National Aeronautics and Space Administration

Veil Nebula

Hubble's Close-Up View of the Veil Nebula

This intriguing Hubble Space Telescope image shows in stunning detail a small section of a supernova remnant called the Veil Nebula, or Cygnus Loop. The nebula is the expanding remains of a star that exploded between 5,000 and 10,000 years ago in our Milky Way galaxy.

The entire nebula is 110 light-years across, covering six full moons on the sky as seen from Earth, and resides about 2,100 light-years away in the constellation Cygnus the Swan. The Hubble view shows a small area roughly 2 light-years in diameter, encompassing less than 1 percent of the entire Veil Nebula. This small area of the Veil Nebula is part of a region called NGC 6960.

Colorful smoke-like wisps of gas are all that remain visible of what was once a star some 20 times more massive than our sun. Prior to the explosion, a strong stellar wind (a stream of charged particles) from this star blew a large cavity or bubble in the surrounding area. The intertwined wisps of gas in the Veil Nebula result from the energy released as the fast-moving shock wave, or blast wave, from the ancient explosion plows into the edges or walls of this cavity. The blast wave initially heated the material to millions of degrees, but as the gas cools down again, it produces the brilliant glowing colors seen in the Hubble image.

The image shows an incredible array of structures and detail from the interaction. The ripples in the gas, for example, look like crumpled bed sheets viewed from the side. The bright regions are where the shock wave is encountering relatively dense material or where the ripples in the bed sheet are viewed exactly edge-on.

The nebula's colors correspond to variations in the temperature and density of the glowing interstellar material. Blue, for example, arises in hotter gas that has more recently encountered the shock wave. The green and most of the red material denote cooler gas that collided with the blast wave even longer ago.

Although the supernova explosion occurred thousands of years ago, the speedy shock wave is still moving at 1.4 million miles per hour (2.3 million kilometers per hour). The shock wave is moving so fast that it could travel from Earth to the Moon in 15 minutes. It takes years, however, before this motion is even slightly visible to telescopes because the nebula is so far away.

Credit for Hubble image: NASA, ESA, and the Hubble Heritage Team (AURA/STScI)
Credit for ground-based image: T.A. Rector (University of Alaska Anchorage) and WIYN/NOAO/AURA/NSF

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Goddard Space Flight Center
8800 Greenbelt Road
Greenbelt, Maryland 20771

www.nasa.gov

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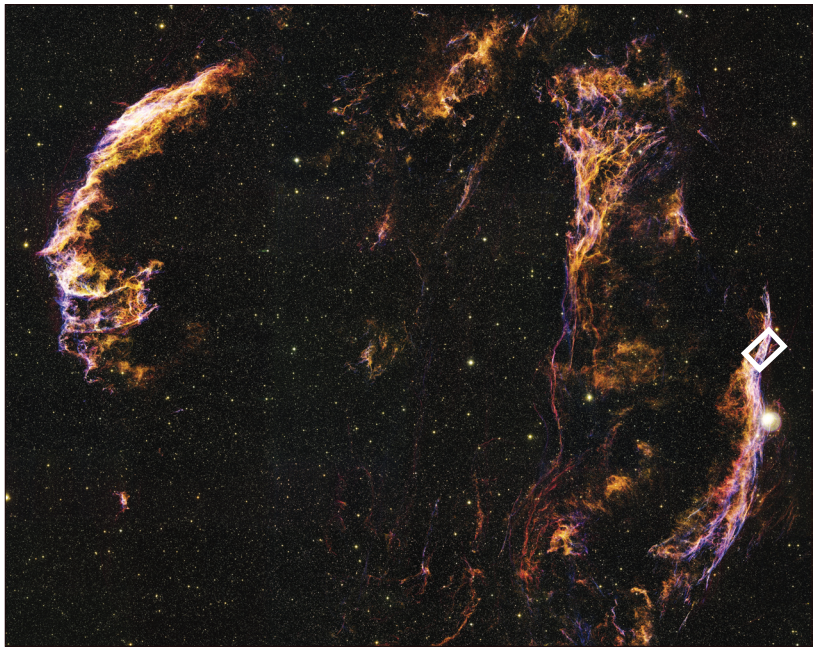

Ground-based view of Veil Nebula
A ground-based telescope took this image of the Veil Nebula, which measures 110 light-years across. The small white box at far right marks the location of Hubble's view, which is roughly 2 light-years in size.

VOCABULARY

Nebula: A cloud of gas and dust located between stars and/or surrounding stars. Nebulae are often places where stars form.

Shock wave: A high-pressure wave that travels at supersonic speeds. Shock waves are usually produced by an explosion.

Supernova remnant: The material that remains following the explosive death of a star.

You can get images and other information about the Hubble Space Telescope on our website, **http://hubblesite.org/**

The corresponding classroom activity for this lithograph can be found at: **http://amazing-space.stsci.edu/eds/tools/type/pictures.php** 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 … Supernovae

Description

The "Veil Nebula" lithograph serves as the initial source of information to engage students in a Level One Inquiry Activity. In this activity, educators will use lithograph images to help students formulate questions about supernovae. Educators will suggest selected resources about supernovae to help students answer their questions. Students will then conduct research and provide supporting evidence for their conclusions. 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 an educator. The process of inquiry-based learning can help prepare students to become more independent thinkers.

Grade Level

High school, grades 11-12

Prerequisites

Students should know that a star is a gaseous, self-luminous object held together by its own gravity. The core of a star is extremely hot and releases energy by fusing lighter atomic nuclei into heavier nuclei. When massive stars run out of fuel, they explode as supernovae.

Misconceptions

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

Vocabulary

Terms students may encounter while doing further research on supernovae include:

Supernova remnant: The material that remains following the explosive death of a star. The remnant is visible in many kinds of light because of the expanding shock wave (blast wave) that sweeps up and heats the interstellar gas and dust as it moves outward.

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 also will organize their material, present their findings, and reflect on what they have learned.

Materials

- "Veil Nebula" lithograph
- Computer with Internet connection for conducting research

Instructions for Educators

Preparation

- Obtain a lithograph for each student. The "Veil Nebula" lithograph can be found at **http://amazing-space.stsci.edu/capture/galaxies/preview-veil.php**
- Preview the Overview page at **http://amazing-space.stsci.edu/eds/overviews/print/lithos/veil.php**
- Bookmark or identify as favorites the following suggested websites:
  - STScI: 2015 press release for Veil Nebula: **http://hubblesite.org/newscenter/archive/releases/2015/29/**
  - STScI: "Uncovering the Veil Nebula": **http://hubblesite.org/newscenter/archive/releases/2007/30/**
  - STScI: "Hubble's Close-Up View of a Shock Wave from a Stellar Explosion": **http://hubblesite.org/newscenter/archive/releases/1995/11/**
  - STScI: "Hubble Reveals New Details in a Supernova's Blast Wave": **http://hubblesite.org/newscenter/archive/releases/1993/01/**

- STScI: News releases related to supernova remnants: **http://hubblesite.org/newscenter/archive/releases/nebula/supernova-remnant/**
- STScI: News releases related to stars becoming supernovae: **http://hubblesite.org/newscenter/archive/releases/star/supernova/**
- CfA: "The High-Z SN Search": **https://www.cfa.harvard.edu/supernova/newdata/supernovae.html**

Procedure

Identify your students' misconceptions about stars by having them write down anything they know and understand about this topic. 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 Hubble image of the Veil Nebula on the front of the lithograph, and then look at the ground-based image of the nebula on the back. Have students 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. Have students use the Internet to research their questions. The Internet sites listed in the "Preparation" section provide a starting point for their research. Tell students how to access other websites.

Have students prepare presentations or written reports that include the answers to their questions. The presentation can be in the form of a skit, a story, a graphic organizer, or a PowerPoint show – 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 if they have any additional questions.

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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 Hubble image of the Veil Nebula on the front of the lithograph, and then look at the ground-based image of the nebula on the back. Write down as many questions as you can about what you see in the images. When instructed by your teacher, 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 then will ask you to create a presentation or a written report to demonstrate your understanding of the material you collected through your research. The presentation can be in the form of a skit, a story, a graphic organizer, a PowerPoint show, or whatever format that will communicate the information you learned about supernovae. Your teacher will direct you to work individually or in small groups. You may be instructed to make your presentation to another student, to a group of students, or to the entire class.

Education Standards

AAAS Benchmarks: Project 2061
http://www.project2061.org/publications/bsl/online/index.php

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.

4. The Physical Setting

A. The Universe

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

- Eventually, some stars exploded, producing clouds containing heavy elements from which other stars and planets orbiting them could later condense. The process of star formation and destruction continues.

Educational Product

Educators & Students | Grades 11–12