I. Objectives

1. Demonstrate what you have learned about the solar system.
2. Work as a member of a team in a coordinated research effort.
3. Use your creativity and critical thinking skills in organizing, displaying, and evaluating your team's materials.
4. Share and communicate what you have learned with others both in and out of class.
5. Create a professional and informative display.

II. Introduction

From our small world we have gazed upon the cosmic ocean for thousands of years. Ancient astronomers observed points of light that appeared to move among the stars. They called these objects planets, meaning wanderers, and named them after Roman deities--Jupiter, king of the gods; Mars, the god of war; Mercury, messenger of the gods; Venus, the god of love and beauty, and Saturn, father of Jupiter and god of agriculture. The stargazers also observed comets with sparkling tails, and meteors or shooting stars apparently falling from the sky.

Since the invention of the telescope, two more planets have been discovered in our solar system: Uranus (1781), Neptune (1846), and several dwarf planets: Pluto (1930), Haumea (2004), Makemake (2005), and Eris (2003) . Ceres, the largest asteroid, discovered in 1801, was classified as a dwarf planet in 2006. In addition, there are thousands of small bodies such as asteroids and comets. Most of the asteroids orbit in a region between the orbits of Mars and Jupiter, while the home of comets lies far beyond the orbit of Pluto, in the Oort Cloud.

The four planets closest to the Sun--Mercury, Venus, Earth, and Mars--are called the terrestrial planets because they have solid rocky surfaces. The four large planets beyond the orbit of Mars--Jupiter, Saturn, Uranus, and Neptune--are called gas giants. Tiny, distant, Pluto has a solid but icier surface than the terrestrial planets.

Nearly every planet and some of the moons have atmospheres. Earth's atmosphere is primarily nitrogen and oxygen. Venus has a thick atmosphere of carbon dioxide, with traces of poisonous gases such as sulfur dioxide. Mars' carbon dioxide atmosphere is extremely thin. Jupiter, Saturn, Uranus, and Neptune are primarily hydrogen and helium. When Pluto is near the Sun, it has a thin atmosphere, but when Pluto travels to the outer regions of its orbit, the atmosphere freezes and "collapses" to the planet's surface. In this regard, Pluto acts like a comet.

There are more than 100 natural satellites, or moons, around the various planets in our solar system, ranging from bodies larger than our own Moon to small pieces of debris. Many of these were discovered by planetary spacecraft. Some of these have atmospheres, including Saturn's Titan; some even have magnetic fields, such as Jupiter's Ganymede. Jupiter's moon Io is the most volcanically active body in the solar system. An ocean may lie beneath the frozen crust of Jupiter's moon Europa, while images of Jupiter's moon Ganymede show historical motion of icy

crustal plates. Some planetary moons, such as Phoebe at Saturn may be asteroids that were captured by planet's gravity.

From 1610 to 1977, Saturn was thought to be the only planet with rings. We now know that Jupiter, Uranus, and Neptune also have ring systems, although Saturn's is by far the largest. Particles in these ring systems range in size from dust to boulders to house sized, and may be rocky and/or icy.

Most of the planets also have magnetic fields which extend into space and form a "magnetosphere" around each planet. These magnetospheres rotate with the planet, sweeping charged particles with them. The Sun has a magnetic field, the heliosphere, which envelops our entire solar system.

Ancient astronomers believed that the Earth was the center of the Universe, and that the Sun and all the other stars revolved around the Earth. Copernicus proved that Earth and the other planets in our solar system orbit our Sun. Little by little, we are charting the Universe, and an obvious question arises: are there other planets around other stars? Are there other planets where life might exist? Only recently have astronomers had the tools to indirectly detect large planets around other stars in nearby galaxies. Direct detection and characterization of such planets awaits development of yet more powerful observing tools and techniques (NASA Spacelink Our Solar System Lithographs).

III. Lab Procedure

1. You and your team will select one of the display panels and one of the following solar system topics:
   a. the Moon, including lunar landings, phases, lunar eclipses, formation hypotheses
   b. the Sun, including sunspots and the sunspot cycle, solar flares, solar eclipses, type of star, composition, structure
   c. Mercury, Venus, Mars and its moons, including structures, geology, atmospheres, climates, spacecraft discovery history
   d. Jupiter and Saturn and their moons, including structures, atmospheres, rings, spacecraft discovery history
   e. Uranus and Neptune and their moons, including structure, atmospheres, rings, spacecraft discovery history
   f. dwarf planets Ceres, Pluto and its moons, Haumea, Makemake, and Eris, including discovery history, and definition of a dwarf planet
   g. asteroid belt, Kuiper belt, comets and the Oort cloud, and the heliosphere
   h. formation and evolution of the solar system, nebular hypothesis

2. You will then need to locate materials related to your solar system topic, which may include myths, historical descriptions, maps, drawings, photographs, and written information about the topic, or other materials.

3. You **may** use whatever sources you like but you must keep track of the sources for everything that you obtained from the Internet, magazines, books, etc. and information about that source must be included.

4. You **may not** simply copy and post materials located from the sources above. You will need to coordinate your materials with the other members of your team, and remove materials that are not relevant. **All text must be typed.**

5. Everyone in your team will receive the same grade (unless a team member doesn't cooperate and participate). There is a maximum of 25 points available for this lab and your completed project, which must be done by the date indicated on the syllabus.

6. Your grade will be based on:
   a. organization: are the materials you selected well organized on the display?
   b. research: were your research efforts adequate and appropriate in locating a wide variety materials listed in 2. above?
   c. clarity: did you select materials that can be understood by others both in and out of the class?
   d. conciseness: did you only include materials that are relevant to items listed in 2. above?
   e. professionalism: does your display have a professional appearance? is it interesting and informative?

IV. Lab Discussion

1. Describe at least one new concept, idea, or topic that you learned about from each of your classmates' panels.

Panel	Concept, idea, or topic