Classroom Activity

GROUP THE GALAXIES
using Galaxy Trading Cards

GRADES: 5 – 7 (Target grade: 6)

GOAL: Sort and categorize galaxies

In this activity, students are introduced to the information on the Galaxy Trading Cards by creating categories based on recognized patterns. The process skills used in this activity are sorting and categorizing.

Download Galaxy Trading Cards PDF from:

http://amazing-space.stsci.edu/eds/overviews/print/activities/group.php

Contents

CLASSROOM ACTIVITY

SUPPLEMENTAL MATERIALS AVAILABLE ONLINE

Download the following supplemental materials from *http://amazing-space.stsci.edu/eds/overviews/print/activities/group.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)

Group the Galaxies

Sorting Galaxies Into Groups

PURPOSE

The purpose of the activity is to introduce students to the information on the Galaxy Trading Cards by creating categories and classifications based on recognized patterns. The process skills used in this activity are sorting and categorizing.

MATERIALS

- **Galaxy Trading Cards**, available as a separate PDF
- **Student Activity Sheet**: "Group the Galaxies," including directions, found on pages 13 – 14

EXECUTION TIME

40 – 50 minutes

Instructions for the Teacher

PREPARATION

Make one copy of the activity sheet, "Group the Galaxies," for each student and make a set of Galaxy Trading Cards for each student or group of students.

To make the cards: Download the trading cards PDF file from *http://amazing-space.stsci.edu/eds/overviews/print/activities/group.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.

SCIENCE BACKGROUND

To use this activity, teachers should be familiar with the material covered in

(... continued on page 4)

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

questions 1, 2, and 5 – 8 of the teacher's science background document, "Galaxy Q&As," available 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.

STUDENT READING

A student background document, "About Galaxies," is available as a separate PDF. The section entitled "The Milky Way" can be used as an introduction or a follow-up reading. The sections entitled "Shape" and "Classification" can be used as follow-up readings. Teachers of younger students may need to read these sections to the class, choosing what is necessary and appropriate for the younger group.

STRATEGIES

Students' ability levels will determine how to conduct this activity. Very young students will need more teacher guidance than will older students. Teachers may need to read the information contained on the back of the cards to their students and help them think of different ways to sort the cards.

Students can work on this activity individually or in small groups. Each group or each student working individually should have a set of Galaxy Trading Cards.

PROCEDURE

Start the activity by asking students if they have ever heard of the Milky Way galaxy. Ask them to share what they know about it. Make sure they are aware that a galaxy is a very large collection of stars, dust, and gas held together by the force of gravity. They should also be aware that not all galaxies look the same.

Provide students with copies of the activity sheet and the trading cards. Tell them the cards have images of galaxies on one side and information about the galaxies and the constellations in which they reside on the other side. Explain that some of these galaxies are very similar to the Milky Way galaxy and others are not. All galaxies, however, are composed of stars, dust, and gas. Tell students that they are going to sort or order the cards based on some trait or characteristic the cards have in common. They can sort their cards into groups based on similarities in the shapes or color of the galaxies, or even

(... continued on page 5)

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

by the shape of the pictures. Information on the backs of the cards can be used for sorting as well.

Some students may need help getting started. Suggest that they sort the cards according to galaxy shapes. Tell students to place the round or oval galaxies into one pile, the pinwheel-shaped galaxies into another pile, and the oddball-shaped galaxies into a third pile. Once students have placed their cards in piles, ask them to fill out the worksheet by writing "shapes of galaxies" on the line that says "Galaxies sorted by:" Underneath "Groups," they should write "round or oval," "pinwheel," and "other" in a column. Then have the students turn their pile of round galaxies over and find the NGC or ESO numbers near the top of the cards. Astronomers use these numbers to catalog and identify galaxies. Under the heading "Members of the group," students should record the NGC or ESO numbers to the right of the words "round or oval." Students should do the same thing with their "pinwheel" and "other" piles.

Now ask students to think of other sorting methods and record them on their worksheet. Once they have done so, ask them to follow the same procedure for sorting and recording the results. Encourage students to read and use the information found on the backs of the cards. Monitor their work, and if they appear to be running out of ideas, conduct a brainstorming session in which they share possible groupings with each other.

When students have finished the worksheet, ask them to explain their various groupings. Students may come up with a variety of different groupings, all of which may be valid. Some of them are discussed in the answer key to the activity sheet (p. 9).

After the discussion, explain the three main groups of galaxies: elliptical, spiral, and irregular. ❖

Learning Outcomes Mapped to Education Standards

Learning outcomes from the activity	Alignment with National Science Standards	Alignment with McREL Standards
Using galaxy image data, students will be able to sort and categorize galaxies, based on recognized similarities.	**Science as Inquiry, Content Standard A (pg. 145, Grades 5-8)** 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.	**Life Skills: Thinking and Reasoning, Standard 3** [Student] effectively uses mental processes that are based on identifying similarities and differences. **Benchmark 3, Level III (Grades 6-8)** [Student] selects criteria or rules for category membership that are relevant and important.

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

(... continued on page 8)

(Prerequisites, continued from page 7 ...)

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

Possible ways to group the galaxies:

By shape of the galaxies (based on looking only at the images on the card fronts):

- Elliptical (oval or round): NGC 3377 and NGC 4881 (Students could include ESO 350-G040, an irregular galaxy, and NGC 7217, a spiral galaxy.)
- Spiral (pinwheel): NGC 4321 and NGC 4156
- Irregular (lumpy): NGC 4038 and 4039, and NGC 5253

By the labels at the top, on the backs of the cards:

- Barred Spirals: NGC 4156
- Spirals: NGC 4321 and NGC 7217
- Irregular: NGC 5253
- Colliding: NGC 4038 and 4039, and ESO 350-G040
- Elliptical: NGC 3377 and NGC 4881

By the symbols at the top, on the backs of the cards:

- Oval-shaped: NGC 3377 and NGC 4881
- Pinwheel-shaped: NGC 4321, NGC 7217, and NGC 4156
- Irregularly-shaped (scattered blob): NGC 5253, ESO 350-G040, and NGC 4038 and 4039

By the shape of the pictures:

- Pictures with the chevron shape: NGC 4881 and NGC 4038 and 4039
- Pictures without the chevron shape: All the rest

By galaxies with young/new stars versus those with only old stars:

- Only old stars: NGC 4881 and NGC 3377
- Young/new stars: All the rest

By galaxy color:

- Red/yellow: NGC 4881 and NGC 3377
- Blue: NGC 4321, NGC 7217, and NGC 4156
- Red/yellow and blue: NGC 5253, ESO 350-G040, and NGC 4038 and 4039

(... continued on page 10)

(Answer Key, continued from page 9 ...)

By how the galaxy is identified:

- ESO plus number: ESO 350-G040
- NGC and M plus number: NGC 4321 (M100)
- NGC plus number: All the rest (Students could single out the galaxies NGC 4038 and 4039 — the Antennae — as being a separate class because they have two NGC numbers.)

By constellation:

- Animal: NGC 4038 and 4039, NGC 7217, NGC 3377, and NGC 4156
- Person: NGC 4881 and NGC 4321
- Neither or both: NGC 5253 and ESO 350-G040

By putting the constellations in alphabetical order:

1) Canes Venatici (NGC 4156)
2) Centaurus (NGC 5253)
3) Coma Berenices (NGC 4881)
4) Corvus (NGC 4038 and 4039)
5) Leo (NGC 3377)
6) Pegasus (NGC 7217)
7) Sculptor's Workshop (ESO 350-G040)
8) Virgo (NGC 4321)

By amount of gas (and dust):

- Large amount of gas (and dust): NGC 4321, NGC 7217, NGC 5253, and NGC 4156
- Small amount of gas (and dust): NGC 3377 and NGC 4881
- No information on card: ESO 350-G040 and NGC 4038 and 4039 ❖

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 Name:

Group the Galaxies

Directions:

Scientists sort galaxies into different groups to study how galaxies work. Your teacher will give you a set of cards with pictures of galaxies on the front and information about the galaxies on the back. You can use the pictures and the information to create your own galaxy categories. Examine the cards, both front and back. How do the galaxies look different? How do they look the same? Think of some groups, based on the differences and similarities between the cards. Once you have decided on the groups to use, decide which cards fit into which groups. Record the groupings on the activity sheet, using the NGC or ESO numbers. Don't let the scientists' groupings keep you from thinking of your own groups.

Galaxies sorted by:

Groups: **Members of the group:**

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