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Final Exam

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Part 1

"MOON, MARS, COMETS, IMPACTS, AND LIFE"

143353

INTRODUCTION TO PLANETOLOGY

Due Date:

Monday, Feb 2nd, 2015

NOTE: AS DISCUSSED IN CLASS, THIS EXERCISE WILL COUNT AS THE ESSAY QUESTIONS ON THE FINAL EXAMINATION. YOU WILL GET UP TO 50 POINTS TOTAL CREDIT ON THE FINAL IN THE FORM OF THIS EXERCISE. THE FINAL EXAM WILL CONSIST OF 50 POINTS WORTH OF SHORT ANSWER AND MULTIPLE CHOICE QUESTIONS THAT WILL COVER THE MATERIAL IN THE COURSE. PLEASE WRITE YOUR ANSWERS ON SEPARATE SHEETS AND RETURN YOUR ANSWERS WITH THIS SIGNED EXERCISE.

PLEASE TYPE YOUR ANSWERS - NO HANDWRITTEN ANSWERS!

I. INTRODUCTION AND BACKGROUND

In the last several years, fundamental changes in our thinking have taken place in terms of the origin, evolution, extinction, and uniqueness of life in the cosmos. The most basic of life forms have been found at Earth seafloor vents many kilometers below the surface of the ocean, and bacteria have been found deep in the crust of the Earth. Rocks from Mars have several features and structures suggesting the possibility that they contain fossil life (perhaps dating from before life appears in the Earth record!). An impact in the Yucatan peninsula some 65 million years ago appears to have caused the collapse and extinction of much of the biota on Earth and led to the rapid demise of the dinosaurs. Many other radical changes in the biotic evolution of the Earth are now suspected of being related to impact events. Images of the surface of Europa strongly suggest that there is a deep liquid water ocean underlying the global ice layer. Mars once was water-rich and possibly had an ocean. And even on the Moon water has been detected. Titan is believed to have an atmosphere and surface that may have been like that of the early Earth. Comets contain organic compounds. Planets are now being found around other stars. The question is being debated about the presence of intelligent life elsewhere in the Universe.

The purpose of this exercise is to allow you to take the knowledge and expertise that you have developed in this course and to assess the significance of some of these recent findings and how they have (or should have) changed our way of thinking. In order to aid in this I have attached several articles that relate to some of the recent findings described above:

1. "Geology and Climate Change: Mechanisms of Extinction": A short note from The Planetary Report. (Volume XVI, number 4, July/August, 1996).
2. "Phoenix on Mars", Walter Goetz. American Scientist, 98, 40-47, 2010.
3. "Philae Landing" and "Rosetta and Philae" DLR Newsletter Countdown 4/2014, Nr. 27.
4. "The MOON Will Save Us", NASA Memo from Apollo 16 Commander John W. Young, 10/2/02.
5. "Volatile content in lunar volcanic glasses and the presence of water in the Moon's interior", Saal et al., Nature 454, 07/10/2008.

II. QUESTIONS

Please read each of these articles and answer the following questions:

I. Impact, Climate Change and Mechanisms of Extinction. Article 1. (4 points total):

1. On the basis of the evidence cited in the paper, what were the most lethal aspects of the impact event in terms of influence on the biota?

II. Volatiles on Mars. – Article 3 (14 points total)

1. Briefly describe what we learned about the distribution of ice in the soil. (4 points)
2. Describe some of the exciting results for the martian soil in terms of grain size, composition, etc. What are the caveats and what are the implications for life? (6 points)
3. In the article it is reported that Phoenix found calcium carbonate (limestone). Why is this an important finding? (4 points)

III. The Rosetta Mission. Article 3 (14 points total)

1. Describe the scientific goals of the Rosetta mission. Why is it important to study comets? (4 points)
2. Describe some of the difficulties (scientific, programmatic, technical) that Rosetta faced on its way to comet 67P/Churyumov-Gerasimenko. (6 points)
3. Some people argued that the landing of Philea is of similar importance than the lunar Apollo landings. Discuss this statement by providing arguments to support or reject it. What is your opinion? (4 points)

IV. "The MOON Will Save Us". Article 4. (4 points total)

1. Astronaut Young outlines nine technologies that he thinks must be developed to live and work on the Moon. Which four of the technologies suggested by Astronaut Young appear to you to be the most important, and why? (4 points)

V. Lunar water. Article 5. (8 points total)

1. What are the possible reservoirs of lunar volatiles? (4 points)
2. How can we be sure that the measured volatile abundances are not caused by terrestrial contamination? (4 points)

VI. How has the information in this course changed your way of thinking about time, space and your place in the Solar System, and how, if at all, will this change your perspective about the present and future? (6 points total)

It might be helpful to start with your frame of reference before you came into the course, and use this as a starting point to map out changes in your thinking or perspective.