

A Description of the Lab:

Purpose: To introduce students to the topic of nucleosynthesis through the technique of x-ray spectroscopy of a supernova remnant. Produced in collaboration with the XMM-Newton office of Education and Public Outreach, this exercise uses spectra taken with the XMM-Newton satellite of the supernova remnant Cassiopeia A.

In this computer-based exercise, high school and college students analyze realistically simulated X-ray spectra of a supernova remnant and determine the abundances of various elements in them. In the end, they will find that the elements necessary for life on Earth—the iron in their blood, the calcium in their bones— are created in these distant explosions.

The exercise puts students in control of a space-based x-ray telescope equipped with a spectrograph. Students sample four locations in the supernova remnant Cassiopeia A, remnant of a 1680 supernova blast. The spectra can then be matched with an interactive program that models the physical composition, temperature, and density in the remnant. By finding the conditions that produce the best fit to the data, students are able to determine the amount of iron produced by the supernova remnant, and compare that with the amount of iron in the earth.

While performing this activity, students will learn basic science skills such as spectral analysis, model fitting, and statistical analysis. They will also get a feel for how supernovae create elements, the quantity these elements created in supernovae, and how these elements are critical to our own existence.