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**COURSE DESCRIPTION, ASSESSMENTS, AND SCHEDULE**

**Course Description:** This core graduate-level course delves into the chemical journey of our solar system from its formation to the present day. We will discuss the nuclear processes responsible for the synthesis of the elements and their isotopes, the chemical evolution of the galaxy, and the chemical and physical processes that have shaped our solar system over geological time. We will also learn about different types of planetary materials, how they are studied, and the missions that collect and return them.

**Instructor:** Dr. Jessica Barnes, [jjbarnes@email.arizona.edu](mailto:jjbarnes@email.arizona.edu), 520-621-2012, Kuiper Space Sciences, Room 540. Office Hours by appointment only and can be conducted either in-person or via Zoom.

**Schedule:** Monday and Wednesday from 9:30 to 10:45 AM in Kuiper Space Sciences, Rm. 312.

**Course Format and Teaching Methods:** This course will be offered live in-person and will be mostly composed of lectures with an in-class discussion component. Remote participation will be accommodated for those who request it via email ahead of class time.

**Course Prerequisites:** none.

**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:

- Demonstrate an understanding of the basic principles of cosmochemistry and a working knowledge of the latest theories in the field.
- 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 Website:** Course materials will be uploaded to the PTYS 510A course page on D2L (<https://d2l.arizona.edu/d2l/home/1119816>, 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:

- *Cosmochemistry* (H. Y. McSween Jr. and Gary R. Huss), 2010. Cambridge University Press, 549 p. This book presents the state of the field (as of 2010) in classical textbook format. Probably the best and most accessible presentation of material for newcomers to the field. *For those considering careers in cosmochemistry, I recommend purchasing a physical copy of this textbook, however, you may consider waiting to purchase until the new version comes out in Spring 2022.*
- *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. A more up-to-date account of the state of the field in a more encyclopedic format.

In addition, the following are useful resources that are available in the LPL library:

- *Meteorites and the Early Solar System 2* (D.S. Lauretta and H. Y. McSween Jr., eds.), 2006. The University of Arizona Press, 943 p. An encyclopedic compendium of the chemical and physical processes that led to the formation of the solar system as revealed through the meteoritic record. Assumes a large degree of prior knowledge of the field.
- *Meteorites, Comets, and Planets* (A. M. Davis, ed.), 2014. Elsevier. 737p. A good introduction to the variety of planetary materials available in terrestrial collections and what such materials tell us about the evolution of the solar system.
- *Planetary Materials* (J. J. Papike, ed.) 1998. Mineralogical Society of America. Although out of date, it is a nearly complete overview of the variety of planetary materials at that time. The book contains limited discussion of the significance of such materials for origins of the solar system and instead emphasizes the properties, e.g., chemistry, structure, of the constituent minerals of meteorites, interplanetary dust particles, etc.

**Equipment and software requirements:** For this class you will need daily access to the following hardware: laptop or web-enabled device with webcam and microphone in case of virtual classes; regular access to reliable internet signal; ability to download and run the following basic software: web browser, Adobe Acrobat, Excel (or other data processing program of your choosing e.g., MATLAB), Word.

**Class Recordings:** Lectures will be recorded and made available via D2L. For lecture recordings, which are used at the discretion of the instructor, students must access content in D2L only. Students may not modify content or re-use content for any purpose other than personal educational reasons. All recordings are subject to government and university regulations. Therefore, students accessing unauthorized recordings or using 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

Week #	Topic	Assignment due	Note
1	Introduction to cosmochemistry		
2	Geochemistry		No class M 17 <sup>th</sup> Jan [MLK]
3	Geochemistry & Minerals		
4	Planetary Materials	H1	
5	Origin of the Elements		
6	Chemical Evolution & Isotopes	H2	
7	Stable Isotopes		No class W 23 <sup>rd</sup> Feb [O-REx STM]
8	Radiogenic Isotopes	H3	
9	-	-	No classes [spring break/LPSC]
10	Noble Gases	M	
11	Cosmogenic nuclides & Organics		
12	Comets & Asteroids	H4	
13	Thermodynamics	E1	
14	Solar system chronology		
15	Solar system dynamics	E2	
16	Planets and surfaces	E3	
17	Big picture & wrap up		

M = midterm, H = homework/problem set, E = essay

### Assessments:

Item	% of final grade	Due dates
Mid-term test	15	M: 03/16
Homework/problem set (x4)	40 (10% each)	H1: 01/31; H2: 02/14; H3: 02/23; H4: 03/28
Topic essay (x3)	30 (10% each)	E1: 04/06; E2: 04/18; E3: 04/27
Final exam	15	F: 05/12

M = midterm, H = homework/problem set, E = essay, F= final

### Grading Scale (%):

A	≥ 90
B	80 to 89
C	70 to 79
D	60 to 69
E	< 60

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

### Final Exam:

- See for <http://registrar.arizona.edu/courses/final-examination-regulations-and-information?audience=students&cat1=10&cat2=31> final-exam regulations.
- See <http://www.registrar.arizona.edu/students/courses/final-exams> for the final exam schedule.
- The final exam for our class is scheduled for **Thursday 12<sup>th</sup> May 10:30am - 12:30pm (Kuiper rm 312)** this will be an open-book, in-class test.

## HEALTH AND WELLNESS INSIDE AND OUTSIDE OF THE CLASSROOM

### Classroom attendance in the time of COVID-19:

- If you feel sick, or may have been in contact with someone who is infectious, stay home. Except for seeking medical care, avoid contact with others and do not travel.
- Notify your instructor(s) if you will be missing a course meeting or an assignment deadline.
- Non-attendance for any reason does **not** guarantee an automatic extension of due date or rescheduling of examinations/assessments.
- Please communicate and coordinate any request directly with your instructor.
- If you must miss the equivalent of more than one week of class, you should contact the Dean of Students Office [DOS-deanofstudents@email.arizona.edu](mailto:DOS-deanofstudents@email.arizona.edu) to share documentation about the challenges you are facing.
- Voluntary, free, and convenient [COVID-19 testing](#) is available for students on Main Campus.
- COVID-19 vaccine is available for all students at [Campus Health](#).
- Visit the [UArizona COVID-19](#) page for regular updates.

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

- You can also find graduate student resources here: <https://asuatoday.arizona.edu/basic-needs>

**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.

### **CLASSROOM BEHAVIOR AND ACCOMMODATIONS**

**Classroom Behavior:** 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 Facebook or other social media activities are permitted or anything else that might be construed as behavior that distracts from the lecture.

**Absence and Class Participation Policies:** Absences for any sincerely held religious belief, observance, or practice will be accommodated where reasonable. See <http://policy.arizona.edu/human-resources/religious-accommodation-policy>. Absences pre-approved by the UA Dean of Students (or dean's designee) will be honored.

**Accommodations for Students with Disabilities:** For students with disabilities, reasonable accommodations will be provided by the Disability Resources Center: [drc.arizona.edu/instructors/syllabus-statement](http://drc.arizona.edu/instructors/syllabus-statement)

**Academic Integrity Policy:** The Student Code of Academic Integrity prohibits plagiarism: [deanofstudents.arizona.edu/policies-and-codes/code-academic-integrity](http://deanofstudents.arizona.edu/policies-and-codes/code-academic-integrity).

**Nondiscrimination and Anti-Harassment Policy:** Please see University Policy 200E on prohibited behaviors: <http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy>

**Threatening Behavior Policy:** The UA policy on threatening behavior prohibits threats of physical harm to any member of the University community: [policy.arizona.edu/education-and-student-affairs/threatening-behavior-students](http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students).

**Subject to change notice:** 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.