

PTYS 416

Asteroids, Comets, and Kuiper Belt Objects

Fall 2026 | Section 001 | 3 credits | Tuesdays and Thursdays, 2:00-3:15 p.m. | Kuiper 312

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Course designation PTYS Minor Elective	Course type Undergraduate (PTYS 416 only)

Course Overview

This course introduces the “minor planets” - asteroids, comets, Kuiper Belt objects, and dwarf planets. These small bodies are remnants of planet formation and preserve physical and chemical clues to the history of the solar system. We will examine their distributions, physical properties, compositions, origins, and evolution, as well as the observational, laboratory, and spacecraft techniques used to study them.

Course Objectives

The course will provide a broad overview of small-body science and planetary exploration. It will connect meteorites and remote observations to spacecraft investigations and will emphasize how planetary scientists combine multiple types of evidence to reconstruct solar-system history.

Expected Learning Outcomes

- Identify and compare the defining characteristics of asteroids, comets, Kuiper Belt objects, and dwarf planets.
- Explain how small bodies preserve evidence of planet formation, migration, and solar-system evolution.
- Describe and evaluate the principal techniques used to discover, observe, sample, and analyze small solar-system bodies.
- Analyze real or analog planetary data and observations using appropriate scientific reasoning.
- Synthesize evidence from the scientific literature into a clear, accurate undergraduate research paper.

Course Format and Communications

The course combines lecture, discussion, in-class laboratory exercises, guest lectures, and one evening field activity. Occasional lectures may be delivered remotely via Zoom, with advance notice. D2L is the official source for readings, assignment instructions, announcements, schedule updates, and grades. Course communication will use D2L and official UA email; students should check both regularly.

Required Materials and Readings

There is no required textbook and no special purchased equipment is required. Required journal articles, handouts, data files, and other readings will be posted in D2L. The following books are recommended background references:

- Asteroids III (University of Arizona Press, 2002)
- Asteroids IV (University of Arizona Press, 2015)
- Comets II (University of Arizona Press, 2004)
- The Solar System Beyond Neptune (University of Arizona Press, 2008)
- Andrew S. Rivkin, Asteroids, Comets and Dwarf Planets (Greenwood, 2009)

Required Field Activity

Students will participate in one evening visit to a Catalina Sky Survey telescope at the University of Arizona's Mount Lemmon facilities. The expected commitment is approximately six hours, including travel. Group dates, transportation, safety guidance, weather contingencies, accessibility planning, and an alternative assignment for students unable to participate will be posted in D2L.

Assignments and Evaluation

The course uses participation, five applied homework assignments, and a final term paper in lieu of a final examination. Detailed prompts and rubrics will be posted in D2L.

Course component	Weight	Evidence of learning
Class participation	20%	Prepared attendance, discussion, and in-class work
Homework assignments	60%	Five applied assignments, including laboratory and field work
Final term project	20%	Literature-based synthesis on an approved small-body topic
Total	100%	

Grading Scale and Policies

Final grades use the following scale: A = 90.1-100%; B = 80.1-90.0%; C = 70.1-80.0%; D = 60.1-70.0%; E = 60.0% or below. The instructor may lower, but will not raise, these thresholds if warranted by overall class performance.

Late work. Unless an assignment states otherwise, late work loses 10% of the available points per calendar day and is not accepted more than seven days late. Contact the instructor as soon as possible about illness, emergency, approved absence, disability-related barriers, or other circumstances that may warrant an extension.

Extra credit. No extra-credit opportunities are planned. Any opportunity added later will be offered equitably to the entire class.

Grade questions. Raise questions or disputes within one week after a grade is posted. Begin by identifying the specific rubric item or calculation in question.

Incomplete or withdrawal. Requests must follow University policy. See the UA grades and grading-system policy in the University Catalog.

Participation and Absence Expectations

Attendance and participation are important because lectures, discussions, laboratory work, and guest presentations contribute directly to the learning outcomes. Participation is evaluated through prepared attendance, constructive contributions to discussion, and completion of in-class activities. Simply being physically present does not constitute full participation.

If you anticipate an absence, are unexpectedly absent, or cannot participate in an activity, contact the instructor as soon as possible. Reasonable accommodations will be made for sincerely held religious observances, disability-related needs, and absences pre-approved by the Dean of Students. Missed in-class work may be made up only when an alternative is feasible and arranged promptly. Students who register late should contact the instructor within three business days of enrolling to establish deadlines for missed work.

Classroom Expectations

Help maintain a safe, welcoming, and inclusive learning environment. Focus on course activities and avoid disruptive conversations, phone use, messaging, or unrelated web browsing. Laptops and tablets may be used for course-related work. Students who repeatedly disrupt the class may be asked to stop, move, or leave and may be referred to the Dean of Students.

Use of Generative AI

Generative AI tools may be used for selected homework tasks only when the individual assignment expressly permits them. They may not be used to draft, rewrite, paraphrase, or generate any portion of the final term paper. When AI use is permitted, you must acknowledge the tool, describe how it was used, and verify all facts and cited sources. Undisclosed or prohibited AI use may violate the Code of Academic Integrity.

Do not enter confidential, personal, unpublished, or proprietary information into an AI system. AI outputs can contain fabricated citations, factual errors, and bias; you remain responsible for everything you submit. If an assignment does not clearly authorize AI use, ask before using it. AI-detection scores alone will not be treated as proof of misconduct.

Final Project

The final project is an undergraduate term paper that synthesizes peer-reviewed scientific literature on an approved topic related to asteroids, comets, Kuiper Belt objects, dwarf planets, or small-body exploration. A topic proposal is due November 12. The completed paper is due December 3 through D2L. There is no separate final examination. Final-exam regulations and schedules are available at <https://registrar.arizona.edu/faculty-staff-resources/room-course-scheduling/schedule-classes/final-exams>.

Tentative Fall 2026 Course Schedule

Dates and topics may shift with reasonable advance notice. Assignment due dates shown here are planning dates; D2L contains the controlling assignment instructions and submission times. Guest lectures are subject to confirmation.

Week	Dates	Topics / activities	Assignment or milestone
1	Aug. 25 & 27	Course introduction; syllabus; ungraded assessment quiz; solar-system review	-
2	Sept. 1 & 3	Historical observations and nomenclature; telescopic observations and surveys	Assignment 1: Decadal Survey
3	Sept. 8 & 10	Introduction to meteorites (guest lectures: (Melissa Bruker, Dante Lauretta); meteorite laboratory exercise	-
4	Sept. 15 & 17	Introduction to asteroids; evidence from asteroids, meteorites, and comets: planet formation	Assignment 2: Meteorite Lab
5	Sept. 22 & 24	Evidence for planet migration (guest lecture: Kevin Walsh); Galileo asteroid flybys and NEAR at Eros	-
6	Sept. 29 & Oct. 1	Hayabusa at Itokawa; DART mission (guest lecture: Mike Nolan)	Assignment 3: Crater Scaling
7	Oct. 6 & 8	Dawn at Ceres; Dawn at Vesta	Catalina Sky Survey field activity begins (Oct 9-10); group dates in D2L
8	Oct. 13 & 15	OSIRIS-REx at Bennu and Hayabusa2 at Ryugu; introduction to comets	Catalina Sky Survey field activity continues (Oct 16-17); group dates in D2L
9	Oct. 20 & 22	Comets continued; Giotto and the Halley Armada	
10	Oct. 27 & 29	Deep Impact and Stardust; Rosetta at comet 67P/Churyumov-Gerasimenko	Assignment 4: Spectroscopy
11	Nov. 3 & 5	Introduction to Kuiper Belt objects; the search for an additional planet (guest lecture: Kat Volk)	Term-project topic proposal due Nov. 6
12	Nov. 10 & 12	New Horizons at Pluto and Arrokoth; interpreting Kuiper Belt observations	
13	Nov. 17 & 19	Small bodies and the origin of life (guest lecture: Dante Lauretta); future missions	Term-project research and synthesis
14	Nov. 24	Integrating evidence across small-body populations	No class Nov. 26 (Thanksgiving recess)
15	Dec. 1 & 3	Course synthesis; Term-project presentations	Final term projects due Dec. 3
16	Dec. 8	Term-project presentations; Course wrap-up and reflection	Last class meeting

University Policies and Student Resources

All students must familiarize themselves with the policies and resources at <https://catalog.arizona.edu/syllabus-policies>. This page includes University policies on attendance and participation, religious accommodations, threatening behavior, accessibility and accommodations, academic integrity, nondiscrimination and anti-harassment, and campus safety.

Accessibility and Support

At the University of Arizona, we strive to make learning experiences as accessible as possible. If you anticipate or experience barriers based on disability or pregnancy, contact the Disability Resource Center at 520-621-3268 or <https://drc.arizona.edu/> to establish reasonable accommodations. Please also contact the instructor early so that course activities, including the field trip, can be planned accessibly.

Students experiencing academic, financial, health, housing, food-access, or personal barriers are encouraged to contact the Dean of Students Student Assistance Program (520-621-7057), Campus Health (520-621-9202), Counseling and Psych Services (520-621-3334), or the Campus Pantry. Current links are available through the University syllabus-policies page above.

Subject to Change. Information contained in this syllabus, other than the grading and absence policies, may be subject to change with reasonable advance notice, as deemed appropriate by the instructor. Changes will be announced through D2L and official UA email.