National Aeronautics and Space Administration

Star-forming Nebula NGC 3603

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Stellar Evolution Revealed in a Giant Nebula

Thousands of stars sparkle like diamonds in this Hubble Space Telescope view of a vast star-forming region.

At the center of this stellar "jewel box" is a giant star cluster dominated by young, hot, massive stars. Some of them are the heftiest known stars in the universe. The stars reside in the nebula NGC 3603, a large gas cloud in our Milky Way Galaxy.

This Hubble image provides astronomers with a family portrait of stars in different stages of their lives, from infant stars still wrapped in cocoons of gas to stars nearing the end of their lives.

Bluish clouds of gas and dust, the raw material for new star formation, surround the stars. Powerful ultraviolet radiation and violent stellar winds from the cluster's largest stars have blown out an enormous cavity in the gas-and-dust cloud, providing an unobstructed view of the cluster.

Fierce radiation from those massive stars also has sculpted tall towers of dense gas. The gaseous towers are a few light-years tall and are embedded in the nebula's walls. These monoliths may be incubators for new stars.

One of the most massive stars in the nebula, Sher 25, is in a late stage of its life. This rapidly aging star is surrounded by a unique ring of glowing gas. Sher 25 will end its life in a powerful supernova blast within the next million years.

Most of the stars in the cluster formed about 1 or 2 million years ago in a single burst of star formation. Although the stars share the same age, they do not all evolve at the same rate. Their lifespan depends on their mass, and these stars have a wide range of masses. High-mass stars are very bright and hot and burn through their fuel supply much faster than their less massive, fainter, and cooler counterparts. Ultimately, the gas surrounding the cluster will be blown away by supernova explosions.

NGC 3603 is one of the most active star-forming regions in the Milky Way Galaxy. It was discovered in 1834 by British astronomer Sir John Herschel.

Credit: NASA, ESA, R. O'Connell (University of Virginia), F. Paresce (National Institute for Astrophysics, Bologna, Italy), E. Young (Universities Space Research Association/Ames Research Center), the WFC3 Science Oversight Committee, and the Hubble Heritage Team (STScI/AURA)

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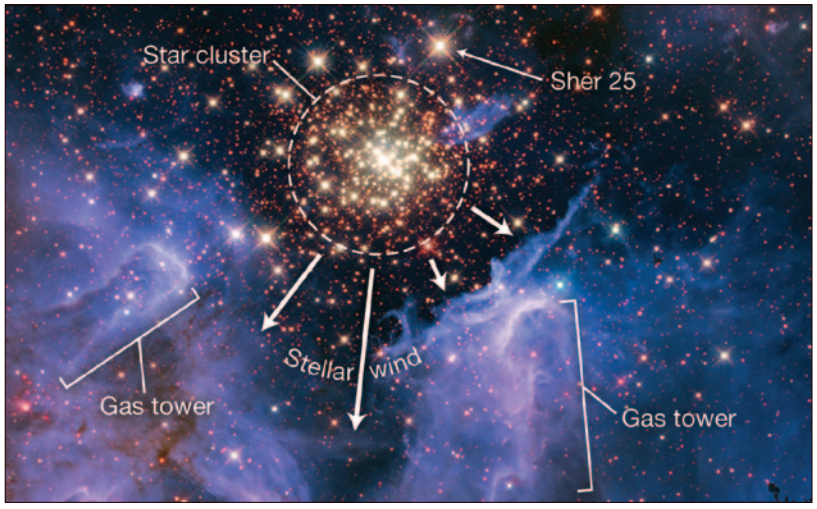

Life cycle of stars

Stars from all stages of life are shown in this image of the nebula NGC 3603. In the center of the image is a giant star cluster dominated by young, hot, massive stars. The bright star at the upper right edge of the central cluster is Sher 25. A faint, wispy blue ring of gas surrounds this massive, aging star. The image also reveals how the cluster's most massive stars have shaped their environment. Radiation and stellar winds have eaten into the bluish gas-and-dust cloud along the bottom, carving out tall ghostly towers of dense gas.

VOCABULARY

Star cluster: A group of stars born at almost the same time and place, capable of remaining together for billions of years because of their mutual gravitational attraction.

FAST FACTS

Distance: About 20,000 light-years away
Location: Constellation Carina

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

The corresponding classroom activity for this lithograph can be found at: **http://amazing-space.stsci.edu/** or may be 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 … Stellar Evolution

Description

Use the "Star-forming Nebula NGC 3603" lithograph as the initial source of information to engage your students in a Level One Inquiry Activity. Students will use the images and text on this lithograph to generate questions about how stars change over time. They will conduct research to answer their questions. This curriculum support tool is designed to be used as an introductory activity in a unit that incorporates scientific inquiry or that has a stellar evolution theme.

About Inquiry-based Learning

The inquiry process is driven by a student's own curiosity, wonder, interest, or passion to understand an observation or to solve a problem. It involves a process of exploring the natural or material world. This exploration prompts students to ask questions and to make discoveries in the search for new insights. A Level One Inquiry activity uses questions and problem-solving methods directed by the teacher. In this activity, teachers will use the lithograph images to help students formulate questions about how stars change over time. Teachers will suggest selected resources about stellar evolution to help students answer their questions. Students will provide supporting evidence for their conclusions. This process can help prepare students to become more independent thinkers.

Grade Level

High school, grades 11–12.

Prerequisites

Students should be aware that a star is a gaseous, self-luminous object held together by its own gravity. Stars change as they age. These changes are determined by the original mass of the star.

Misconceptions

Teachers should be aware of the following common misconceptions and determine whether their students harbor any of them. Students may have misconceptions about stars. They may think that all stars are the same, that stars live forever, or that all stars end their lives in the same way.

Vocabulary

These are terms students may encounter while doing further research on star evolution.

Stellar Evolution: The sequence of changes that occurs in a star as it ages.
Stellar Wind: Streams of charged particles flowing from the star.
Supernova(e): The explosive death of a massive star whose energy output causes its expanding gases to glow extraordinarily bright for weeks or months.

See the lithograph for additional vocabulary terms.

Purpose

The purpose of this activity is to engage students in a Level One Inquiry Activity with astronomical images and information. Students will gain experience using the Internet to search for information. They will practice the process skills of observing and analyzing. Students will also organize their material, present their findings, and reflect on what they have learned.

Materials

- "Star-forming Nebula NGC 3603" lithograph.
- Computer with Internet connection for conducting research.

Instructions for the Teacher

Preparation

Obtain copies of the lithograph for each student.

The "Star-forming Nebula NGC 3603" lithograph can be found at **http://amazing-space.stsci.edu/capture/stars/preview-ngc3603-nebula.php**. Preview the Overview page, found at: **http://amazing-space.stsci.edu/eds/overviews/print/lithos/ngc3603-nebula.php**. Use the "Related Materials" section to (1) become familiar with inquiry-based learning and/or (2) become familiar with stellar evolution.

In Search of … Stellar Evolution

Bookmark or identify as favorites the following suggested websites:

STScI: "Starburst Cluster Shows Celestial Fireworks"
http://hubblesite.org/newscenter/archive/releases/2010/22/image/a/

STScI: "Star Cluster Bursts into Life in New Hubble Image"
http://hubblesite.org/newscenter/archive/releases/2007/34/image/a/

STScI: "Hubble Snapshot Captures Life Cycle of Stars"
http://hubblesite.org/newscenter/archive/releases/1999/20/image/a/

Procedure

Before beginning this activity, identify your students' misconceptions about stars by having them write down anything they know and understand about this topic. Use those statements to evaluate your students' misconceptions. Have students volunteer their ideas about stars. From those ideas, identify their misconceptions and discuss them with the class. An alternative method is to collect your students' written ideas about stars. From those ideas, compile a list of their misconceptions and discuss them with the class.

Ask students to study the images on the front and the back of the lithograph. Then tell your students to write as many questions as they can about the features visible in the images. Collect the questions and group them by common themes. Ask students to read the information on the back of the lithograph. Then ask them if they found the answers to any of their questions. Tell students to use the Internet to research their questions. The Internet sites listed on the preview page provide a starting point for their research. Tell students how to access other websites. Ask students to prepare presentations that include answers to their questions. Their presentations should also address how stars change over time. This presentation can be in the form of a skit, a story, a graphic organizer, a PowerPoint show, or a written report — any method that conveys a student's understanding of the topic to another student, to a group of students, or to the entire class. Students may work individually or in groups. Ask students to check whether their original questions were answered during their research or from talking with other students. Then ask students if they have any additional questions.

Instructions for the Student

Your teacher will ask you to write down what you know and understand about stars. You may be asked to share this information with the rest of the class. Study the images of the nebula on the front and the back of the lithograph. Write down as many questions as you can about what you see in the images. Read the back of the lithograph to find answers to your questions.

Using your questions as a guide, conduct research on the Internet to find the answers to your questions. Your teacher will provide Websites to use for your research. Your teacher will also ask you to create a presentation to demonstrate your understanding of the material you collected through your research. The presentation could be a skit, a story, a graphic organizer, a PowerPoint show, or whatever format that will communicate the information you learned about how stars change with time. Your teacher will direct you to work individually or in small groups. You may make your presentation to another classmate, to another group of students, or to the entire class.

Education Standards

AAAS Benchmarks: Project 2061

http://www.project2061.org/publications/bsl/online/bolintro.htm

1. The Nature of Science

B. Scientific Inquiry

By the end of the 12th grade, students should know that:

- Sometimes, scientists can control conditions in order to obtain evidence. When that is not possible, practical, or ethical, they try to observe as wide a range of natural occurrences as possible to discern patterns.

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Educational Product

Educators & Students | Grades 11-12