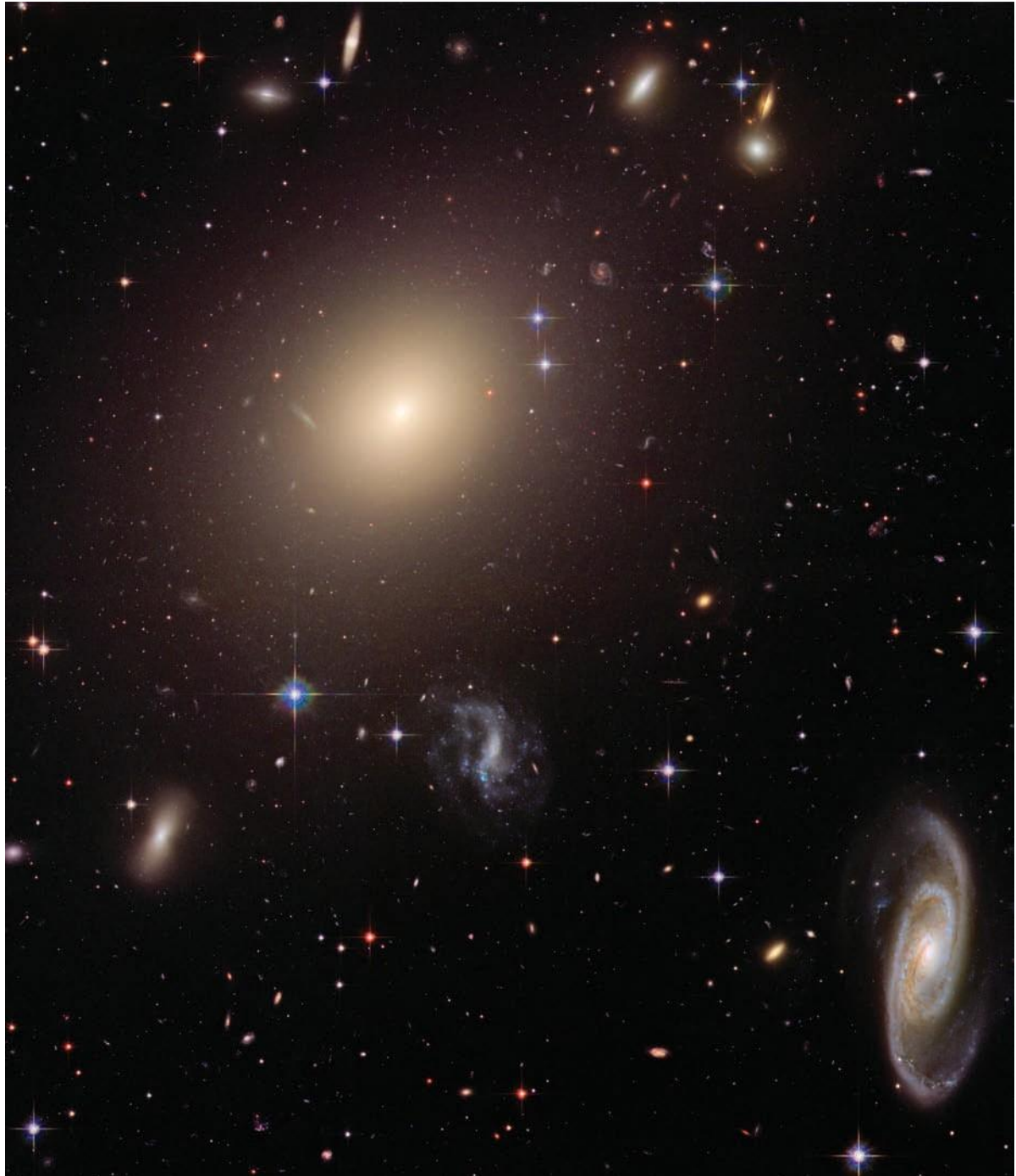
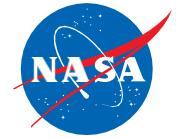




Diverse Galaxies

A Universe of Diverse Galaxies

Galaxies come in an assortment of shapes, sizes, ages and colors. The galactic hodgepodge seen in the image on the front from NASA's Hubble Space Telescope highlights the diversity of our universe. The image contains thousands of galaxies. Some of the largest galaxies are members of a small cluster of galaxies called Abell S0740.

The golden ball of light, to the left and slightly above center, that dominates the image is an elliptical galaxy. Elliptical galaxies are stellar retirement homes. They mainly contain aging stars, and are no longer giving birth to new generations of stars. This oval galaxy, named ESO 325-G004, is packed with a few hundred billion stars. Stars are clumped tightly in the center of the galaxy and are sprinkled sparingly on the edges. They are spread out so much in the outskirts of the galaxy that it is transparent — the light of distant galaxies shines through.

The glittering whirlpool in the bottom, right corner of the image is a spiral galaxy. Sweeping arms speckled with young blue stars coil out from the galaxy's bulging middle. Spiral galaxies are rich in dust and gas, the two important ingredients for making new stars.

Our own Milky Way Galaxy is a spiral galaxy. We view the Milky Way from inside it, and cannot get a bird's-eye view of the whole structure. Observing distant spiral galaxies, like this one, gives us the chance to better understand what our home galaxy looks like.

Many more elliptical and spiral galaxies are sprinkled throughout the background. Some of the spiral galaxies are slanted — their flat spiral disks are seen edge-on with their centers protruding like eggs cooked sunny-side up. Others appear face-on from our viewpoint and look like pinwheels.

In the image on the front, a number of stars within the Milky Way appear in the foreground. Individual stars can be distinguished from galaxies because they appear to have narrow crosses of light protruding from them. The cross pattern is not real but is produced by the telescope's optics. The foreground blue stars are young and hot. The red stars are older and cooler.

Galaxies far outnumber the individual stars seen in the image. The section of sky in this view is no wider than a pencil tip, but extends 450 million light-years into outer space. In this narrow slice of sky, astronomers see a wide variety of galaxies. They are typical of the rich diversity of galaxies in our universe.

Galaxy Types



These four galaxies, taken from the image on the front of this lithograph, show the three main varieties of galaxies in the universe. While spiral and elliptical galaxies are clearly seen in the image, many irregular galaxies are barely visible.

1a. This sideways, or edge-on, view of a spiral galaxy reveals its thin disk and central bulge of stars. **1b.** This face-on view of a spiral galaxy shows its pinwheel shape. **2.** This elliptical galaxy has an oval shape, but others may be more round. **3.** This irregular galaxy is so-named because it does not have a regular shape. Irregular galaxies are generally small, and some may later grow to become spirals or ellipticals.

Credit: NASA, ESA, and The Hubble Heritage Team (STScI/AURA).

VOCABULARY

Galaxy cluster: A collection of dozens to thousands of galaxies bound together by gravity.

FAST FACTS

Constellation: Centaurus.

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

You can find the corresponding Classroom Activity for this lithograph at <http://amazing-space.stsci.edu/> 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 ... Galaxy Types

Description

Use the “Diverse Galaxies” lithograph as the initial source of information to engage your students in a Level One Inquiry activity. Students will use the images and text to generate questions about the diverse collection of galaxies on the front of the lithograph. They will conduct research to answer their questions, identify patterns, and/or compare and contrast galaxy characteristics. This curriculum support tool is designed to be used as an introductory activity in a unit that has a scientific inquiry and/or a galaxy classification 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 solve a problem. It involves a process of exploring the natural or material world. This exploration prompts students to ask questions and 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 use the lithograph images to help students formulate questions about galaxy characteristics. Teachers suggest selected resources about galaxies to help students answer their questions, discern patterns, and/or compare galaxy characteristics. Students provide supporting evidence for their conclusions. This process can help prepare students to be more independent thinkers. Note: The preparation section below can direct you to resources for inquiry-based learning.

Grade Level

Middle–high school, grades 6 –12

Prerequisites

Students should be aware that galaxies are groups of stars, gas, and dust held together by gravity.

Misconceptions

Teachers should be aware of the following common misconceptions and determine whether their students harbor any of them. Students

may think all galaxies are the same size, shape, and color, and/or that most galaxies can be viewed without the aid of a telescope. In addition, students may not comprehend the vastness of the universe nor the number of galaxies it contains.

Purpose

The purpose of this activity is for students to participate in a Level One Inquiry-based activity using astronomical images and information. Students will gain experience using the Internet to search for information. They will practice the process skills of pattern recognition and comparing and contrasting. Students will organize their material and present a report. Students then will reflect on their learning.

Materials

- “Diverse Galaxies” lithograph
- Computer with Internet connection for researching galaxy characteristics.

Instructions for the Teacher

Preparation

- Obtain a lithograph for each student. The lithograph is available as a PDF file at: <http://amazing-space.stsci.edu/capture/galaxies/preview-diverse-galaxies.php>.
- Preview the Overview page found at: <http://amazing-space.stsci.edu/eds/overviews/print/lithos/diverse-galaxies.php>. Use the “Related Materials” section to (1) become familiar with inquiry-based learning and/or (2) familiarize yourself with the galaxy types.
- Note that a similar list of “Related Websites” can be found on the preview page for the lithograph: <http://amazing-space.stsci.edu/capture/galaxies/preview-diverse-galaxies.php>. Identify the appropriate Websites for your students to use.

Procedure

Before beginning this activity, evaluate your students’ misconceptions about galaxies by having them write down anything they know and understand about this topic. Use these statements to

In Search of ... Galaxy Types

evaluate your students' misconceptions in one of two ways. Have students volunteer their ideas about galaxies. From those ideas, identify their misconceptions and discuss them with the class. An alternative is to collect their written ideas about galaxies. From those ideas, compile a list of their misconceptions and discuss them with the class.

Ask students to look at the image of the galaxies on the front of the lithograph, and write three questions about the features visible in the image.

Collect these 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. Using the Internet, have students research their questions. The Internet sites listed on the preview page provide a starting point for their research. Tell students how to access other Websites.

Ask students to prepare a report in which they answer their questions, identify patterns, and/or compare and contrast galaxy characteristics. This report could be in the form of a slide show, a skit, a story, a graphic organizer, a Power Point presentation, or a written report—anything that conveys a student's understanding of the topic to another student, a group of students, or the entire class. Ask students to review their original questions to see if they were answered during their research or from talking with other students. Then ask them if they have any additional questions.

Instructions for the Student

Your teacher will ask you to write down things you know and understand about galaxies. You may be asked to share this information with the rest of the class. Study the image of the galaxies, and write down three questions about what you see in the image. Then read the back of the lithograph, and check if any of your questions were answered.

Using your questions as a guide, conduct an Internet research to find the answers to your questions, identify patterns, and/or compare

and contrast galaxy characteristics as directed by your teacher. Your teacher also will guide your search by providing some Websites to use. To demonstrate your understanding of the material you researched, your teacher will ask you to present a report. This report could be in the form of a slide show, a skit, a story, a graphic organizer, a Power Point presentation, or whatever presentation you think will communicate the information you learned about the galaxies. You can work individually or in small groups. You can make your presentations to another classmate, another group of students, or the entire class.

Education Standards

Project 2061

<http://www.project2061.org/publications/bsl/online/bolintro.htm>

4. The Physical Setting

A. The Universe

By the end of the 8th grade, students should know that

- The sun is a medium-sized star located near the edge of a disk-shaped galaxy of stars, part of which can be seen as a glowing band of light that spans the sky on a very clear night. The universe contains many billions of galaxies, and each galaxy contains many billions of stars. To the naked eye, even the closest of these galaxies is no more than a dim, fuzzy spot.

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.

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