88 Classifying Space Objects

INVESTIGATION

Many kinds of objects in the sky can be observed with the naked eye and with telescopes. In this activity you will further investigate objects in space, mostly those found in our own Solar System. Our Solar System, with its one star, is just one tiny part of our galaxy. Our galaxy is only one of billions of galaxies.

CHALLENGE

What types of objects are found in space?

This galaxy made up of billions of stars forms a spiral shape.

MATERIALS

For each group of four students

1 **set of 23 Space Object Data Cards**

PROCEDURE

1. Spread your Space Object Data Cards out on a table.
2. Read each card carefully, noting the similarities and differences among the objects.
3. With your group of four, classify the Space Objects into 5 to 10 groups that have similar features. Work together to agree on a classification system.
   - Listen to and consider explanations and ideas of other members of your team.
   - If you disagree with your team members about how to classify a space object, explain why you disagree.
4. In your science notebook, list the common features of each group of space objects. Then write down the numbers of the objects that belong to each group. Label your classification system, "Our Classification System."
5. Discuss with the class your group's classification system. Observe the similarities and differences between your system and the others.
6. Get a set of Classification Cards from your teacher. Each card represents a group of space objects as classified by astronomers. Based on the information described on the Classification Cards, place each Space Object Data Card under one of the Classification Card categories.
7. In your science notebook, list the common features of each category of space objects as described on the Classification Cards. Then list the objects that belong to each set. Label this classification system, "Astronomers' Classification System."

8. With your group, compare the two classification systems. Describe how the systems are:
   - similar
   - different
9. Record your group's ideas in your science notebook.

ANALYSIS

1. How did your group classify the objects? Describe your system.
2. List the seven major objects described in the Astronomers' Classification System. For each classification, write down at least two of the major features of that category.
3. Carefully read the article below.
   a. Why was Pluto's classification changed?
   b. Do you agree with the changes made by the International Astronomical Union? Explain your choice using evidence from the article.

AUGUST 25, 2006

Pluto Demoted!

Prague, Czech Republic —Today the International Astronomical Union, a group of more than 9,000 astronomers around the world, voted to change the definition of a planet. Scientists met to settle the debate over the classification of Pluto and other solar system objects. The result of the vote is that Pluto, discovered in 1930 and designated our ninth planet, is no longer a planet. Pluto is round and orbits the Sun, as required by the definition. However, it does not qualify as a planet because the area around its orbit is not clear of other objects.

The new definition of a planet also settles the debate about Eris (formerly known as Xena), discovered in 2003. Eris is round and orbits the Sun. It is slightly larger in diameter and three times as far from the Sun as Pluto. The old definition said that a planet was any round object orbiting the Sun that is made of rock or gas and has a diameter equal to or larger than Pluto. If the old classification system were used consistently, Eris, Pluto, and another object named Ceres would all be planets.

The scientists were faced with a difficult choice. Either they had to add more planets to our solar system or they had to reclassify Pluto and similar objects. Currently there are dozens of objects like Pluto, Eris, and Ceres. Scientists predict that hundreds more will be discovered in the future.

The new classification system makes Pluto, Eris, and Ceres "dwarf planets," which is a new category. Objects that orbit the Sun but are not planets or dwarf planets are now called Small Solar System Bodies. Although the new definitions settled the debate about Eris, the new classification system is being criticized. Shortly after the vote was taken, 300 astronomers signed a statement saying they would not use the new definitions. They do not like that the new classification depends on how an object moves (namely, that the area around its orbit is clear of other objects) instead of on its properties. Furthermore, the definitions do not always work outside our Solar System.

89 Where in the Solar System Am I?

INVESTIGATION

Planets have many features in common. For example, all planets are spherically shaped and each orbits a star. But each planet in our Solar System also has many other characteristics that make it different from the others.

Imagine that sometime in the future, people travel to all the planets in the Solar System. Imagine you are living in this time, and some of your friends are away on trips into outer space. You have received messages from your friends on other planets, but there is a problem with some of them. Four of your friends forgot to say what planet they are visiting.

CHALLENGE

What features make each planet unique?

MATERIALS

For each student

1 **Student Sheet 89.1, "Planet Information"**

PROCEDURE

1. Read the four messages from space shown on the next page.
2. Choose one of the messages and carefully compare the descriptions in it with the information provided on Student Sheet 89.1, "Planet Information."
3. With your partner, decide which planet that message was sent from.
4. In your science notebook:
   - Record the name of the person who sent the message and the name of the planet he or she was visiting.
   - List the evidence in the message that helped you decide which planet the message came from.
5. Repeat Steps 2–4 for the other three messages.

ANALYSIS

1. Write a message from a planet in our Solar System other than the ones already used in the four messages presented in this activity. In your message describe several features that would help someone else identify the planet.

Interplanetary Message

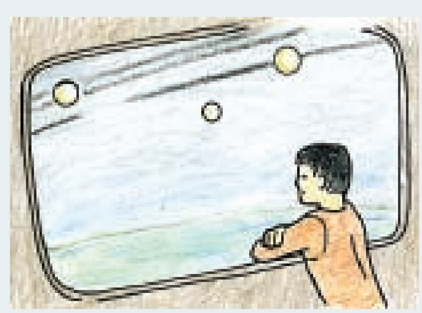
The temperature is so extreme here! During the day, the Sun looks huge and bright, and so it's very, very hot outside. When it is night, it gets really, really cold. Nighttime is always pitch black because there is no Moon. I guess it is kind of like living at the North or South Pole during summer or winter. There are no clouds, wind, or any kind of weather. Thank goodness we brought our own oxygen so we can breathe. I'm glad I brought my space hiking books because there are lots of large craters, kind of like the Moon. I visited one yesterday that is the size of Texas!

Kayla

Interplanetary Message

I can't believe I finally got here! It took close to 10 years to make the trip. I'm glad to be here during this planet's summer, but it's still below −130°C. And, because the planet is tipped on its side, the Sun doesn't shine at all in winter, which lasts more than 7,500 Earth days. The Sun is shining now, but it's not very big, bright, or warm. I'm not sure how long I'll be here, because one year on this planet takes a lifetime, but it's weird because one day is so short.

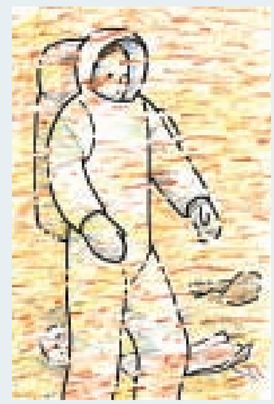
Not having a solid surface to walk on is kind of tricky, so I spend most of my time on the spacecraft. They say there are a bunch of moons, but I've only seen five. I think the others must be pretty small. I can see some faint gray lines that go all the way across the sky. I'm not sure what they are—I'll have to keep looking.



Ronin

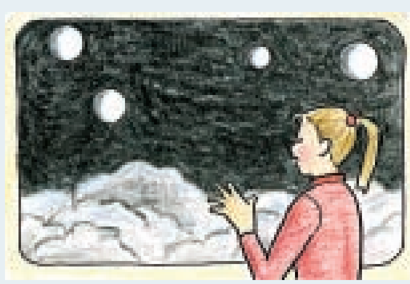
Interplanetary Message

There is so much iron here! The other day, I made the mistake of getting caught in a dust storm. The red dust coming off all the rocks completely blocked my view, and I was lost for a while. The day length is similar to back home, but even in the summer it is still cold. It's like Earth's South Pole in winter, but there is no snow. There is a lot of trash and equipment from previous explorations. It was quite a quick trip here, so I'll be home soon.



Len

P.S. I forgot to tell you that it's kind of spooky having more than one moon zipping across the sky.



Interplanetary Message

This place is so bizarre because it has no solid surface! It is a huge ball of gas, and our space hotel hovers above it. Going out for a walk is certainly not an option.
We saw this place that has a huge red hurricane almost three times the size of Earth. It has 400 mph winds that have been blowing for centuries. That's over twice the speed of the winds from the strongest hurricanes on Earth. The atmosphere is constantly swirling and has a lot of hydrogen and helium.

Last night I saw four big moons, which are easy to see, and many little ones that I can't tell apart. It's easy to stay up all night long to watch them because a full night is only about 5 hours long. The daylight time is only 5 hours long, too, so a full day lasts only 10 hours. I can also see a few faint rings when I look out into the sky during the day.

Eva

90 Drawing the Solar System

MODELING

When you look into the night sky, most of the objects other than the Moon appear to be about the same size. They also look like they're all about the same distance from Earth. They are neither. Although early astronomers' observations gave people some idea of how big and how far away the planets are, it took the invention of telescopes, satellites, and rockets, to make accurate measurements.

In this activity, you will use a **scale**—a ratio between the actual size of an object and its size in a model—to turn scientific measurements into an accurate model showing the distances of the planets from the Sun.

CHALLENGE

How far away are other planets in the Solar System?

A model, such as this one of a skyscraper, helps people visualize something that is very large or small.

MATERIALS

For each student

1 **Student Sheet 90.1, "Talking Drawing 1: The Solar System"**

1 **Student Sheet 90.2, "Talking Drawing 2: Scaled Sun-to-Planet Distances"**

1 **ruler**

PROCEDURE

Use Student Sheet 90.1, "Talking Drawing 1: The Solar System" to prepare you for the following activity.

Part A: Distances in the Solar System

1. Using the data in Table 1 below and a scale of **1 cm = 200,000,000 km**, calculate the relative distances of the planets from the Sun.

   Hint: To calculate the distance in centimeters (cm), you will need to divide the planet's distance from the Sun in kilometers (km) by the scale.

Table 1: Planets' Distance from the Sun

Planet	Approximate Distance from the Sun (km)
Mercury	58,000,000
Venus	108,000,000
Earth	150,000,000
Mars	227,000,000
Jupiter	778,000,000
Saturn	1,429,000,000
Uranus	2,869,000,000
Neptune	4,505,000,000

2. Record the results of your calculations in the table on Student Sheet 90.2, "Scaled Sun-to-Planet Distances." Round your answers to the nearest 0.1 centimeter.

3. Using the information you just calculated, make a scaled drawing of the distances on Student Sheet 90.2. Measuring from the center of the Sun, draw an X on the line where each planet is located. Record the name of each planet next to its location on the line.

Part B: Diameters in the Solar System

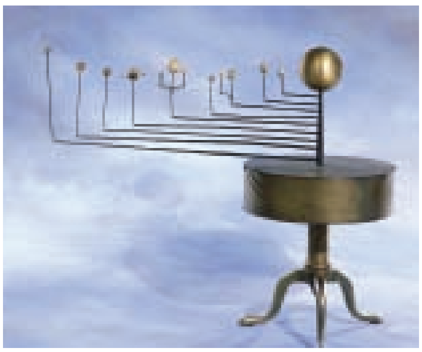
4. Look at the diameters of the planets shown in Table 2 below.

Table 2: Diameters of the Planets

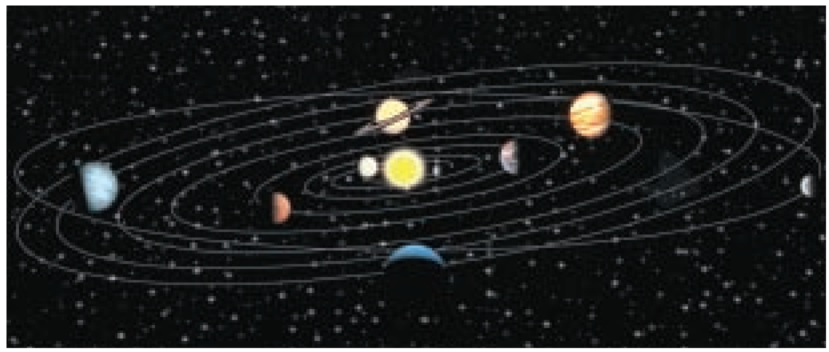
Planet	Diameter (km)
Mercury	5,000
Venus	12,000
Earth	13,000
Mars	7,000
Jupiter	143,000
Saturn	120,500
Uranus	51,000
Neptune	49,500

5. In your group, discuss the following questions about making a scale model of the planets' diameters.
   - Is the scale used in Part A (1 cm = 200,000,000 km) a useful scale for drawing the diameters of the planets? Explain why or why not.
   - The Sun has a diameter of 1,390,000 km. Is the scale used in Part A (1 cm = 200,000,000 km) a useful scale for drawing the diameter of the Sun? Explain why or why not.
   - Using a piece of regular notebook paper and a pencil, can you draw a picture that uses the same scale to accurately show the diameter of the Sun, the distances from the planets to the Sun, and the diameters of the planets?

6. Carefully examine each of the following models of the Solar System. With your group, discuss what is accurate and what is *not* accurate in each image. Record your ideas in your science notebook.



1



2

3

4

Models of the Solar System

ANALYSIS

1. Astronomers often measure distances in the Solar System using a unit called the **astronomical unit** (AU). One AU is about 150,000,000 km—the distance between Earth and the Sun.

   a. Why do you think the AU is used to measure distance in the Solar System?

   b. Why do you think the AU is not used to measure distances on Earth?

2. What are the main advantage(s) and the main disadvantage(s) of drawing a picture of the Solar System on a piece of regular notebook paper?