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 pendulum for their clocks.

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.

Wednesday Dr de Callafon introduced students to the Working Model 2D software. This program lets the students simulate their clock pendulums and later their final projects. 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 predictions. Cluster 2 Website
In week 2 COSMOS Cluster 2 was joined by our third instructor, Dr. Jack Silberman. Students also finished analyzing the timing of the clocks. All students in the cluster were under 8% error in their predictions for the period of their clock pendulums. The clocks functioned beautifully, ticking and tocking as designed.

A team building exercise was the recursive water balloon drop. Students formed teams and dropped a water balloon from ever increasing heights into a device constructed to cushion the fall and prevent breakage. The Cluster students had to use their knowledge of physics and their engineering skills to design and construct the device. The greatest height survived by a water balloon was 8 feet. This activity introduced students to the design process with limited tools and materials as well as limited time.

For science communications Cluster 2 gave oral presentations on their water balloon project and also made webpages for the clock project. The student pages can be viewed here https://sites.google.com/a/eng.ucsd.edu/kinetic-sculpt/teams Students attended the Discovery Lecture by Dr. Silva on artificial intelligence.

Cluster 2 also learned the physics of falling objects and rolling balls. They worked on calculating the speed of balls at a height given initial height and accounting for rotational kinetic energy. The students made predictions with calculations and the Working Model 2D simulation program, then built apparatus to test their predictions in the real world. This activity introduced them to the Chaos roller coaster kits they will use for their final project, the kinetic sculpture.
CLUSTER 2: ENGINEERING DESIGN AND CONTROL OF KINETIC SCULPTURES

In week 3 of COSMOS Cluster 2, students worked on their mini sculptures. The goal of this project is to work out the most difficult aspects of the final kinetic sculpture. Some students used their skills in CAD and the Lasercamm to cut out acrylic parts for their sculptures. Others 3D printed their parts. To get the sculpture to move, servos were controlled with Lego NXT or Arduino. In order to make these work the students had to program in ArduinoC or RobotC.

On Monday Dr. De Callafon lectured on the design process and on the physics of motion in the sculpture. Students had worked on ideas for their sculpture over the weekend and brought them into the Design Studio for prototyping. In the afternoon they drew aspects of their sculptures in Working Model 2D and modeled the physics.

On Tuesday Dr. John Hildebrand from Scripps Institution of Oceanography gave a fascinating Discovery Lecture on marine archaeology. Students then spent more time in the Design Studio on their mini sculptures.

On Wednesday Dr. De Callafon guided students on a tour of the Mechanical and Aerospace Engineering controls lab where students saw a wind tunnel and various other experimental apparatus. The cluster also received a lecture on controls and how to implement them in their projects.

The rest of the week students were hard at work on the mini sculptures. They learned more about the design process and how to refine their ideas. A key lesson was remembering that they could give up a component that wasn't working and replace it with another component that would perform the same task. On Friday students presented the results of their mini sculptures and started their final project, the kinetic sculpture.
Week 4 of COSMOS was intense for Cluster 2 as they worked to finish their kinetic sculptures.

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

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

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

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