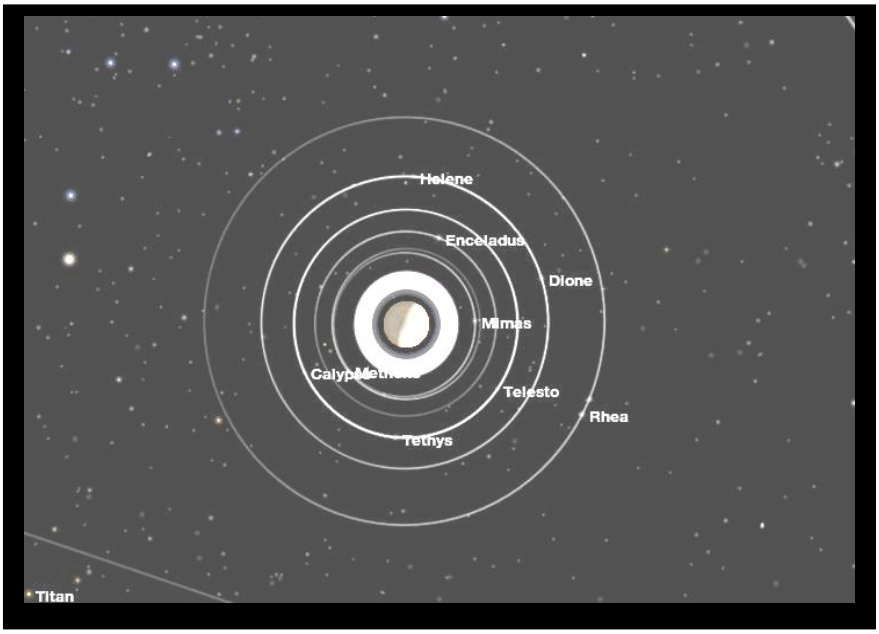
Eye Spy – Exploring the Frequency of Moons and Planets



Get the Data

Visit EOSS **http://1.usa.gov/Hgc0ol** to recreate this exact scene. Recommended operating system: MS Vista or later; Browser: MS Internet Explorer 8 or later.

Step 1 – Click on the 'Visual Controls' tab and make sure that the following items are selected with a 'white spot': stars, planetary bodies, and metric.

Step 2 – Activate the Distance Measuring tool and measure the distances from Saturn of each of the displayed moons including the distant moon Phoebe.

Answering Questions

Problem 1 – Sort the moons into two equal groups by distance from Saturn. What is the midpoint distance for this data?

Problem 2 – Compare the midpoint distance to the orbital distance of the moon Phoebe. What is the percentage of the midpoint distance compared to the orbital distance of Phoebe?

Problem 3 - What is the percentage of the circular area of this radius compared to the disk with a radius equal to that of Phoebe's orbit?

Math Challenge

In our solar system, 50% of the planets are located inside the orbit of Jupiter (750 million km) and half outside. The orbit of Neptune is 4.5 billion km. How does this compare to the answer that you calculated in Problem 2? How are the planets orbiting our sun grouped compared to the satellites of Saturn?

Answer Key

Problem 1 –At what distance from Saturn are half of the moons inside, and half of the moons outside?

Answer: The display shows only 11 of the more than 62 moons known to exist in orbit around Saturn. From the 11, we want the orbit of the 6th moon for which 5 moons are inside and 5 are outside this moon's orbit. The 6th moon in this display is Dione, whose distance from Saturn is 316,000 kilometers.

Problem 2 – What is the percentage of this radius compared to the orbital radius of Phoebe?

Answer: The orbital radius of Phoebe is 13.5 million kilometers. P = 100% x (0.316/13.6) = **2.3%.**

Problem 3 - What is the percentage of the circular area of this radius compared to the disk with a radius equal to that of Phoebe's orbit?

Answer: The ratio of the circular areas is just $(0.316/13.6)^2$ = 0.00054, so we see that for Saturn, 50% of the moons shown in this simulation are located in the interior **0.054%** of the surrounding satellite disk.

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Answer: For the solar system, the '50%' radius for finding planets is the orbit of Jupiter, which defines only P = 100% (750 million/4.5 billion) = 17% of the diameter of the solar system. The percentage of the area of the solar system disk is P = 100% $(0.17)^2$ = 2.9% of the area of the solar system disk. When we compare this with the corresponding percentages for Saturn's moons, we get 2.3% and 0.054%. This means that, at least for the Saturnian moons considered, they are more concentrated towards Saturn than the planets in our solar system are concentrated towards our sun.

Note: Had we used the full catalog of 62 moons of Saturn, the 50% radius would have been at a distance of 17 million kilometers, and the outermost moon is at a distance of 24.5 million kilometers, so the percentages are 71% for the radius and 50% for the area. This means that the moons of Saturn are actually much more spread out than the planets of our solar system where huge gaps exist beyond the orbit of Jupiter.