Name:

Alien Worlds in the Solar System

Distances in the Solar System and Beyond

First, let's get a sense for distance in the solar system. The following table lists the distances from the Sun of all the major bodies in the solar system. The units are "astronomical units," or AU, which is the average distance from the Earth to the Sun. There are 1.5 x 10^8 (150 million) km in an AU.

Object	Distance (in AUs)
Mercury	0.4
Venus	0.7
Earth	1.0
Mars	1.5
Asteroid Belt	2.0
Jupiter	5.2
Saturn	9.5
Uranus	19.1
Neptune	30.1
Pluto	39.5

1) **Calculate the distance to the Sun in km for Mars, Jupiter, Saturn and Pluto and fill out the values in the table below. The rest of the values have already been filled out for you.** *Example: Venus is 0.7 AU x (1.5 x 10^8 km/AU) = 1.05 x 10^8 km*

Object	Distance (in km)
Mercury	5.98 x 10^7
Venus	1.05 x 10^8
Earth	1.496 x 10^8
Mars	
Asteroid Belt	2.99 x 10^8
Jupiter	
Saturn	
Uranus	2.86 x 10^9
Neptune	4.50 x 10^9
Pluto	

2) **Calculate how many minutes it takes light from the Sun to get to Mars, Jupiter, Saturn and Pluto and fill out the values in the table below. The speed of light is 3.0 x 10^5 km/s.**

Object	Distance (in light min)
Mercury	3.32
Venus	5.83
Earth	8.31
Mars	
Asteroid Belt	16.61
Jupiter	
Saturn	
Uranus	158.89
Neptune	250
Pluto	

3) **NASA's New Horizons was the fastest spacecraft to ever leave Earth's orbit (17 km/s). Calculate how many years it would take New Horizons to get to Mars, Jupiter, Saturn, and Pluto from the Earth and fill out the values in the table below. Hint: There are 3.15 x 10^7 seconds in a year.**

Object	Distance from Earth (km)	Travel Time (years)
Mars	7.44 x 10^7	
Jupiter	6.28 x 10^8	

Saturn	1.27 x 10^9	
Pluto	5.76 x 10^9	

4) **Calculate how many years it would take New Horizons to get to the closest star to our Sun, Alpha Centauri. This star is 4.22 light-years away from the Sun, or 3.99 x 10^13 km.**

Temperatures in the Solar System

5) **You can calculate the temperature of a planet by setting equal the amount of energy absorbed by the planet—which depends on size of the planet, distance from the Sun, brightness of the Sun, and fraction of light absorbed—to the amount of energy radiated by the planet. The table below lists the planet, the theoretical, or expected temperature based on the calculation above, and the actual temperature. Why do you think the theoretical temperatures are so far from the actual temperature for Venus and Earth, but not Mercury and Mars?**

Object	Theoretical Temp (F)	Actual Temp (F)
Mercury	320	257 (avg)
Venus	-43.6	867.2
Earth	-2.2	59
Mars	-81.4	-76

Radiation in the Solar System

6) **An astronaut on a mission to Mars would experience nearly 50 times the average annual dose of radiation for a person on Earth. What are two reasons why exposure to radiation from the Sun and cosmic rays would be higher in space and on Mars than on Earth?**

Surface Ages in the Solar System

7) **Give two reasons why the surface of Earth is not as heavily cratered (old) as the surfaces of other terrestrial bodies in the Solar System (i.e. Mercury, Moon, Mars, etc.).**

Challenge Questions

8) **Given the Solar System bodies discussed in lecture, and the questions you answered above, come up with at least 5 important qualities you would find in an alien world that might harbor life. For instance: "has liquid water."**

9) **Given the important qualities you list above, as well as the distances to different solar system bodies calculated in the first part of this worksheet, pick one of the following and justify why you would send a mission there to look for life: Mars, Enceladus, Titan, or Europa.**