Enceladus Flyby: Student Worksheet

Particle Travel Rate - CCSS.MATH 6.RP.A.3.B

Based on the size of the silica grains (6 to 9 nanometers), scientists think they spend anywhere from several months to a few years (a longer time than that means the grains would be larger) traveling from hydrothermal vents to space, a distance of 40 to 50 km.

1. What rate (in km/day) are the particles traveling if it takes them 6 months to travel 50 km (assume 182 days)?

2. What rate are they traveling if it takes two years to travel 40 km?

3. Do you think the particles in each example traveled at the same speed the entire time they moved?

4. Why might the particle rate vary? At what point in their journey might particles have been traveling at the highest rate?

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Plume Data - CCSS.MATH 6.RP.A.3.B and 8.G.B.7

Cassini will be flying past Enceladus at a staggering 8.5 km per second (19,014 mph). At an altitude of 49 km, the plume is estimated to be approximately 130 km across.

How long will Cassini have to capture particles and record data while within the plume?

If Cassini is 49 km above the surface of Enceladus at the center of the plume, what is its altitude as it enters and exits the plume (the radius of Enceladus is 252.1 km)?

This information can help scientists determine where in the plume heavy particles may fall out if they are not detected on the edge of the plume but are detected closer to the middle of the plume. It is also important because the Cosmic Dust Analyzer uses a high-rate detector that can count impacting particles at over 10,000 parts per second to tell us how much material is being sprayed out.

Volume of Enceladus' Ocean - CCSS.MATH 8.G.C.9 and HSG.GMD.A.3

Gravity field measurements of Enceladus and the wobble in its orbital motion show a 10 km deep ocean beneath a layer of ice estimated to be between 30 and 40 km thick. If the mean radius of Enceladus is 252.1 km, what is the minimum and maximum volume of water contained within its ocean?

This is important because if scientists know how much water is in the ocean and how much vapor is escaping through the plume, they can make estimates about how long the plume has existed -- or could continue to exist.

NGSS and CCM Standards

NGSS 5-ESS2-1 - Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact

CCSS.MATH 6.RP.A.3.B - Solve unit rate problems including those involving unit pricing and constant speed. For example, if it took 7 hours to mow 4 lawns, then at that rate, how many lawns could be mowed in 35 hours? At what rate were lawns being mowed?

CCSS.MATH 8.G.B.7 - Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.

CCSS.MATH 8.G.C.9 - Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.

CCSS.MATH HSG.GMD.A.3 - Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.