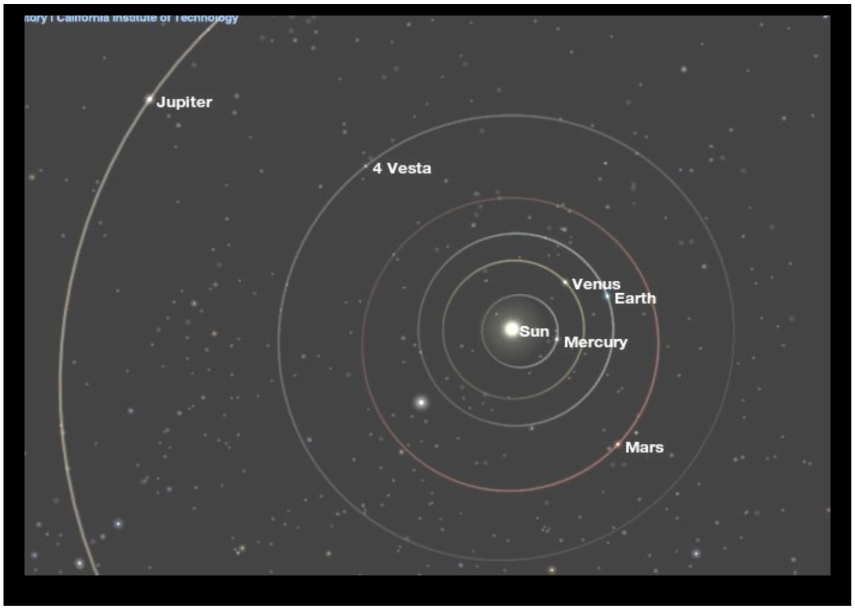
Eye Spy – Exploring Solar Power Across the Solar System!



Get the Data

Visit EOSS **http://1.usa.gov/RkSMFA** to recreate the scene shown above. 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': spacecraft, planets, labels, orbit lines, trails and metric.

Step 2 - Activate the 'Distance Tool' by pointing cursor at a planet name label (example 'Sun') and right-clicking mouse. Select bottom function 'Measure distances'. Then point to destination target name label (example 'Mars') and left-click mouse to open From-To measurement panel. Read out the distance in kilometers. Also provided is the light travel time!

Answering Questions

Math Challenge

The Juno mission to Jupiter will use solar panels to provide electricity, but because sunlight is so dim at this distance from the sun, the solar panels have to be about 27 times bigger than the same solar panels at Earth to produce the same power.

The dimming of sunlight follows the Inverse-Square Law. When you double the distance, the brightness falls to 1/4 of what it was. At 3 times the distance you get 1/9, at 4 times the distance you get 1/16. For Jupiter, it is 5.2 times farther from the sun than Earth so sunlight is 5.2 x 5.2 = 27.04 times fainter. For these problems we will round this to 27.

Problem 1 - Use the Inverse-Square relationship, and *Eyes on the Solar System,* to figure out how large solar panels have to be at the distance of Saturn, compared to their size on Earth, to generate the same amount of electricity.

Answer Key

Problem 1 – Use the *Eyes on the Solar System* distance measuring tool to measure the distance from the sun to Earth on July 12, 2012 using the URL. Then locate Saturn and determine its distance from the sun. Repeat the measurement for Earth.

Answers: Saturn = 1457 million km, Earth = 151 million km

Calculate the ratio of Saturn's distance to Earth's distance.

1457 million / 151 million = 9.65

Calculate the product of the distance ratio 9.65 x 9.65 to get 93.12 which we round to 93.

At the distance of Saturn, the solar panels have to be 93 times bigger in area in order to generate the same amount of electrical power!

Note: Here is an application of how areas scale with increasing dimensions.

To generate 500 watts of electricity at Earth, we need a solar panel with an area of 3 square meters. At Jupiter (the Juno Mission) the 3 panels each measure 3 meters x 9 meters for a total area of 3 x 27 = 81 square meters.

At Saturn, the area is 93 times 3 square meters = 279 square meters. A single panel this large would measure about 17 meters wide and 16 meters long.

Another way to look at this is that the Juno panel is 81 square meters so the Saturn panel would have 279/81 = 3.4 times the area of the Juno solar panel. If it had the same rectangular shape as the 3 Juno panels, each Saturn panel would have dimensions: 5.6 meters by 16.7 meters.

You can check that this equals 279 square meters from 3 x 5.6 x 16.6 = 279 square meters.