

Observational Astronomy Travel Course in Hawaii

Course Description:

This one-week immersion course on the Island of Hawaii will focus on the observational aspects of the science of astronomy, including its history, current state, and future. We will study the tools that astronomers use—telescopes, spectrographs, and cameras—and the challenges they face, from engineering to weather, as they seek to explore the universe. Because it is so remote, the Island of Hawaii hosts 13 of the world's largest and most advanced telescopes on the summit of Mauna Kea—one of the darkest and clearest places on earth. Staff at the Keck Observatory (whose director is a Wesleyan alumnus) will give us a tour of the observatory on the summit of Mauna Kea. There, we will view stars and watch astronomers conduct research. We will learn about the observable universe by stargazing through a telescope and with binoculars at the 9200 foot elevation, where the visitors' center is located. We will also tour the headquarters and telescope control facilities of the Keck Observatory in Waimea. The basics of small telescope design and use, binocular astronomy and naked eye astronomy will all be covered.

Student Expectations:

Students are expected to attend all of the class meetings in Hawaii and observing sessions and to participate in them. They are expected to prepare for the field trips by reading the assigned material and becoming familiar with the terms and definitions of our science. Students in Connecticut are strongly encouraged to attend the pre- and post- trip meetings. All students are expected to become familiar with the winter night sky as seen from both the mainland U.S. and Hawaii and demonstrate that familiarity by being able to point out bright stars, constellations and planets. They will also learn the basics of binocular and small telescope astronomy. Advanced students who wish to do a project in astrophotography will be encouraged to do so, but it is not a course requirement. Evaluation will be on the basis of class participation, a journal of activities, and a demonstrated basic competency in naked-eye astronomy.

Syllabus

Date and Time TBA

Pre-trip meeting 1 (for CT-based astronomers): (Note, students who live too far from Wesleyan to participate in this will need to read the assigned material and prepare on their own. The instructor will be available via e-mail or voice communication to assist with this, if needed.)

We will introduce the basics of the sky, constellations, the magnitude system, diurnal motion, planetary motion, coordinate systems, observing aids and resources. Weather permitting, we will use the actual sky as our laboratory. Otherwise, we will use a Starlab portable planetarium.

Date and Time TBA

Pre-trip meeting 2 (for CT-based astronomers): (Note, students who live too far from Wesleyan to participate in this will need to read the assigned material and prepare on their own. The instructor will be available via e-mail or voice communication to assist with this, if needed.)

The basics of optical instruments (telescopes and binoculars) will be introduced. We will use the telescopes at Van Velck Observatory to view celestial objects and see the effects of such astronomical effects as seeing, sky brightness and transparency on viewing. We will also study the effects of aperture size, focal length, field of view and magnification on viewing. We will review important astronomical coordinate and time systems, including Right Ascension, Declination, Hour Angle and Sidereal Time.

Monday, January 12

2:00 – 4:30 P.M. at hotel: Basics of observing: An Introduction and/or Review of the Language and Concepts of Observational Astronomy to prepare students for the summit trip.

7-9:30 pm at or near hotel: Observing session to acclimate to Hawaii

skies (weather permitting). In the case of cloudy weather, this will be replaced by an extension of the theory session of the afternoon.

Tuesday, Jan. 13

11:00 am until late evening: Field trip to the summit of Mauna Kea, including a guided tour of the W. M. Keck telescopes (the largest telescopes in the world) by two members of the Keck Observatory staff. We will have lunch in Waimea, prior to the summit visit and dinner in Waimea afterward. The evening will include observing at the Visitor's Center of the Mauna Kea Observatory, using their telescopes and facilities. We will see, in practice, all of the aspects of observational astronomy discussed previously, including coordinate systems and object location, the effects of aperture, seeing, field of view and transparency on astronomical observations. We will see first-hand how these issues are tackled by modern astronomers. This will include discussion of active optics and interferometry for improving resolution. The wavelength dependence of astronomical conditions and equipment will be illustrated and discussed.

Wed., Jan. 14

3 :30 pm until 6:00 pm: Field trip to the Headquarters of the W.M. Keck Observatory in Waimea. Visit to the control rooms of the Keck I and Keck II telescopes. Opportunity to witness the opening procedures of astronomers scheduled to observe on the Keck telescopes that evening.

7:00 pm – 9:00 pm: Lecture by the instructor as part of the Keck Public Outreach Program. Professor Herbst will lecture on the use of the Keck I telescope and high resolution spectrograph to study an object of extreme interest, known as the winking star. We will cover the basics of star and planet formation as an example of how modern instrumentation on the world's largest telescopes can be brought to bear on these issues at the forefront of science.

Thursday, Jan. 15

noon - until evening: Field trip to the Imiloa Astronomy Center of Hawaii in Hilo, including a planetarium visit and exhibits on the connection between Hawaiian cultural traditions and the science of

astronomy. Here we will study how cultures other than our own viewed the sky. We will also have access to a planetarium where the objects and phenomena being viewed in the actual sky can be brought under more control to illustrate their motions and relationships.

Friday, Jan. 16

2-4:30 pm: Discussion of field trips and review of concepts exhibited. Opportunity for students to demonstrate their competence with the ideas and to raise questions and suggest avenues for further exploration (post-course).

6:30 - 9:00 pm: Final viewing session and re-cap. Students will point out constellations, planets, interesting objects and use telescopes or binoculars to view them. They will demonstrate their knowledge of the night sky and of various ways to observe it, and record it, from naked eye to CCD camera.

Date and Time TBA

Post-trip meeting (for CT-based astronomers): (Note, students who live too far from Wesleyan to participate in this will need to read the assigned material and prepare on their own. The instructor will be available via e-mail or voice communication to assist with this, if needed.)

The purpose of this optional meeting is simply to gather once more for a re-cap of the trip, what we have learned and how observing in Hawaii contrasts with observing from CT or elsewhere in the mainland U.S. We will answer questions, reflect on the trip and use the facilities of Van Vleck Observatory once again to view the heavens, hopefully from a new and enriched perspective.

Reading

The main reference texts for the course are:

Nightwatch: A Practical Guide to Exploring the Universe
by Terence Dickinson et al.

Observing the Universe: A Guide to Observational Astronomy and Planetary Science by Andrew J. Norton.

Readings will be selected from either of these sources depending on the background and preparation of the students. The first text is for more prepared students and the second for less prepared students. It is recommended that you purchase the second book. The first is optional.

Writing Assignments

All students are required to keep a written journal of the field trip and log of their observational sessions. For observing sessions, this will include a description of the appearance of objects by naked eye, through binoculars and through telescopes as well as the particulars of the observing procedure. For the field trips it will include a basic description of what was presented as well as the student's reaction to it.

Grade

Grades will be based on class participation (with obvious allowance for students not resident in CT), preparation for the field trips and observing sessions, observing logs, field trip journals, and demonstrated knowledge of the night sky. There will be no written exam, but there will be an observing practicum during the last session in Hawaii.