

Faculty of Science Course Syllabus
Department of Earth Sciences
ERTH2020 A Journey Through the Solar System
Fall Semester 2018

Instructor(s): *Richard Cox (richard.cox@dal.ca)* *LSC (Earth Science wing) 3rd floor (3027)*

Lectures: *2 per week (Tue and Thu - 6:05-7:25PM)*
Location: LSC common area (Room C208)

Laboratories: *N/A*

Tutorials: *N/A*

Course Description

The course offers an introduction to the geological features of the planets, asteroid belt, and major satellites of our solar system, and the current understanding as to their formation. The course will use the Earth as an analog to compare the landforms, and both the measured and inferred geology of the solar system.

Course Prerequisites

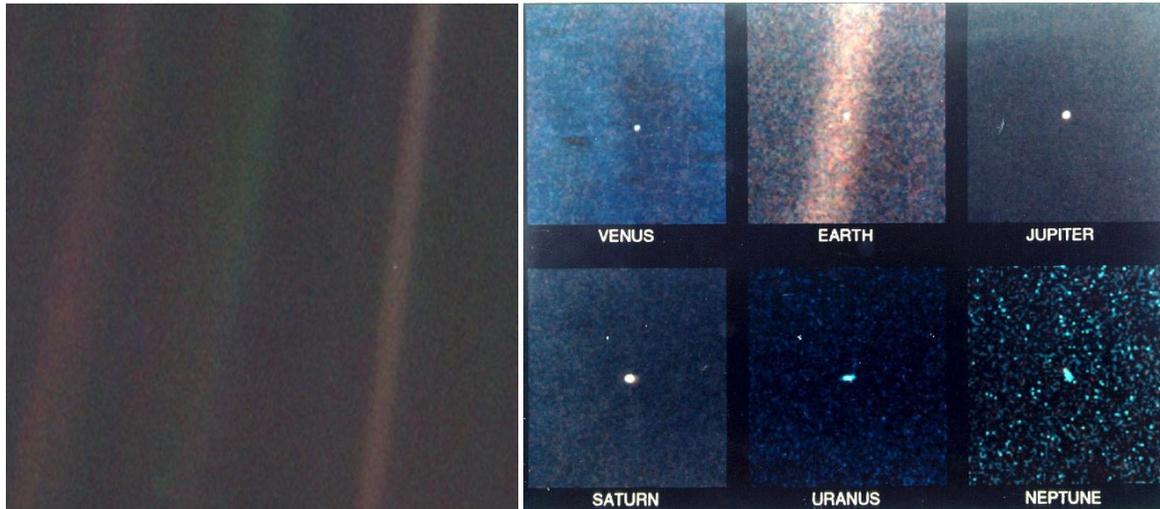
All students must be in their 2nd year. No specific course prerequisites are required. Note: that a general understanding of physical sciences and basic mathematics will be necessary to successfully complete the course.

Course Objectives/Learning Outcomes

Why is this course called EARTH2020? The Voyager missions are probably the most successful examples of exploration of our solar system that have ever been carried out. On August the 25th, 2012, Voyager I became the first object launched by us to leave our solar system after completing a 35 year long journey. One of the last images taken by Voyager was called at the time “The Pale Blue Dot”. The tiny blue dot visible in the centre right of the image (below) is the Earth from 6.44 billion km away. This was one a series of images of our solar system captured in 1990. Voyager II is also currently on its way out of our solar system and will also leave the Solar System by 2020, having been the only spacecraft to have visited all of the outer planets. As we watch these two fragile man-made objects become interstellar spacecraft, we will look back at our own solar system, and review what we have discovered using some of the information gathered by these historic missions.

Why study the planets? To understand how the Earth works we look at the current and recent geological record of events and apply our understanding of these events to model the processes that have shaped the Earth over the course of the last 4.5 billion years. In other words, the present is the key to the past, a concept known as uniformitarianism. However, because the Earth is a shaped by different dynamic processes, and contains widely contrasting environments, we simply do not have a complete geological record. By examining other planetary bodies in our solar system we can hopefully see a record of events that are not preserved on Earth. However, there is more to this field of study. It is often

the differences rather than the similarities between the Earth and her neighbors that are the most striking. By recognizing these differences, and understanding why they occur in our solar system, we gain a greater insight into the workings of our home planet. The Earth is our home, and for the foreseeable future, is the only home we will ever have. Is it not wise to understand how your home was built and how it works?



“The Pale Blue Dot” (left). Part of series of image of our solar system taken by Voyager I (right). The images from <http://voyager.jpl.nasa.gov/imagesvideo/imagesbyvoyager.html>.

The overall goals for this course: To examine the ongoing exploration of terrestrial planets, larger moons, asteroids, comets and Kuiper Belt objects in our solar system; to recognize the main features present on these planetary bodies and compare them with those on Earth; to understand the main geological processes involved in the formation of these planetary bodies.

Learning outcomes: The learning outcomes include, but are not restricted to;

- 1) To gain a basic knowledge of how the planets and satellites in our solar system are studied and the analytical methods that have been used, and are currently being used.
- 2) To gain knowledge about the age, composition and structure of the main geological features of the terrestrial planets, asteroids, comets, the main satellites of the outer planets, and dwarf planets of our solar system.
- 3) To understand how the main geomorphological features of extraterrestrial planetary bodies in the solar system have formed and how these compare to the Earth.
- 4) To apply the knowledge gained during the course to create your own mission package which will help you to solve a particular problem in Solar System exploration.
- 5) To evaluate and analyze a data set delivered by your mission package which will help solve a specific geological problem.
- 6) To appreciate the importance of pushing the boundaries of understanding and why we must continue to explore our solar system.

Course Materials

Required Textbook:

Claudio Vita-Finzi and Dominic Fortes **"Planetary Geology"** ISBN 978-1-78046-015-4

Other materials required:

Other materials will be posted on Brightspace.

Course Outline

Proposed Lecture Schedule (subject to change):

Exploring the Solar System.

- a) The order and structure of the planets, their moons and the Asteroid and Kuiper Belts.
- b) The age of the planets and a general model for the formation of the Solar System.
- c) Why do we explore?
- d) What can we tell about a planetary body's geological history?
- e) What can we measure and how do we do it?
- f) Manned versus unmanned missions.

Quiz 1: The age and composition of the solar system

The Earth, our home and native land.

- a) The surface of the Earth.
- b) The structure of the Earth.
- c) Plate tectonics.
- d) The composition of the Earth.
- e) Geological processes and geological cycles.
- h) A brief global geological history: When did this all occur?

Quiz 2: The Age, Composition and Structure of the Earth

Luna, our nearest neighbor.

- a) A history of lunar exploration.
- b) The far side and near side: The main features of the Moon and her composition.
- d) A Geological history of the Moon.

The inner planets; A Visit to Venus and Mercury

- a) The main geological features of the Venus.
- b) Venus Earth's (evil) twin? A comparison between Venus and the Hadean Earth.
- c) The current understanding of the geology of Mercury.

Quiz 3: The Moon, Venus and Mercury

The Red Planet

- a) The main geological features of Mars.

- b) Geological environments on Mars: rocks, weathering, winds and sand.
- c) Where on Earth is Mars? A comparison of geological terranes.

The Asteroid Belt

- a) The large-scale structure of the Asteroid Belt.
- b) The study and classification of meteorites: a planet in the making.
- c) Mini-planets: Vesta, Ceres and other bits and pieces.

Quiz 4: Mars and the Asteroid Belt

The Servants of the Gods: The moons of the outer planets

- a) The Galilean Moons: Ganymede, Callisto, Io and Europa.
- b) The rings and moons of Saturn and the mystery of Titan.
- c) The moons of Uranus and Neptune and the capture of Triton.

The Outer Limits: Comets and the Kuiper Belt

- a) What are comets and where do they come from?
- b) Pluto and the dwarf planets.
- c) The Kuiper Belt and Oort Cloud. What do we know?

Quiz 5: The outer moons and dwarf planets

The Journey Continues: Future missions

- a) Current and future missions: Where do we go from here and why?
- b) Can we really live in space, the Moon, Mars?
- c) Summary and Conclusions

Term Project: Design your own Mission

The term project involves two parts each worth a maximum of 15% of your course mark when properly completed. For part 1, you will be assigned a specific exploration problem (e.g. examining volcanism on Venus, the relative chronology of events recorded by Mercury, the search for water on the Moon, comparing the chemical composition of the asteroids, a study of plate tectonics on Europa, etc.). Once you have read the basic mission statements and goals you will have to complete and submit a mission proposal which will include a basic mission (instruments) package and what data you wish to gather. This is done by completing the mission statement form on-line through Brightspace. You may of course consult with the mission directors (course instructors and demonstrators) beforehand. Your mission will either be approved with a mark awarded based on how successfully you have designed your mission package, or rejected because the requested mission package will not fulfill the mission goals. resubmit your proposal but 5% of your mark will be deducted for each failed attempt. After three attempts your mission package will be assigned for you and half of your project mark will have been lost (15% of the course total).

The second part of the project involves the launch and deployment of your mission package and data return. You will have to evaluate, interpret and report on the data gathered and produce a short final report which is also completed using the templates provided on Brightspace. You will be marked on your

interpretation of your data and how well your mission has met the scientific goals set. Up to 15% of your final course mark will be awarded at this stage and your final project mark calculated.

Course Assessment

*Class Quizzes (5 in total x 5% each as described above). The best 4 marks will be counted = **20%** of your final mark). These must be must completed on-line.*

*Midterm Exam (The terrestrial planets and satellites) = **20%** of your final mark.*

*Term Project "Design your mission" (see description above). Mission design, data collection and objective completion (2 x 15%) = **30%** of your final mark.*

*Final Exam, which will be cumulative (scheduled by the registrar) = **30%** of your final mark.*

Other course requirements

Regular attendance at lectures, reading the required course materials thoroughly and most importantly, a genuine enthusiasm for studying in a wide range of science and technology disciplines.

Conversion of numerical grades to Final Letter Grades follows the Dalhousie Common Grade Scale

A+ (90-100)	B+ (77-79)	C+ (65-69)	D	(50-54)
A (85-89)	B (73-76)	C (60-64)	F	(<50)
A- (80-84)	B- (70-72)	C- (55-59)		

Course Policies

Attendance at all lectures is required. In-class exercises may be presented and will greatly help towards understanding the graded materials during the semester. Quizzes submitted on Brightspace after the deadline will not be graded. Term project modules (2 parts) submitted late without reasonable and documented cause will be deducted 50% after the deadline and a further 10% per day. Term project modules completed more than 5 days late will not be graded. Note: You will be required to complete each module of the term project in order. Failure to complete a module will prevent you from completing the rest of the term project. See the description of the Term Project above for further details.

University Policies and Statements

This course is governed by the academic rules and regulations set forth in the University Calendar and by Senate

Academic Integrity

At Dalhousie University, we are guided in all of our work by the values of academic integrity: honesty, trust, fairness, responsibility and respect (The Center for Academic Integrity, Duke University, 1999). As a student, you are required to demonstrate these values in all of the work you do. The University provides policies and procedures that every member of the university community is required to follow to ensure academic integrity.

Information: https://www.dal.ca/dept/university_secretariat/academic-integrity.html

Accessibility

The Advising and Access Services Centre is Dalhousie's centre of expertise for student accessibility and accommodation. The advising team works with students who request accommodation as a result of a disability, religious obligation, or any barrier related to any other characteristic protected under Human Rights legislation (Canada and Nova Scotia).

Information: https://www.dal.ca/campus_life/academic-support/accessibility.html

Student Code of Conduct

Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don't follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and informal manner—perhaps through a restorative justice process. If an informal resolution can't be reached, or would be inappropriate, procedures exist for formal dispute resolution.

Code: https://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html

Diversity and Inclusion – Culture of Respect

Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness

Statement: <http://www.dal.ca/cultureofrespect.html>

Recognition of Mi'kmaq Territory

Dalhousie University would like to acknowledge that the University is on Traditional Mi'kmaq Territory. The Elders in Residence program provides students with access to First Nations elders for guidance, counsel and support. Visit or e-mail the Indigenous Student Centre (1321 Edward St) (elders@dal.ca).

Information: https://www.dal.ca/campus_life/communities/indigenous.html

Important Dates in the Academic Year (including add/drop dates)

https://www.dal.ca/academics/important_dates.html

University Grading Practices

https://www.dal.ca/dept/university_secretariat/policies/academic/grading-practices-policy.html

Missed or Late Academic Requirements due to Student Absence (policy)

https://www.dal.ca/dept/university_secretariat/policies/academic/missed-or-late-academic-requirements-due-to-student-absence.html

Student Resources and Support

Advising

General Advising https://www.dal.ca/campus_life/academic-support/advising.html

Science Program Advisors: <https://www.dal.ca/faculty/science/current-students/academic-advising.html>

Indigenous Student Centre: https://www.dal.ca/campus_life/communities/indigenous.html

Black Students Advising Centre: https://www.dal.ca/campus_life/communities/black-student-advising.html

International Centre: https://www.dal.ca/campus_life/international-centre/current-students.html

Academic supports

Library: <https://libraries.dal.ca/>

Writing Centre: https://www.dal.ca/campus_life/academic-support/writing-and-study-skills.html

Studying for Success: https://www.dal.ca/campus_life/academic-support/study-skills-and-tutoring.html

Copyright Office: <https://libraries.dal.ca/services/copyright-office.html>

Fair Dealing Guidelines <https://libraries.dal.ca/services/copyright-office/fair-dealing.html>

Other supports and services

Student Health & Wellness Centre: https://www.dal.ca/campus_life/health-and-wellness/services-support/student-health-and-wellness.html

Student Advocacy: <https://dsu.ca/dsas>

Ombudsperson: https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/where-to-get-help/ombudsperson.html

Safety

Biosafety: <https://www.dal.ca/dept/safety/programs-services/biosafety.html>

Chemical Safety: <https://www.dal.ca/dept/safety/programs-services/chemical-safety.html>

Radiation Safety: <https://www.dal.ca/dept/safety/programs-services/radiation-safety.html>

Scent-Free Program: <https://www.dal.ca/dept/safety/programs-services/occupational-safety/scent-free.html>

COPYRIGHT

All members of the Dalhousie community are expected to comply with their obligations under Canadian copyright law. Dalhousie copyright policies and guidelines, including our Fair Dealing Guidelines, are available at <http://www.dal.ca/dept/copyrightoffice.html>. Copyright questions should be directed to the Copyright Office at copyright.office@dal.ca.

SERVICES AVAILABLE TO STUDENTS

The following campus services are available to help students develop skills in library research, scientific writing, and effective study habits. The services are available to all Dalhousie students and, unless noted otherwise, are free.

Service	Support Provided	Location	Contact
General Academic Advising	Help with <ul style="list-style-type: none"> - understanding degree requirements and academic regulations - choosing your major - achieving your educational or career goals - dealing with academic or other difficulties 	Killam Library Ground floor Rm G28 Bissett Centre for Academic Success	In person: Killam Library Rm G28 By appointment: <ul style="list-style-type: none"> - e-mail: advising@dal.ca - Phone: (902) 494-3077 - Book online through MyDal
Dalhousie Libraries	Help to find books and articles for assignments Help with citing sources in the text of your paper and preparation of bibliography	Killam Library Ground floor Librarian offices	In person: Service Point (Ground floor) By appointment: Identify your subject librarian (URL below) and contact by email or phone to arrange a time: http://dal.beta.libguides.com/sb.php?subject_id=34328
Studying for Success (SFS)	Help to develop essential study skills through small group workshops or one-on-one coaching sessions Match to a tutor for help in course-specific content (for a reasonable fee)	Killam Library 3rd floor Coordinator Rm 3104 Study Coaches Rm 3103	To make an appointment: <ul style="list-style-type: none"> - Visit main office (Killam Library main floor, Rm G28) - Call (902) 494-3077 - email Coordinator at: sfs@dal.ca or - Simply drop in to see us during posted office hours All information can be found on our website: www.dal.ca/sfs
Writing Centre	Meet with coach/tutor to discuss writing assignments (e.g., lab report, research paper, thesis, poster) <ul style="list-style-type: none"> - Learn to integrate source material into your own work appropriately - Learn about disciplinary writing from a peer or staff member in your field 	Killam Library Ground floor Learning Commons & Rm G25	To make an appointment: <ul style="list-style-type: none"> - Visit the Centre (Rm G25) and book an appointment - Call (902) 494-1963 - email writingcentre@dal.ca - Book online through MyDal We are open six days a week See our website: writingcentre.dal.ca