Lab #8

The Moons of the Outer Planets

Introduction

In this lab, we will explore the outer planets and their fascinating moons using the latest information on the Web. There are several processes at work in these systems that are also seen in the solar system as a whole. For example, the same type of tidal force that affects the Earth and the Moon is also present between Jupiter and its moons. Jupiter's gravitational pull, however, is much stronger on its moons than the Earth's, so the effects of tides are much more pronounced on Jupiter's moons.

One effect of tidal forces is that they tend to squeeze a planet out of its natural spherical shape into an oblong shape a little like a football. The effect is small enough that it is difficult to detect with the naked eye, but the squeezing is real, and it serves to provide a tremendous amount of heat energy to the moons the closer they are to Jupiter.

On Jupiter's moons, we also see evidence of geological forces such as volcanism and surface flows just like we see on the Earth. And we can also see the scars of impact craters. On Earth's moon, we can use the relative density of craters to guess that the smoother maria are geologically younger than the densely cratered highlands, since the maria have obviously been exposed to bombardment from incoming material for a shorter time. Similarly on Jupiter's moons, we can say a lot about their histories by simply looking at the craters on their surfaces. We'll also find that Saturn's moons are somewhat icier than Jupiter's moons, and one of Saturn's moons even has a thick atmosphere of its own.

Tonight's Sky

First, fire up your favorite browser, and search for "Sky at a Glance". This will take you to the very useful web page from the amateur Astronomy magazine Sky and Telescope. The page summarizes what's worth looking out for in the sky each week, and it is updated weekly. Scroll down on this page to find out what is going on right now with Jupiter and Saturn, and answer the associated questions below:

What constellation is Jupiter located in today?

_____

What constellation is Saturn located in today?

_____

If Jupiter is visible tonight, state what time and what direction on the sky it can be found. Otherwise, write "not visible".

If Saturn is visible tonight, state what time and what direction on the sky it can be found. Otherwise, write "not visible".

Jupiter's Moons

Most of the information we will gather to answer the remaining questions in this lab can be found at the website http://nineplanets.org. Please navigate to that website to answer questions about Jupiter and its major moons.

What two elements make up the majority of Jupiter's composition (one is 90%, the other is about 10%)?

_____

Explain how Jupiter maintains its thin ring system, despite the fact that ring particles are constantly being pulled into Jupiter by atmospheric and magnetic drag.

List the four major satellites of Jupiter (with radii larger than 1500 km), in order according to their distance from Jupiter:

1)

2)

3)

4)

Learn a little about each major moon by clicking on its name in the data table. Which of these four moons appears to have the most active geology, as evidenced by the molten surface and active volcanism?

_____

Explain why this moon is thought to have more geological activitity than the other three moons.

Why does Io have so little water compared to the other three major satellites?

Europa is thought to have a thin Oxygen atmosphere, but it is not of biological origin like Earth's Oxygen. Explain where Europa's Oxygen atmosphere originates.

On Callisto, the feature named "Gipul Catena" is a series of impact craters in a straight line across the face of Callisto. What is the explanation for this phenonmenon?

Saturn's moons

Saturn has recently been explored by the Cassini mission, and we have many updated pictures and discoveries about its moons as a result. Visit the Saturn page and its associated moons pages on the Nine Planets website to answer the questions on your worksheet about Saturn and its moons. I will ask other questions about Saturn's moons in the essay portion of the lab.

Which of Saturn's satellites has an enormous crater that makes the moon look like the Death Star from "Star Wars"? And what is the name of the crater?

Moon: _____ Crater name: _____

What is the name of Saturn's largest moon? _____

What are the three main components of the atmosphere of Saturn's largest moon?

_____, _____, _____

Uranus and Neptune

Read the Nine Planets website to discover information about the moons of these two outermost giant planets, and answer the associated questions on your worksheet.

Which of the five most massive moons of Uranus has a surface that appears to be mixed up terrain?

_____

What is the name of Neptune's most massive moon?

_____

What is unusual about Triton's orbit?

Essay

For your essay, you'll need to summarize some information about two NASA spacecraft that have taught us more about the two largest planets in our solar system, Jupiter and Saturn (and their moons). Two recent NASA missions that have successfully concluded are Juno (which explored Jupiter) and Cassini (which explored Saturn). The associated web sites for each are http://www.nasa.gov/juno and https://www.nasa.gov/mission_pages/cassini/main

For the first part of your essay (the Juno mission), click "Overview" on the menu bar of the Juno mission home page, below the image of the spacecraft. This is a brief overview of the mission. Read through this and then for your essay, describe three things Juno was scheduled to observe and briefly what we hoped to learn from each observation.

Next, go to the Cassini website and look on for the search box on the upper right. Enter "Enceladus powerhouse" in that box, and click on the article entitled "News | Cassini Finds Enceladus is a Powerhouse". View the related images and read the story. In your essay, describe what Cassini discovered on Enceladus.

Next, return to the Cassini mission homepage and search for "Titan mixture", then read the news release entitled "News | Cassini Data Show Ice and Rock Mixture Inside Titan." Summarize what the Cassini mission learned about Titan's interior and how it is different from Jupiter's largest moon Ganymede (and why it is different).