Monday morning we proved that we take the saying “safety first” literally by attending a lecture on safety. Students learned about how to conduct themselves safely in the labs, how to behave around common hazards, how to avoid accidents and prevent injury. Then we walked the rest of the way across the campus through Warren engineering quad to our home for the next four weeks, the artfully named EBU-2.

Students filed into a lecture hall and Dr. Delson warmly welcomed students and gave an introduction to cluster 2 as well as the pros and cons of three different fastening mechanisms. Students considered a challenging problem individually at first and then vigorously discussed it in small groups. Informal votes were taken before and after discussion for each of the three fastening methods.

A cluster two tradition followed the morning lecture as we headed out to the engineering quad to examine the mechanical clock built by a team of UC San Diego engineering students. We sat in circles as students introduced themselves and talked about their background and goals for the summer. It is clear to this Teacher Fellow that we have a very talented and bright group of students.

In the afternoon we split into two groups and began the process of making the pendulum clock. Students were instructed on the proper use of tools and safety in workshop and began to drill, file and tap parts. Chris Cassidy led us through the lab and TA Madeline expertly guided students in their clock build. Down in the computer lab, TA Ivan showed students how to master AutoDesk inventor to create the escapement wheel and pendulum for the clock.

Tuesday morning we had the first of our inspirational Discovery Lecture speakers, Mr. Thomas Bewley who regaled us with the tale of the birth of a robot from the seed of an idea in a final exam question, all the way through research and development and bringing the toy to market and selling over a hundred thousand units. This toy, called the "Mip" (short for motorized inverted pendulum" was the star of the show, and much of the theory behind its success related to our cluster. He also gave students advice on project hardware like the Beaglebone Black Linux-based processor and what to expect in college life and beyond.

After the Discovery lecture, we learned about the physics of pendulum motion from Dr. Delson, who used calculus (some students seeing this for the first time!) to derive the equation of pendulum motion. A perfect topic to explain the physics of the robot that had just captured our imaginations and also one we will apply in the analysis of the pendulum clocks students are building this week.

Wednesday was a full-on build and design day after students got an introduction to powerful modeling software, Working Model 2D, from Dr. de Callafon. Students in the computer lab clicked away on their unique and creative designs and they clearly display a diversity of interests and aesthetics values. In the design studio, students completed their clock bases with some countersunk bolt holes, press fitting axes and minor assembly. All of this is motivating them to finish their designs so they can have them cut out by the laser cutter for final assembly in a working clock.

Thursday morning we had a presentation entitled "virtual library tour" in which all COSMOS students were introduced to the myriad of online resources provided to students of UC San Diego. Also discussed were research methods with the school’s ROGER database and the deep web. It is clear that students will be able to capitalize on this information this summer and then also during their academic year. Later, students were assigned a clock web page where they will put their analysis reports, videos and animations. Construction of the clocks continued in the afternoon and we cut out the first pendulums for students who had completed their designs.

Friday we will work on finishing the clocks, working on the clock web pages and talking about the ethics essay which is due next week. The first week has been an intense and immersive engineering experience for the students and they seem excited to continue designing, building and problem solving in the next several weeks.
This second week newsletter begins with an exciting update to the end of week. Friday night cluster two earned a "silver medal" in the COSMOlympics with a fantastically choreographed and scripted musical montage (thanks Alejandra and Pollo!) What a great way to end an amazing first week.

Over the weekend, in addition to working on their ethics essays, students were tasked to form groups of four with an emphasis on creating diversity in each group. As a warm up to their kinetic sculpture project, and to get them thinking and acting like engineers, students spent the morning with an activity called "recursive water balloon drop with high speed photography". In layperson's terms, this means that students rapidly prototyped a container to protect a dropped water balloon, drop tested it from increasing heights, analyzed the ground impact with high speed video, and then used their analysis to redesign and improve the vehicle's performance. Students struggled with the concept "fail early to succeed sooner" as they struggled against limited time to do multiple iterations of their designs.

In the afternoon, students learned about the physics of a marble dropping vertically and also rolling down a ramp from Dr. de Callafon. Concepts of rotational and linear kinetic energy were used in analyzing the motions and predictions the speed of the marble as it drops. Students then went to the design studio to do a lab measure these motions with marble and track from their upcoming sculptures and compare their measurements to the theoretical values predicted by the derived motion equations. Following the lab and a short wrap-up discussion led by Dr. de Callafon, students had time to work on finishing their pendulum clocks and work on the clock analysis web pages.

Tuesday morning started with a great Discovery Lecture about plant adaptation to changing ecosystems by Dr. Elsa Cleland. After the lecture, we walked up to the lab and student groups gave their oral presentations on the water balloon drop exercise. Teams reflected on the success and failure of their ideas, the process of developing ideas, and analyzed their teamwork. The oral presentations were well done and students and faculty were able to give each team feedback that will help them to better prepare when they present their final projects in two and a half weeks.

Tuesday afternoon students continued their study of physics of ball dropping by considering two dimensional trajectories. This information will help them program their sculptures later. To reinforce the ideas, they completed a lab in the design studio. Later, students finished up their clocks and worked on the timing analysis.

Wednesday morning, students were tasked to bring four sketched ideas each for their mini sculpture. The mini sculpture project is designed to get students focused on the critical aspect of design and control of the sculpture with a relatively simple structure. Dr. Delson discussed creativity and how to promote it among a team and his lecture included some interesting challenges that got students thinking laterally and "outside the box". Teams then used Pugh charts to objectively rank their ideas on a number of important criteria and choose one to use in their mini sculpture. Once the idea was chosen, students were able to dig into the massive collection of sculpture parts and began building.

Wednesday afternoon students learned about programming from Dr. de Callafon and then were able to practice their new skills by programming a simple back and forth robot that utilized one touch sensor and one sonar sensor. When they had accomplished that task, they were able to work on their clock analysis and web page.

Thursday morning we settled in for a cluster information session in which we learned about the cool things going on in other clusters but left still glad we were in cluster 2! The morning continued in the computer lab as students worked to finish their clock web pages. After lunch students learned more advanced programming and did another hands on activity where they programmed a machine to catch a ball in a small basket. The challenges keep increasing and students are meeting them!

Friday ended another week packed with new skills and accomplishments. Students really were able to dig into their mini sculpture and use their creativity, design methods, and teamwork to make functional, fanciful interactive structures.
Students arrived after a (rainy) family weekend rested and ready to continue working on their mini sculptures. By the end of the week, each group will present their mini sculpture design to the group. These mini sculptures. Each presentation will focus on the conceptual design, risk reduction tests, prototyping, and various iterations that resulted in the final working machine.

Monday morning students were treated to a lecture on bearings by Dr. Delson. The tips he gave concern how to mechanically constrain motion made students think about how to best construct a linear slider mechanism, build a jam free linkage, and to minimize wobble that can lead to inconsistency and early failure in a machine. With this new knowledge, students hit the design studio to continue working on their machines. At the end of the day, Dr. Delson walked around to consult with each group on their progress and plans to complete all of the requirements of the mini sculpture by Friday. With a day taken away due to our field trip, and given how fast time flies during COSMOS, it was not too early to consider the plan for completion.

Tuesday began with a fantastic Discovery Lecture from Dr. Amaro who is using computational methods to discover new drugs to fight a number of human diseases. Then we boarded a bus for an off-campus adventure. Our first stop was a company called Solar Turbines which makes large gas powered generators that power many industrial processes. Students learned how the company designs and builds medium sized gas powered turbines to power generators, compressors, and pumps all over the world. It was remarkable how similar the turbine assembly process was to our clock assembly project. In addition, students saw how impressively clean and organized the work areas were considering each "package" is constructed from approximately 40,000 parts. The largest of these turbines costs approximately 30 million dollars and can be constructed in about one month. An interesting note is that the company’s maintenance revenue has exceeded its yearly sales revenue.

After a brief lunch at Solar Turbines, we jumped back on the bus to head to Belmont Park, a small but fun packed amusement park located in Ocean Beach just north of San Diego harbor. With unlimited ride bands, students were able to experience some of the physics they have been learning about from Dr. de Callafon. Dr. Delson posed a thought-provoking question to the students: which car of a multicar roller coaster experiences the most acceleration? In order to answer this question, he distributed a number of cell phones with an accelerometer app on it which the students activated and then rode the coaster in one of the twelve rows. Unfortunately the phones were unable to sense any accelerations over 2g's. Next year we will bring 4g phones!

Wednesday we jumped right into the design studio to continue working on the sculptures. Teams added elevators to enable the machines to run in continuous loop mode. Students are starting to realize that sometimes when they think they are 95% done, they still are only halfway there. One of the groups also started 3-D printing a mini foosball table for people interacting with their sculpture to play. Other exciting design elements teams have designed and built so far include machines that sort balls by color, adjustable ramps with moving catch baskets, interconnecting gear mechanisms, a movable catapult, and dueling trampoline jumps. In the afternoon, Dr. de Callafon gave a brief talk on dynamic modeling and started the students working on modeling their mini sculptures in working model. You will see the results of these modeling sessions in the final presentations.

Thursday we were treated to another cluster exploration session in the morning which once again left us fascinated but yet STILL glad we had chosen the BEST cluster. After that, students learned about Design Thinking from their teacher fellow and then had some time in the design studio to work on their sculptures. The afternoon session was devoted to more work on fine tuning the mini sculptures in preparation for team presentations tomorrow.

After a week of brainstorming, designing, troubleshooting, testing and refining their mini sculptures, each group presented what they had learned in the process. Moving forward into the final week of COSMOS, these mini sculptures will form the foundation of students final project sculptures which will be presented to family and friends at the COSMOS Expo next weekend. This teacher fellow cannot wait to see how each group uses its creativity and skill to create an amazing final sculpture!
nating topic as it integrated mathe-
matics, physics and computer sci-
ence. We have control to thank for
DVD and bluray players, cruise
control in cars, balancing in a Seg-
way personal transporter, and many
products that we use every day. In
fact, we only really hear about con-
trol in the rare cases when it goes
wrong, or when it is not used.

Tuesday morning’s Science
Communication session saw teams
focused on working on their post-
ers, oral presentations and team
websites. The skills these students
pick up as they document their en-
gineering process will likely pay div-
idends in a higher level of academic
performance during the year. A
number of teams have employed
the 3-D printers available to them
to document the process. Timelines
were reconsidered as the ambitious
plans from early in the week
bumped up against the reality of the
time constraints. Students worked
at a furious pace to make sure that
their presentation posters were fin-
ished by the end of the work day.

Thursday teams finished their
oral presentation slides and prac-
ticed their talks with whoever they
could get to listen. In addition, fin-
ishing touches were put on the
sculptures. It seems the mini sculp-
tures have morphed into complex
mega-sculptures!

After a single final hour of con-
struction time in the design studio
on Friday morning, our six incredi-
ble teams ventured down to the
computer lab to give their oral
presentations to cluster nine. After
lunch, our teams served as the audi-
ence and watched the presentations
by cluster nine teams who wowed
us by showing us how they designed
and built musical instruments from
circuits. Musical performances with
these instruments was a highlight!

Students are excited to reunite
with their families and to share the
projects that their hard work have
produced. In addition, I am sure they
will miss their new found friends
from cluster 2 and the stimulating,
creative environment of the Design
Studio.