

Lab #9

NASA Missions

Introduction

In today's lab, we will learn about three different NASA missions, all of which are related to the kinds of planetary science we are studying in lecture this semester.

Part 1 (Better than Earth?)

For this first part, I will ask you to read a Scientific American article entitled "Better than Earth" from a Fall 2017 special edition. You can find the article through the library's website or you can link to it directly with the URL:

<http://personal.tcu.edu/dingram/better.pdf>

Answer the following questions from the article, which are asked in the same order as the topics covered in the article:

- 1) Reading through the article and looking at the descriptive box on page 110, explain why the authors argue that the Earth will likely be uninhabitable within the next two billion years, long before the Sun swells to become a red giant.

2) Based on the diagram on pages 108 and 109, briefly describe the properties of the core and mantle of a "super-Earth" that would tend to provide an advantage over our own Earth that would better enable life to exist and thrive.

3) From the diagram on pages 108 and 109 and the further discussion on page 110, explain why a planet orbiting a K-dwarf star (somewhat cooler than our G-dwarf Sun) would have an advantage favorable to life compared to our own Earth.

4) Explain why even cooler M-dwarf stars would likely not be as favorable as K-dwarf stars in terms of supporting habitable planets (an example of this recently in the news was Proxima Centauri, an M-dwarf star that appears to have an orbiting super-Earth).

Part 2 (Shadows of Other Worlds)

For the next part, you will read another Scientific American article entitled "Shadows of Other Worlds" from the March 2018 edition. You can find this on the library's website or link directly with the following URL:

<http://personal.tcu.edu/dingram/shadows.pdf>

Answer the following questions from the article:

5) Explain what the Transiting Exoplanet Survey Satellite (TESS) will do and how it is different from the Kepler mission.

6) Explain the purpose of the Characterizing Exoplanet Satellite (CHEOPS), how it will complement the TESS mission.

7) Explain why TESS is more likely to find planets in the habitable zones of red dwarfs as supposed to sunlike stars.

8) Explain how future missions beyond TESS and CHEOPS will determine whether any of these newly discovered exoplanets may be inhabited.

Part 3 (OSIRIS-REx)

Closer to home, another upcoming NASA mission will try to find answers to questions about planetary formation in our own solar system. The mission is called OSIRIS-REx, and it is described in the article "The Seven Year Mission to Fetch 60 Grams of Asteroid" from the August 2016 edition of Scientific American. You can find this on the library's website or go to:

<http://personal.tcu.edu/dingram/osiris.pdf>

Answer the following questions from the article.

9) Explain why the asteroid Bennu was selected as the target for this mission (two reasons).

10) One potential problem with Bennu is the unpredictability of its orbit, caused by the Yarkovsky effect. Use the diagram on pages 66 and 67 (and the description on pages 68 and 69 in the article) to explain how this effect works to change the orbit of an asteroid.

11) Explain the main thing we hope to learn from the sample that is returned to Earth, if all goes well.