

Science Modules

This module focuses on classifying and organizing information. If you are using Genesis science modules for the first time, read the [User's Guide](#) thoroughly before you begin. ([View User's Guide as PDF.](#))

The following classroom materials are available in Portable Document Format (PDF) for your browsing and printing convenience. The files are print-optimized, and should be printed to achieve maximum resolution. **Adobe's new Acrobat Reader 4.0 is required** to view and/or print. To install the FREE reader, visit the [Adobe Web site](#).

Take a look at additional [science modules](#) that are available on the Genesis Web site. All technical terms in the science modules are compiled in the [Glossary](#) for easy access.

[Technology Applications](#) are available for this module.

Periodic Table of the Elements																0																						
IA											IIIA	IVA	VA	VIA	VIIA	He																						
1	H															2	He																					
3	Li	4	Be											5	B	6	C	7	N	8	O	9	F	10	Ne													
11	Na	12	Mg											13	Al	14	Si	15	P	16	S	17	Cl	18	Ar													
19	K	20	Ca	21	Sc	22	Ti	23	V	24	Cr	25	Mn	26	Fe	27	Co	28	Ni	29	Cu	30	Zn	31	Ga	32	Ge	33	As	34	Se	35	Br	36	Kr			
37	Rb	38	Sr	39	Y	40	Zr	41	Nb	42	Mo	43	Tc	44	Ru	45	Rh	46	Pd	47	Ag	48	Cd	49	In	50	Sn	51	Sb	52	Te	53	I	54	Xe			
55	Cs	56	Ba	*La	Hf	72	Ta	73	W	74	Re	75	Os	76	Ir	77	Pt	78	Au	79	Hg	80	Tl	81	Pb	82	Bi	83	Po	84	At	85	Rn					
87	Fr	88	Ra	+Ac	Rf	104	Ha	105	Sg	106	Ns	107	Hs	108	Mt	109	110	111	112	113																		
* Lanthanide Series	58	Ce	59	Pr	60	Nd	61	Pm	62	Sm	63	Eu	64	Gd	65	Tb	66	Dy	67	Ho	68	Er	69	Tm	70	Yb	71	Lu										
+ Actinide Series	90	Th	91	Pa	92	U	93	Np	94	Pu	95	Am	96	Cm	97	Bk	98	Cf	99	Es	100	Fm	101	Md	102	No	103	Lr										

Cosmic Chemistry: An Elemental Question

This module focuses on classifying and organizing information. With the periodic table as their guide, students choose various paths through question-finding exercises. Students experience the unique type of thought process that is required to predict missing information based on scant evidence and focused questioning. As they embark on a search for information, the students' quest is to find the missing evidence that is needed for further understanding of our solar system.

The Search for Critical Questions

- [Teacher Guide](#)
- [Student Activity](#)

Briefing

Use the Student Activity, "The Search for Critical Questions" to create interest in learning more about solving problems by asking questions. The activity starts with students attempting to predict the characteristics of pieces missing from a jigsaw puzzle. It concludes with an examination of the questions that were formulated by lab groups as they searched for understanding.





Exploration of a Problem: Making Sense of the Elements

- [Teacher Guide](#)
- [Student Activity](#)

A Historic Overview: Mendeleev and the Periodic Table

- [Student Text](#)

The Modern Periodic Table

- [Student Text](#)

Exploration

In the activities to come, the teacher's instructional role is socratic. Through effective questioning, students are prompted to examine their logic as they attempt to solve two major mysteries--Mendeleev's landmark development of the Periodic Table of Elements, and the Genesis mission scientists' quest for elemental and isotopic abundance clues to the origin of the solar system.

Use the activity, "Exploration of a Problem: Making Sense of the Elements" to generate discussion, leading students to examine some of their basic assumptions. This activity offers the teacher a snapshot of the class's present level of understanding about elements and their chemical characteristics. It is up to the discretion of the teacher to determine how much review or initial instruction of chemistry concepts is appropriate at this time.

Curriculum Connections

National Standards Addressed

Grades 9-12

Science as Inquiry

- Understandings about scientific inquiry
- Abilities necessary to do scientific inquiry

Physical Science

- Conservation of energy and the increase in disorder
- Interactions of energy and matter

Science in Personal and Social Perspective

- Natural and human-induced hazards
- Science and technology in local, national, and global challenges

Science and Technology

- Abilities of technological design
- Understandings about Science and Technology

History and Nature of Science

- Science as a Human Endeavor
- Nature of Scientific Knowledge
- Historical Perspectives

Student Mission

Students will practice problem-solving processes such as asking helpful questions and creating useful mathematical models. They will investigate isotopic abundance data from samples of material from the moon, Mars, and meteorites in an attempt to determine the origin of an unidentified sample.

Development of a Model: Analyzing Elemental Abundance

- [Teacher Guide Part I](#)

Development of a Model: Analyzing Elemental Abundances on Earth

- [Student Activity](#)

Atoms, Elements, and Isotopes

- [Student Text](#)



[PowerPoint Presentation](#)



[PowerPoint Presentation as PDF](#)

Development

Models corresponding to real events and objects help scientists understand and explain how things work. These explanations also generate logic-based models through incorporation of new findings. Terms such as "model" and "theory" become easier for students to understand as they construct a model and offer explanations based on critical questioning and applications of mathematical and logical concepts.

During this more formal encounter with the investigative process, students in lab groups ask questions, construct models, make observations, and read and discuss text materials. Using the student activity, "Development of a Model: Analyzing Elemental Abundance," each student records data, conducts analyses, and interprets relationships between evidence and decision making. Teachers may introduce technical vocabulary at this point in the learning cycle. The student text, "Atoms, Elements, and Isotopes" can be used at this point, or later in the process, wherever deemed appropriate by the teacher.





Development of a Model: Analyzing Elemental Abundance

- [Teacher Guide, Part II](#)

Development of a Model: Analyzing Extraterrestrial Elemental Abundances

- [Student Activity](#)

Interaction/Synthesis

Students interact with peers in order to accomplish many of the tasks in the sections above. Each activity contains lab work done in groups, and preliminary and summary discussions are held as a class.

Students are asked to individually synthesize their knowledge by using what they have learned in group activities and discussions to answer a series of related questions in their laboratory notebook or in another format determined by the teacher.

In the activity, “Development of a Model: Analyzing Extraterrestrial Elemental Abundances,” students determine the origin of material from Antarctica, comparing its oxygen isotope ratios to those of other identified samples. Students integrate all they have learned about asking questions and creating graphs to analyze data on these samples. The activity concludes with the class holding a public discussion in which lab groups argue for further support of this type of research.

Connecting Models and Critical Questions

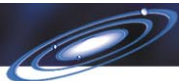
- [Teacher Assessment Guide](#)
- [Student Assessment Activity](#)

Assessment

Use the final activity, “Connecting Models and Critical Questions” to assess students’ abilities to search for patterns in tables of data, to create mathematical models, and to communicate their findings with their peers.

In “Connecting Models and Critical Questions,” students initially meet in lab groups to discuss information provided about a subset of the elements. They finish the assessment individually, creating a mathematical model to explain differences in chemical reactivity among these elements, analyzing the process of developing this model, interpolating from their model the characteristics of a hypothetical element, and planning a presentation to their peers on their model.





This education module, *Cosmic Chemistry: An Elemental Question* was developed by educators at [Mid-continent Research for Education and Learning](#).



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