

Graduate Syllabus

Spring 2022

GEOS/PTYS 520 (Meteorites)

Instructor Information

Instructor: Prof. Vishnu Reddy, vishnureddy@arizona.edu, Kuiper Space Sciences Building, Room 242. **LPL web page:** <https://www.lpl.arizona.edu/faculty/reddy>

Course Website: Course material will be uploaded to GEOS/PTYS 520 course page on D2L as the semester progresses. (<https://d2l.arizona.edu/d2l/home/1112350>, NetID login is required)

Class Hours: Monday and Wednesday every week from 11:00 am-12:15 pm

Office Hours: Office hours can be scheduled on an as needed basis via email.

Course Description

Meteorites are time capsules that enable us to understand the conditions that prevailed early in our Solar System history. In this course we will focus on the classification of meteorites based on their chemical, mineralogical and isotopic compositions; study their cosmic abundances, ages, interaction with solar and cosmic radiation (space weathering) and their relation to asteroids. Our study could involve a combination of lectures, laboratory experiments with meteorites, telescopic observations of asteroids, field trips (covid willing) and final presentation/paper. This is a 3-credit class.

Course Prerequisites or Co-requisites

None

Course Format and Teaching Methods

Course Modality – Live in person.

Course Objectives

The objective of this course is to provide students with an in-depth understanding of meteorites and their relation to asteroids. We will begin our approach to this topic from cosmochemical/petrological point of view with a review of basics rocks and minerals, meteorite history and classification followed by focused lectures on meteorite groups. The course will introduce remote characterization of asteroids and how to use visible and near-infrared spectroscopy to identify parent bodies of meteorites.

Expected Learning Outcomes

At the end of the course, students should be able to:

- Identify meteorites based on their physical properties and morphology
- Demonstrate an understanding of what meteorites are.
- Demonstrate an understanding about meteorite types and their classification based on chemical, mineralogical and isotopic compositions.
- Participate in group-activity using laboratory- and telescopic derived spectral data to identify parent bodies/meteorite analogs. This is designed to develop and foster skills working as a team and provide hands-on experience working with real meteorite samples.
- Written assessment of identifying meteorite analogs for main belt asteroids
- Describe and discuss major scientific questions in the field of meteoritics.

Required Texts and Materials

There is no formal textbook assigned for the course, however, student might be assigned reading material that would help understand the lectures and final projects. These will be made available on D2L under 'resources' tab.

Schedule of Topics and Activities for Option 2 Class Size

Day	Date	Lecture Topic
W	01/12/2022	Lecture 1: Introduction and Syllabus
M	01/17/2022	Dr. Martin Luther King Jr. Day (Federal Holiday/No Class)
W	01/19/2022	Lecture 2: Minerals and Rocks
M	01/24/2022	Lecture 3: Introduction to Meteorites
W	01/26/2022	Lecture 4: Overview and History of Meteorites
M	02/07/2022	Lecture 5: Chondrites
W	02/07/2022	Lecture 6: Achondrites
M	02/14/2022	Lecture 7: Irons & Stony-Irons
W	02/16/2022	Lecture 8: Introduction to Asteroids
M	02/21/2022	Lecture 9: Asteroid Surface Compositions
W	02/23/2022	Lecture 10: Chondritic Parent Bodies
M	02/28/2022	Lecture 11: Achondrite Parent Bodies
W	03/02/2022	Lecture 12: Iron and Stony-Iron Parent Bodies
M	03/07/2022	Spring Break (No Class)
W	03/09/2022	Spring Break (No Class)
M	03/14/2022	Lecture 13: Moon, Mars, and Tektites
W	03/16/2022	In Class Discussion: Space Weathering
M	03/21/2022	Mid-term Exam (In class identification of Meteorites)
W	03/23/2022	In Class Discussion: Identifying Asteroids for Final Class Project
M	03/28/2022	Nighttime observations of Asteroids using RAPTORS-1 telescope*
W	03/30/2022	Nighttime observations of Asteroids using RAPTORS-1 telescope*
M	04/04/2022	Lab: Asteroid Data Reduction
W	04/06/2022	Lab: Introduction to Laboratory Characterization of Meteorites
M	04/11/2022	Lab: Sample Preparation
W	04/13/2022	Lab: Visible-Near Infrared Spectroscopy of Meteorites
M	04/18/2022	Lab: Visible-Near Infrared Spectroscopy of Meteorites
W	04/20/2022	Lab: Meteorite Data Processing
M	04/25/2022	Lab: Linking Asteroids to Meteorites
W	04/27/2022	Final Presentations
M	05/04/2022	Final Presentations

*No class during the daytime. Observation time will depend on the targets we select and weather.

Assessments

Grading Scale (%):

A ≥ 90

B 80 to 89

C 70 to 79

D 60 to 69

E <60

Final Project*

***We will select one of three options below depending on the class size and student input**

Option 1 (Small Class Size ~5 students): Take a meteorite class (say OCs) and study their spectral properties over a wide wavelength (0.2-25 μm) range and publish it as peer-reviewed paper. Whole class will study one meteorite class with each student focusing on a specific wavelength range (e.g., UV, visible, NIR, Mid-IR).

Option 2 (Medium Class Size 5-10 students): Students will pick 1-2 large main belt asteroid(s) and observe it with RAPTORS-1 telescope to obtain their low-resolution visible wavelength spectra. They will reduce and analyze the telescopic data by collecting laboratory spectra of analog meteorites to identify for the parent body of the asteroid. No peer-reviewed paper.

Option 3 (Larger Class Size >10 students): Each student will get a meteorite type/class (depending on the number of students) and study their spectral properties over a wide wavelength (0.2-25 μm) range and publish it as peer-reviewed paper. Each student will contribute a section to the peer-reviewed paper on their assigned meteorite type/class.

Potential Extra Credit Field Trips (Covid willing we will do some of these): Tucson Gem Show, ASU Meteorite Curation Facility, Meteor Crater, Meteor Shower Observations (eta Aquariids-May 4th, 2022)

Grading Scale and Policies (Shown for Option 2)

Task	% Final Grade
Class Participation (reading, discussions, Q&A etc.)	10%
Mid-term test (In class identification of Meteorites)	20%
Field Trip Reports	10%
Lab Projects Written Reports	30%
Final Student Presentations	30%

Grading Details for Final Lab Project Written Reports (Option 2)

Task	% Final Grade
Draft Outline	5%
Abstract	5%
Figures and Tables	5%
Literature Review	5%
Analysis and Interpretation	10%

Grading Details for Final Lab Project Presentations (Option 2)

Task	% Final Grade
Organization (Presentation Flow and Outline)	5%
Content (Audio/Visual)	5%
Content (Literature Review)	5%
Content (Critical Analysis)	5%
Responses to Questions	10%

Nondiscrimination and Anti-harassment Policy

The University of Arizona is committed to creating and maintaining an environment free of discrimination. In support of this commitment, the University prohibits discrimination, including harassment and retaliation, based on a protected classification, including race, color, religion, sex, national origin, age, disability, veteran status, sexual orientation, gender identity, or genetic information. For more information, including how to report a concern, please see: <http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy>

University Policies

All university policies related to a syllabus are available at: <https://academicaffairs.arizona.edu/syllabus-policies>. By placing this link in your syllabus, you no longer need to have each individual policy included in your syllabus.

Subject to Change Notice

Information contained in the course syllabus, other than the grade and absence policies, may be subject to change with reasonable advance notice, as deemed appropriate by the instructor of this course.

Graduate Student Resources

Please consider including a link to the University of Arizona's Basic Needs Resources page: <http://basicneeds.arizona.edu/index.html>

Covid-19

As we enter the Spring semester, the health and wellbeing of everyone in this class is the highest priority. Accordingly, we are all required to follow the university guidelines on COVID-19 mitigation. Please visit www.covid19.arizona.edu for the latest guidance.