

**Interacting Galaxies Arp 147**

## Hubble Scores a “10” with These Oddball Galaxies

When it comes to snapping breathtaking images of celestial objects, the Hubble Space Telescope has earned many “perfect tens” from the public. In this Hubble image, the object itself appears to form the number 10. The image shows a pair of interacting galaxies called Arp 147.

The object on the left, or the “1,” is a disk galaxy that appears nearly edge-on to our line of sight. It is relatively undisturbed except for a smooth ring of starlight. The galaxy on the right, or the “0,” appears to have suffered the worst from this galactic encounter. Its pancake-shaped disk of material appears to have been shredded. What remains is a clumpy blue ring of intense star formation. The dusty reddish blob at the bottom of the blue ring is probably the galaxy’s original nucleus. The bright object at lower left is a foreground star in our Milky Way Galaxy.

Arp 147 is one of 338 oddball galaxies compiled by astronomer Halton Arp in a book called the Atlas of Peculiar Galaxies. Many of the images in the book, published in 1966, shows what happens when galaxies pass by each other too closely. The gravity of one galaxy tugs on another galaxy, stretching it and creating an irregular shape.

Most astronomers were astonished at the images of those galactic misfits. They had spotted a few distorted galaxies during their observations of the sky, but they did not realize there were so many of them.

Arp began taking the images for his book in the 1960s. He was fascinated with the oddly shaped galaxies in our galactic neighborhood that did not fit the mold of normal-looking galaxies. Many of the unusual shapes were the result of galaxies interacting with one another. At the time, interactions between galaxies were considered highly unlikely. Many astronomers thought that most galaxies consisted of orderly and symmetrical spirals and ellipticals.

Arp realized that astronomers had very little understanding of how galaxies change over time. He hoped that his catalogue of peculiar galaxies would provide insights into galaxy evolution.

Observations over the last few years have proven the importance of galactic interactions in forming galaxies and have shown that galaxies change over billions of years.

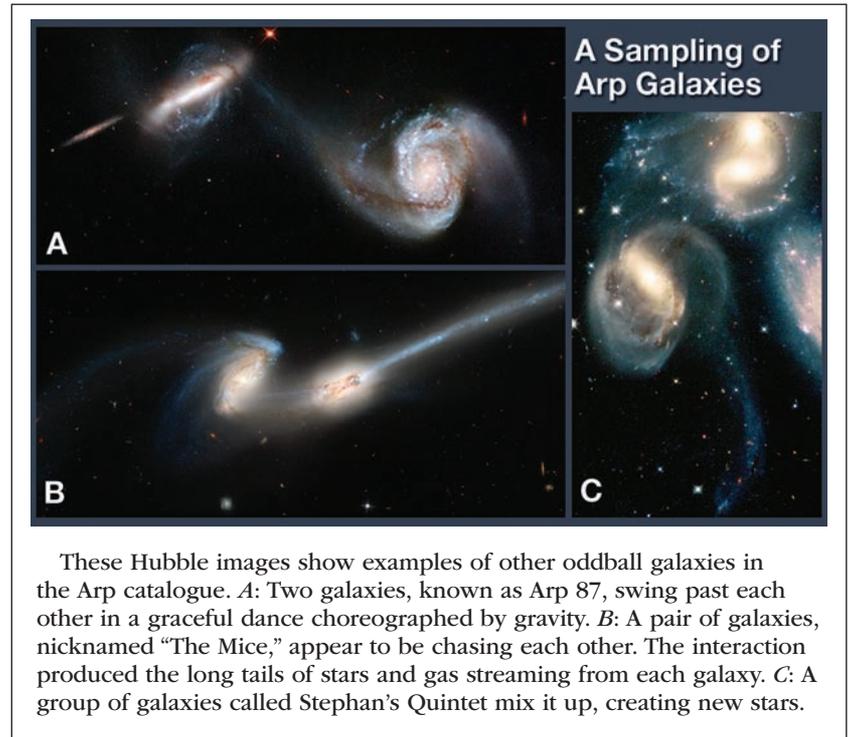
*Credit for Hubble image: NASA, ESA, and M. Livio (STScI).*

National Aeronautics and Space Administration

Goddard Space Flight Center  
8800 Greenbelt Road  
Greenbelt, Maryland 20771

[www.nasa.gov](http://www.nasa.gov)

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## VOCABULARY

**Arp catalogue:** The catalogue, called the Atlas of Peculiar Galaxies, includes 338 odd-looking galaxies gathered by Dr. Halton C. Arp between 1961 and 1966.

**Interacting galaxies:** When two galaxies pass close enough to gravitationally disrupt each other’s shape. The interaction rips streamers of stars from the galaxies, fuels an explosion of star birth, and can ultimately result in both galaxies merging into one. *Note:* The stars in each galaxy are far apart and usually do not collide when galaxies merge.

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

The corresponding classroom activity for this lithograph can be found at: <http://amazing-space.stsci.edu/> or may be obtained by contacting the Office of Public Outreach at the Space Telescope Science Institute, 3700 San Martin Drive, Baltimore, MD 21218.





## In Search of ... Peculiar Galaxies

### Description

Use the “Interacting Galaxies Arp 147” 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 the history of our understanding of galaxy interactions. They will conduct research to answer their questions. They also will analyze the images of the galaxies to determine how peculiar galaxies, such as those compiled by Arp in the 1960s, contributed to today’s understanding of galaxy evolution. This curriculum support tool is designed to be used as an introductory activity in a unit that incorporates scientific inquiry or that has a galaxy 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 use the lithograph images to help students formulate questions about the history of our understanding of galaxy interactions. Teachers suggest selected resources about galaxies to help students answer their questions and examine the role Arp’s catalogue played in today’s understanding of galaxy interactions. Students provide supporting evidence for their conclusions. This process can help prepare students to become more independent thinkers. Note: The preparation section below provides resources for inquiry-based learning.

### Grade Level

High school, grades 11–12.

### Prerequisites

Students should know that galaxies are huge collections of stars, gas, and dust held together by gravity. Students also should be aware that galaxies differ in age, shape, and size, as well as in their distance from Earth.

### Misconceptions

Teachers should be aware of the following common misconceptions and should determine whether their students harbor any of them. Students may have misconceptions regarding galaxies. They may think all galaxies are the same and remain unchanged.

Galaxies are dynamic and change over millions of years. Stars are born and die in galaxies. A galaxy also can interact with another galaxy, which alters both galaxies’ shapes.

### Vocabulary

**Elliptical galaxy:** A galaxy that is shaped like a football and contains mainly old stars with little gas or dust.

**Spiral galaxy:** A large pinwheel-shaped system of stars, dust, and gas clouds.

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 their learning.

### Materials

- “Interacting Galaxies Arp 147” lithograph
- Computer with Internet connection for conducting research.

## Instructions for the Teacher

### Preparation

- Obtain copies of the lithographs for each student. The “Interacting Galaxies Arp 147” lithograph can be found at <http://amazing-space.stsci.edu/capture/galaxies/preview-arp147.php>.
- Preview the Overview page, found at: <http://amazing-space.stsci.edu/eds/overviews/print/lithos/arp147.php>. Use the “Related Materials” section to (1) become familiar with inquiry-based learning and/or (2) become familiar with the history of our understanding of galaxy interactions.
- Note that a similar list of “Related Web sites” can be found on the preview

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page for the lithograph: <http://amazing-space.stsci.edu/capture/galaxies/preview-arp147.php>. Identify the appropriate Web sites for your students to use.

## Procedure

Before beginning this activity, identify your students' misconceptions about galaxies by having them write down anything they know and understand about this topic. Use those responses to 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 method is to collect your students' written ideas about galaxies. From those ideas, compile a comprehensive 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 on the preview page provide a starting point for their research. Tell students how to access other Web sites.

Ask students to prepare presentations that answer their questions. Their presentations also should examine the role Arp's catalogue played in today's understanding of galaxy interactions. 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 students' 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 students 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 galaxies and how they change over time. You may be asked to share this information with the rest of the class. Study the image of the galaxies on the front and back of the lithograph. 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 ask you to determine how Arp's catalogue contributed to today's understanding of galaxy interactions. Your teacher will provide Web sites to use for your research. Your teacher 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 the history of our understanding of galaxy interactions. Your teacher will direct you to work individually or in small groups. You may make your presentation to another classmate, to another group of students, or to the entire class.

## Education Standards

### Benchmarks for Science Literacy

#### American Association for the Advancement of Science:

<http://www.project2061.org/tools/benchol/bolframe.htm>

#### 1. The Nature of Science.

##### A. The Scientific Worldview.

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

- From time to time, major shifts occur in the scientific view of how things work. More often, however, the changes that take place in the body of scientific knowledge are small modifications of prior knowledge. Continuity and change are persistent features of science.

Educational Product

Educators & Students

Grades 11–12