reaching out to each other. If you do not wish to be contacted, do not add your information.