

☆ ☆ ☆ ☆ ☆ **COURSE SYLLABUS** ☆ ☆ ☆ ☆ ☆

Geological Sciences 0050

MARS, MOON, AND THE EARTH

Semester 1 2009-2010, G Hour (MWF, 2:00-2:50 PM), MacMillan Hall 117

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Office hours: Mon 10-11 AM, Thur 1-2 PM, or by appointment

I. Introduction:

How does the Earth work and what are the main issues concerning its history and its fate in the future? What can we learn from the Earth's formative years about its current state and where we are heading in the future? What can we learn by placing the Earth in the context of its neighborhood, the Solar System? What lessons can we learn from comparative planetology? Do some planets represent the way the Earth used to be, or do some represent the way it might be in the future? Is life on Earth unique in this Solar System or are the purported fossils from Mars real? Does life exist now on Mars? Below the ice on Europa? Under the atmosphere on Titan? On planets around other stars?

What information do we need to address the pressing issues of today, such as environmental degradation and global climatic change, extinctions and human pressure on the biota, and the allocation of scarce resources to support the whole human population fairly? Are we aware of the full range of major changes that the Earth might face in the future? What clues can the planets provide about these issues?

What are the current and upcoming missions all about and what role do Brown scientists play? What are Mars Exploration Rovers, Mars Reconnaissance Orbiter, Cassini at Saturn, MESSENGER to Mercury, and the Lunar Reconnaissance Orbiter and LCROSS at the Moon doing this semester? What will humans do when they return to the Moon in the near future? What will future missions do? What do you want them to do? What questions would you ask someone who has personally explored the Moon (Apollo 15 Commander David Scott will lecture this semester).

II. Earth: The Home Planet

1. Characteristics of the Earth and Planetary-Scale Surface Provinces.
2. The Earth's Interior: What's Beneath the Surface, Drives the Surface.
3. The Earth's Lithosphere: Evidence for Interior Processes.
 - a. Tectonic Activity and Mountain Building Processes.
 - b. Continental Drift, Sea Floor Spreading, and Plate Tectonics.
 - c. Volcanic Activity and Igneous Processes.
4. The Earth's Atmosphere and Hydrosphere: Where Did They Come From? Where Are They Going? What is "Snowball Earth" and When Did it Happen?

5. The History of the Earth: How Do We Know It and What Do We Know? When Did Life Appear? Has Earth Always Been Like It Is Today?
6. Summary: The Earth as a Planet.
 - a. Catastrophes in the Earth's Past, Present, and Future.
 - b. Global Climate Change, Biotic Extinctions, and What We Can Do.

III. The Moon: A Record of the Earth's Past?

1. Exploration of the Moon by the United States and the Soviet Union: The Role of Politics, Science, and Exploration.
2. Characteristics of the Moon and Planetary-Scale Surface Provinces.
3. The Moon's Interior.
4. The Moon's Lithosphere.
 - a. Lunar Craters and Basins and the Impact Cratering Process - What if One of These Things Formed on Earth?
 - b. Volcanic Activity and Igneous Processes - When and Where?
 - c. Tectonics and Mountain Building - Why Are They Different From Earth?
5. The Lunar Atmosphere - Where Is It??
6. Lunar History - How Do We Know It and How Does It Compare With Earth?
7. Summary: The Moon as a Planetary Body - Was it Born From Earth?

IV. Mars: Radical Changes in the Atmosphere: What Lessons for Earth?

1. Exploration of Mars by the United States, the Soviet Union, and Europe.
2. Characteristics of Mars and Planetary-Scale Surface Provinces.
3. The Interior of Mars.
4. The Lithosphere of Mars.
 - a. Craters and Basins and the Impact Cratering Process - What is the Influence of the Atmosphere and Subsurface Ice and Water?
 - b. Volcanic Activity / Igneous Processes - Why are Volcanoes So Huge?
 - c. Tectonics and Mountain Building - The Giant Tharsis Rise.
5. The Martian Atmosphere and Hydrosphere - Where Is The Water?
 - a. The Atmosphere and Polar Caps: Today and Yesterday.
 - b. Martian Rivers and Oceans: Where Did The Water Go and When?
 - c. Winds and Surface Change: The Martian Dunes and Deserts.
6. Martian History - Epochs of Change: What Went "Wrong" and Why?
7. Life on Mars Yesterday and Today?: What is the Evidence? Where Do We Look? How Do We Determine For Sure?
8. Summary: Mars as a Planetary Body - The Earth's Moon With An Atmosphere And Life?
9. Phobos and Deimos: The Moons of Mars.

V. Mercury: The Hot Planet With An Earth-Like Interior?

1. Exploration of Mercury.
2. Characteristics of Mercury and Planetary-Scale Surface Provinces.
3. Mercury's Interior: An Earth-like, Moon-sized Core.
4. The Lithosphere of Mercury.

- a. Impact Craters and Basins -What is the Influence of Increased Gravity?
 - b. Volcanic Activity and Igneous Processes - When and Where?
 - c. Tectonics and Mountain Building -A Shrinking Planet and Global-Scale Changes. Is This How Plate Tectonics Starts?
 - d. Polar Ice Caps on Mercury?
5. Summary: Mercury as a Planetary Body - Where Does It Fit? Earth-like Interior, Moon-like Surface? What will the MESSENGER Mission tell us?

VI. Venus: Earth's Twin, Sibling, Cousin, or Just Bad Genes?

1. Exploration of Venus by the United States, the Soviet Union, and Europe.
2. Characteristics of Venus and Planetary-Scale Surface Provinces: Continents and Ocean Basins?
3. The Interior of Venus: Convection and Hot Spots.
4. The Lithosphere of Venus.
 - a. Craters and the Impact Cratering Process - Influence of a Dense Atmosphere and Lessons for an Earth Impact Event.
 - b. Volcanic Activity / Igneous Processes - Why are Volcanoes So Short?
 - c. Tectonics and Mountain Building - Plate Tectonics and Crustal Spreading?
5. The Venus Atmosphere - A Runaway Greenhouse: Is This the Earth's Future?
6. Venus History - What About Ancient Venus? Uniformitarianism Versus Catastrophism.
7. Summary: Venus as a Planetary Body - Vertical, Not Horizontal, Crustal Growth? Is Present Venus a Model For Early Earth? Is Venus on the Verge of a Global Catastrophe?

VII. Comets and Asteroids: The Basic Building Blocks of the Solar System

1. Comets: Ancient Organic-rich Snowballs? Precursors of Life?
2. Asteroids and Meteorites - Clues to Pre-Solar History and Early Solar System Events.
3. The Shoemaker-Levy Comet Impact with Jupiter.

VIII. The Outer Planets and Their Satellites

1. The Gas Giants - Jupiter, Saturn, Uranus, Neptune: Why So Different From the Inner Planets?
2. Outer Planet Satellites
 - a. Active Volcanoes, Giant Iceballs, and Frozen or Active Oceans.
 - b. Miniature Solar Systems?
3. Environments for the Origin and Development of Life?: Europa, Enceladus, and Titan.
4. Ring Systems - Where Do They Come From? How Long Do They Last?
5. Pluto and Charon - The Odd Couple.

IX. Summary

1. The Origin of the Planets - Is There a Genetic Code?
2. Planetary Evolution - Different Paths or Different Stages?
3. The Earth's Place in the Solar System - Center or Family Member?
4. Are There Other Solar Systems and Earth-like Planets?
5. Life in the Solar System and Beyond - Are We Unique?
6. A Perspective on Earth's Future

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Laboratory and Take-Home Exercises..... 35%
Two Hour-long Exams..... 35%
 Wednesday, October 14, 2009
 Friday, November 13, 2009
Final Exam..... 30%
 Monday, December 14, 2009 at 9:00 AM

☆ ☆ ☆ ☆ ☆ **TEXTBOOKS** ☆ ☆ ☆ ☆ ☆

The Earth's Dynamic Systems (Tenth Edition, 2003) W. K. Hamblin and E. H. Christiansen, Prentice Hall, Englewood Cliffs, N. J.

Exploring the Planets , E. H. Christiansen and W. K. Hamblin.

** Both Available Online for Free! See the Geo 5 Website for Details