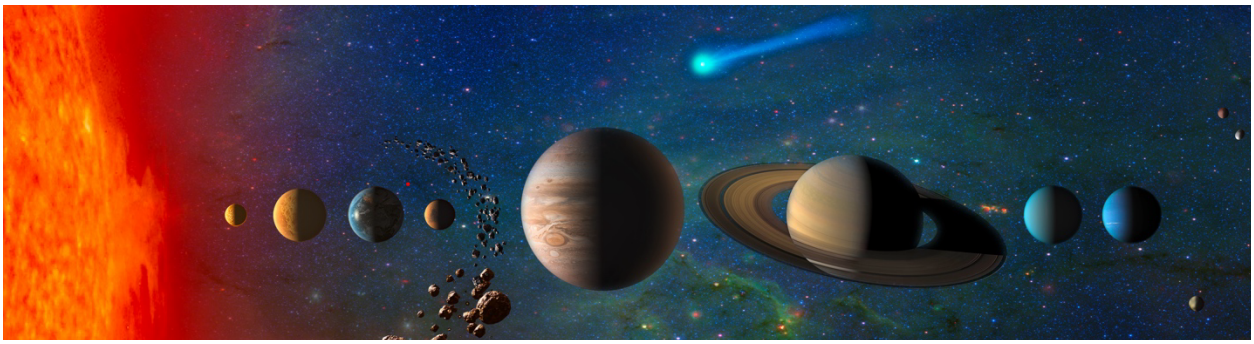

# PTYS 510: COSMOCHEMISTRY

Kuiper 312

Tuesdays and Thursdays from 11:00 AM to 12:15 PM

## Description of Course

This graduate-level core course explores the chemical history of our solar system from its formation to the present. We will examine the nuclear processes responsible for the synthesis of the elements and their isotopes, the galaxy's chemical evolution, and the physical and chemical processes that have shaped our solar system over geological time. Additionally, we will learn about different types of planetary materials, how they are analyzed, and the missions that collect and return them.

## Instructor and Contact Information

**Prof. Pierre Haenecour**

Office: Kuiper 530

Email: haenecour@arizona.edu (putting PTYS 510 in the subject line is appreciated)

Office hours (in-person or on Zoom): schedule by email appointment

## Schedule:

Tuesdays and Thursdays from 11:00 AM to 12:15 PM in Kuiper Space Sciences, Room 312.

## Course Objectives

The objective of this course is to provide students with an understanding of the origins and evolution of our solar system from a chemical perspective. The course will cover the following broad topics: the origin of the elements, including nucleosynthesis; minerals; planetary materials; stable, radiogenic, and cosmogenic isotopes; solar system chronology; and space missions.

## Expected Learning Outcomes

At the end of the course, students should be able to: 1/ Demonstrate an understanding of the basic principles of cosmochemistry and a working knowledge of the latest theories in the field; 2/ Use chemical datasets and calculations to understand and/or identify chemical and physical processes relevant to the formation and evolution of the solar system.

## Course Format and Teaching Methods

This course will be offered live in person and will primarily consist of lectures, with an in-class discussion component. those who request it via email ahead of class time.

Class Format: ***Live In-Person***

## Course Prerequisites

None.

## Course Website

Course materials will be uploaded to the PTYS 510A course page on D2L (https://d2l.arizona.edu/d2l/home/1726935, student login is required) as the semester progresses.

## Required Texts/Materials

There is no formal textbook assigned for the course. It is intended that all material will be self-contained within the lectures. However, several textbooks serve as excellent references and are worthwhile investments for students planning a career in cosmochemistry. The following will be available on D2L as e-books, and I will indicate relevant chapters where appropriate:

- **Main recommended book:** *Cosmochemistry* (H. Y. McSween Jr. and Gary R. Huss), 2022. Cambridge University Press, 452 p. This book presents the state of the field (as of 2022) in a classical textbook format. It is probably the best and most accessible introduction to the material for newcomers to the field. *For those considering careers in cosmochemistry, I recommend purchasing a physical copy of this textbook.*
- *Treatise on Geochemistry, Second Edition, Volume 1: Meteorites and Cosmochemical Processes* (Heinrich D. Holland, editor, and Karl K. Turekian, editor), 2014. Elsevier Science, 454 p. State of the field in a more encyclopedic format.
- *Field guide to meteors and meteorites.* 2009. Johnston, L. R. Norton, O. Richard. CHOICE: Current Reviews for Academic Libraries, *46(5), 926-928.*

## Equipment and software requirements

For this class, you will need daily access to the following hardware: a laptop or a web-enabled device. You will also need the ability to download and run the following basic software: a web browser, Adobe Acrobat, Excel (or another data-processing program of your choice, e.g., MATLAB), and Word.

## Class Recordings

Lectures may be recorded and made available via D2L. For lecture recordings, which are used at the instructor's discretion, students must access them only through D2L. Students may not modify, share, or reuse the content for any purpose other than personal educational use. All recordings are subject to government and university regulations. Therefore, students who access unauthorized recordings or use them in a manner inconsistent with UArizona values and educational policies (Code of Academic Integrity and the Student Code of Conduct) are also subject to civil action.

## Schedule of topics and activities

| Date | Anticipated Topic(s) | Date | Anticipated Topic(s) |
|---|---|---|---|
| 01/15 | Introduction to cosmochemistry | **03/17** | **LPSC – No class** (book chapter to read) |
| 01/20 | Geochemistry | **03/19** | **LPSC – No class** (***Midterm #1 on D2L***) |
| 01/22 | Geochemistry | 03/24 | OSIRIS-REX (Guest: Jess Barnes) |
| 01/27 | Geochemistry and Minerals | 03/26 | Asteroids and comets (***HW#4***) |
| 01/29 | Geochemistry and Minerals | 03/31 | Noble Gases and Cosmogenic Nuclides |
| 02/03 | Planetary Materials | 04/02 | Thermodynamics |
| 02/05 | Planetary Materials (***HW#1***) | 04/02 | Solar System Chronology |
| 02/10 | Origins of the Elements | 04/07 | Solar System Chronology |
| 02/12 | Origins of the Elements | 04/09 | Solar System Dynamics |
| 02/17 | Chemical Evolution & Isotopes (***HW#2***) | 04/14 | ***Midterm #2 (oral)*** |
| 02/19 | Chemical Evolution & Isotopes | 04/16 | ***Midterm #2 (oral)*** |
| 02/24 | Stable isotopes | 04/21 | Solar System Dynamics |
| 02/26 | Stable isotopes | 04/23 | Planets and surfaces |
| 03/03 | Radiogenic Isotopes | 04/28 | Astrobiology/Origins of Life |
| **03/05** | Radiogenic Isotopes (***HW#3***) | 04/30 | Big Picture & Wrap-up |
| 03/10 | **Spring recess - no classes** | 05/05 | ***Midterm #3*** |
| 03/12 | **Spring recess - no classes** | **05/07** | **Reading Day - no classes or finals** |
| | | **05/12** | **No Final Exam** |

The topics in logical units in a weekly schedule, including assignment due dates and exam dates, are listed above for information. The workload, topics, and course requirements are subject to change at the discretion of the instructor (with proper notice to the student).

## Assessments – Grading Scale and Policies

Students will be assessed based on:

| Item | % of final grade | Due dates |
|---|---|---|
| Mid-term test (x3) | 30 (10% each) | M1: 03/19; M2: 04/14-16; M3: 05/05 |
| Homework/problem set (x4) | 40 (10% each) | H1: 02/05; H2: 02/17; H3: 03/05; H4: 03/26 |
| Group topic essay (x1) | 30% | Due on 5/07 |

Credit is not given for assignments that are turned in late unless arrangements have been made with the instructor ahead of the deadline.

Grading Scale for the Course:

A — 90-100%
B — 80-90 %
C — 70-80%
D — 60-70%
E — 0-60%

## Incomplete (I) or Withdrawal (W)

Requests for incomplete (I) or withdrawal (W) must be made in accordance with University policies, which are available at http://catalog.arizona.edu/policy/grades-and-grading-system#incomplete and http://catalog.arizona.edu/policy/grades-and-grading-system#Withdrawal respectively.

## Dispute of Grade Policy

The acceptable time for disputing a grade on a paper/assignment, presentation, or quiz/exam is a maximum of a week after the grade has been posted onto D2L. The student must email the instructor to request an office hour meeting to discuss the disputed grade.

## Health and Wellness inside and outside of the classroom

**Classroom attendance:**

- If you feel sick or may have been in contact with someone who is infectious, do not come to class. Except for seeking medical care, avoid contact with others and do not travel.
- Notify your instructors if you will be missing an in-person or online course.

**Life challenges:** If you are experiencing unexpected barriers to your success in your courses, please note the Dean of Students Office is a central support resource for all students and may be helpful. The Dean of Students Office can be reached at 520-621-2057 or DOS-deanofstudents@email.arizona.edu.

**Physical and mental health challenges:** If you are facing physical or mental health challenges this semester, please note that Campus Health provides quality medical and mental health care. For medical appointments, call (520-621-9202. For after-hours care, call (520) 570-7898. For the Counseling & Psych Services (CAPS) 24/7 hotline, call (520) 621-3334.

## Absence and Class Participation Policy

Participating in the course and attending lectures and other course events are vital to the learning process. As such, attendance is required at all lectures and discussion section meetings. Absences may affect a student's final course grade. The UA's policy concerning Class Attendance, Participation, and Administrative Drops is available at: http://catalog.arizona.edu/policy/class-attendance-participation-and-administrative-drop.

If you anticipate being absent, are unexpectedly absent, or are unable to participate in class online activities, please contact me as soon as possible.

Absences pre-approved by the UA Dean of Students (or Dean Designee) will be honored. See: https://deanofstudents.arizona.edu/absences.

The UA policy regarding absences for any sincerely held religious belief, observance or practice will be accommodated where reasonable, http://policy.arizona.edu/human-resources/religious-accommodation-policy.

Assignments are due at the time of the class on their due dates. Late work will be accepted, although students should expect reduced credit. If a student anticipates an absence on the due date of an assignment, please either turn in your work early or discuss alternative arrangements with the instructor.

To request a disability-related accommodation to this attendance policy, please contact the Disability Resource Center at (520) 621-3268 or drc-info@email.arizona.edu.

If you are experiencing unexpected barriers to your success in your courses, the Dean of Students Office is a central support resource for all students and may be helpful. The Dean of Students Office is located in the Robert L. Nugent Building, room 100, or call 520-621-7057.

## Makeup Policy for Students Who Register Late

Late course registrations will be considered on a case-by-case basis. Students who want to register late to the course should email the instructor to discuss potential options (and the timeline) to make up missed assignments/quizzes.

## Course Communications

Online communication will be conducted through the official UA e-mail address and D2L. Students are encouraged to email the instructor about any questions and/or concerns.

## 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, reading a newspaper, making phone calls, web surfing, etc.). Please review the UA policy on disruptive behavior: http://policy.arizona.edu/education-and-student-affairs/disruptive-behavior-instructional-setting.

Students are asked to refrain from disruptive conversations with people sitting around them during lectures. 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 the lecture or discussion (or excluded from the Zoom call) and may be reported to the Dean of Students.

No mobile phone use during class unless it is somehow involved in the lecture/discussion. Computers are allowed to take notes or otherwise for lecture-relevant content. No social media activities of any kind are permitted or anything else that might be construed as behavior that distracts from the lecture.

## Threatening Behavior Policy

The UA Threatening Behavior by Students Policy prohibits threats of physical harm to any member of the University community, including to oneself. See http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students.

## Accessibility and Accommodations

For students with disabilities, reasonable accommodations will be provided by the Disability Resources Center: drc.arizona.edu/instructors/syllabus-statement.

## Code of Academic Integrity

The Student Code of Academic Integrity prohibits plagiarism: deanofstudents.arizona.edu/policies-and-codes/code-academic-integrity.

Zoom recordings are part of the students' educational record. Selling and/or sharing class notes, ZOOM recordings and/or other course materials to other students or to any third party is not permitted without the instructor's express written consent. Violations to this and other course rules are subject to the Code of Academic Integrity and may result in course sanctions. Additionally, students who use D2L or UA e-mail to sell or buy these copyrighted materials are subject to Code of Conduct Violations for misuse of student e-mail addresses. This conduct may also constitute copyright infringement.

## UA Nondiscrimination and Anti-harassment Policy

The University is committed to creating and maintaining an environment free of discrimination; see http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy

Our classroom is a place where everyone is encouraged to express well-formed opinions and their reasons for those opinions. We also want to create a tolerant and open environment where such opinions can be expressed without resorting to bullying or discrimination of others.

## Additional Resources for Students

UA Academic policies and procedures are available at http://catalog.arizona.edu/policies. Student Assistance and Advocacy information is available at http://deanofstudents.arizona.edu/student-assistance/students/student-assistance

## Confidentiality of Student Records

http://www.registrar.arizona.edu/personal-information/family-educational-rights-and-privacy-act-1974-ferpa?topic=ferpa

## Subject to Change Statement

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