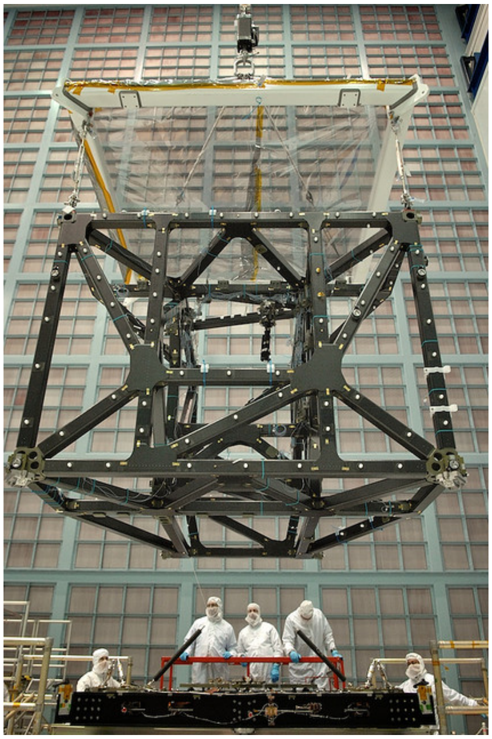

The Webb Space Telescope, to be launched in 2014, will allow astronomers to see the first generations of stars that formed in the universe.

The ISIM, or the Integrated Science Instrument Module Flight Structure, will serve as the structural "heart" of the James Webb Space Telescope. It will serve as the cage in which the many sensitive instruments will analyze the ancient starlight from the distant universe.

NASA engineers recently tested the ISIM structure by exposing it to extreme cryogenic temperatures, proving that the structure will remain stable when exposed to the harsh environment of space.

The ISIM is 1.92 meters tall and has a mass of 193 kilograms. Engineers invented a new material so that the ISIM can support more than four times its own mass in sensitive scientific equipment. It also has to keep the geometry of this equipment exactly right under cold space conditions. The heating and cooling of the ISIM in space causes expansion and contraction, which can ruin the scientific measurements. The latest cold tests by NASA engineers proved that the ISIM does not change its shape by more than 150 microns as it is chilled from room-temperature (300 K) to near-absolute zero (20 K). This is very good news!

To better see how little the ISIM changed its dimensions, suppose that you created a scale model of this structure and made it the same size as a 10-story building 30 meters tall.

Problem 1 –On this scale, how much would your model of the ISIM have changed its dimensions?

Problem 2 – Engineers prefer to work in English units. If the density of the composite materials used in this structure is 0.06 pounds/inch^3, what is the density in metric units of kilograms/meter^3 if 1 pound = 0.45 kg, and 1 meter = 39.4 inches?

Problem 1 – On this scale, how much would your model of the ISIM have changed its dimensions?

Answer: The true size of the ISIM is 1.92 meters tall, so the new scaled model is a factor of 30 meters / 1.92 meters = 15.6 times larger that the actual ISIM module. The original ISIM module changed its dimensions during cooling by 150 microns, so in the new scaled model the dimensions would have changed by 15.6 x 150 microns = 2340 microns. In terms of meters, this is just 2340 microns x (1 millimeter/1000 microns) = **2.3 millimeter**. On the scale of the 10-story building, the structure would have changed by about the thickness of a dime!

Problem 2 – Engineers prefer to work in English units. If the density of the composite materials used in this structure is 0.06 pounds/inch^3, what is the density in metric units of kilograms/meter^3 if 1 pound = 0.45 kg, and 1 meter = 39.4 inches?

Answer: 0.06 pounds/inch^3 x (0.45 kg/1 pound) x (39.4 inches/1 meter)^3 = **1651 kg/m^3**
Note: For the correct number of significant figures (0.29 and 0.45 have 2 which is the minimum number) the answer would be **1700 kg/m^3** . By comparison, water has a density of 1000 kg/m^3.

The diagram below shows how the ISIM module will be loaded with scientific equipment to measure the faint starlight collected by the Webb Space Telescope in 2014. The instruments are very much like 'high-tech' digital cameras that can precisely measure the brightness of the light falling onto the millions of pixels in each camera system. Astronomers will use these images to discover the first generation of stars and galaxies born in our universe over 13 billion years ago.