Core Curriculum

Course Information

Core area: Life and Physical Sciences
Course type: New Course
Course ID: GEOL 1315
TCCN: GEOL 1315
School or College: Science
Department: Earth and Environmental Sciences
Course title: Meteorites, Asteroid Impacts, Flood Volcanisms and Mass Extinctions

Course catalog description: Geology of the solar system through studies of meteorites, their mineralogy and chemical composition; origin of the earth, moon and other planets; earth model based on meteorites; impact cratering history of the earth and in the solar system; massive rapid flood volcanism on earth; history of life on planet earth punctuated by periodic mass extinctions; synchrony and causal relations among impacts, flood volcanisms’ and mass extinctions.

Number of sections to be offered per year: 1
Estimated enrollment per year: 60
Total enrollment 2012-2013 (Fall/Spr/Sum): New course, not offered previously

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Assessment for this course: The objectives will be assessed through communal assessment using signature assignments.

Coordinating Board Objectives

1. 1. Critical Thinking Skills:
Critical thinking skills in studying meteorites, their mineralogical and chemical composition will be enhanced through the direct investigations of meteorites held in hand, by their observed similarity with terrestrial rocks, especially the earth’s mantle-derived rocks, and the returned lunar samples from the Apollo Program, and finally through a comparison with the solar composition as obtained from solar spectral studies. An inquiry-based approach will be used in the signature project Meteorite Impacts, Flood Volcanism and Mass Extinctions Information will have to be gathered, analyzed and synthesized in completing this terminal project, to be sourced from all the readings assigned, the lectures delivered, as well as utilizing other lab/homework exercises. The assessment of the critical thinking skills will be performed through this key assignment and other work assigned throughout the semester.

1. 2. Communication Skills:
Communication skills in Meteorites, Asteroid Impacts, Food Volcanisms and Mass Extinctions will be developed through discussions among students and between the instructor and students in lecture and lab. Students will work in groups and exchange ideas and share knowledge in the signature project *Meteorite Impacts, Flood Volcanism and Mass Extinctions*. They will also prepare visuals and a written report as well as perform an oral presentation for their terminal project, which will be used for the assessment of the communication skills.

1.3. **Empirical and Quantitative Skills:**
Empirical and quantitative skills in Meteorites, Asteroid Impacts, Food Volcanisms and Mass Extinctions will be enhanced through the gathering, evaluation and synthesis of data and information in lab/homework exercises and especially in the key project for this course *Meteorites, Asteroid Impacts, Food Volcanisms and Mass Extinctions*. The assessment of the empirical and quantitative skills will be performed based on this project and based on a few homework assignments that will require understanding simple mathematical formulations, algebraic equations involving geometry, trigonometry and home exercises using logarithmic plots, all of which will be recapitulated in lectures and the lab.

1.4. **Teamwork Skills:**
Teamwork skills will be promoted in the key project *Meteorite Impacts, Flood Volcanism and Mass Extinction* in which students will work in groups in order to compare and synthesize information and prepare a team report and presentation. The assessment of the teamwork skills will be performed based on this project.

**Course Syllabus (Sample)**

**GEOL 1315**

Meteorites, Asteroid Impacts, Food Volcanisms and Mass Extinctions

**Lecture and Lab**

Instructor: TBA

Time and Location TBA

This course satisfies the [University of Texas at Arlington core curriculum requirement in Life and Physical Sciences](https://www.utdallas.edu/).

**Course Description:** Students will be taught the geology of the solar system through studies of meteorites, their mineralogy, age, and chemical compositions, geologic knowledge based on our home planet, Earth, and through mankind’s space explorations. They will also learn about our current knowledge on the origin of the earth, moon and other planets, impact cratering history of the earth and in the solar system, massive rapid flood volcanism in earth history, history of life on planet earth punctuated by periodic mass extinctions. They will learn about a frontier field of research in the planetary sciences, involving synchrony and causal relations among impacts, flood volcanisms and mass extinctions.

**Student Learning Outcomes:** After completion of this class, students will be able to learn(I)
the minerals, and their chemical compositions that make up the different meteorites, (II) how we deduce the bulk composition of the Earth based on the age and chemical composition of the most primitive meteorites (III) understand impact cratering process in the solar system, their frequency of bombardment, crater morphology and how to recognize them, (IV) basaltic volcanism in planets, and whether impact-triggered large and rapid flood volcanism is possible in causing mass extinctions in earth history. The Students will enhance their critical thinking skills, communication skills, empirical and quantitative skills, and teamwork skills by completing assignments pertaining to the above listed learning outcomes.

**Office Hours:** TBA  
**Email:** TBA  
**Phone:** TBA


**Course Material available via Blackboard:** Go to [http://elearn.uta.edu/](http://elearn.uta.edu/), login with your NetID and password

**Exams:**  
Exams will be multiple choice, “fill-in-the-blank”, and some short answer questions. The final exam will have some essay-type questions.  
Exams must be taken at the scheduled time. Make-up exams only in case of illness or family emergency with supporting documentation. Students who do not take an exam receive zero points as a grade on that exam.

**Quizzes:**  
Quizzes will be unannounced and will cover the material of the last four lectures. 4 quizzes will be given, only the best 3 quizzes will count for every student. **No make-up quizzes.**

**Key Activities and Assignments:**  
*Identifying and classifying key meteorite types in hand specimens and under the microscope.*  
Students will be exposed to a variety of the major meteorite types, Under the polarizing light microscopy they will see the oldest objects in the solar system, namely the chondrules in chondritic meteorites that are 4.6 Billion years old. They will also examine rock samples from the Moon and meteorite samples from Mars.

*Geology of terrestrial and extraterrestrial Impact craters*  
In this exercise, students will be assembled in groups and will be assigned an impact crater, either on the earth, the moon or in another planet such as Mercury where multiple sets of data are available on a particular crater. For example, the Chicxulub crater in the Yucatan peninsula in Mexico that formed 66 Million years ago at the K/T boundary when the dinosaurs became extinct is a region for which the students can gather different sets of geologic data, such as lithology of geologic units, their age, and geologic extent, and tectonic setting information from various sources. Each student in the group will be assigned a different disciplinary aspect. They will present their data to the other students in their group and then assess and interpret the data together in order to infer the geologic impact evidence and history of that region. Each group will then present their findings to the other groups.
The geologic maps and data submitted, the oral presentation, as well as a written summary will all be graded for this exercise.

This kind of activity includes all of the required core objectives: critical thinking (through inquiry, analysis and synthesis of data), communication skills (through visual, oral, and written presentation), empirical and quantitative skills (through assembling and categorizing data), and teamwork (through the participation in two different working groups).

Other Exercises:
Additional lab exercises will be assigned on the topics of meteorite identification, and other direct evidence of impacts, such as shocked minerals and rocks, tektites, geochemical signatures including isotopic shifts at major impact events.

Grading and Grade Calculation:

<table>
<thead>
<tr>
<th>Grading</th>
<th>Lecture Portion: 75% of course</th>
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<tbody>
<tr>
<td>Lab Portion: 25% of course</td>
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</tbody>
</table>

Lecture Portion:
Quizzes 9% of course (3% each)
Exams 45% of course (15% each)
Final Exam 21% of course

Lab Portion:
Key Assignments 10% of course
Other Exercises 15% of course

Final grade calculation:
0.1 x key assignments + 0.15 x other exercises + 0.09 x quizzes + 0.45 x exams + 0.21 x final exam. Score will be translated into a grade based on class average.

Attendance:
Minimum of 95 percent in class attendance is required and will be monitored by various means. Lower than 95 percent attendance will influence the final grade.

Lab Safety Training:
Students registered for this course must complete all required lab safety training prior to entering the lab and undertaking any activities. Once completed, Lab Safety Training is valid for the remainder of the same academic year (i.e., through the following August) and must be completed again in subsequent years. There are no exceptions to this University policy. Failure to complete the required training will preclude participation in any lab activities, including those for which a grade is assigned.

Students with Disabilities (Americans With Disabilities Act):
Any student requiring an accommodation for this course must provide the instructor with official documentation in the form of a letter certified by the staff in the Office for Students with Disabilities, University Hall 102. Only those students who have officially documented a need for an accommodation will have their request honored. Information regarding diagnostic criteria and policies for obtaining disability-based academic accommodations can be found at www.uta.edu/disability or by calling the Office for Students with Disabilities at
(817) 272-3364.

**Drop Policy:**  
Students may drop or swap classes through self-service in MyMav from the beginning of the registration period through the late registration period. After the late registration period, students must see their academic advisor to drop a class or withdraw. It is the student's responsibility to officially withdraw if they do not plan to attend after registering. Students will not be automatically dropped for non-attendance.

**Academic Integrity:**  
Academic dishonesty (such as cheating, plagiarism, taking an exam for another person, etc.) will not be tolerated in any form and will be disciplined in accordance with University regulations and procedures. All students enrolled in this course are expected to adhere to the UT Arlington Honor Code:

*I pledge, on my honor, to uphold UT Arlington’s tradition of academic integrity, a tradition that values hard work and honest effort in the pursuit of academic excellence.  
I promise that I will submit only work that I personally create or contribute to group collaborations, and I will appropriately reference any work from other sources. I will follow the highest standards of integrity and uphold the spirit of the Honor Code.*

**Student Support Services:**  
UT Arlington provides a variety of resources and programs designed to help students develop academic skills, deal with personal situations, and better understand concepts and information related to their courses. Resources include tutoring, major-based learning centers, developmental education, advising and mentoring, personal counseling, and federally funded programs. For individualized referrals, students may visit the reception desk at University College (Ransom Hall), call the Maverick Resource Hotline at 817-272-6107, or view the information at [www.uta.edu/resources](http://www.uta.edu/resources).

**Electronic Communication:**  
UT Arlington has adopted MavMail as its official means to communicate with students about important deadlines and events, as well as to transact university-related business regarding financial aid, tuition, grades, graduation, etc. All students are assigned a MavMail account and are responsible for checking the inbox regularly. There is no additional charge to students for using this account, which remains active even after graduation. Information about activating and using MavMail is available at [http://www.uta.edu/oit/cs/email/mavmail.php](http://www.uta.edu/oit/cs/email/mavmail.php)

**Student Feedback Survey:**  
At the end of each term, students enrolled in classes shall be directed to complete a Student Feedback Survey (SFS). Instructions on how to access the SFS for this course will be sent directly to each student through MavMail approximately 10 days before the end of the term. Each student’s feedback enters the SFS database anonymously and is aggregated with that of other students enrolled in the course. UT Arlington’s effort to solicit, gather, tabulate, and publish student feedback is required by state law; students are strongly urged to participate. For more information, visit [http://www.uta.edu/sfs](http://www.uta.edu/sfs).

No use of cell phones or other electronic devices during class/exams. Computers are allowed for note-taking only during the lectures.
Lecture Schedule

Text book Readings are (RS) from Rocks from Space , and (M) for Meteorites by Zanda and Rotaru

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<thead>
<tr>
<th>Week</th>
<th>Topic</th>
<th>Textbook Readings</th>
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<tbody>
<tr>
<td>1</td>
<td>Introduction to the course, Map of the Solar System, Spacing of the planets; non volatile elements in the Sun and in Chondritic meteorites; geochemical classification of the elements; chemical classification of rocks and meteorites, cations and anions, common minerals in meteorites.</td>
<td>Lecture notes and class handouts</td>
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<tr>
<td>2</td>
<td>Hand specimen identification of Minerals and Rocks, including those found in meteorites, by their physical properties; hand specimen identification of meteorites, microscopic identification of chondrules in Allende meteorite, observation of a thin section of a Martian meteorite</td>
<td>Class handout and lecture notes, and pages 175-180 from RS Pages 181-184 from RS Pages 53-59 from M</td>
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<tr>
<td>3</td>
<td>Fractional Crystallization and the igneous process; silicate mineral structure and their classification. Minerals in the earth’s crust and in stony meteorites. Differentiation and differentiated meteorites</td>
<td>Class notes and handouts. Pages 175-184, RS Pages 350-351, RS Pages 53-59, M</td>
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<td>4</td>
<td>Role of temperature in the formation of planets; formation of the first minerals in the solar system, minerals to rocks to planetesimals; meteorite parent bodies, little planets</td>
<td>Chapters 18-19, RS Pages 69-75, M</td>
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<td>5</td>
<td>Types of meteorites; Chondrites and Achondrites; iron meteorites and stony iron meteorites</td>
<td>Chapters 10-11, RS Pages 53-67, M Chapters 12-13, RS</td>
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<td>6</td>
<td>Comprehensive Meteorite Classification, review and summary of the scheme of meteorite classification</td>
<td>Handouts and sections in RS and M on Meteorite classification</td>
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<td>7</td>
<td>How to find impact structures on earth and in the solar system</td>
<td>Handouts, Chapters 5-7, RS, pages 131-153, RS; Pages 31-39,</td>
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<tr>
<td>2&lt;sup&gt;nd&lt;/sup&gt; Exam</td>
<td><strong>On topics covering the last 6 lectures</strong></td>
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<td>8</td>
<td>A Glass Menagerie: Chicxulub and the Haitian Tektites, Origin of the Moon and a Lunar attic</td>
<td>Handout, Pages 391-398 , RS  Repeat readings from week 7, especially Pages 131-153, RS, and pages 31-39, 41-49, M</td>
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<td>9</td>
<td>Enormous eruptions and disappearing seaways; Gondwana comes apart; Supercontinents and their fragmentation</td>
<td>Handout, and lecture notes</td>
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<td>10</td>
<td>Isotopes of Carbon, Oxygen, Strontium and Helium; isotopic variations across P/T and K/T boundaries; Laboratory experiments on the origin of life</td>
<td>Handouts and lecture notes Pages 87-93</td>
</tr>
<tr>
<td><strong>3&lt;sup&gt;rd&lt;/sup&gt; Exam</strong></td>
<td><strong>Exam on topics covered in the last 3 lectures</strong></td>
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<td>11</td>
<td>A combination of volcanic and impact scenarios Heavy volcanic eras caused by plumes from the earth’s core</td>
<td>Lecture notes and handouts</td>
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<td>12</td>
<td>A Tale of Two Plumes: A combination of volcanic and impact scenarios</td>
<td>Lecture notes and handouts; Slide presentation</td>
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<tr>
<td>13</td>
<td>The Dating Game: How the age of the Earth and Meteorites are determined</td>
<td>Lecture notes and handouts</td>
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<tr>
<td>14</td>
<td>Review of meteorites and Impact craters</td>
<td>Lecture notes</td>
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<tr>
<td>15</td>
<td>Review of Course material</td>
<td>Lecture notes and class discussions</td>
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<tr>
<td><strong>FINAL EXAM</strong></td>
<td><strong>Comprehensive</strong></td>
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