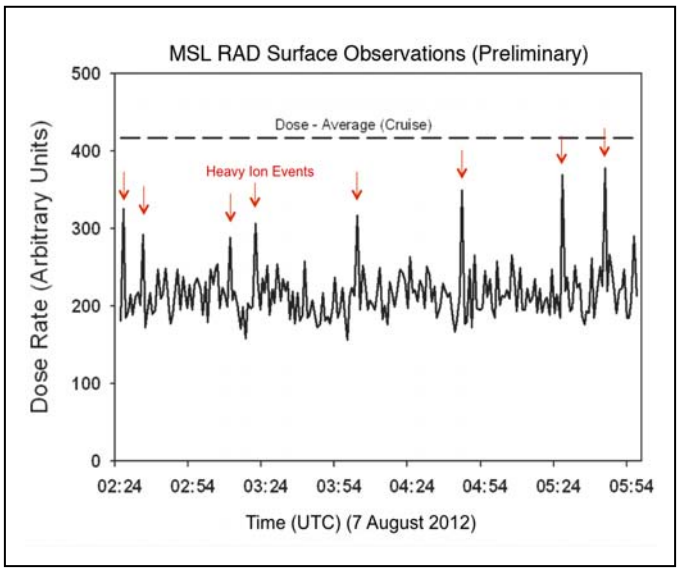

On its journey to Mars, the Mars Science Lab measured the level of radiation it was receiving in space during its 253-day travel from Earth to Mars. Once the Curiosity Rover landed on Mars, the Radiation Assessment Detector (RAD) instrument continued to measure the radiation level at the landing site. The graph to the left shows the radiation measured during a 3-hour period on August 7, 2012. NASA scientists now predict that astronauts making this journey and working on Mars will not have significant problems with radiation exposure if they take standard precautions.

Problem 1 - Ignoring the 'heavy ion events' (points marked with arrows) caused by cosmic rays, about what is the average radiation dose rate indicated by the remaining points shown in the graph above?

Problem 2 - By what factor is the average radiation dose rate in space during the cruise to Mars greater than the ground-level dose rate on the surface of Mars?

Problem 3 - The Curiosity Rover RAD instrument says that on the surface of Mars, an astronaut will receive an average dose rate of about 0.7 milliSieverts per day of radiation. What is the estimated dose rate in space during the cruise to Mars?

Problem 4 - Suppose an astronaut took a 180-day journey to Mars, stayed there for 600 days, and then returned on a 180-day trip back. What would the astronauts total radiation dose be for the entire 960-day trip?

Problem 5 - If an astronaut remained on Earth, the normal background radiation dose rate is 3 milliSieverts/year. How many equivalent years of normal Earth exposure would a single trip to Mars produce?

December 4, 2012 Press Release: http://www.space.com/18753-mars-radiation-manned-mission.html
Astronauts Could Survive Mars Radiation for Long Stretches, Rover Study Suggests

"…Astronauts could endure a long-term, roundtrip Mars mission without receiving a worryingly high radiation dose, new results from NASA's Mars rover Curiosity suggest. A mission consisting of a 180-day outbound cruise, a 600-day stay on Mars and another 180-day flight back to Earth would expose an astronaut to a total radiation dose of about 1.1 sieverts (units of radiation) if it launched now, according to measurements by Curiosity's Radiation Assessment Detector instrument, or RAD. RAD has found radiation levels on the Martian surface to be comparable to those experienced by astronauts in low-Earth orbit. A person ambling around the Red Planet would receive an average dose of about 0.7 millisieverts per day, while astronauts aboard the International Space Station experience an average daily dose between 0.4 and 1.0 millisieverts, "

Problem 1 - Ignoring the 'heavy ion events' (points marked with arrows) caused by cosmic rays, about what is the average Dose Rate of the remaining points shown in the graph above? Answer: About **215**.

Problem 2 - By what factor is the average Dose in space during the cruise to Mars greater than the ground-level Dose rate on the surface of Mars?

Answer: About 415/215 = **1.9 times** higher in space.

Problem 3 - The Curiosity Rover RAD instrument says that on the surface of Mars, an astronaut will receive an average Dose Rate of about 0.7 milliSieverts per day of radiation. What is the estimated Dose Rate in space during the cruise to Mars?

Answer: 0.7 x 1.9 = **1.3 milliSieverts/day**.

Problem 4 - Suppose an astronaut took a 180-day journey to Mars, stayed there for 600 days, and then returned on a 180-day trip back. What would the astronauts total radiation exposure be for the entire 960-day trip?

Answer: 180x0.0013 + 180x0.0013 + 600x0.0007 = **0.88 Sieverts**.

Problem 5 - If an astronaut remained on Earth, the normal background radiation dose rate is 3 milliSieverts/year. How many equivalent years of normal Earth exposure would a single trip to Mars produce?

Answer: 0.88 Sieverts over 960 days = 338 milliSieverts/year. So it equals 338/3 = **112 years**!