Term:	**Fall 2022**
Class:	**Introduction to Astronomy and Planetary Science**
Location:	**Halawa Correctional Facility (Honolulu, HI)**
On-Site Personnel:	**Roseanne Propato**
In-Person/Remote:	**Remote (Zoom)**
Course period:	**Tuesdays 21:00-22:30 Pacific (20:00-21:30 after DST)**
PEP Volunteers:	**Jay Dickson (instructor), Halina Tran**

Course Description

This course consisted of an introduction to astronomy (viewing the universe from the Earth) and an introduction to modern planetary science (using spacecraft data). Each class was divided into three sections:

1. This Week in the Sky. Phases of the Moon, anticipated meteor showers, updates from missions (launches, spacecraft encounters, space in the news, etc.), weather report from Mars. (~15 min)
2. Astronomy Fundamentals. Covers the PEP course schedule material (see table below). (~20 min)
3. Planetary Science. Detailed tour of the solar system, transitioning from dots in the sky to planets we can visit, culminating with discussion of newly discovered solar systems (see table below). (~50 min)

Week	Astronomy Fundamentals	Planetary Science
1	Intro	Solar System Tour / Class Preview
2	Kepler's Laws	The Earth
3	Newton's Laws	The Moon
4	Detectors	Mercury
5	Electromagnetic Waves	Venus & Mars
6	Optics	Asteroid Belt
7	*Cancelled – Handout provided*	*Cancelled – Handout provided*

Course goals, themes, objectives

1. Challenge students to think at scales of time and distance that get them out of the "here and now." Think on the scale of billions of years and at inter-planetary distances.
2. Engage students in the search for life outside of the Earth.
3. Prompt students to reevaluate relative size/importance: How big is one person compared to the Earth as a whole; how big is the Earth compared to the solar system; how big is the solar system compared to the Milky Way galaxy; how big is the Milky Way compared to the universe.
4. Use fundamentals of astronomy to engage students in the scientific process. How do laws of physics manifest as predictions for what we should observe in the sky? Make students think scientifically, using concepts of prediction, reproducibility, traceability.

5. Convey to students that science is *dynamic*, not static. Science is not absorbing facts, it is a process of iterative approximations that is perpetually refined. Part of science is acknowledging when your assumptions were wrong.

Challenges

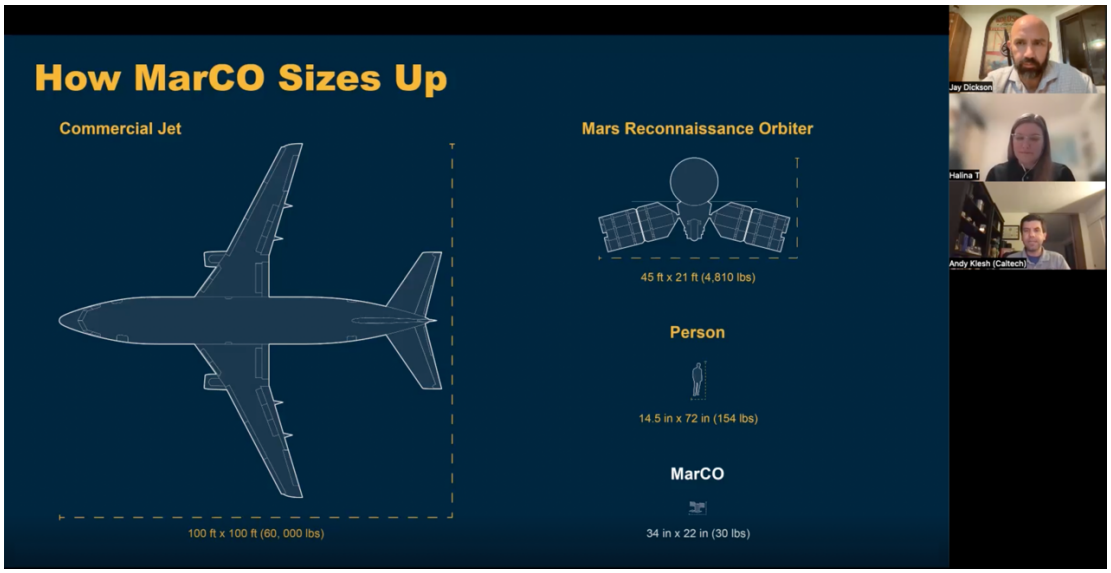
1. After starting the term with four consecutive classes, multiple issues caused postponements of our class. Initially, Halawa had staffing issues so security personnel for the education unit had to be reassigned elsewhere, meaning we could not have class. Then a Covid outbreak delayed class, then further staffing issues cancelled classes. Finally, after New Years, Roseanne informed us that we would not be able to finish the course, as the educational unit was already booked. We did complete six of our seven classes, but it was very disappointing not to close out the class, despite the best efforts of Roseanne and others at Halawa. Halina and I did prepare an extensive handout and sent that to Halawa this week, so the students did get some of the content from the last class.

   There's nothing on our end to be done about this, other than to be vigilant about reminding our volunteers that we need to be flexible and accommodating. Fortunately, all PEP volunteers that I have worked with already have this mentality.

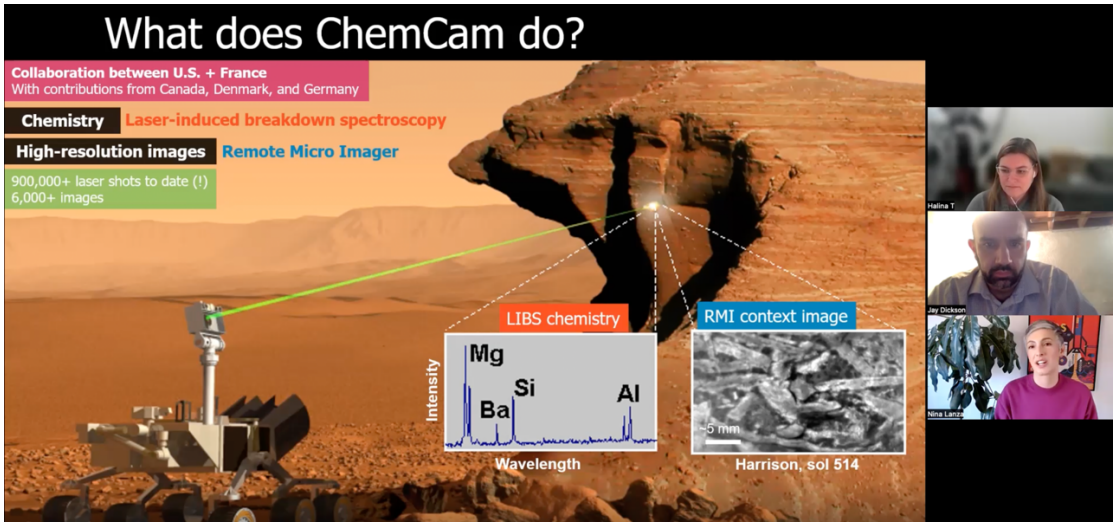
Successes

1. Halina was an exceptional fellow volunteer and was more of a co-teacher for the course, which took a major load off my shoulders. She volunteered to teach all of the physics sections for the course, which she is beyond qualified to do. She was capable of answering questions from the students clearly and was brilliant at engaging with them. This was especially impressive as her father died suddenly early in the term, so she travelled to Germany yet still made time for our class and for our guest presentations at very early hours in Europe.
2. For the first time, we experimented with a take-home assignment for the students. I challenged them with a real-life problem that we have encountered on the Mars 2020 Perseverance Rover mission. We are collecting samples of Mars right now that a future mission will go to Mars, pick up and return to Earth. We can only collect ~40 samples, and we there are a litany of decisions to make about (1) which samples are most important to collect, (2) should we drop samples back at the landing site before traversing challenging terrain, or (3) should we keep all samples and take them to a second landing site, but run the risk of the rover dying and not getting any samples back at all? This challenged the students to think critically about what priorities are most important, and what trade-offs need to be made. This assignment was good because there was no one right answer, it was a vehicle to get discussion going and to get the students thinking seriously. They had excellent ideas and truly engaged with the problem. Halina and I were able to sit back and just let them discuss with each other what strategy made the most sense. It also showed the students that the problems we encounter in space missions are problems that they are capable of addressing. This was a big success and worth repeating in future classes.
3. We had two excellent guest speakers this term who were thrilled to participate in our course. As in the past, recruiting speakers who are involved with space missions worked very well, as this is both exciting but also relatable to the students.

The first guest lecture was by Dr. Andy Klesh, a systems engineer at JPL. Dr. Klesh is a gifted speaker in addition to being a talented engineer, so he told us about his work on MarCO, a pair of small satellites that flew to Mars in 2018. A theme we have developed with our students is that space is becoming more accessible via the revolution of small satellites, and Dr. Klesh made it clear that space is now becoming accessible via this change in attitude: doing more with less.



The second presentation was by a college friend of mine, Dr. Nina Lanza. Dr. Lanza is a scientist at Los Alamos National Laboratory and the Principal Investigator for the ChemCam instrument on the Curiosity Rover on Mars. ChemCam uses lasers to vaporize small portions of rocks and then measures the composition of the vapor that is created through the process. This is a thoroughly engaging and exciting scientific technique that I knew our students would enjoy, and it is similar to the type of work that Halina does, so was a perfect fit for this term. Dr. Lanza also excels at public outreach and is often featured on NOVA and Discover Channel programs.



Both presentations can be found at the following link:

http://murray-lab.caltech.edu/PEP/GuestLectures/

Thoughts going forward

With the exception of the scheduling challenges and not being able to conduct our final class, this was the most successful iteration of this course. The students were fantastic and seriously engaged with the content. Halina and I make a great team and we hope to work together again in the future. Roseanne was fantastic as the staff contact, as she was very responsive, had the handouts printed and ready for the class, and had class up and ready to go every week.

The major addition this term was having a take-home assignment. I have avoided this in previous terms simply for logistical reasons, but I am glad we tried it this term. The students are serious about the content and really engaged with the material and with each other. It is very challenging to convince our students that they can contribute to the space program, that they just need to be serious and thoughtful, but they were able to do that, which made me very proud.

I think that future classes should have 2 take-home assignments, preferably focused on a current issue in space science. The first halves of classes 3 and 6 can be set aside for discussion of these assignments, so they are spread out through the term. It has always been important to me that our students hear from multiple voices besides my own, and we have always had success with (1) fellow PEP volunteers and (2) guest lectures. But now we can strive to have the students listen to each other as part of the class, which has always been a worthwhile goal but difficult to achieve. Given the success of this term, I think we have a pathway to do that now.