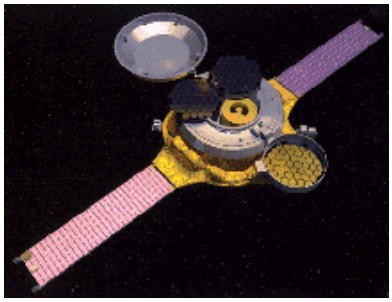
Cosmic Chemistry: An Elemental Question

Development of a Model: Analyzing Elemental Abundances on Earth

STUDENT ACTIVITY



Genesis mission scientists are on a quest. They want to find out more about solar isotopic abundance. This information will help them learn about events and conditions during the origin of our solar system. But how will this knowledge assist them in their search, and what is necessary for them to understand the information once it has been collected?

Before these questions can be addressed, it is necessary to understand what scientists know. What do we mean when we refer to *element and isotope abundance*? Why do scientists believe that the isotopic abundance data that the Genesis spacecraft is being designed to collect is a key to the solution? What questions are they asking? How do scientists know that these questions are important? By what processes do they reach the point where they can ascertain the value of what they seek?

In this activity, you will develop a fundamental understanding of the types of data the mission scientists have been discussing. You will also gain some insight into the mechanisms of inquiry whereby this information is studied and viewed as both obstacles and assistance to further studies.

Table 1: Terrestrial Isotope Data Set

Element Name	*Average* Atomic Mass (in amu's)	Symbols of Isotopes Present	Mass of Isotopes* amu	*Rank Order* of Terrestrial Abundance	Terrestrial Percent Abundance
Hydrogen	1.0079	^{1}H	1.0078250		
		^{2}H	2.0141018		
		^{3}H	3.0160493		
Helium	4.0026	^{3}He	3.0160293		
		^{4}He	4.0026032		
Carbon	12.011	^{12}C	12.0000000		
		^{13}C	13.0033548		
Nitrogen	14.007	^{14}N	14.0030740		
		^{15}N	15.0001089		
Oxygen	15.999	^{16}O	15.9949146		
		^{17}O	16.9991315		
		^{18}O	17.9991604		
Sulfur	32.064	^{32}S	31.9720707		
		^{33}S	32.9714585		
		^{34}S	33.9678668		
		^{36}S	35.9670809		

*Data from Table of the Nuclides, Korean Atomic Energy Research Institute, http://hpngp01.kaeri.re.kr/CoN/index.html

Show your calculations and attach graphs.

Questions:

1. a) What techniques or clues did your group use to determine the rank order and/or the percent isotope abundances in Table 1, Terrestrial Isotope Data Set?

   b) What problems and solutions did you come across in the process?

2. a) What patterns did your group notice in the graphing portion of this activity?

   b) Were any of the abundance data more difficult to graph than others? Less difficult?

   c) Why do you think this was the case?

   d) Describe the reasoning behind the types of graphs your group chose to use.

3. a) What is a ratio?

   b) How do you determine (calculate) a ratio when given certain pieces of data?

   c) In the class graphing activity involving ratios of isotopic abundance, what patterns and/or anomalies did you observe? Explain your response.