

ESS 306 – Summer 2013

“Points to Ponder” : Part of your grade for this course (8%) is based on giving 2 short (5 min.) presentations to the class. These aren’t graded, you just automatically get 4 pts for each one you do ($4 \times 2 = 8\%$). The presentations should consist of 3-4 slides, and can be on any topic related to planetary geology. You can choose from the suggested topics/questions listed below, or you can come up with your own – all I ask is that you run it by me first to OK it.

The idea behind this assignment is to provide you a chance to look deeper into particular topics that you come across in lecture or reading that interests you, and to provide the class as a whole a more diversified exposure to planetary geology topics besides just the ones I choose to talk about. In addition, I think it’s good to have as many opportunities as possible to practice giving presentations – since you’ll probably have to do it in whatever career you go into. And it gives me an opportunity to give you constructive feedback (which I’ll email to you) to help you prepare for the final project presentation at the end of the quarter.

Suggested Topics

(Note: This list will continue to grow throughout the quarter, with updated versions posted on the course website)

Week 1: Orbits, Spacecraft, and Remote Sensing

1. Which planets are currently visible to the naked eye - where and when?
2. What do nighttime infrared images look like and what do they tell you about the surface of a planet?
3. What is synthetic aperture radar and how does it work?
4. What is a typical speed of interplanetary spacecraft and about how long would it take to get to Jupiter, Pluto, and Alpha Centauri?
5. Who was Nicolaus Copernicus and what was his major scientific contribution? When?
6. Who was Tycho Brahe and what was his major scientific contribution? When?
7. Make a graph of orbital period versus height above the surface for Mars.
8. What is Mössbauer spectroscopy and which spacecraft have used it?
9. What have we learned about the planets using the Hubble Space Telescope?
10. What are 2 of the non-imaging instruments on the Dawn spacecraft and what will they tell us?
11. What are 2 of the non-imaging instruments in the payload for the Mars Science Laboratory rover and what will they tell us?
12. What is photoclinometry and what is it good for?
13. How does a neutron spectrometer physically detect neutrons coming from the surface of Mars?
14. What is the Rosetta mission and what will it do in November 2014?

Week 2: The Moon

1. How close was the Moon to the Earth when it formed? What is the relationship between the size of its orbit and the length of Earth’s day?
2. Describe the landing site and scientific objectives of the Apollo 14 mission?
3. Describe the landing site and scientific objectives of the Apollo 15 mission?
4. Describe the landing site and scientific objectives of the Apollo 16 mission?
5. Describe the landing site and scientific objectives of the Apollo 17 mission?

6. What is known about moonquakes – and how do we know it?
7. What was the local time of day (position of the sun in their sky) when the astronauts landed on the Moon and what would have happened to them if they had stayed for two weeks (Earth weeks, that is)?
8. The recent LCROSS mission purposely crashed into a dark polar crater on the Moon. Why and what did we learn from it?
9. Is there any reason to think the Earth had a magma ocean like the Moon?
10. What process(es) formed Earth's continental crust? When?
11. The Moon's crust is primarily made of anorthosite. Where can anorthosite be found on Earth, and how is it thought to have formed?
12. Pick an instrument on the Lunar Reconnaissance Orbiter and briefly describe its measurement technique, scientific goals, and if you wish, some results already obtained using that instrument. (<http://lunar.gsfc.nasa.gov/spacecraft.html>)
 - a. Cosmic Ray Telescope for the Effects of Radiation (CRaTER)
 - b. Diviner Lunar Radiometer Experiment (DLRE)
 - c. Lyman Alpha Mapping Project (LAMP)
 - d. Lunar Exploration Neutron Detector (LEND)
 - e. Lunar Orbiter Laser Altimeter (LOLA)
 - f. Lunar Reconnaissance Orbiter Camera (LROC)
 - g. Miniature Radio Frequency (Mini-RF or Mini-SAR)

Week 3: Mercury, Regolith, and Space Weathering

1. What are some strategies used by designers of the MESSENGER spacecraft to survive the extreme conditions of orbiting Mercury?
2. Pick an instrument on the MESSENGER payload and briefly describe its measurement technique, scientific goals, and if you wish, any results from that instrument. (<http://messenger.jhuapl.edu/instruments>)
 - a. Mercury Dual Imaging System (MDIS)
 - b. Gamma-Ray and Neutron Spectrometer (GRNS)
 - c. X-Ray Spectrometer (XRS)
 - d. Magnetometer (MAG)
 - e. Mercury Laser Altimeter (MLA)
 - f. Mercury Atmospheric and Surface Composition Spectrometer (MASCS)
 - g. Energetic Particle and Plasma Spectrometer (EPPS)
 - h. Radio Science (RS)
3. Glass spherules are common in lunar regolith – what makes some of them green and orange?
4. How can we measure the length of time a rock (or soil grain) has been sitting on the surface of the Moon? On the surface of the Earth?
5. What is thought to be the source of ultra high energy cosmic ray particles such as the Oh-My-God particle?

Week 4-5: Venus and Mars

1. What did we learn from the images taken of Venus' surface by the Soviet Venera landers?
2. Describe one example of something we learned from the non-imaging data returned by one of the Soviet Venera landers.

3. Give an overview of the Venus Express mission and describe any geological (i.e. non-atmospheric) science objectives.
4. What are some current ideas about life on Venus – past and/or present? (Hint: prominent idea people include Grinspoon and Schulze-Makuch)
5. Describe the Vega Venus mission and anything we learned from it.
6. Describe a proposed future Venus surface mission, and how it will deal with the extreme conditions.
7. Give an overview of the Mars Mariner 9 orbiter mission. What was happening on Mars when it arrived?
8. Does it snow on Mars?
9. How did the MAWD instruments on the Viking Orbiters measure the amount of water vapor in the atmosphere?
10. Where is gray hematite found on Mars and what is its significance?
11. Where is andesite found on Mars and what is its significance?
12. What is the mineralogy of the Martian meteorites (found on Earth) and how does it compare with what we see on Mars from spacecraft?
13. How is ALH84001 different than the other Martian meteorites, and why did President Clinton talk about it at a press conference in 1996?
14. What are pingos, and what is the evidence for them on Mars?
15. What is the geologic evidence for past or present glaciers on the northwest flanks of the Tharsis volcanos?
16. What are the current locations and status of the Mars Exploration Rovers (Spirit and Opportunity)? What are some of the latest results from those missions?
17. What is the formation hypothesis for Solis Planum on Mars put forth recently by UW Prof. David Montgomery and colleagues?
18. What is the formation hypothesis for the light-toned layered deposits in Juventae Chasma on Mars put forth by UW Prof. David Catling and colleagues?