Star Birth in Orion

SUPPLEMENTAL MATERIALS
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In turning his telescope to the heavens in 1609, Galileo embarked upon a journey that would revolutionize science and culture alike, profoundly changing our view of our place in the universe. Our views of the universe, and how they have evolved over time, are portrayed in the images and text of the “Visions of the Universe: Four Centuries of Discovery” exhibit.

In recognition of the International Year of Astronomy, this exhibit includes six two-sided panels that feature key astronomical discoveries from the past 400 years. The exhibit also highlights the technological advancements that made these discoveries possible. Exhibit topics range from celestial objects within our own “cosmic backyard” to those beyond the realm of our solar system. Featured objects include the Sun, the Moon, Saturn, Mars, comets, stars, nebulae, and galaxies. Images are accompanied by captions that highlight relevant, historical discoveries.

The “Visions of the Universe: Four Centuries of Discovery” exhibit is supported by supplemental resource documents available online, in PDF format, for each panel. These twelve documents include science background information in the form of Q&As, related science misconceptions, a glossary, and links to additional resources on NASA’s Amazing Space Web site. In addition, each exhibit panel is available as a downloadable, poster-size file. These materials are available from: [http://amazing-space.stsci.edu/visions](http://amazing-space.stsci.edu/visions)

The “Visions of the Universe: Four Centuries of Discovery” exhibit was produced in December 2008 by the Space Telescope Science Institute, the American Library Association, and the Smithsonian Astrophysical Observatory, through funding from the National Aeronautics and Space Administration. 🌌
Science Background

NOTE: Words in boldface italics are defined in the glossary.

Q1:
Who was Christiaan Huygens?

ANSWER:
Christiaan Huygens (1629–1695) was a physicist and astronomer. He designed and built a refracting telescope with which he observed Saturn and discovered Titan, the first moon of Saturn. In 1659 Huygens discovered and published a sketch of the Orion Nebula (M42), including three of the four Trapezium stars. In the same year, he observed and sketched dark features on Mars, which perhaps showed a polar ice cap. Beyond astronomy, he patented a pendulum clock and contributed to our understanding of light.

Q2:
Who was William Huggins?

ANSWER:
William Huggins (1824–1910) used a technique called spectroscopy to carry out extensive observations of various celestial objects. He was the first astronomer to distinguish between nebulae and galaxies.

Q3:
Who was Henry Draper?

ANSWER:
Henry Draper (1837–1882) was a doctor by trade but enjoyed astronomy and photography. He is best known for obtaining the first photograph of the Great Nebula of Orion on the night of September 30, 1880. Although the image was not very impressive, he quickly improved it. Andrew Ainslee Common and Isaac Roberts were able to take further improved images after Draper’s death. Draper is also known for his high-quality photographs of the Moon.

Q4:
What is astrophotography?

ANSWER:
Astrophotography is a specialized type of photography that entails making photographs of astronomical objects in the sky including the Moon, Sun, planets, stars, and deep-sky objects such as star clusters and galaxies. With only a few exceptions, almost all astrophotography uses time exposures, because both film and digital cameras can accumulate and add light over long periods of time.

Continued …
Q5: How did astronomers figure out how stars are born?

ANSWER: By making observations of many star-forming regions, the process of star formation was revealed. Stars take millions of years to form, so a single human lifetime is not long enough to trace the changes taking place in a single star. Astronomers, however, can look at many different areas in the sky where stars are forming and from the different stages observed, piece together the process of star formation.

Q6: Why do astronomers use infrared light to study star-forming regions?

ANSWER: Infrared light is a region of the electromagnetic spectrum not visible to the human eye. This region of light that cannot be seen is similar to the range of sounds that are too low for the human ear to hear. The properties of infrared light allow it to pass through many materials, such as dust, which visible light cannot pass through. By using infrared light, astronomers can study dusty star-forming regions.

Q7: How do astronomers determine the ages of stars?

ANSWER: Astronomers have seen that stars are born in clusters. The age of a star cluster can be determined by measuring the brightness (called luminosity) and temperature of the stars. Using these values for a group of stars, astronomers plot the stars’ luminosity against their temperature, creating a diagram for the cluster. Through careful interpretation of the stars’ positions on the diagram, the astronomers can determine the age of the group.

Q8: What are the protoplanetary systems seen in Orion?

ANSWER: Disks around young stars (also known as circumstellar or protoplanetary disks) are thought to be made up of mostly gas. The red glow in the center of each disk is a young, newly formed star, roughly one million years old (compared with the 4.5-billion-year age of the Sun). As they evolve, the disks may go on to form planetary systems like our own. While only a handful of these dark-silhouette disks have been discovered so far, they seem to belong to a much larger family of similar objects, and current indications are that protoplanetary disks are common in the Orion Nebula. The disks range in size from two to eight times the diameter of our solar system.
Myth 1:
All stars are exactly the same.

Fact: All stars are not the same. Stars vary in brightness, color, mass, temperature, and age.

Myth 2:
The stars in a constellation are close to each other.

Fact: The stars that make up a constellation are the brightest ones in that region of the sky, but they are not close to each other. Some groups of stars are close to each other and reside at the same distance from Earth. The Pleiades is such a group. ✽
Astrophotography

A specialized type of photography that entails making photographs of astronomical objects in the sky, including the Moon, Sun, planets, stars, and deep-sky objects such as star clusters and galaxies.

Electromagnetic spectrum

The entire range of wavelengths of electromagnetic radiation, including radio waves, microwaves, infrared light, visible light, ultraviolet light, X-rays, and gamma rays.

Galaxy

A collection of stars, gas, and dust bound together by gravity. The smallest galaxies may contain only a few million stars; the largest galaxies have thousands of billions of stars. Our Sun is one star in the Milky Way Galaxy. Galaxies are classified or grouped by their shapes. Round or oval galaxies are elliptical galaxies, and those showing a pinwheel structure are spiral galaxies. Others are called irregular because they do not resemble elliptical or spiral galaxies.

Infrared light

A region of the electromagnetic spectrum not visible to the human eye. This region of light that cannot be seen is similar to the range of sounds that are too low for the human ear to hear. Infrared light can be detected as the heat from a fire or a light bulb.

Interstellar cloud

A cloud of gas and dust located between stars. An interstellar gas cloud is composed mostly of gas.

Nebula (pl., nebulae)

A cloud of gas and dust located between stars and/or surrounding stars. Nebulae are often places where stars can form or have recently formed.

Protoplanetary disk

A rotating disk of dense gas surrounding a young, newly formed star. Protoplanetary disks are thought to evolve into planetary systems.
Refractor (Refracting telescope)

A type of telescope, also known as a refracting telescope, that uses a transparent convex lens to gather the light and bend it to a focal point.

Spectroscopy

The study and interpretation of a celestial object’s electromagnetic spectrum, the entire range of wavelengths of electromagnetic radiation, including radio waves, microwaves, infrared light, visible light, ultraviolet light, X-rays, and gamma rays. A spectrograph or spectrometer is used to analyze an object’s electromagnetic spectrum.

Trapezium stars

A small group of young stars seen with the unaided eye as the middle star in the sword of Orion. The four brightest stars in the Trapezium form the corners of a trapezoid shape and are easily visible through a small telescope. The Trapezium is located in the heart of the Great Nebula of Orion (M42).
“Amazing Space” uses the Hubble Space Telescope’s discoveries to inspire and educate about the wonders of our universe. The Amazing Space Web site includes curriculum support tools, a section for the general public, and a special section for educators and developers. The curriculum support tools are developed by a team of scientists, education specialists, and multimedia experts. They are aligned with national educational standards and are reviewed for scientific accuracy. Find teaching tools, graphic organizers, Online Explorations, and more.

Online Explorations

“Online Explorations” are fun, interactive activities for exploring various space science topics.

• Telescopes From the Ground Up
Telescopes From the Ground Up traces the 400 years of telescope development from Galileo’s refractor to NASA’s Great Observatories. The overview for this activity can be found at:
http://amazing-space.stsci.edu/eds/overviews/explorations/telehistory.php

Specific sections of “Telescopes From the Ground Up” related to this exhibit panel include:

“Huygens’ Refractors,” which describes the telescopes Huygens made and used when he observed the Orion Nebula.

“Harvard 15-inch Refractor,” which describes how telescope technology joins forces with photography.
http://amazing-space.stsci.edu/resources/explorations/groundup/lesson/scopes/harvard/

“Biography: Gibor Basri,” which describes the man behind the discovery of the first brown dwarf, a failed star.
http://amazing-space.stsci.edu/resources/explorations/groundup/lesson/bios/basri/

“Spitzer Space Telescope,” which offers information about this infrared telescope.

• Star Light, Star Bright
This Online Exploration explores the nature of the electromagnetic spectrum. The overview for this activity can be found at:
http://amazing-space.stsci.edu/eds/overviews/explorations/slsb.php

Continued …
Reading Selections

These selections are grade-appropriate readings based on Hubble press releases. “Star Witness News” stories are written for grades 5–8. “Tales of…” stories are written for grades 9–12.

**Star Witness News**

“**Hubble Reveals Orion in Picture-Perfect Glory,**” which features a zoomable image of the nebula and highlights the nebula’s location in the constellation Orion.

http://amazing-space.stsci.edu/news/archive/2006/01/

**Tales of …**

“**Extreme star birth in the Carina Nebula,**” which explores the formation of stars in the Carina Nebula.

http://amazing-space.stsci.edu/resources/tales/carina.php

Graphic Organizers

This is a collection of T-charts and Venn diagrams that compare and contrast various celestial objects and phenomena. The downloadable organizers are available in teacher versions (full chart) and student versions (blank organizer with images).

**Comparison of globular and open star clusters**

This Venn diagram shows the similarities and differences between the two types of star clusters.

http://amazing-space.stsci.edu/eds/overviews/organizers/starclusters.php

Lithographs

These are Hubble Space Telescope images of celestial objects that include informational text and inquiry-based classroom activities.

**Orion Nebula**

This lithograph shows the central region of the Orion Nebula.

http://amazing-space.stsci.edu/eds/overviews/print/lithos/orion_nebula.php

**Globular Cluster M80**

This lithograph shows a tightly packed crowd of stars that resembles a swarm of bees.

http://amazing-space.stsci.edu/eds/overviews/print/lithos/m80.php

**NGC 346 in the Small Magellanic Cloud**

This lithograph features open star clusters.


Fast Facts

This is a collection of tables that provide vital statistics for the planets and other celestial objects.

**Orion Nebula**

This table lists the name, description, location, size, and distance of the nebula from Earth.

http://amazing-space.stsci.edu/eds/overviews/fastfacts/orion_nebula.php