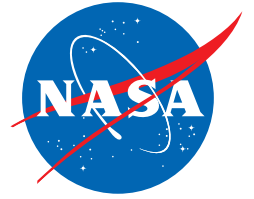


The Ring Nebula, NGC 6720

National Aeronautics and
Space Administration



Hubble reveals the nebula's true shape

The Ring Nebula (NGC 6720) is a bright, glowing gas cloud that is a favorite of both amateur and professional astronomers alike. Located in the constellation Lyra (the lyre, or harp), the nebula is situated within the famous Summer Triangle of bright stars (Vega, Altair, and Deneb) for northern hemisphere observers. At a distance of 2,300 light-years, and with the main ring structure about one light-year across, the nebula presents a large enough target for amateur telescopes and provides excellent detail for professional telescopes.

The Ring Nebula is classified as a planetary nebula, although such nebulae have nothing to do with planets. That name arose from their planet-like appearance when viewed through small telescopes. Planetary nebulae actually represent the beautiful death throes of a medium-sized star.

Such a star lives for billions of years, powered by nuclear fusion in its core. When its nuclear fuel is depleted, the core gets smaller and hotter, and the star swells to hundreds of times its previous size. Further core contraction and heating causes the outer layers to blow off into space. The picturesque nebula expands, cools, and fades away over tens of thousands of years. In contrast, the core becomes a super-hot stellar remnant, called a white dwarf, which slowly cools for trillions of years.

This image showcases the high-resolution, visible-light observations from the Hubble Space Telescope. To the human eye, the nebula appears as a pinkish-white glowing oval. The colors in this image derive from seven separate observations that isolate the emission from different wavelengths of light and different chemical elements. A combination that includes the glows from hydrogen, helium, oxygen, nitrogen, and sulfur created this stunning Ring Nebula portrait.

These observations study in detail the different temperature regions and structures of the nebula. New details show that the Ring Nebula's shape is more complicated than once thought.

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

You can find the corresponding classroom activity for this lithograph at <http://amazing-space.stsci.edu/eds/tools/type/pictures.php> or by contacting the Office of Public Outreach at the Space Telescope Science Institute, 3700 San Martin Drive, Baltimore, MD 21218.

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The Varied Shapes of Planetary Nebulae

Planetary nebulae have a multitude of shapes, each determined by how the outflow from the dying star pushes away the gas. The Spirograph Nebula, or IC 418 (*upper left*), exhibits a bubble-like structure, with complex patterns on its surface. The Retina Nebula, or IC 4406 (*upper right*), has a cylindrical shape, which indicates the outflow is stronger along one axis. The hourglass shape of the Butterfly Nebula, or NGC 6302 (*lower left*), is due to a tight ring of material constricting the outflow near the dying star. The Cat's Eye Nebula, or NGC 6543 (*lower right*), has a complex shape from multiple outbursts and wobbling jets of emission.

Credit for Spirograph and Retina nebulae: NASA and the Hubble Heritage Team (STScI/AURA)

Credit for Butterfly Nebula: NASA, ESA and the Hubble SM4 ERO Team

Credit for Cat's Eye Nebula: NASA, ESA, HEIC, and the Hubble Heritage Team (STScI/AURA)

Based on these observations, astronomers have constructed a three-dimensional model of the nebula. Understanding these structures helps them piece together the stages and development in the death of a star. Such knowledge foretells the future of our star, the Sun, which is expected to die in this manner about 5 billion years from now.

VOCABULARY

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

FAST FACTS

Location: The constellation Lyra

Distance from Earth: About 2,300 light-years

Dimensions: The main ring structure is about one light-year across.

Credit for Ring Nebula: NASA, ESA, and the Hubble Heritage (STScI/AURA)-ESA/Hubble Collaboration





In Search of ... Planetary Nebula Shapes

Description

“The Ring Nebula, NGC 6720” 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 the similarities and differences in the shapes of planetary nebulae. Educators will suggest selected resources about planetary nebulae 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 9-12

Prerequisites

Students should know that stars vary in brightness, color, age, temperature, and mass, and that mass determines a star’s evolution and how its life will end. Students also should be aware that normal stars, like the Sun, fuse hydrogen in their cores. The depletion of this fuel source initiates the final stages in the life of a star, resulting, for a Sun-like star, in a planetary nebula.

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 planetary nebulae include:

Light-year: The distance light travels in a year (about 6 trillion miles or 10 trillion kilometers).

White dwarf: The hot, compact stellar remnant of a medium-sized star like our Sun that has exhausted its sources of thermonuclear fuel.

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:

- “The Ring Nebula, NGC 6720” lithograph
- Computer with Internet connection for conducting research

Instructions for Educators

Preparation

- Obtain copies of the lithograph for each student. “The Ring Nebula, NGC 6720” lithograph can be found at: <http://amazing-space.stsci.edu/capture/stars/preview-ringneb.php>.
- Preview the Overview page at: <http://amazing-space.stsci.edu/eds/overviews/print/lithos/ringneb.php>. Use the “Related Materials” section to become familiar with planetary nebulae.
- Bookmark or identify as favorites the following suggested websites:
 - STScI: Planetary Nebula press releases and images. <http://hubblesite.org/newscenter/archive/releases/nebula/planetary/>
 - STScI: “Hubble Captures Stars Going Out in Style.” <http://hubblesite.org/newscenter/archive/releases/nebula/planetary/2007/33/image/a/>

In Search of ... Planetary Nebula Shapes

- STScI: “Dying Star Creates Fantasy-like Sculpture of Gas and Dust.” <http://hubblesite.org/newscenter/newsdesk/archive/releases/2004/27/>
- STScI: “NASA’s Hubble Space Telescope Reveals the Ring Nebula’s True Shape.” <http://hubblesite.org/newscenter/archive/releases/nebula/planetary/2013/13/>

Procedure

Identify your students’ misconceptions about planetary nebulae 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 planetary nebulae. From those ideas, identify their misconceptions and discuss them with the class. An alternative method is to collect your students’ written ideas about planetary nebulae. From those ideas, compile a list of their misconceptions and discuss them with the class.

Ask students to study the images on both the front and back of the lithograph. Then 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. Their presentations or reports also should address the similarities and differences in the shapes of planetary nebulae. 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 planetary nebulae. You may be asked to share this information with the rest of the class. Study the image of the Ring Nebula on the front of the lithograph, and then look at the images 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 also 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 could be a skit, a story, a graphic organizer, a PowerPoint show, or whatever format that will communicate the information you learned about the similarities and differences in the shapes of planetary nebulae. 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/bolintro.htm>

1. The Nature of Science

B. Scientific Inquiry

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

- Investigations are conducted for different reasons, including to explore new phenomena, to check on previous results, to test how well a theory predicts, and to compare different theories.
- 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.

Educational Product

Educators & Students

Grades 9–12