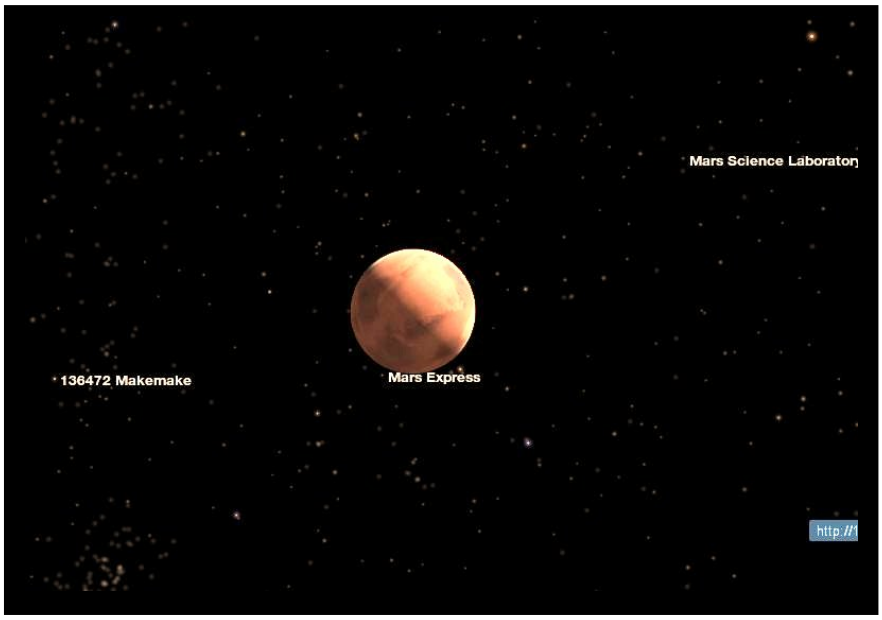
Eye Spy – Exploring the Mars Science Lab Encounter



Get the Data

Visit EOSS **http://1.usa.gov/McwrUg** to recreate the scene 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 Measuring tool and measure the distance between Mars and the Mars Science Laboratory spacecraft during its August 6, 2012 encounter.

Answering Questions

On August 6, 2012 the Mars Science Laboratory will reach Mars and deposit the Curiosity Rover on the surface of Mars inside Gale Crater located near the martian Equator. At T = 12:20:44 am, and with the Origin at the center of Mars, MSL is located at X=12,180 km and Y= 7714 km; at T=12:37:20 am, MSL is located at X=8,729 km and Y = 5,057 km. The radius of Mars is 3,396 km.

Problem 1 – How far from the surface of Mars is MSL at 12:20:44 am?

Problem 2 – How far from the surface of Mars is MSL at 12:37:30 am?

Problem 3 – If the two points on the approach trajectory are separated by about 16.5 minutes in time, what is the approach speed of MSL in kilometers/hr?

Math Challenge

At what time will MSL reach the surface of Mars if it continues on the same trajectory defined by the two measured points, and at the same average speed?

Answer Key

At T = 12:20:44 am, and with the Origin at the center of Mars, MSL is located at X=12,180 km and Y= 7714 km; at T=12:37:20 am, MSL is located at X=8,729 km and Y = 5,057 km. The radius of Mars is 3,396 km.

Problem 1 – How far from the surface of Mars is MSL at 12:20:44 am?

Answer: The distance of MSL from the center of Mars is found by using the Pythagorean Distance Formula and the coordinate differences between the Origin at (0,0) and Point 1 at (12180, 7714) which is just D = $(12180^2 + 7714^2)^{1/2}$ = 14,417 km. This is the distance to the center of Mars. The surface is located at +3,396 km, so the distance from the surface is D = 14417 – 3396 = **11,021 km.**

Problem 2 – How far from the surface of mars is MSL at 12:37:30 am?

Answer: The distance of MSL from the center of Mars is found by using the Pythagorean Distance Formula and the coordinate differences between the Origin at (0,0) and Point 1 at (8729, 5057) which is just D = $(8729^2 + 5057^2)^{1/2}$ = 10,088 km. This is the distance to the center of Mars. The surface is located at +3,396 km, so the distance from the surface is D = 10088 – 3396 = **6,692 km**.

Problem 3 – If the two points on the approach trajectory are separated by about 16.5 minutes in time, what is the approach speed of MSL in kilometers/hr?

Answer: Speed = Distance/time. During the 16.5 minutes, MSL changed its distance to the martian surface by 11,021 – 6,692 = 4,329 km. Its approach speed was S = 4329 km/16.5 minutes = 262 km/minute. Because there are 60 minutes in 1 hour, the hourly speed is just S = 262 km/min x (60 min/1 hr) = **15,720 km/hr.**

Challenge Problem: At what time will MSL reach the surface of Mars if it continues on the same trajectory defined by the two measured points, and at the same average speed?

Answer: The remaining distance to travel from Point 2 is 6,692 km. At the average speed of approach of 262 km/minute, it will take 6692/262 = 25 ½ minutes to travel the remaining distance. Since Point 2 was recorded at 12: 37:20 am, adding another 25.5 minutes to this time we get a predicted landing time of **1:02:50 am**.