

# PTYS 407 – Chemistry of the Solar System

Kuiper Space Sciences Building – Room 312

Fall 2024 – Mondays and Wednesdays – 9:30-10:45 am

## Description of Course

This course explores key topics in cosmochemistry and planetary science related to the origin and evolution of the solar system and its constituents. We examine the origin of the elements, the chemistry of the bulk solar system, planetary formation, and subsequent geological and atmospheric evolution. We focus on chemical data obtained from analysis of meteorites, interplanetary dust particles, and returned samples from the Moon, Mars, asteroids, and comets. We also investigate chemical data obtained through spacecraft remote sensing and telescopic observations.

## Course Prerequisites

Two semesters of General Chemistry and one semester of College Algebra or their equivalents. These requirements may be waived by special permission of the instructor.

## Instructor and Contact Information

**Instructor:** Professor Dante Lauretta, Lunar and Planetary Laboratory, University of Arizona

**Office:** Kuiper Space Sciences Building (1629 E University Blvd) 536

**Email:** [lauretta@arizona.edu](mailto:lauretta@arizona.edu)

**Office Hours:** Tuesdays: 11 am – 12 pm in person

By appointment: Zoom or in person, contact Dante to schedule.

## Web Information

All class materials, including presentations, homework, oral presentation, and written report details are available on the course website on D2L. Website: <https://d2l.arizona.edu/d2l/home/1488356>

## Course Format and Teaching Methods

The course format will be in-person presentations from the instructor accompanied by assigned reading. Students will engage in active learning both in and out of the classroom through homework, an oral presentation, and a written report.

The course content will be presented and evaluated through a combination of:

- Classroom lectures focused on key topics in cosmochemistry
- Assigned reading
- Monthly quantitative homework assignments
- Student oral presentation
- Student written report

## Course Objectives

During this course students will:

- Use core values, concepts, theories, and quantitative methods from planetary science, chemistry, and geosciences to understand:
  - What are the analytical techniques used to acquire cosmochemical data sets?
  - What are the types of cosmochemical data and how are different elemental and isotopic systems applied to study extraterrestrial samples?
- Engage in critical thinking to apply chemical data to understand planetary and solar-system--scale processes.
- Identify and interrelate the wide variety of disciplines that address the fundamental questions:
  - How did the solar system form?
  - What are the chemical processes on planetary bodies across the solar system?

## Expected Learning Outcomes

- The ability to utilize multiple perspectives and make meaningful connections across disciplines, think conceptually and critically, and solve problems
- Competency in working with numerical information by critically analyzing quantitative information, generating ideas that are supported by quantitative evidence, assessing the relevance of data and its associated implications in a variety of contexts, and communicating those ideas and/or associated interpretations using various formats (graphs, data tables, illustrations, oral presentations, or written report).

## Course Communications

The instructor is available during office hours, via email, and by appointment. All course material will be posted on D2L. Instructor presentations will be delivered in person. Grades will be updated regularly on D2L. Students are allowed to work in small groups outside of class for the homework assignments.

## Required Readings

*Treatise on Geochemistry • Second Edition* (2014) Editors-in-Chief: H. D. Holland and K. K. Turekian

Assigned Chapters will be posted on D2L

## Assignments: Schedule/Due Dates

### Homework (HW) Assignments

Four homework assignments will be given throughout the semester. The schedule for their assignment and due dates is:

Assignment	Date Assigned	Date Due
<b>HW1</b>	9/2/24	9/23/24
<b>HW2</b>	9/25/24	10/16/24
<b>HW3</b>	10/16/24	11/6/24
<b>HW4</b>	11/6/24	11/27/24

## Oral Presentations (OP)

Students are required to present one in-class oral presentation. This presentation must be on a cosmochemical data set of relevance to the course topics. The data set may be from the scientific literature or from the student's own research. Presentations will be "conference style," with ten minutes for presentation and five minutes for questions. Students will be assigned one of these dates for their presentation:

Oral	
Presentation Slot	Date
<b>OP1</b>	9/25/24
<b>OP2</b>	10/14/24
<b>OP3</b>	10/30/24
<b>OP4</b>	11/18/24
<b>OP5</b>	12/4/24
<b>OP6</b>	Final Exam Period (if needed)

## Final Project - Written Report (WR)

Students are required to submit a written report on a cosmochemical data set of relevance to the course topics. The data set may be from the scientific literature, from the student's own research, or a combination of both. Reports will be "Research Article" style, limited to 1500 words (not including references and figure captions), 5 display items (figures or tables), and a maximum of twenty citations. The main text should be divided into sections with brief subheadings. The data should be presented in figures as relevant. All plotted data should also be included as a supplementary file.

Report	Due Date
<b>WR</b>	12/11/24

## Grading Scale and Policies

Final grades will be calculated based on:

60%: *Homework (15% each)*

20%: *Oral Presentation*

20%: *Written Report*

The grade distribution for the course is as follows:

A:	≥90%	= excellent (regular grade)
B:	≥80% – <90%	= good (regular grade)
C:	≥70% – <80%	= satisfactory (regular grade)
D:	≥60% – <70%	= poor (regular grade)
E:	<60%	= failure (regular grade)

## Scheduled Topics/Activities

Date	Reading	Topic	Due
8/26/24	NA	Class Introduction/OSIRIS-REx	
8/28/24	1.2.1	Early History of Meteoritics and Asteroid Science	
9/2/24		Labor Day - No Class	
9/4/24	2.14.3	Spaceflight Instrumentation	
9/9/24	2.1	Nucleosynthesis	
9/11/24	2.3.2	Protoplanetary Disks	
9/16/24	1.10.2	Condensation and Evaporation of Solar System Materials	
9/18/24	1.2.3	Cosmochemical Classification of the Elements	
9/23/24	NA	Laboratory Techniques for Sample Analysis	HW1
9/25/24		Oral Presentations	OP1
9/30/24	1.2.5	Chondrite Components and Parent-body Alteration	
10/2/24	1.1.2	Stable Isotopes	
10/7/24		K-ALFAA Lab Tour	
10/9/24	1.11.1-3	Short-Lived Radionuclides and Relative Geochronology	
10/14/24		Oral Presentations	OP2
10/16/24	1.12.1	Long-Lived Radionuclides and Absolute Geochronology	HW2
10/21/24	2.14.6	Asteroids	
10/23/24	2.13	Comets	
10/28/24	2.4.4-6	Planet Formation	
10/30/24		Oral Presentations	OP3
11/4/24	2.6	Mercury	
11/6/24	2.7	Venus	HW3
11/11/24		Veteran's Day - No Class	
11/13/24	2.9	The Moon	
11/18/24		Oral Presentations	OP4
11/20/24	1.5	Abiotic Organic Molecular Evolution	
11/25/24	10.1.5	The Early History of Life on Earth	
11/27/24	NA	Open Session	HW4
12/2/24	2.10.2	Martian Meteorites	
12/4/24		Oral Presentations	OP5
12/9/24	2.11	Giant Planets	
12/11/24	2.12	Major Satellites of the Giant Planets	WR

### Legend

	No class
	HW due date
	Student oral presentations
	Instructor out of town
	Written Report due date

## Incomplete (I) or Withdrawal (W):

Requests for incomplete (I) or withdrawal (W) must be made in accordance with University policy, which is available at <https://catalog.arizona.edu/policy/courses-credit/grading/grading-system>.

## Classroom Behavior Policy

To foster a positive learning environment, students and instructors have a shared responsibility. We want a safe, welcoming, and inclusive environment where all of us feel comfortable with each other and where we can challenge ourselves to succeed. To that end, our focus is on the tasks at hand and not on extraneous activities (e.g., texting, chatting, making phone calls, scrolling social media, etc.).

Students are asked to refrain from disruptive conversations with people sitting around them during lecture. Students observed engaging in disruptive activity will be asked to cease this behavior. Those who continue to disrupt the class will be asked to leave lecture or discussion and may be reported to the Dean of Students.

## Additional Resources for Students

UA Academic policies and procedures are available at <http://catalog.arizona.edu/policies>

### **Campus Health**

<http://www.health.arizona.edu/>

Campus Health provides quality medical and mental health care services through virtual and in-person care.

Phone: 520-621-9202

### **Counseling and Psych Services (CAPS)**

<https://health.arizona.edu/counseling-psych-services>

CAPS provides mental health care, including short-term counseling services.

Phone: 520-621-3334

### **The Dean of Students Office's Student Assistance Program**

<https://deanofstudents.arizona.edu/support/student-assistance>

Student Assistance helps students manage crises, life traumas, and other barriers that impede success. The staff addresses the needs of students who experience issues related to social adjustment, academic challenges, psychological health, physical health, victimization, and relationship issues, through a variety of interventions, referrals, and follow up services.

Email: [DOS-deanofstudents@email.arizona.edu](mailto:DOS-deanofstudents@email.arizona.edu)

Phone: 520-621-7057

### **Survivor Advocacy Program**

<https://survivoradvocacy.arizona.edu/>

The Survivor Advocacy Program provides confidential support and advocacy services to student survivors of sexual and gender-based violence. The Program can also advise students about relevant non-UA resources available within the local community for support.

Email: [survivoradvocacy@email.arizona.edu](mailto:survivoradvocacy@email.arizona.edu)

Phone: 520-621-5767

## Confidentiality of Student Records

<http://www.registrar.arizona.edu/ferpa>

## University-wide Policies link

Links to the following UA policies are provided here, <https://academicaffairs.arizona.edu/syllabus-policies>:

- Absence and Class Participation Policies
- Threatening Behavior Policy
- Accessibility and Accommodations Policy
- Code of Academic Integrity
- Nondiscrimination and Anti-Harassment Policy
- Subject to Change Statement