National Aeronautics and Space Administration

30 Doradus: A Turbulent Star-forming Region

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30 Doradus, also known as the Tarantula Nebula, is the brightest nearby star-forming region and home to the most massive stars in our cosmic neighborhood. This star factory resides 170,000 light-years away in the Large Magellanic Cloud, a small satellite galaxy of our Milky Way.

This Hubble Space Telescope image reveals the brilliant light of many stars and the warm glow from a complex array of gas clouds. Sky watchers who first spotted this region thought they were seeing the light from a single star and named the star 30 Doradus. The region is located in the Southern Hemisphere constellation Dorado, which is the Spanish name for goldfish or swordfish.

In 1751, French astronomer Nicholas Lacaille gazed through his telescope and realized that 30 Doradus is a gaseous region, or nebula. Lacaille described its center as looking like a small comet. While observing in South Africa during the 1830s, British astronomer Sir John Herschel described 30 Doradus as one of the most extraordinary objects in the sky.

The Hubble image reveals a fantasy gaseous landscape of clouds, bubbles, pillars, and ridges. Stars are born deep within the dense, dark clouds and, once formed, act to re-shape the nebula. High-energy radiation from bright stars heats the gas and makes it glow. Strong stellar winds, and sometimes stellar explosions, push away the gas to create the tangled shapes.

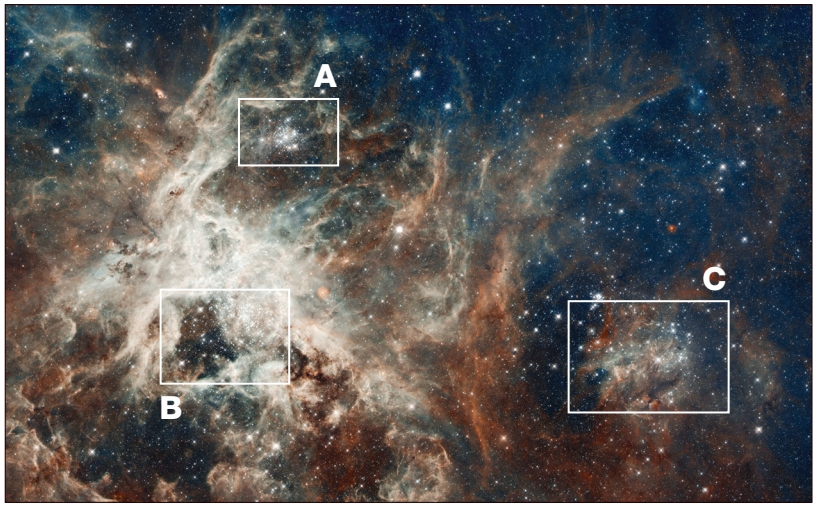
Strewn throughout the nebula are millions of stars. 30 Doradus is an immense star-forming factory that has been creating stars at a furious pace for millions of years. Most notable are several bright, young, massive star clusters, ranging in age from about 2 million to about 25 million years old.

Many astronomers consider 30 Doradus to be the most spectacular nearby star-forming region to study. Within the nebula, they can examine in detail the birth and evolution of massive stars.

VOCABULARY WORDS:

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

Light-year: The distance light will travel in a year — about 10 trillion kilometers or 6 trillion miles.



Prominent star clusters in 30 Doradus

30 Doradus is home to several young, massive star clusters. The boxed regions identify three of those clusters. The star cluster Hodge 301 (A) is 20 million to 25 million years old. Hodge 301 is home to many evolved, red supergiant stars. Roughly 40 massive stars already have exploded as supernovae. The nebula's sparkling centerpiece is a giant, young star cluster named NGC 2070 (B), only 2 million years old. Its stellar inhabitants number roughly 500,000. The cluster's dense core, known as R136, is packed with some of the most massive stars found in the nearby universe. The star cluster NGC 2060 (C) is a loose collection of stars no longer gravitationally bound to each other. The stellar grouping will disperse in a few million years. It contains a supernova that exploded about 5,000 years ago.

Image Credit: NASA, ESA, D. Lennon and E. Sabbi (ESA/STScI), J. Anderson, S. E. de Mink, R. van der Marel, T. Sohn, and N. Walborn (STScI), N. Bastian (Excellence Cluster, Munich), L. Bedin (INAF, Padua), E. Bressert (ESO), P. Crowther (University of Sheffield), A. de Koter (University of Amsterdam), C. Evans (UKATC/STFC, Edinburgh), A. Herrero (IAC, Tenerife), N. Langer (AifA, Bonn), I. Platais (JHU), and H. Sana (University of Amsterdam)

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.

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 … Star Formation

Description

Use the "30 Doradus: A Turbulent Star-forming Region" 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 star formation. 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 star formation. Teachers will suggest selected resources about star formation 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 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

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 formation:

Astronomer: A scientist who studies the universe and the celestial bodies residing in it, including their composition, history, location, and motion. Many of the scientists at the Space Telescope Science Institute are astronomers. Astronomers from all over the world use the Hubble Space Telescope.

Milky Way: The Milky Way, a spiral galaxy, is the home of Earth. The Milky Way contains more than 100 billion stars and has a diameter of 100,000 light-years.

Star: A huge ball of gas held together by gravity. The central core of a star is extremely hot and produces energy. Some of this energy is released as visible light, which makes the star glow. Stars come in different sizes, colors, and temperatures.

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

- "30 Doradus: A Turbulent Star-forming Region" lithograph.
- Computer with Internet connection for conducting research.

Instructions for the Teacher

Preparation

- Obtain copies of the lithograph for each student. The "30 Doradus: A Turbulent Star-forming Region" lithograph can be found at **http://amazing-space.stsci.edu/capture/stars/preview-30dor.php**.
- Preview the Overview page at: **http://amazing-space.stsci.edu/eds/overviews/print/lithos/30doradus.php**. Use the "Related Materials" section to (1) become familiar with inquiry-based learning and/or (2) become familiar with star formation.
- Bookmark or identify as favorites the following suggested websites:
  - 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

- 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

Before beginning this activity, 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 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 in the "Preparation" section provide a starting point for their research. Tell students how to access other websites.

Ask students to prepare presentations that include the answers to their questions. Their presentations also should address the process of star formation. 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 if they have any additional questions.

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 30 Doradus on the front of the lithograph, and then look at the image on the back. 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 also will 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 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 for practical or ethical reasons, they try to observe as wide a range of natural occurrences as possible to be able to discern patterns.

4. The Physical Setting

A. The Universe

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

- The stars differ from each other in size, temperature, and age, but they appear to be made up of the same elements found on earth and behave according to the same physical principles.

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Educational Product

Educators & Students | Grades 11–12