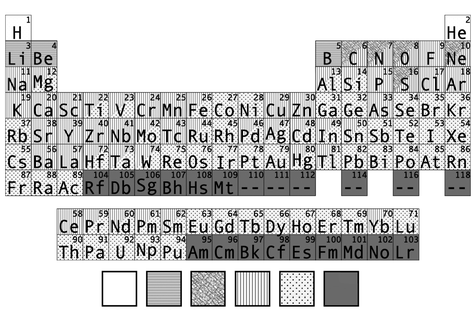
What is Your Cosmic Connection to the Elements?

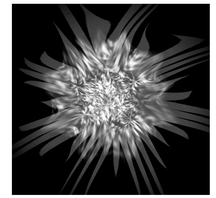
About the Poster

This poster illustrates the cosmic processes and events which give rise to the chemical elements. Each of the processes – the Big Bang, fusion in small and large stars, supernovae, and fragmentation by cosmic rays – form the elements in our bodies and all around us. The poster illustrates this by pointing out objects on or around the girl and identifying the primary element that comprises that object. These elements are then connected to the cosmic process that creates them. (Note that the colors of the elements' names correspond to the colors of the name of the cosmic processes.) The large-print panels on the back of the poster further describe the processes and events that create the elements. The periodic table in the background is likewise color-coded to match the elements to their cosmic origin. The full periodic table is re-produced below.

Some elements come from more than one process. If a second process contributes more than 30% to the abundance of the element in the universe, we have included it.

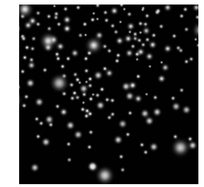


Big Bang



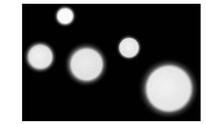
The Big Bang created all the matter and energy in the Universe. Most of the hydrogen and helium in the Universe were created in the moments after the Big Bang. Heavier elements came later.

Small Stars



Small stars fuse hydrogen into helium, and then fuse helium into carbon, nitrogen, and oxygen. These last three elements make up the air we breathe and more than 85% of our body weight.

Large Stars



Large stars make heavy elements as well as light elements through the process of fusion in their cores. For example, large stars create the calcium in your bones and the iron in your blood, the silicon in the soil, and the sulfur that's in your hair.

Grandma's Apple Pie

STUDENT HANDOUT

Introduction

Scientists have been studying the origins of the universe for much of history. Our recent classroom study has focused on this, by taking a critical look at the origins and "life cycle" of matter. This project is designed to give you the opportunity to showcase what you know about where we come from.

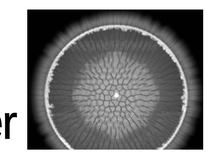
Assignment

Carl Sagan once said, "To make an apple pie from scratch you must first invent the universe." Your group's assignment is to create a presentation that illustrates the meaning of this statement. You will pick an element that can be found in good old American apple pie and trace its evolutionary history back to the birth of the universe itself. Your discussion should address briefly the constant recycling of elements here on Earth, as well as the formation of elements in the cores of active stars and supernovae. You must describe the way in which these elements were dispersed from the star through space and ultimately to the Earth. You will also share your vision of the environment in which that element may find itself 5 or so billion years from now after the Earth is long gone. Both your tracing of the element back through time and your creative vision of that element in the future should show a solid understanding of the "life cycle" of matter. Each presentation should also include an artistic element – an original song, an illustration, a poem, a video, etc. that better explains the scientific concepts you are trying to illustrate.

Project Parameters

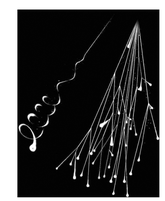
- Every member of the group must participate in the presentation or contribute to design of the artistic element.
- The group must address all parts of the assignment in their presentation.
- Each presentation should be less than 15 minutes in length.
- Each presentation must contain an artistic element that complements the material being discussed.
- Each presentation must show a solid understanding of the scientific concepts being discussed.

Supernovae



The explosive power of supernovae creates and disperses a wide range of elements. For example, the chlorophyll in green plants contains magnesium from supernovae. The gold used in jewelry and the titanium used in light-weight eyeglass frames were formed in supernovae.

Cosmic Rays



The nuclei of the elements formed in the big bang, stars, and supernovae rain down on us from space in the form of cosmic rays. Lithium, used in watch batteries, comes primarily from cosmic rays.

Note to the Teacher

This poster may be used to supplement your chemistry, earth science, physics, or astronomy classes. Refer to the panel "About the Poster" for a description of the imagery.

The large-print panels on the back may be copied and displayed with the poster to provide explanations for how the processes relate to specific elements. You may post them when you initially display the poster, or you may put them up one at a time after your class has discussed a particular process.

The classroom activity, "Grandma's Apple Pie," ties the subject together for your students. A rubric for the "Grandma's Apple Pie" activity, and additional classroom activities, may be found in the accompanying information/activity booklet, and on the "Cosmic Elements" web site (see below).

Acknowledgements

This poster was created by the education team at the Lab for High Energy Astrophysics, NASA/Goddard Space Flight Center, with poster design and artwork by Karen Smale. Classroom activities were developed by the "Elements 2002 Teacher Worskhop" participants. We thank Suzanne Pleau Kinnison, NASA Aerospace Education Specialist at GSFC, for valuable input, and Dr. Ilan Chabay, New Curiosity Shop, for guidance in the development of the classroom activities.

Please take a moment to evaluate this product at http://ehb2.gsfc.nasa.gov/edcats/educational_wallsheet

Additional Resources

See the *"What is Your Cosmic Connection to the Elements?"* Information & Activity Booklet for more detailed information and more classroom activities. A copy of the booklet may be requested by writing to Imagine the Universe! at itu@athena.gsfc.nasa.gov.

Supplemental information, on-line classroom activities and a slide presentation are also available in the "Cosmic Elements" section of the Imagine the Universe! web site at

http://imagine.gsfc.nasa.gov/docs/teachers/elements/

More resources for you and your students may be found at:

http://pearl1.lanl.gov/periodic/ - Properties of each of the elements, with information about their discovery.

http://periodictable.com/pages/AAE_History.html - A brief history of the periodic table.

http://wmap.gsfc.nasa.gov/ - The "Universe" section of this site for the Wilkinson Microwave Anisotropy Probe provides information on the Big Bang and nucleosynthesis.

http://cassfos02.ucsd.edu/public/tutorial/Nukes.html - An overview of nuclear fusion reactions that occur in stars.

http://imagine.gsfc.nasa.gov/docs/teachers/lifecycles/stars.html - An overview of the life cycles of stars, with classroom activities.

http://www.tufts.edu/as/wright_center/cosmic_evolution - Cosmic Evolution from the Big Bang to Human Kind.

http://helios.gsfc.nasa.gov/ - An education web site devoted to cosmic rays.

What is Your Cosmic Connection to the Elements?
EW-2003-1-016-GSFC (Revised Feb 2004)