



Activity

Classroom

FIND THE RIGHT CIRCLE with Galaxy Trading Cards

GRADES: 6 – 8 (Target grade: 7)

GOAL: Use graphic organizers to compare galaxy types

In this activity, students study the Galaxy Trading Cards (and other materials supplied as part of this activity) to observe and record the properties of galaxies. Students use a Venn diagram to compare galaxies' properties.

The process skills used in this activity are comparing and contrasting, and categorizing and listing.

Download Galaxy Trading Cards PDF from:

<http://amazing-space.stsci.edu/eds/overviews/print/activities/circle.php>

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SUPPLEMENTAL MATERIALS AVAILABLE ONLINE

Download the following supplemental materials from
<http://amazing-space.stsci.edu/eds/overviews/print/activities/circle.php>

REQUIRED

- Galaxy Trading Cards (PDF)

OPTIONAL (specific to this activity)

- Teacher's Science Background: Galaxy Q&As (PDF)
- Teacher's Science Background: Constellation Q&As (PDF)
- Student's Background Reading: About Galaxies (PDF)
- Student's Background Reading: About Constellations (PDF)

OPTIONAL (general)

- Glossary of Astronomy Terms Related to Galaxies (PDF)

Find the Right Circle

Comparing Galaxies Using Graphic Organizers

PURPOSE

The purpose of the activity is to observe and record the properties of galaxies by studying the Galaxy Trading Cards and other pictures and readings supplied as part of this activity. Students use a Venn diagram to compare galaxies, based on observed properties. The process skills used in this activity are comparing and contrasting, and categorizing and listing. This activity can be used to teach students about galaxies, or as an assessment, following a study of galaxy types.

MATERIALS

- Selected **Galaxy Trading Cards**; card set available as a separate PDF
- **Activity Sheet A:** Compare/Contrast Chart: Comparison of Galaxies, p. 14
- **Activity Sheet B:** Venn Diagram: Comparison of Spiral and Elliptical Galaxies, pages 15 – 16
- Additional images of spiral, elliptical, and irregular galaxies, pages 17 – 20
- Supplemental student reading: “About Galaxies,” available as a separate PDF

EXECUTION TIME

60 – 70 minutes

Instructions for the Teacher

PREPARATION

Make a copy of each of the activity sheets found at the end of this lesson (“Comparison of Galaxies” chart and the Venn diagram) for each student. Depending on whether this activity is performed at the beginning or at the end of a unit on galaxies, students may also need the supplemental student reading (“About Galaxies,” a separate PDF), which summarizes the characteristics of each galaxy type.

For each student or group of students, make a set of Galaxy Trading Cards. To make the cards: Download the trading cards PDF file

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(Teacher's Instructions, continued from page 3 ...)

from <http://amazing-space.stsci.edu/eds/overviews/print/activities/circle.php>. Print the PDF on heavy paper or card stock. Fold each card on the dotted line to form a front and back. Glue, tape, or laminate the fronts and backs together and trim the cards. Prepare copies of the additional galaxy images found at the end of this activity for each student or group of students, or make color overhead images of these galaxies.

S C I E N C E B A C K G R O U N D

To use this activity, teachers should be familiar with the material covered in questions 1, 2, and 5 – 8 of the teacher's science background document, "Galaxy Q&As," supplied as a separate PDF. Older students can also use this material to do research on related topics, to read as a follow-up to the activity, or to review the major concepts, prior to a class discussion.

S T U D E N T R E A D I N G

Sections in the supplemental student reading ("About Galaxies"), titled "The Milky Way," "Shape," and "Classification," provide students with some background information about galaxies and can be used before and/or during the activity. Teachers of

younger students may need to read these sections to the class, choosing what is necessary and appropriate for the younger group.

S T R A T E G I E S

This activity is a good follow-up to the activity, "Group the Galaxies." In both activities, students read the information on the Galaxy Trading Cards and use it to help determine the characteristics of elliptical, spiral, and irregular galaxies.

Students can work together as a class or break up into small groups to complete the first graphic organizer, the "Comparison of Galaxies" chart. If you decide that students should work together as a class, then post a large chart in the front of the room to record their answers.

Astronomers classify galaxies into three groups, however, the predictable shapes of spiral and elliptical galaxies are compared before the irregular galaxies are addressed.

P R O C E D U R E

Make sure that students know what a galaxy is by asking them if they can describe the characteristics of the Milky Way galaxy.

If students have recently completed the

(... continued on page 5)

(Teacher's Instructions, continued from page 4 ...)

“Group the Galaxies” activity, ask them to describe a galaxy.

Completing Activity Sheet A: “Compare/Contrast Chart: Comparison of Galaxies”

- Provide students with several pictures from the Galaxy Trading Cards. Some of the pictures should be spiral galaxies (such as NGC 4321, NGC 4156 and NGC 7217) and some of elliptical galaxies (such as NGC 4881 and NGC 3377). Be sure that students understand they have two classes of galaxies.
- Ask students to examine the galaxy cards and look for differences and similarities between the spiral and the elliptical galaxies. Students should record the characteristics of these two classes of galaxies in the appropriate column on the “Comparison of Galaxies” chart. If students are just beginning their study of galaxies, then provide them with the information about galaxies found in the student reading to help them complete the chart.
- Once students have finished this section of their charts, provide them with another image of a spiral and an elliptical galaxy. Don't tell them which galaxy is which type. Then ask them to decide whether

the galaxies fit into the spiral or elliptical column on their compare/contrast charts.

- Next, introduce the idea of irregular galaxies by giving them images of irregular galaxies from the Galaxy Trading Cards (such as: NGC 5253, NGC 4038 and 4039, and ESO 350-G040). Ask them, as a class, to try to classify these galaxies. Students should realize that these new galaxies are neither spiral, nor elliptical and belong to the third column, called irregulars. Ask students to write down the characteristics of irregular galaxies in the third column.
 - Once students have completed the whole chart, give them other galaxies to classify based on the information on their compare/contrast charts.
 - If students have been working independently or in small groups, teachers may want to check their charts to make sure they have included all the characteristics in the correct column before proceeding.
- Completing Activity Sheet B:
“Venn Diagram: Comparison of Spiral and Elliptical Galaxies”*
- To emphasize the similarities as well as the differences between the three classes of galaxies, provide students with Activity

(... continued on page 6)

(Teacher's Instructions, continued from page 5 ...)

Sheet B, which contains a two-circle Venn diagram and questions about irregular galaxies. A Venn diagram consists of two or more overlapping circles. It is often used in mathematics to show relationships between sets. In other applications, Venn diagrams are useful for examining similarities and differences in the characteristics of objects or ideas. In this application, the circles represent elliptical and spiral galaxy types. Each circle contains information on a particular galaxy type. Where the two circles overlap, the characteristics are common to both types.

- Tell students to fill in the Venn diagram with the aid of their comparison chart (Activity Sheet A). A characteristic that is

common to both elliptical and spiral galaxies belongs in the central region where the two circles overlap. Otherwise, characteristics common to spiral galaxies belong in the spiral circle and those common to elliptical galaxies belong in the elliptical circle.

- Once the Venn diagram is complete, ask students to answer the questions on irregular galaxies that appear on the first page of Student Activity Sheet B.

E X T E N S I O N

Students can use their Venn diagram to help them write an essay comparing the three types of galaxies. ❖

Learning Outcomes Mapped to Education Standards

Learning outcomes from the activity	Alignment with National Science Standards	Alignment with McREL Standards
<p>Using galaxy image data, students will be able to identify the characteristics of spiral, elliptical, and irregular galaxies, in order to compare and contrast galaxy properties.</p>	<p>Science as Inquiry, Content Standard A (pg. 145, Grades 5-8)</p> <p>As a result of activities in grades 5-8, all students should develop abilities necessary to do scientific inquiry, i.e., use appropriate tools and techniques to gather, analyze and interpret data.</p>	<p>Life Skills: Thinking and Reasoning, Standard 3</p> <p>[Student] effectively uses mental processes that are based on identifying similarities and differences.</p> <p>Benchmark 3, Level III (Grades 6-8)</p> <p>[Student] selects criteria or rules for category membership that are relevant and important.</p> <p>Benchmark 6, Level III (Grades 6-8)</p> <p>[Student] creates a table to compare specific abstract and concrete features of two items.</p>

Prerequisites and Misconceptions

Below are some common misconceptions students may have about galaxies. Teachers should be aware of these misconceptions and determine whether their students harbor any of them. Teachers need to determine the knowledge base of their students, and use the information presented below and elsewhere in this guide to help students learn what they need to know in order to successfully complete these activities. At the very least, students should be aware that galaxies are groups of stars that don't necessarily look the same. They should also be familiar with the way astronomers identify galaxies.

Students may have misconceptions regarding the makeup, distances, and sizes of galaxies. They may not understand that galaxies are groups of stars — not just single stars — that come in a variety of shapes, sizes, and colors. Students should be aware that galaxies are vast collections of stars, gas, and dust held together by gravity, but they don't all look the same. The shapes of galaxies vary — some are elliptical, others are spiral, and

still others have no definite shape. Galaxies aren't even the same size — small galaxies may have only a few million stars in them, while large galaxies can have several trillion stars. Vast distances separate these large numbers of stars.

Galaxies can be several thousand to hundreds of thousands of light-years across. (A light-year is the distance traveled by light in a full year, equal to some 10 trillion kilometers, or about 6 trillion miles.)

Students may be aware of the size of the solar system and think it is very large. Light, however, can travel from the Sun to Earth in about eight minutes, while light from the star closest to the Sun takes about four years to arrive at Earth.

Students may have misconceptions regarding the stars they see at night. All the stars in the night sky are part of the same galaxy — the Milky Way. Many students may think that all stars are exactly the same. Stars, however, vary in brightness, color, mass, temperature, and age. The Milky Way is home to the Sun, the Earth, the entire solar system, billions of stars, and most other celestial bodies visible with the unaided eye. Other galaxies appear as fuzzy spots in the

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(Prerequisites, continued from page 9 ...)

sky when viewed with the unaided eye and even amateur telescopes.

Students should be aware of the significance of galaxy names. For example, NGC 5253 refers to the 5,253rd entry in *The New General Catalogue of Nebulae and Clusters of Stars*, which was compiled by John L.E. Dreyer in the nineteenth century as a comprehensive list of nebulae (cloudy patches) and star clusters. This catalog remains the standard reference used by astronomers

the world over. When first observed, many galaxies were classified as nebulae because astronomers didn't know what they were.

Galaxies whose names begin with "ESO" are part of an archive of observations made by telescopes that are managed fully or in part by the European Southern Observatory. Since the Hubble Space Telescope (HST) is a joint venture between NASA and the European Space Agency, ESO numbers are used to designate HST observations. ❖

Answer Key to Student Activity Sheet A

NOTE: This chart presents a complete comparison of the three types of galaxies. The Galaxy Trading Cards do not provide all of the information contained in this chart. Students may need to search the student readings to find the information.

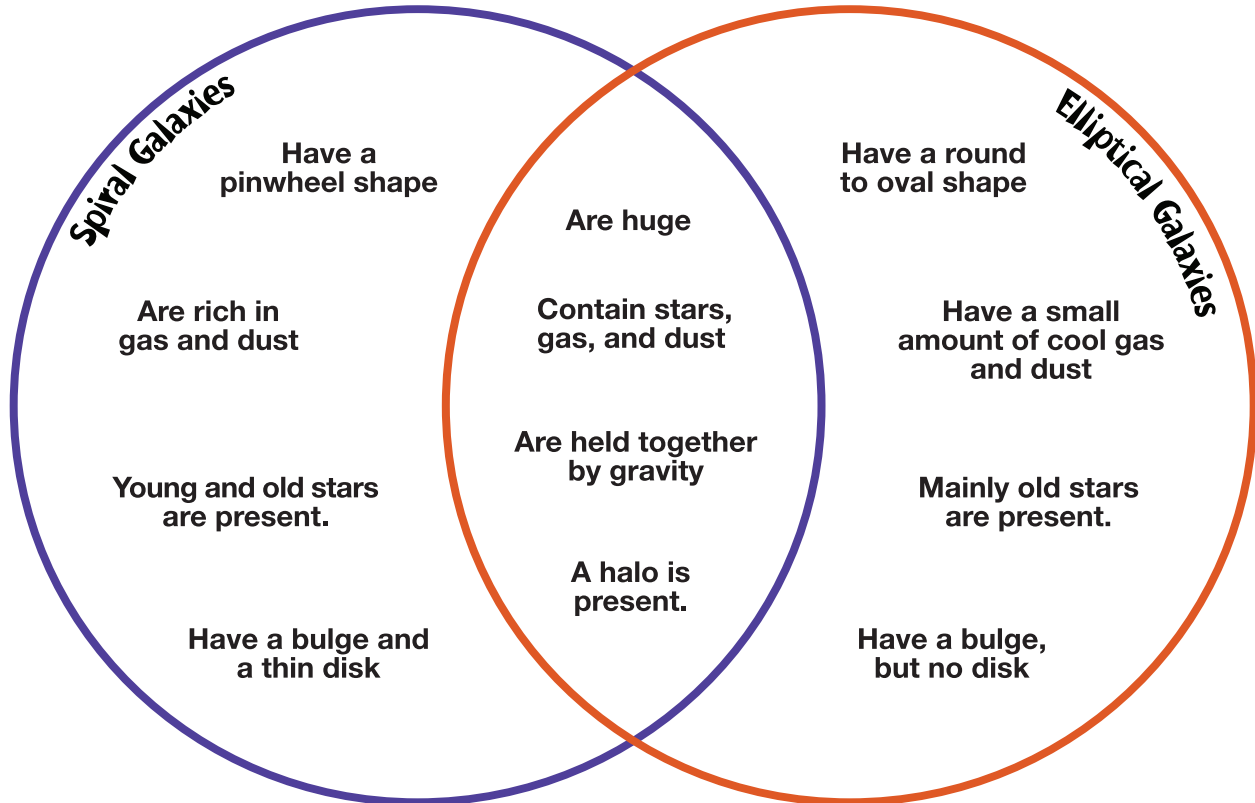
Compare/Contrast Chart: Comparison of Galaxies

Spirals	Ellipticals	Irregulars
Are huge	Are huge	Are huge
Contain stars, gas, and dust	Contain stars, gas, and dust	Contain stars, gas, and dust
Are held together by gravity	Are held together by gravity	Are held together by gravity
A halo is present.	A halo is present.	A halo is present.
Have a pinwheel shape	Have a round to oval shape	Have no predictable shape
Have a bulge and a thin disk	Have a bulge, but no disk	May show signs of a disk and/or a bulge
Are rich in gas and dust	Have a small amount of cool gas and dust	Are usually rich in gas and dust
Young and old stars are present.	Mainly old stars are present.	Young and old stars are present.

Answer Key to Student Activity Sheet B

NOTE: This chart presents a complete comparison of the three types of galaxies. The Galaxy Trading Cards do not provide all of the information contained in this chart. Students may need to search the student readings to find the information.

Venn Diagram: Comparison of Spiral and Elliptical Galaxies



Q1. Explain why irregular galaxies are not part of this comparison.

A: Irregular galaxies don't have a predictable shape or structure.

Q2. What features of irregular galaxies are also common to both spiral and elliptical galaxies?

A: Like spirals and ellipticals, irregular galaxies are huge. They contain stars, gas, and dust — all held together by gravity. They have a halo (but don't always have a bulge).

Q3. What features of irregular galaxies are common to either spiral galaxies or elliptical galaxies (but not both)? (In each case, identify the feature and the type of galaxy that irregulars resemble.)

A: Irregular galaxies are similar to spiral galaxies in two respects: they are usually rich in gas and dust and they have both young and old stars.

New Vocabulary

Barred Spiral Galaxy: A type of spiral galaxy having a linear extension, or “bar,” made of stars and interstellar matter, passing through its center.

Bulge: A rounded structure in the centers of some galaxies, composed primarily of old stars, and having some gas and dust. The bulge of the Milky Way is about 10,000 light-years across.

Compare/Contrast Chart or T-chart: A graphic organizer used to compare two objects or ideas. The objects are listed as headings at the top of two columns. The characteristics being compared are then listed under each heading. The chart’s top, horizontal line and its center vertical line trace out the shape of a “T.”

Disk: A pancake-shaped structure composed primarily of young and middle-aged stars, and having abundant gas and dust. Some old stars are also present. The disk surrounds the bulge in a spiral galaxy. The disk in the Milky Way is 100,000 light-years across and 2,000 light-years thick.

Elliptical Galaxy: A galaxy having an elliptical shape. Some elliptical galaxies are nearly spherical, while others are more oblate, resembling footballs. An elliptical galaxy is essentially a big bulge composed mostly of old stars and containing little interstellar matter (the gas and dust often found in the space between stars).

ESO: These letters, when followed by numbers, refer to the specific entries in an archive of observations made by the European Southern Observatory telescopes. Since the Hubble Space Telescope (HST) is a joint venture between NASA and the European Space Agency, ESO numbers are used to designate HST discoveries. Galaxies with ESO numbers are generally not included in earlier catalogs, such as those with numbers starting with “NGC” (designating John Dreyer’s *New General Catalogue of Nebulae and Clusters of Stars*) or “M” (designating Charles Messier’s *Catalog of Nebulae and Star Clusters*).

Galaxy: A collection of a million to a trillion stars, along with gas and dust, all held together by gravity.

Halo: A roughly spherical collection of old stars, clusters of old stars (called globular clusters), and a little bit of gas and dust that extends farther than all other components of a galaxy. Halos contain dark matter, which is material that we cannot see but whose gravitational force can be measured. In the Milky Way, the halo measures about 130,000 light-years across.

Irregular Galaxy: A galaxy whose shape is neither elliptical nor spiral. It is often rich in interstellar matter (gas and dust).

Light-year: The distance traveled by light in a full year, equal to some 10 trillion kilometers (or about 6 trillion miles).

NGC: These letters, when followed by numbers, refer to specific entries in *The New General Catalogue of Nebulae and Clusters of Stars*, which was compiled by John L.E. Dreyer in the nineteenth century. This comprehensive list remains the standard reference guide used by the world's astronomers.

Spiral Arms: Curved, pinwheel-like structures in the disk of a spiral galaxy. The spiral arms contain blue stars and luminous newborn stars that make their spiral pattern visible.

Spiral Galaxy: A galaxy made up of a disk, spiral arms, and a bulge at its center. The size of the disk and the bulge vary. The galaxy is composed of a mixture of old and young stars, as well as loose interstellar matter (the gas and dust found in the space between stars).

Venn Diagram: A diagram consisting of two or more overlapping circles. It is often used in mathematics to show relationships between sets. In other applications, Venn diagrams are useful for examining similarities and differences in the characteristics of objects or ideas. ❖

Student Activity Sheet A

Name: _____

Find the Right Circle: Compare/Contrast Chart

Directions:

Using the Galaxy Trading Cards and other material provided by your teacher, compare the properties of spiral and elliptical galaxies by listing the characteristics of each in the appropriate column. Once you have finished, look at some examples of irregular galaxies and list their properties in the third column.

Compare/Contrast Chart: Comparison of Galaxies

Spirals	Ellipticals	Irregulars

Student Activity Sheet B

Name:

Find the Right Circle: Venn Diagram

Directions:

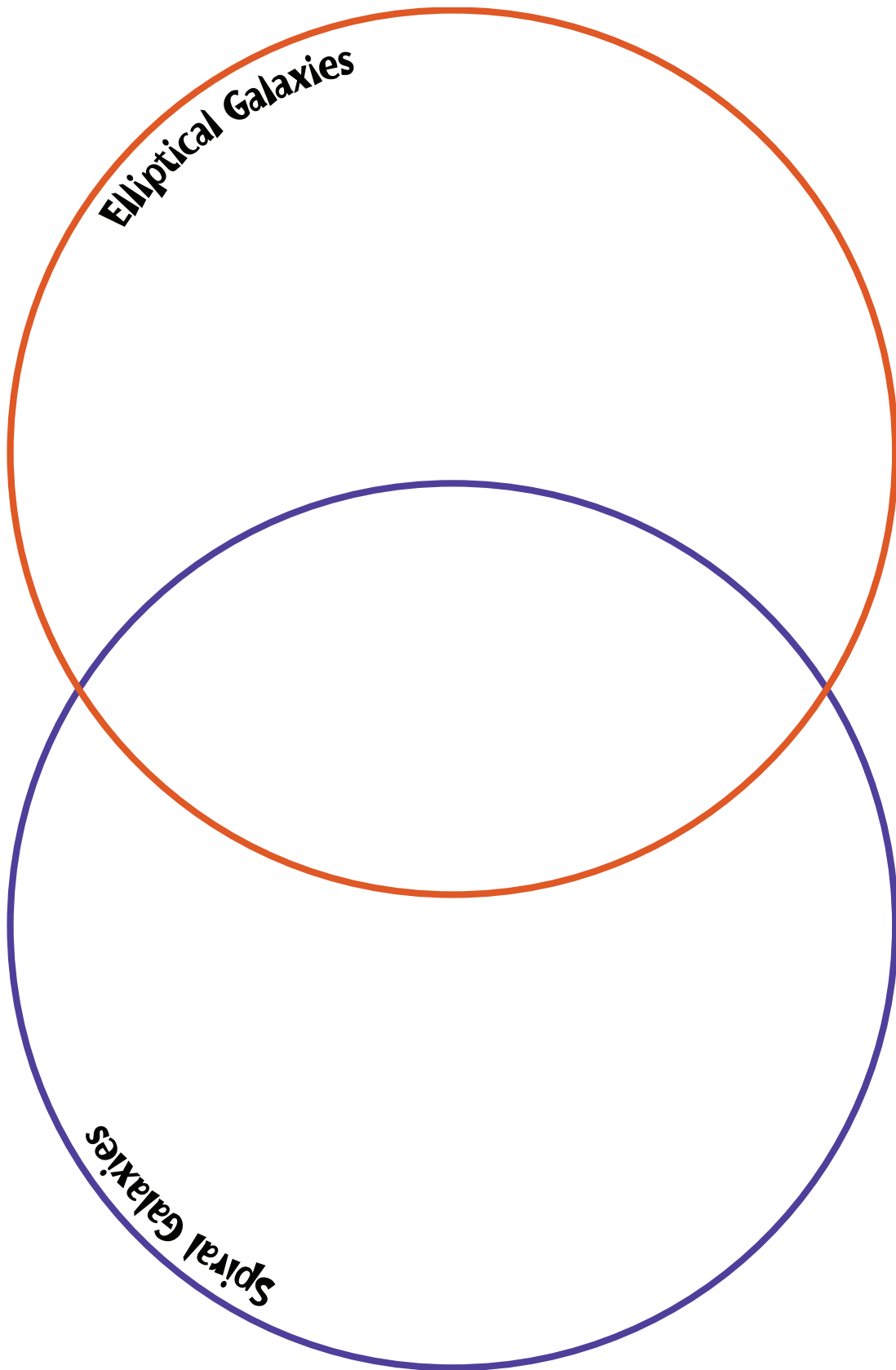
Use your “Comparison of Galaxies” chart (Activity Sheet A) to help you compare spiral and elliptical galaxies in order to fill in the circle diagram on page 2 of this activity. Characteristics unique to only one galaxy type should be listed in the circle for that galaxy type. Characteristics common to both types belong in the region where the circles overlap. When you are finished, answer the three questions below:

1. Explain why irregular galaxies are not part of this comparison.

2. What features of irregular galaxies are also common to both spiral and elliptical galaxies?

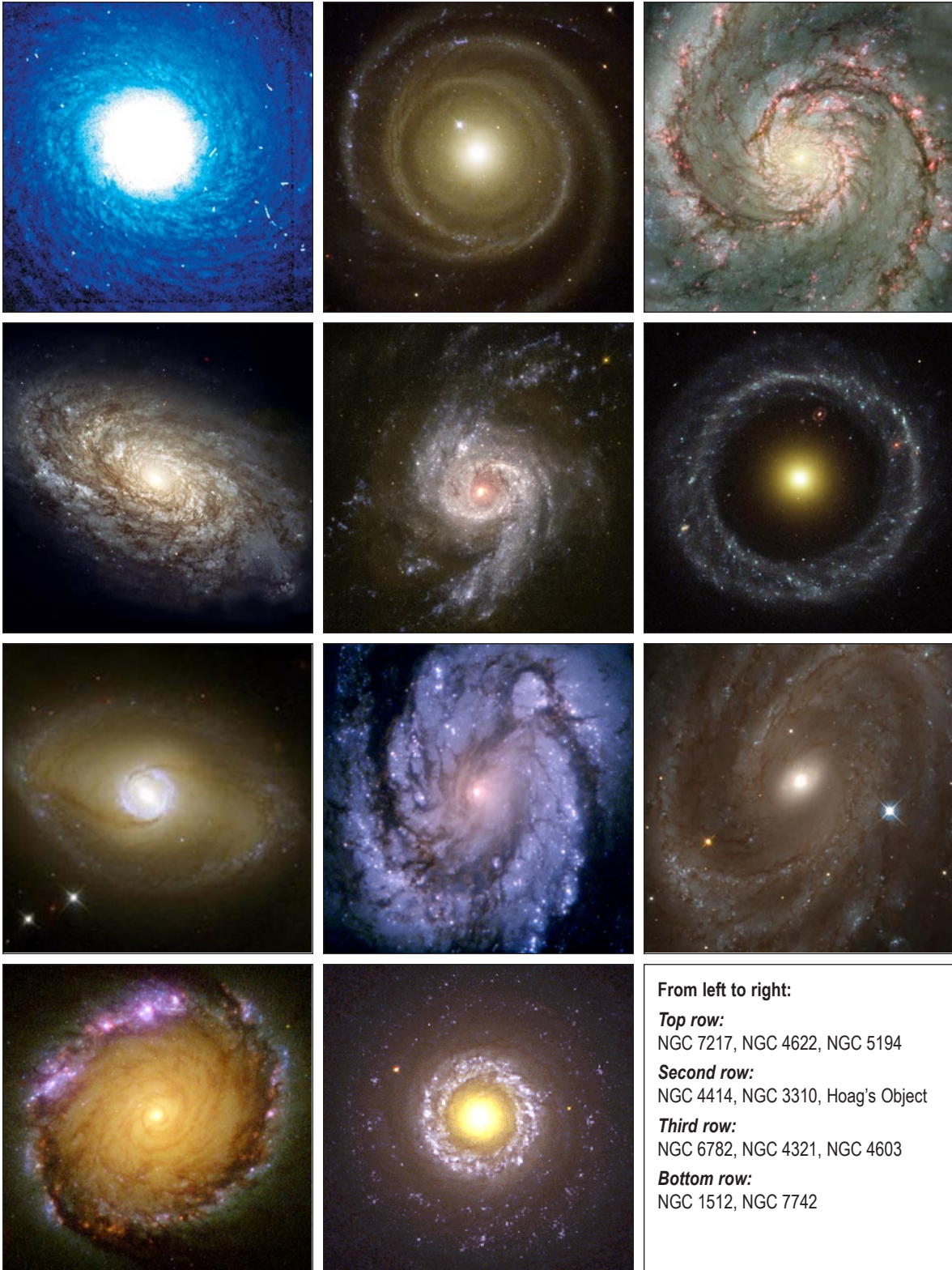
3. What features of irregular galaxies are common to either spiral galaxies or elliptical galaxies (but not both)? (In each case, identify the feature and the type of galaxy that irregulars resemble.)

Venn Diagram: Comparison of Spiral and Elliptical Galaxies



Images of Spiral, Elliptical, and Irregular Galaxies

Spiral Galaxies:



From left to right:

Top row:

NGC 7217, NGC 4622, NGC 5194

Second row:

NGC 4414, NGC 3310, Hoag's Object

Third row:

NGC 6782, NGC 4321, NGC 4603

Bottom row:

NGC 1512, NGC 7742

Barred Spiral Galaxies:



Edge-On Spiral Galaxies:



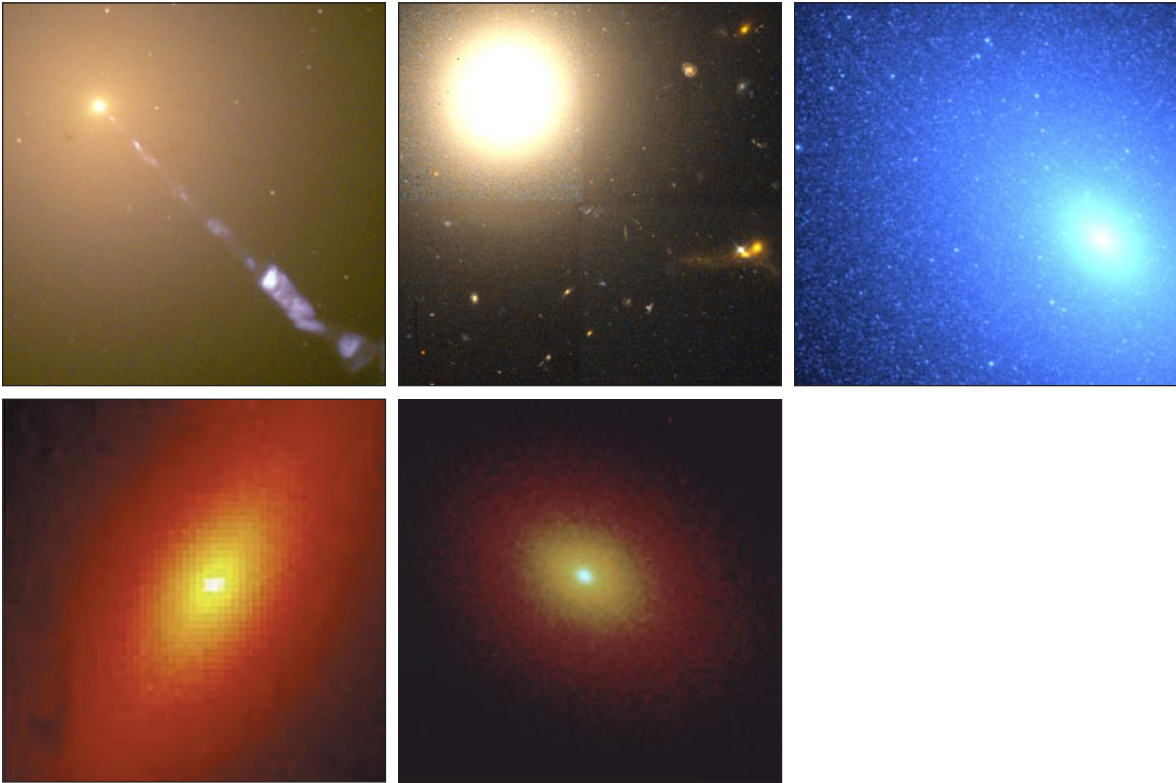
From left to right:

Barred Spiral Galaxies: NGC 4319; NGC 1365; NGC 4156

Edge-on Spiral Galaxies: NGC 4013; ESO 510-G13; galaxy 0313-192*

*This galaxy has a giant radio-emitting "jet," part of which has been marked in red on the image.

Elliptical Galaxies:



From left to right:

Top row: M87, NGC 4881, M32 (UV light image)

Bottom row: NGC 3377, M32 (visible light image)

Irregular Galaxies:

