

Cosmic Chemistry: Cosmogony

A Spongy Universe

TEACHER GUIDE

BACKGROUND INFORMATION

In this activity, your students will not only be working with a model of the universe, but will also be modeling the work of scientists. It is important that you continue your role of asking questions, even though it is sometimes easier to give them answers, as they work through this activity. You may allow them as much time as you consider appropriate for them to complete the seven questions of the activity and any follow-up explorations that may result from the activity.

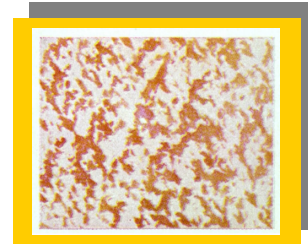
Description vs. Explanation

One of the ways in which students will model scientists is that they will be first making observations of the sponge and then, they will be trying to explain how the sponge came to be formed. You may want to use a copy of Appendix C, "Selected Noteworthy Events in Cosmology" to show students:

- how long astronomers and cosmologists have been studying the structure of the universe;
- what types of scientific instrumentation (technology) have been used to make observations of the structure of the universe; or
- how scientists used "indirect evidence" to describe galactic and cluster structures.

Emphasize that the information given in the Student Text, "A Spongy Universe" was obtained over a long period of time, but that cosmic mapping is relatively new. There was a lot of activity in the cataloging of galaxies and clusters between 1930 and 1985. You may want to explore questions like the following with your students:

- What types of instrumentation had been developed by this time?
- How much evidence was necessary before scientists felt confident enough to tell others about their observations?
- Did scientists try to explain their observations at the same time they made their observations?



The references listed in this module are merely a starting point for reading more about cosmic structure. You and your students are encouraged to explore the many good sources of information on this topic.

Cosmology as an On-going Science

Notice that the Student Text, "A Spongy Universe," ends with questions. It is a characteristic of a good scientific experiment that trying to find an answer to a question results in more questions. Cosmology is a scientific study "in progress." New observations are constantly prompting the asking of more questions, which results in more explorations and sometimes necessitates new and better observational instrumentation. This activity can be used to stimulate your students to ask questions and to search further for the answers.

NATIONAL SCIENCE STANDARDS ADDRESSED

Grades 5-8

Science As Inquiry

Understandings about scientific inquiry

Earth and Space Science

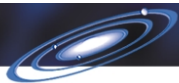
The origin and evolution of the universe

Physical Science

Properties and changes of properties in matter

Motions and forces

Transfer of energy



[Science and Technology](#)

Understandings about science and technology

[History and Nature of Science](#)

Science as a human endeavor

Nature of science and scientific knowledge

History of science and historical perspectives

Grades 9-12

[Science As Inquiry](#)

Understandings about scientific inquiry

[Earth and Space Science](#)

The origin and evolution of the universe

[Physical Science](#)

Structure and properties of matter

Motions and forces

Interactions of energy and matter

[Science and Technology](#)

Understandings about science and technology

[History and Nature of Science](#)

Science as a human endeavor

Nature of science and scientific knowledge

History of science and historical perspectives

(View a full text of the [National Science Education Standards](#).)

MATERIALS

For each student

- Copy of [Student Activity/Report Sheet, "A Spongy Universe"](#)
- Copy of [Student Text, "A Spongy Universe"](#)
- Copy of [Appendix C, "Selected Noteworthy Events in Cosmology"](#)

For each pair of students:

- One household sponge that measures about 3 cm x 8 cm x10 cm
- This set of sponges may all be alike so that you obtain similar responses
or
- You could use a variety of sponges to obtain different responses.
It is preferable to use sponges that have relatively large and irregular spaces. Avoid those types of sponges that have pores too regular to model the structures of the universe.
Another alternative is to use similar sponges for the activity and to have different types of sponges with different size pores to introduce during the feedback sessions.
- Meter sticks for measuring distance between observer and partner in #6.

PROCEDURE

1. Before class, make copies of the Student Activity Report Sheet, "A Spongy Universe," Student Text, "A Spongy Universe," and Appendix C, "Selected Noteworthy Events in Cosmology."
2. Group the class into pairs. Hand out copies of the Student Activity Report Sheet, "A Spongy Universe." Tell them to follow the instructions to complete the activity.
3. Have meter sticks available for #6 of the activity. [Depending upon the size of your classroom and the type of sponges that you select for the activity, it may be necessary for students to go to a hallway to complete #6 of this activity.]

Teaching Tip

During pilot testing the color of the sponges made a difference when students were measuring the distances at which homogeneity was observed. Try sponges of different colors and similar types of pore structure.



4. During post-activity discussion:
 - a) Have students report (either orally or written on a previously prepared chart) the distances at which they could no longer see the “bubbles” or voids in the sponge.
 - b) Ask for reasons why there may have been wide ranges of differences in these distances.
 - c) How did students think the bubbles and structures of the sponge were formed?
 - d) Ask for students to report whether they described their sponges as homogeneous or heterogeneous and on what basis they made their decisions.
5. Distribute copies of the Student Text, “A Spongy Universe,” for students to read before the next class period.
6. Start the next period’s class discussion with questions similar to the following:
 - a) Do you think that a sponge is a good model for the large structures of the universe? Why or why not?
 - b) What do you think caused “bubbles” in the universe?
 - c) Do you think that there is anything in those “voids” that we cannot see?
 - d) What is the difference between isotropic and homogenous?
 - e) After reading the Student Text, “A Spongy Universe,” do you think that the universe is isotropic and homogeneous?
 - f) If your students completed the Student Activity, “The Push and Pull of the Universe,” have them discuss whether or not the box with different types of materials—marbles, cotton balls, wooden blocks, balloons and packing peanuts—could be used as a model for **structure** of the universe as well as to model its **density**.
7. Hand out copies of Appendix C, “Selected Noteworthy Events in Cosmology,” and discuss some or all of the questions posed in the Background Information above.