



# COSMOS UC San Diego

California State Summer School for Mathematics and Science



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

## Week 1 Newsletter

### COSMOS 2014 has begun!

Cosmos is here and what a week it has been! The students are settling in, making new friends and becoming familiar with the campus. This newsletter, the first of our weekly newsletters, will provide you with a glimpse into your students' lives over this past week. A few of the clusters also have websites which you may visit to view their cluster activities. Not all clusters have one, please see below for the links to the clusters that do:

Cluster 1: <http://ucsdcosmoscluster1-2014.blogspot.com/>

Cluster 2: <https://sites.google.com/a/eng.ucsd.edu/kinetic-sculpt/>



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### IMPORTANT INFORMATION

#### Mail

Please address **REGULAR MAIL** to:  
Student's FULL Name  
COSMOS @ UCSD  
ERC Conference Services Center  
9450 Gilman Drive  
La Jolla, CA 92092-0100

Please address **PACKAGES** to:  
Student's FULL Name  
COSMOS @ UCSD  
Jacobs Hall, Suite 1400  
9500 Gilman Drive #0429  
La Jolla, CA 92093-0429

#### Contact Information

COSMOS Office Hours:  
(during the summer program)  
Monday - Friday: 7:30am - 5:30pm  
Emergency after hours, please call:  
(858) 255-0667  
Email: [cosmos@ucsd.edu](mailto:cosmos@ucsd.edu)  
Phone: (858) 822-4361  
Fax: (858) 822-3903

# DISCOVERY LECTURE SERIES

## “Engineering as a Force for Public Good”

Dean Albert Pisano, Dean of the UCSD Jacobs School of Engineering, began the UCSD COSMOS Discovery Lecture series on Tuesday morning with his talk on “Engineering as a Force for the Public Good.” Although the Dean spoke briefly on this topic on COSMOS Opening Day to the parents and students, his morning lecture illustrated in more depth the necessity of engineering as a force for positive social changes around the globe. Dean Pisano asked the students to look around the room and notice that everything in the room was something that an engineer had been involved in creating in some way. His talk challenged the students to expand their concept of engineering beyond their current beliefs into applications that are just emerging. An idea that he talked about was “Introduction to Abundance,” applying engineering solutions to global problems. Engineering solutions could eliminate major problems in medicine, sustainable energy, transportation safety, providing solutions for the developing world within one generation. Bioengineering advancements are producing epidermal electronics for medical monitoring that look like a temporary tattoo but are packed with electronics. Besides the electronic monitoring, the Dean stressed the importance of engineering in solving the problems of adhesion, stretching and compressing with the skin, porosity to allow data transmission and water exposure. Advancements in tiny photoreceptors are allowing them to be surgically implanted in people who have failing vision, restoring sight. The students learned how engineering advancements are allowing solar panels to predict how much energy they will collect based on received atmospheric readings. This allows accurate supply calculations for power companies helping to stabilize the price of electricity through reliability. The Dean’s lecture gave students a glimpse into the future of engineering, the necessity of engineering, and the diverse roles of engineering in creating positive global social change.



## REMINDER!

Family Weekend is July 18<sup>th</sup> thru July 20<sup>th</sup>. Students must be checked out by an adult specified on the Family Weekend Form between 6-9pm on Friday and must return between 2-5pm on Sunday. Optionally, students can be checked out at 6pm 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 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](mailto:cosmos@ucsd.edu).



# RECAP of OPENING DAY

One hundred and eighty one students arrived on the UCSD campus for the greatly awaited COSMOS 2014 program to begin. Families and staff were found dispersed throughout the Eleanor Roosevelt College (ERC) as students moved into their suites, their home for the next month. The joyful music and friendly environment was very welcoming. All people present then walked to Peterson Hall for the Introduction presentation and Welcoming remarks. Students then split into their clusters and took a tour around campus led by the Residential Advisers. 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 throughout the program. Dinner was well-enjoyed at the college dining hall, Cafe Ventanas; afterwards 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

clusters. Eventually, everybody headed to their suites, where they finished moving in and met with the group of people with whom they will be living. Lights were out by 11:30pm, to ensure enough energy for the next day. This was only the beginning. “  
-Belen H., C3

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## RESIDENTIAL LIFE

Your minds will be at ease to know that your student is alive and kicking. As a matter of fact, students have been kicking soccer balls, kicking and screaming when we make them go to sleep at 11pm, and kicking it with their neighbors, cluster mates, and the staff. Activities have included Laundry 101, basketball, chalkboard design, Mason Jar Sundae, ice breakers galore and more. And that was just the first four days. They have also been hard at work preparing their cheers and choreographing their dances/skits for the famous COSMOlympics competition between cluster-set for Friday afternoon. We are thrilled to report that we have had no major injuries so

far despite housing 181 teenagers. In fact, there has been some significant hand strength building from activities like high fives from Akhil and detailed lanyard making by William. Other types of learning have been happening outside of the classroom as Shannon has assisted Phillip in learning his right head turn from his left and Maggie demonstrated details of the Grand Canyon. Kalpana and Lisa are working at hard at making dance turns a step of ease for everyone while Ann-Katherin became seaweed for a little while so Noah could have a chance at being a shark. Though safety has been our number one priority, the students have been successful

in creating a chatty 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. We hope to continue developing the community next week as we go to the zoo; we try out the beach; make it over to the natatorium; and continue to kick it!



# CLUSTER HIGHLIGHTS

## CLUSTER 1: COMPUTERS IN EVERYDAY LIFE

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. Most of us had worked on it before, but it is a scripting language with a



graphical interface which allowed us to put together our simple app in a matter of hours. AppInventor allows us to develop applications for Android based devices, like cell phones. Some of our first applications for the Android phone include: I Have a Dream (which played Martin Luther King's speech and others), PaintPot (drawing and painting application), and a Mole Mash game (similar to Whack-a-Mole). 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 will 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 practiced number conversions between different bases. Then we played "Around the World" where Prof. Kastner showed us a flashcard with a binary number on it and we had to give the hexadecimal equivalent. The "winner" was the one who could go around the room against each person and return to their seat - therefore going around the world. Casey came out on top and won - with Elaine at a close second behind! We also had some guests come to talk to us about robotics. Will and Daryl were undergraduate students in Professor Kastner's Embedded Engineering Design class who built a robot that could solve a Rubic's Cube in about 20 seconds. They challenged us to determine how many different combinations of colors could be made on a cube. One group (Bill, Casey, Anjali, Michelle and Angela) calculated it correctly and got Rubic's Cubes of their own as a prize! It's 43,252,003,274,489,856,000.)

Thursday we heard a presentation from the Science and Engineering librarian that will help us do our research for our

upcoming work. In the afternoon, we will finish up our pro-



jects, create a demo of it and put together a presentation. We'll present our work to our cluster. The presentations will be available on our blog.

On Friday, we'll begin working on Scribbler Robots during lab. We can't wait to begin to get our robots to obey our every command!



# CLUSTER 2: ENGINEERING DESIGN AND CONTROL OF KINETIC SCULPTURES

We have started off quickly in Cluster 2! On Monday we met Professor's Delson and de Callafon, our leaders for the next four weeks. We started by looking at different processes engineers undertake when designing products. We began our investigation into the most mechanical of all devices... clocks! Using the grandfather clock in front of the Jacob's School, the students got a first-hand look at how a



Things didn't slow down on Tuesday when we sat in on the first Discovery Lecture with Dr. Pisano, the Dean at the Jacobs School. He discussed with us the many exciting aspects of engineering at UCSD. Whew! In the afternoon, we continued designing our clock pendulum using AutoCAD software, using the tools in the design studio to build the clock's stand. This included drilling, pressing, and tapping various components into place.



While we mostly worked on our clocks Wednesday, we heard from Dr. de Callafon on the use of computer model simulations in design. We learned to use virtual model 2D, a simply amazing piece of software that allows us to simulate gravity, air resistance, and friction. We will model our pendulums so that we can compare the actual pendulum to a computer model!

clock actually works (fun fact: at one time the British Navy offered the equivalent of the "X-prize" for developing an accurate clock, why?). Students ended the day by receiving parameters for their own clock project! Each of the students will design and build a working mechanical clock, using a LaserCamm to cut out acrylic pieces. This is awesome!

Finally on Thursday, we started our day with information from the library staff. We learned about the many resources available at a research library and how to access various sources while researching topics for our final projects.



# CLUSTER 3: LIVING OCEANS AND GLOBAL CLIMATE CHANGE

In the first week of COSMOS, Cluster 3 has hit the water swimming. Our faculty are Dr. Pomeroy, Climate Change and Dr. Lai, Oceanography. Teacher Fellow, Mr. Tim Towler of San Diego High School of International Studies, is new to COSMOS this year. Below are student observations:

“We kick started our first full day at the beautiful campus of Scripps Institution of Oceanography with Dr. Lai. We got firsthand experience with sea creatures in their habitats. We learned about the marine ecosystem and were able to dissect a lizard fish! In the morning, students explored the tide pools north of Scripps Pier. There were amazing sea creatures to discover and observe. By the end of the day we got exclusive access to the Scripps pier and were able to get an amazing view of the tide and waves, even able to spot stingrays.”



- Jennifer C.

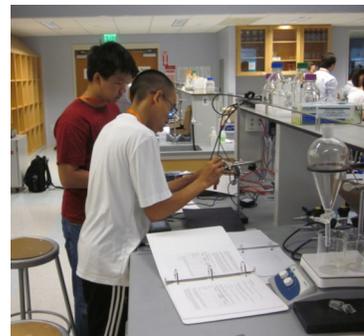
“Tuesday we had the amazing opportunity to have Dean Albert Pisano lecture us. We discovered how engineering can help improve society inspiring many of

the COSMOS students to believe in their own engineering capability. After the lecture, we focused on the information presented and how the information was presented. Focusing on the delivery of the presentation will help us for our future presentations. We broke off into project groups for our final science project with three groups remaining on the UCSD campus with Dr. Pomeroy, two groups traveling to SIO with Dr. Lai.” Each group was introduced to their mentor and began to brainstorm ideas for the topic of their project. “

- Ash L.



“Wednesday, we had our first lecture in global climate change. The instructor, Betsy Stone, introduced us to albedo, the ratio of the amount of radiation reflected from one surface to the amount of radiation striking the surface. We used equipment such as a temperature probe and light sensor with a LabQuest unit in order to determine the percent reflectivity of different surfaces by using colored paper to model them. Next, we received a quick review on molecular chemistry and learned the criteria for gases to be green-



house gases. The lecture continued on infrared spectroscopy and we did a virtual lab on Hooke's law and the spring constant. We went to the Pomeroy Lab nearby to watch an infrared spectroscopy on a balloon made of rubber and filled with helium.”

- Bryan P.

We are still at the beginning of our four weeks with COSMOS and have just begun to delve into our group projects, which will be challenging yet rewarding. We look forward to the experiences yet to come and our project presentations at the end of our investigations.



# CLUSTER 4: WHEN DISASTER STRIKES: EARTHQUAKE ENGINEERING

Cluster 4 students had every right to be dazed and confused following lectures in structural engineering and geophysics.

Instead they showed perseverance and determination as they met the challenge of designing, testing, and analyzing structures. Their hard work and smiles can be viewed in pictures and videos which will soon be uploaded to our Cluster 4 GoogleSite.



Our Cosmopolitans display promptness, daily preparation, and inquisitive attitudes. Their initial activity was designing and building a K'Nex structure, and then testing it on the 'shake table'. After an introduction to structural design, ingenuity and thought lead to designs, some of which withstood simulated seismic energy testing while some failed. Several 'back to the drawing board' moments served to further motivate students. Yes, they are beginning to think like engineers!

We attacked truss analysis, finding math and conceptual skills tested while receiving soph-



omore college level information. They designed and assembled wood and aluminum trusses, calculated a predicted strength, tested them and adapted after unanticipated results required analysis and redesign. They applied the lecture information received one day earlier and beamed with satisfaction with improved results.

Students are learning that not all building materials are equal. We will study metal 'coupons' for tensile strength and behavior, crunch numbers and formulas using Excel, quantify the differences between aluminum, steel, and brass, then graphically display the data. We also will take time to review some physics including vector analysis and summation of forces.



Thursday's field trip, was a guided geologic tour of San Diego by Kevin Robinson, who had given a geology lecture to the students. We appreciated the topography and panoramas from the top of Mt. Soledad, ate lunch at La Jolla Cove, and then went up to Torrey Pines State Natural Preserve where several trails provide magnificent views. We identified several rock formations representing past coastal environments. It was all starting to come together and make sense!

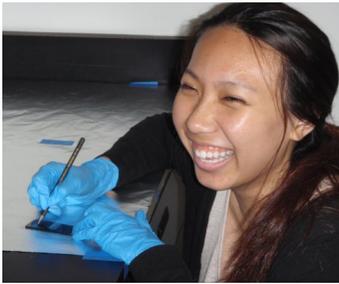
On Friday, they will be placed into project groups to design,



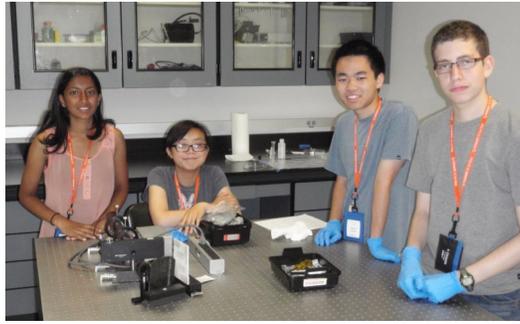
build, test, redesign, and collect data on an assigned structural type. This will be their focus for the remaining three weeks. It is our pleasure to work with your terrific students this summer, it is a highlight of our year! Cluster 4 rocks!

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

The first week of COSMOS is almost over, but the memories are just beginning! We have bonded in class and lab along with preparing for COSMOlympics. We have been busy! After learning about safe usage of lasers and lab equipment, Dr. Tu began our introduction to Light, Optics, and Photonics covering the many applications and concepts of light. He demonstrated bending of light by the use of polarization and dispersion glasses, glow sticks, and lasers.



In the lab that afternoon, we saw the power of lasers, as Dr. Peter Ilinykh demonstrated how the energy in light can be used and directed to burn paper and wood. Dr. Ilinykh, along with Cluster Assistants Joseph Smalley and Joseph Ponsetto (commonly called “The Joes”), then combined different lasers to show the effects of refraction, reflection, and dispersion. Taking measurements and using Snell’s Law, we were able to accurately predict Total Internal Reflection and Critical Angles in different materials, the concepts used in fiber optics and lenses.



Students enjoyed Dean Al Pisano lecture about “Engineering for the Public Good”, impressed with his passion and enthusiasm for engineering and science careers. We all were inspired to continue working towards positively impacting our society and world.



Tuesday and Thursday were devoted to preparation for their final project. They learned the importance of proper communication and the ethical considerations of scientific discovery and applications, ideals that will be implemented in their final projects. Students were introduced to a solar cell project, then made their own solar cell from Titanium Oxide,



Berries, graphite, and conductive glass plate. After testing, many cells were able to reach the maximum theoretical volts. This is one of the projects the students may choose to expand into a larger final project.



Wednesday, students were introduced to the theoretical concepts of LEDs and semiconductors, then gathered data and conducted experiments. Later they worked on spectroscopy and the applications of this science, making their own spectrometers and discussing how this project could be expanded into another of the four final projects.

Throughout this amazing learning everyone is doing, we have all bonded as a great group and family. What an amazing week and we all look forward to the great things that are to come, in Cluster 5!

## CLUSTER 6: BIODIESEL FROM RENEWABLE SOURCES

Students in Cluster 6 are off and running this week. Day one: students got a big dose of laboratory safety at UCSD and then moved right into the lab to get to work. In the lab, students learned about FAME - not fame and fortune, or the movie, but rather Fatty Acid Methyl Ester, aka biodiesel. In fact, students produced their own biodiesel from canola oil, along with its by-product glycerol. By day two students were able to clean their biodiesel by chemically washing out impurities, and continued by drying their biodiesel to remove water. In the coming weeks, we will analyze the biodiesel for its purity and determine whether it meets the standards for use in diesel engines. Project groups have been decided and students began working on their small group research projects on Thursday. Discussions about organic chemistry keep the students on their toes, but using the labs as a platform really helps the chemistry make sense!



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

Cluster 7 has been busy this week learning the fundamentals of red blood cell (RBC) biology.

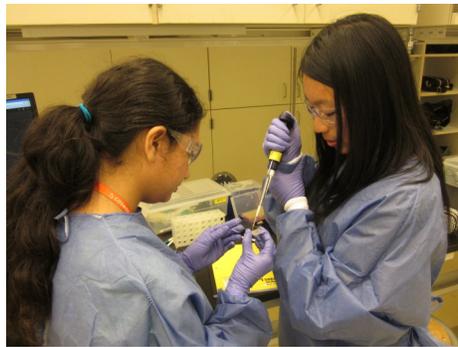


Three days were devoted to hands-on laboratory work to learn some of the fundamental techniques used by bioengineers to analyze RBCs. On Monday students learned how to use small volume transfer equipment (micropipettors) commonly used in bioengineering research labs. By Wednesday students were using micropipettors in a lab that analyzed micro volumes of bovine blood under different experimental conditions. Blood cells were analyzed by light microscopy and students learned firsthand that blood contains a huge proportion of RBCs together

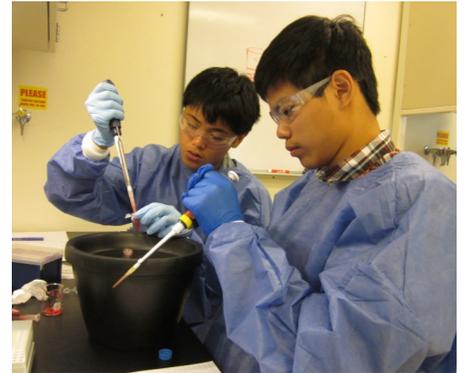


er with a much smaller amount of white blood cells (leukocytes). Using Image J software (from the National Institutes of Health) students were also able to quantify the morphology of RBCs under hypertonic, isotonic or hypotonic conditions. All of the first week labs were closely linked to highly engaging Prezi presentations given by Dr. Carlos Vera on the molecular and cell biology of blood cells.

In the science communication segment, students attended the first of a series of



Discovery lectures given by Professor Pisano, Dean of the Jacobs School of Engineering. He presented a highly engaging overview of engineering research at UCSD. Students attended two presentations given by UCSD staff on general lab safety and biosafety, the latter including specific safety considerations when working in the Bioengineering building. UCSD is truly a safety first institution! The UCSD library system presented a summary of the electronic resources available to students to facilitate their research projects. Students are



beginning to analyze the steps involved in generating and effectively analyzing scientific data with a big emphasis on graphical analysis of data. Finally, students launched a biography presentation series this week in which the lives and contributions of prominent scientists are researched and summarized in an informal presentation made to all of Cluster 7. Cluster 7 students are off to a great start this summer and have been very busy building a solid foundation for their remaining bioengineering studies.



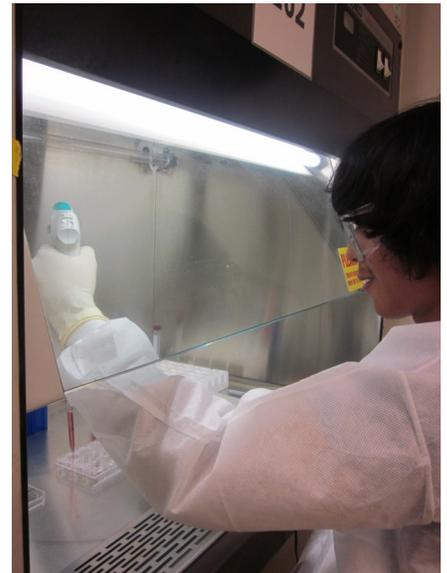
# CLUSTER 8: TISSUE ENGINEERING AND REGENERATIVE MEDICINE

**E**arly Monday morning we began with safety training to make certain we were properly trained to safely perform our research in the lab. We began



learning how tissue engineering has helped patients, either as new models are developed to study tissues, or in the clinical setting such as controlling or enhancing wound healing. We're also learning how to keep a scientific lab notebook and

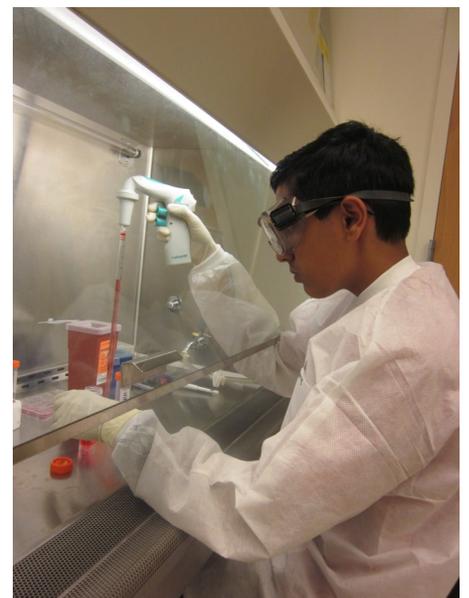
were given an introduction to our tissue engineering labs. That was just the first day and we have not stopped since! In the lab we have all learned how to properly pipette, use serological pipettes, make serial dilutions, use a spectrophotometer, use sterile technique, make media, and use light transmitting microscopes to visualize cells. Tuesday, we were given an overview of how to best utilize the UCSD library, which will be critical for



how people learn, how to effectively communicate and we had a brief introduction to our ethics project. Overall we have had an amazing start because the brilliant, hard-working, young minds in Cluster 8 are great!

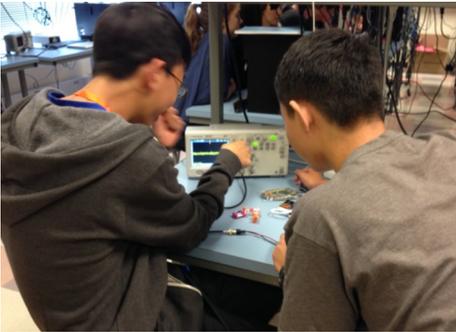


our ethics and research papers. We have had the opportunity to refine our Excel skills, hear about current topics in tissue engineering, and learn more about how cells differentiate into epithelial, connective, nerve or muscle cells and their fate as they may be used for motion, adhesion, or secretion. At this point we definitely have a clearer understanding of tissue engineering. In our scientific communications section the discussions have been focused on



## CLUSTER 9: MUSIC AND TECHNOLOGY

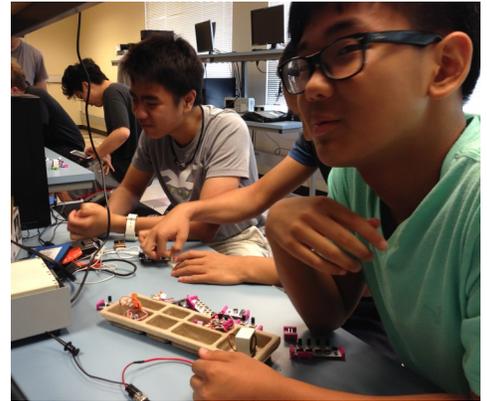
**W**eek 1 of Cluster 9 really started with a bang! Professor Mauricio de Oliveria and Professor Shlomo Dubnov brought a lot of energy and passion for music and technology. We began by seeing a demo on littleBits, which makes an open



source library of electronic modules that snap together with tiny magnets for prototyping, learning, and fun. We were introduced to four different modules included in the Synth Kit: power supply, oscillator, speaker, and keyboard, then got a demo from Dr. Shlomo of the IPython Notebook, which imports various audio files and shows the visual differences in sound waves by plotting on a graph. iPython is a web-based interactive computational environment combining code execution, text, mathematics,

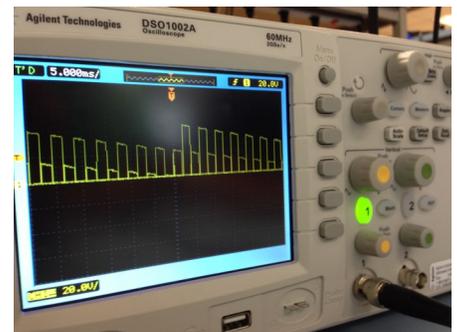


plots and rich media into a single document. Professor Shlomo continued by discussing “What is Sound?” Is it noise, silence, an art form, enjoyable sounds, a form of expression, a form of communication, or organized sound? Is it a combination of multiple things? A bike guitar instrument used a strobe light to make standing waves on a guitar string more apparent to the human eyes. A strobe light at the same frequency of the string vibration can make the string appear to be stationary, rather than moving. Continuing with wave visualization, students had a chance to see the difference between a longitudinal wave and a transverse wave. Movement of waves through a metal spring was displayed by hitting the spring vertically, creating a transverse wave to the other end, and then the wave was inverted and returned.



Then a part of the spring was compressed to send a longitudinal wave through the spring. When one end was left un-fixed, the wave returned without being inverted.

Looking ahead, we are so excited to be going to the Digital Media Arts Gym in North Park next Wednesday July 16th!





Fun



pics

