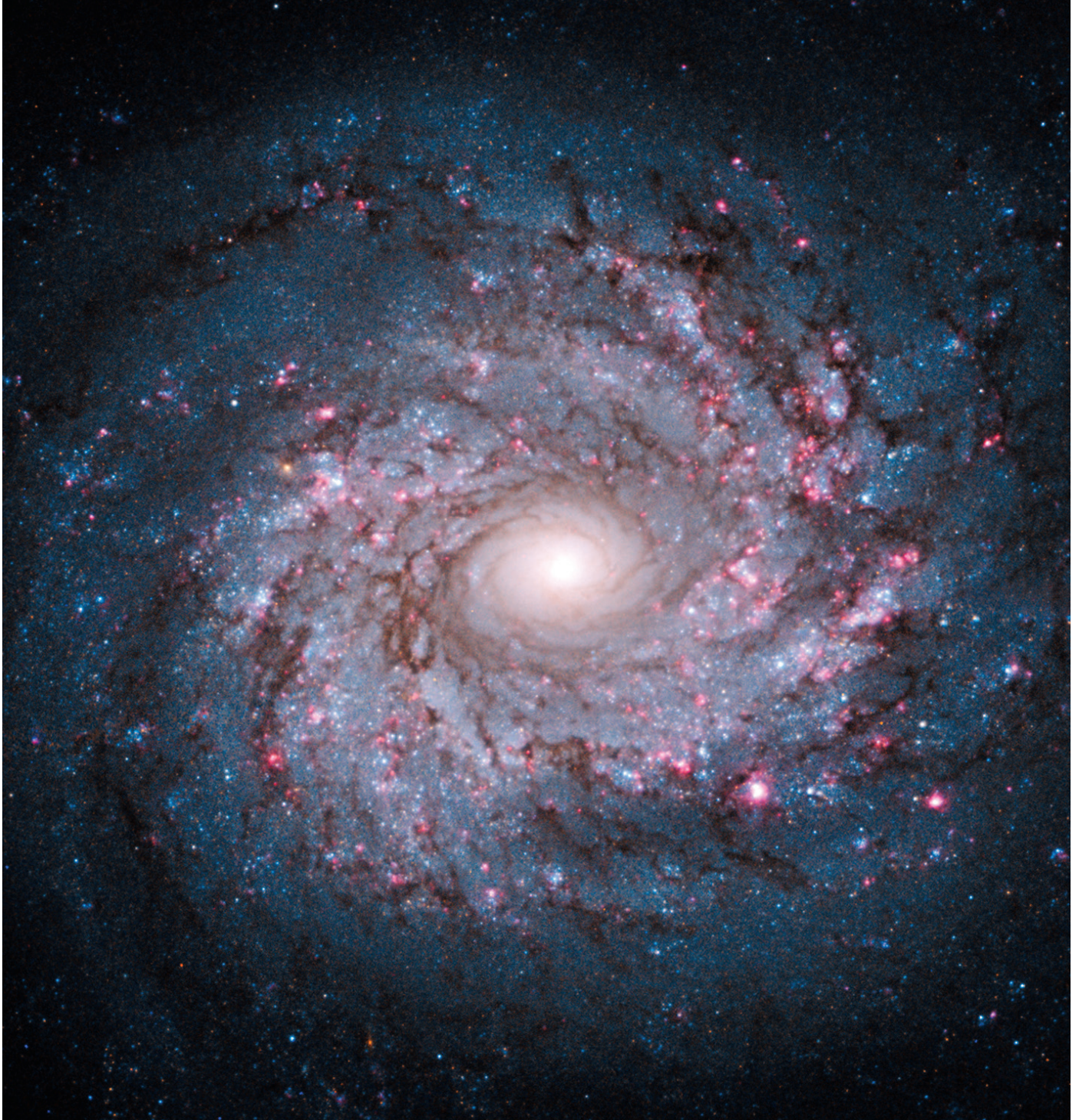
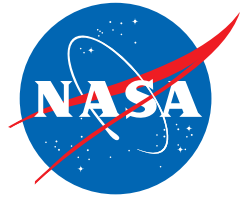


# Spiral Galaxy NGC 3982

National Aeronautics and  
Space Administration



## Cosmic Pinwheels of Stars, Gas, and Dust

The billions of galaxies across the universe have a wide variety of sizes and shapes. For most people, however, the beautiful spiral pattern exemplified by spiral galaxy NGC 3982 on the front of the lithograph is the first to come to mind. Indeed, spirals are the dominant shape of medium to large galaxies, and spiral galaxies show considerable variation in their patterns. The accompanying images at the right showcase several of these variations.

The most immediate characteristic of these galaxies is the spiral arm pattern. Two of the galaxies (M81 and NGC 1300) are dominated by two long spiral arms, while the others (NGC 3982 and NGC 5584) show many arms and even some short segments of spiral pattern. The dense, dark clouds that trace the spiral pattern are the nebulae in which gas condenses to form stars. The bright pink regions seen in NGC 3982 are glowing nebulae where stars have recently formed.

Astronomers also take note of whether the spiral arms are tightly or loosely wrapped around the core of the galaxy. Here, the tight wrapping in NGC 3982 adds to its resemblance to a pinwheel.

The center of a spiral galaxy is home to a spherical- or oblong-shaped bulge of stars. The bulge can be rather small, as in NGC 5584, or somewhat large, as in M81. In addition, NGC 1300 is called a “barred spiral galaxy” because of its elongated bar-shaped bulge. Many spiral galaxies, including our own Milky Way Galaxy, have such a bar in their centers.

These characteristics of the spiral arms and central bulges help astronomers classify spiral galaxies into groups. The patterns arise from each individual galaxy’s development over billions of years. Like snowflakes, no two spiral galaxies are exactly alike.

Within each spiral galaxy is an assembly of billions of stars, along with vast clouds of gas and dust. The three-dimensional shape is a thin pancake-like disk, with the rounded bulge at its

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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.

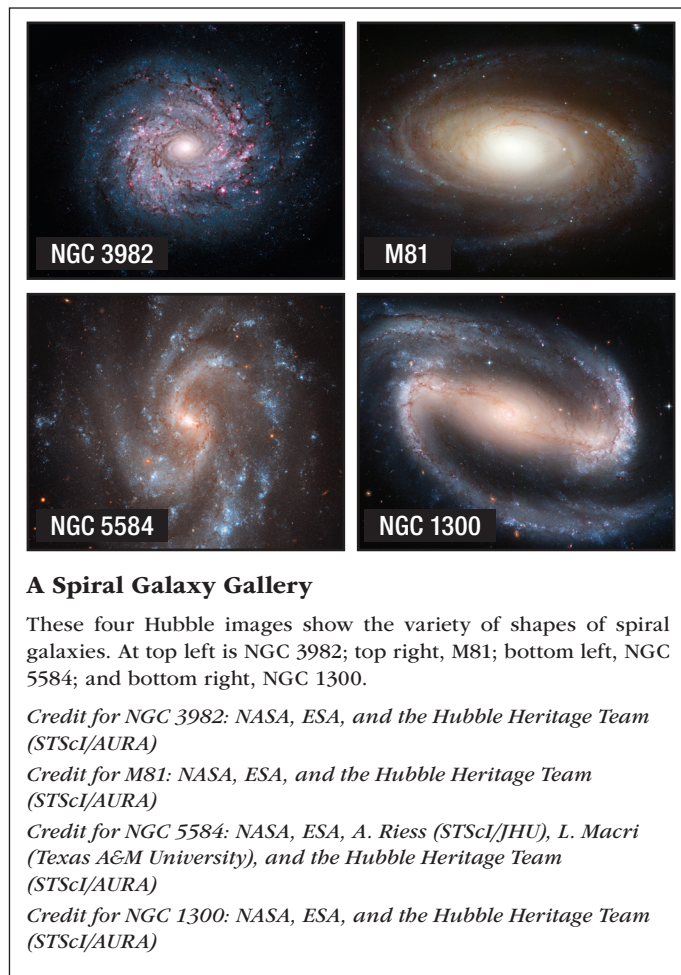
You can find the corresponding classroom activity for this lithograph at <http://amazing-space.stsci.edu/eds/tools/type/pictures.php> or by contacting the Office of Public Outreach at the Space Telescope Science Institute, 3700 San Martin Drive, Baltimore, MD 21218.

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### A Spiral Galaxy Gallery

These four Hubble images show the variety of shapes of spiral galaxies. At top left is NGC 3982; top right, M81; bottom left, NGC 5584; and bottom right, NGC 1300.

*Credit for NGC 3982: NASA, ESA, and the Hubble Heritage Team (STScI/AURA)*

*Credit for M81: NASA, ESA, and the Hubble Heritage Team (STScI/AURA)*

*Credit for NGC 5584: NASA, ESA, A. Riess (STScI/JHU), L. Macri (Texas A&M University), and the Hubble Heritage Team (STScI/AURA)*

*Credit for NGC 1300: NASA, ESA, and the Hubble Heritage Team (STScI/AURA)*

core. The accompanying images show mostly face-on views of the disks. If viewed from the side, the disks would be remarkably thin.

### VOCABULARY

**Galaxy:** A collection of stars, gas, and dust bound together by gravity.

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

### FAST FACTS

**Location:** In the constellation Ursa Major.

**Distance from Earth:** About 68 million light-years from Earth.

**Dimensions:** The disk of NGC 3982 is about 30,000 light-years across.





## In Search of ... Spiral Galaxies

### Description

The “Spiral Galaxy NGC 3982” 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 spiral galaxies. Educators will suggest selected resources about spiral galaxies 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 spiral galaxy 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

Middle to high school, grades 6-12

### Prerequisites

Students should know that galaxies are large collections of stars, gas, and dust held together by gravity. A galaxy’s stars have different masses, colors, and brightnesses. These characteristics influence a galaxy’s appearance.

### Misconceptions

Educators should be aware of the following common misconceptions and determine whether their students harbor any of them. Students may have misconceptions regarding the makeup, distances, color, and sizes of galaxies.

### Vocabulary

Terms students may encounter while doing further research on spiral galaxies include:

**Central Bulge:** A round structure at the center of spiral galaxies composed mostly of old stars and some gas and dust.

**Spiral Arms:** A pinwheel structure composed of dust, gas, and young stars that extends from the core of a normal spiral galaxy and from the ends of a bar in a barred spiral galaxy.

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:

- “Spiral Galaxy NGC 3982” lithograph
- Computer with Internet connection for conducting research

## Instructions for Educators

### Preparation

- Obtain copies of the lithograph for each student. The “Spiral Galaxy NGC 3982” lithograph can be found at <http://amazing-space.stsci.edu/capture/galaxies/preview-ngc3982.php>.
- Preview the Overview page at: <http://amazing-space.stsci.edu/eds/overviews/print/lithos/ngc3982.php>. Use the “Related Materials” section to become familiar with spiral galaxies.
- Bookmark or identify as favorites the following suggested websites:
  - STScI News Release Archive: Galaxy, Spiral <http://hubblesite.org/newscenter/archive/releases/galaxy/spiral/>
  - STScI: “The Pinwheel Galaxy (M101)” lithograph <http://amazing-space.stsci.edu/capture/galaxies/previewpinwheel.php>
  - STScI: “Sombrero Galaxy” lithograph <http://amazing-space.stsci.edu/capture/galaxies/previewsombrero.php>
  - STScI: “Whirlpool Galaxy” lithograph <http://amazing-space.stsci.edu/capture/galaxies/previewwhirl.php>

# In Search of ... Spiral Galaxies

## Procedure

Identify your students' misconceptions about spiral galaxies 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 spiral galaxies. From those ideas, identify their misconceptions and discuss them with the class. An alternative method is to collect your students' written ideas about spiral galaxies. 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 describe the characteristics of spiral galaxies and how spiral galaxies are classified. 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.

## Instructions for the Student

Your teacher will ask you to write down what you know and understand about spiral galaxies. You may be asked to share this information with the rest of the class. Study the image of Spiral Galaxy NGC 3982 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 characteristics of spiral galaxies and how galaxies are classified. 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 8th grade, students should know that:

- 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.

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Educational Product

Educators & Students

Grades 6–12