National Aeronautics and Space Administration

Globular Cluster M80

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A Swarm of Stars

This tightly packed crowd of stars, which resembles a swarm of bees, is a globular star cluster. Called M80 (NGC 6093), the stellar swarm is one of the densest globular clusters in our Milky Way Galaxy. M80 contains hundreds of thousands of mostly low-mass stars that orbit around a common center of gravity.

More than 150 globular clusters are known to exist in our galaxy. Each cluster contains tens of thousands to a million stars packed together more tightly than stars like our Sun. Globular clusters reside within the "galactic halo," which surrounds the disk of our galaxy and similar galaxies.

Globular clusters are the pioneer homesteaders of our Milky Way. They were formed billions of years ago and are among the oldest objects in our galaxy. Every star visible in this image of M80 is older than our Sun. Especially obvious are the bright red giants, which are Sun-like stars nearing the ends of their lives. Globular clusters also are homes to a few exotic stars like blue stragglers, which are more massive than our Sun. These blue-hued stars form when two stars collide and merge in the cluster's dense environment.

Astronomers can judge a star's age by the amount of heavy elements it has, and they classify elements other than hydrogen and helium as heavy elements. Heavy elements are made in the cores of stars. Each time a star dies, it releases some of its heavy elements into space. These elements become part of a new generation of stars. Each successive generation of stars, therefore, has more heavy elements than its ancestors.

Stars in globular clusters, when compared with the Sun and other stars in the galactic disk, appear to have fewer heavy elements. The tiny amount of heavy elements in these globular cluster stars indicates that they were formed very early in the history of our galaxy. The chemical makeup of stars differs from one cluster to the next. All the stars within a given cluster, however, have similar compositions, indicating that they were born from the same cloud.

While a globular cluster is known for its older, redder stars, an open cluster — the second type of star cluster — is recognized for its bluer, younger stars. An open cluster is an irregularly shaped grouping of stars held together by mutual gravitational attraction. The grouping contains up to several thousand stars, far fewer stars than in a globular cluster. While globular clusters are ancient relics of our galaxy, open clusters are short-term inhabitants. Open cluster stars are not as tightly bound as those in globular clusters. Open clusters, therefore, eventually disperse as their stars drift apart. While globular clusters inhabit the galactic halo, open clusters are found in the galactic disks of spiral galaxies. Globular and open star clusters do share one important feature: Stars in each cluster type were born at the same time and formed out of the same cloud of interstellar gas. Both types of clusters are valuable to astronomers because they provide well-defined populations for studying how stars evolve.

The Pleiades Star Cluster
The brilliant stars seen in this image are members of the popular open star cluster known as the Pleiades, or Seven Sisters. One thousand stars comprise the cluster, located in the constellation Taurus.

Credits: Color-composite image from the Palomar 48-inch Schmidt telescope, from the second Palomar Observatory Sky Survey (part of the Digitized Sky Survey).

VOCABULARY

Messier catalogue (M): A catalogue of about a hundred of the brightest galaxies, star clusters, and nebulae compiled in the late 1700s by the French astronomer Charles Messier.

New General Catalogue (NGC): A catalogue of star clusters, nebulae, and galaxies compiled in 1888.

FAST FACTS

Location: Constellation Scorpius.
Distance from Earth: 32,600 light-years.

Credits: The Hubble Heritage Team (NASA/AURA/STScI).

You can get images and other information about the Hubble Space Telescope on the World Wide Web. Visit **http://hubblesite.org** and follow the links.

The corresponding classroom activity for this lithograph can be found at **http://amazing-space.stsci.edu/eds/overviews/print/lithos/m80.php** or obtained by contacting the Office of Public Outreach at the Space Telescope Science Institute, 3700 San Martin Drive, Baltimore, MD 21218.

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In Search of … Star Clusters

Description

Using the "Globular Cluster M80" lithograph, engage your students in a Level One Inquiry activity to compare the two types of star clusters. A Level One Inquiry activity can help prepare students to be independent thinkers. Students conduct research to answer questions they have about star clusters.

Grade Level

High school: grades 10–12

Prerequisites

Students should be aware that gravity is a force of attraction between all masses in the universe. They should know that a star is a gaseous, self-luminous object held together by its own gravity and that stars vary in brightness, color, mass, temperature, and age.

Misconceptions

Teachers should be aware of the following common misconceptions and determine whether their students harbor any of them. Students may think that stars are solitary — like the Sun — when, in reality, astronomers estimate that roughly half of all stars in the sky are members of binary systems (two stars orbiting a common center). Students may think that the only groups of stars that exist are galaxies, whereas star clusters are smaller groups of stars that reside within a galaxy.

Purpose

The purpose of this activity is to apply a Level One Inquiry technique, using images and text to compare globular star clusters to open star clusters. In this activity, the components of inquiry learning that students can practice are: asking questions, planning and conducting investigations, using critical-thinking skills, making comparisons, and communicating results. Students will make comparisons, formulate questions, and read for a purpose.

Materials

- "Globular Cluster M80" lithograph.
- Computer with Internet connection for researching answers.

Instructions for the Teacher

Preparation

- Obtain a lithograph for each student. Lithographs are available as PDF files at **http://amazing-space.stsci.edu/eds/tools/type/pictures.php**.
- Bookmark or identify as favorites the following suggested websites, and /or prepare a list of websites that students can access to obtain additional information about star clusters.
- Space Telescope Science Institute (STScI) Background Info: "Globular Star Clusters": **http://hubblesite.org/newscenter/archive/releases/2002/10/background/**.
- STScI Background Info: "Hubble Space Telescope's Wide Field Camera Reveals Splendor of 'Supergiant' Nebula": **http://hubblesite.org/newscenter/archive/releases/2001/21/background/**.

Procedure

Evaluate your students' misconceptions about star clusters by having them write down anything they know and understand about clusters. Have students volunteer their ideas about star clusters. From those ideas, identify their misconceptions and discuss them with the class. Or, collect the papers containing their ideas about star clusters. From those ideas, compile a list of their misconceptions and discuss them with the class.

Ask students to look at the images of M80 and the Pleiades and to write down three questions they want answered about star clusters. Compile a list of questions, and group students by common theme. Ask students to read the information on the back of the lithograph and check if any of their questions have been answered. Allow students to refine their questions by discussing them with their group.

Have students use the Internet to research their questions. The Internet sites listed previously can provide a starting point for their research. Instruct students on how to access other Web sites that may be appropriate.

Ask students to prepare a report in which they compare globular clusters with open clusters. This report could be in the form of a slide show, a skit, a story, a graphic organizer, a Power Point presentation, or a written report — anything that conveys their understanding of the topic to another student, a group of students, or the entire class. Ask students to review their original questions to see if they were answered. Then ask them if they have any additional questions.

Instructions for the Student

Your teacher will ask you to write down things you know and understand about star clusters. You may be asked to share this information with the rest of the class. Study the images of the star clusters, and write down three questions about what you see in the images. Then read the back of the lithograph, and check if any of your questions were answered.

Your teacher will assign you to a group to research the answers to your questions. You can research your answers by using the Internet sites provided by your teacher. To demonstrate your understanding, your teacher will ask you to give a report that compares the similarities and differences between globular clusters and open clusters. This report could be a slide show, a skit, a story, a graphic organizer, a Power Point presentation, or whatever presentation you think will communicate the information you learned about star clusters. You may be allowed to work individually or in small groups. You can make your presentations to another classmate, another group of students, or the entire class.

At the conclusion of this activity, you will be asked to review your original list of questions and reflect on whether, through your research, they were answered fully, partially, or not at all. Your teacher also may ask if you thought of any other questions when you were researching the answers to your original questions.

Education Standards

National Science Education Standards

http://www.nap.edu/openbook.php?record_id=4962

Content Standard D: The origin and evolution of the universe

As a result of their activities in grades 9–12, all students should develop an understanding of the origin and evolution of the universe.

• Early in the history of the universe, matter, primarily the light atoms hydrogen and helium, clumped together by gravitational attraction to form countless trillions of stars. Billions of galaxies, each of which is a gravitationally bound cluster of billions of stars, now form most of the visible mass in the universe.

McREL Language Arts Standards and Benchmarks

http://www.mcrel.org/compendium/standardDetails.asp?subjectID=7&standardID=7

Reading Standard 7:

Level 4 (Grade 9–12)

1. Uses reading skills and strategies to understand a variety of informational texts (e.g., textbooks, biographical sketches, letters, diaries, directions, procedures, magazines, essays, primary source historical documents, editorials, news stories, periodicals, catalogs, job-related materials, schedules, speeches, memoranda, public documents, maps).

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