NGC 2174: Pillars in the Monkey Head Nebula

National Aeronautics and Space Administration

A Nearby Star Factory

In celebration of the 24th anniversary of the launch of NASA's Hubble Space Telescope (on April 24, 1990), astronomers have taken an infrared-light image of a turbulent region of star birth.

The image unveils a collection of carved knots of gas and dust in a small portion of the Monkey Head Nebula (also known as NGC 2174). The nebula is a star-forming region that hosts dusty clouds silhouetted against glowing gas.

Newly formed stars shine brightly, illuminating and heating the cloud to create the glowing gas of the nebula. Radiation and stellar winds from the region's hottest stars eat away at the low-density gas of the cloud, often making tall pillar-like structures.

This Hubble image studies a collection of such pillars within NGC 2174 using infrared light. Dense gas is generally opaque to visible light, appearing dark and relatively featureless in such images. Infrared light reveals more detail for two reasons: first, the longer wavelengths can penetrate deeper into the cloud, and second, some of the gas has been heated enough that it glows in infrared light.

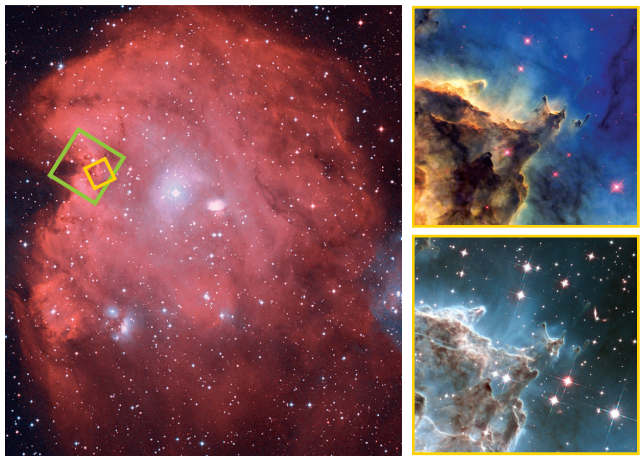
Particularly striking in this infrared view are the small, finger-like prominences scattered across the gaseous landscape. The bright edges show where the stellar radiation is being absorbed, and thereby outline the dense pocket of potential star formation.

Most of the nebula is semi-transparent to infrared light, revealing stars both within and behind the gas cloud. Infrared light is also more efficient at observing small, cool stars, which emit much of their light at these longer wavelengths. In the background, many distant galaxies can be seen across the image.

NGC 2174 is located about 6,400 light-years away in the constellation Orion.

VOCABULARY

Infrared (IR) Light: The part of the electromagnetic spectrum that has slightly lower energy than visible light, but is not visible to the human eye. Just as there are low-pitched sounds that cannot be heard, there is low-energy light that cannot be seen. Infrared light can be detected as the heat from warm-blooded animals.



Three Views of NGC 2174
The ground-based, visible-light view at left shows the entire Monkey Head Nebula. Its nickname derives from envisioning this glowing gas cloud as the profile view of a monkey's head.

The green box outlines the area of Hubble's infrared view of the pillars on the front of the lithograph. The yellow box outlines the area of Hubble's close-up views (right) of the top of the region.

At top right is the visible-light view of the pillars. Hubble's infrared view of the same region is shown at bottom right. Notice how many stars, and even some galaxies, are revealed within and behind the nebula. Infrared light sees through regions that are both bright and dark in the visible-light image.

Credit for the image at left: Digitized Sky Survey

Credit for image at top right: NASA, ESA

Credit for image at bottom right:
NASA, ESA, and the Hubble Heritage Team (STScI/AURA)

Credit for "NGC 2174: Pillars in the Monkey Head Nebula": NASA, ESA, and the Hubble Heritage Team (STScI/AURA)

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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In Search of … Star Formation

Description

The "NGC 2174: Pillar in the Monkey Head 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 star formation. Educators will suggest selected resources about star formation 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. Our Sun, the center of our solar system, is a yellow star of average temperature and size.

Misconceptions

Educators 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

Terms students may encounter while doing further research on star formation include:

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

Radiation: The process by which electromagnetic energy moves through space as vibrations in electric and magnetic fields. This term also refers to radiant energy and other forms of electromagnetic radiation, such as gamma rays and X-rays.

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:

- "NGC 2174: Pillar in the Monkey Head Nebula" lithograph
- Computer with Internet connection for conducting research

Instructions for Educators

Preparation

- Obtain copies of the lithograph for each student. The "NGC 2174: Pillar in the Monkey Head Nebula" lithograph can be found at: **http://amazing-space.stsci.edu/capture/stars/preview-ngc2174.php**.
- Preview the Overview page at: **http://amazing-space.stsci.edu/eds/overviews/print/lithos/ngc2174.php**. Use the "Related Materials" section to become familiar with star formation.
- Bookmark or identify as favorites the following suggested websites:
  - STScI: "Hubble Celebrates Its 24th Anniversary with an Infrared Look at a Nearby Star Factory": **http://hubblesite.org/newscenter/archive/releases/2014/18/**
  - STScI: "Cosmic Ice Sculptures: Dust Pillars in the Carina Nebula": **http://hubblesite.org/newscenter/archive/releases/2010/29/**
  - STScI: "Hubble's 22nd Anniversary Image Shows Turbulent Star-making Region": **http://hubblesite.org/newscenter/archive/releases/star-cluster/2012/01/**

In Search of … Star Formation *(cont'd)*

- STScI: "Hubble Space Telescope's Wide Field Camera Reveals Splendor of 'Supergiant' Nebula": **http://hubblesite.org/newscenter/archive/releases/2001/21/background/**
- STScI: "Tales of … Extreme star birth in the Carina Nebula": **http://amazing-space.stsci.edu/resources/tales/carina.php**
- STScI: "Starry-Eyed Hubble Celebrates 20 Years of Awe and Discovery": **http://hubblesite.org/newscenter/archive/releases/2010/13/image/a/**

Procedure

Identify your students' misconceptions about star formation 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 star formation. From those ideas, identify their misconceptions and discuss them with the class. An alternative method is to collect your students' written ideas about star formation. 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 process of star formation. 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 star formation. You may be asked to share this information with the rest of the class. Study the image of the star-forming region NGC 2174 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 star formation. 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:

- 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