Size, Distance, & Scale

Throughout the guide, teaching tips are in red.

Activity Description & Estimated Class Time

Over the course of two 50-minute class periods, students will explore the scale of the solar system. They will explore the sizes of all planets and then examine a scale model of each planet's distance from the sun.

Correlations to NC Science Standards

ESS.6.1.2 Analyze and interpret data to compare the planets in our solar system in terms of: size and gravitational force relative to Earth, surface and atmospheric features, relative distance from the sun, and ability to support life.

ESS.6.1.4 Analyze and interpret data from historical and ongoing space exploration to illustrate the size and scale of the components of our solar system, galaxy, and universe.

Learning Target

Students will demonstrate the ability to:

- compare the size and scale of the planets using models and other data
- compare the distances from the sun using models and data
- analyze and interpret data

Brief Science Background

Space exploration has transformed our understanding of the size and scale of planets in our solar system. Before space missions, our knowledge was limited to telescopic observations and mathematical models, which only provided estimates of planetary dimensions. The arrival of spacecraft such as Voyager and Mars rovers allowed for direct measurements and high-resolution imaging, revealing intricate details about planetary sizes, compositions, and atmospheres. For instance, the Voyager missions provided crucial data that refined our knowledge of the gas giants' enormous sizes and intricate ring systems, while missions like Juno have offered unprecedented insights into Jupiter's complex atmospheric dynamics. This direct exploration has not only confirmed and refined previous theories but has also highlighted the vast diversity and scale of planets, showcasing the immense expanses and dynamic processes at play across our solar system.

Part 1 — Planet Sizes

Materials

Materials for whole class

- ability to project information from the internet
- ability to project Planet Size Chart (SD 1)

Materials for groups of 2 students

- ruler
- compass

Procedure

1. Ask students, "Have you ever wondered about the sizes of the planets in the solar system?" In this activity, you will draw all the planets to scale so you can see how they compare.
2. Hand out a ruler and a compass to each pair of students. Each student will draw their own scale model of the solar system, but share the ruler and compass.
3. Have each student draw a 1 cm line on the back of their Planet Size Chart (SD 1). Let them know that this line represents the equator, or, the middle of the Earth.

Procedure cont.

4. For our model we will draw circles to represent each planet. We will use the compass to draw our circles. Give the students a few minutes to play with the compass and practice drawing circles.
5. Challenge the students to draw a circle with a diameter of 1 cm.
6. After some trial and error, assist all students in drawing a correct circle on SD 1. Show students how to use half of the diameter, or radius and a compass to draw a circle that will represent Earth.
   - Show students how to calculate radius.
   - Draw a line the length of radius. (0.5cm)
   - Use the compass and place the pencil tip at one end of the line, and the pointer on the other half of the line.
   - Use the compass to draw the circle.
   - Have students measure across the circle to confirm the diameter is 1.0 cm.
7. Explain that this circle represents Earth. The middle of the earth, or the equator, is 1 cm. This number is also the diameter. Have students label the circle Earth.
8. Now that we know the size of Earth in our model, let's draw another planet in our solar system, Uranus. Project: https://www.readworks.org/article/Planets-of-the-Solar-System/f0ba2fd8-a604-4c4e-876a-67b8c5996f7b#!articleTab:content/contentSection:e75f9457-45ab-4d99-add8-1d78aa49cc7b/ .
9. Have students read the information about Uranus. Ask students to predict the size of Uranus compared to our model of Earth. Students can draw their predictions on the same page.
10. Uranus is 4 times the size of Earth, therefore Uranus has a diameter of 4 cm in our model. On the board write 1 cm (Earth) x 4 = 4 cm (Uranus). Record this on SD 1.
11. Ask students what information they need to draw Uranus.
12. Challenge students to draw a circle with a diameter of 4 cm on the back of SD 1. Many will say 4 cm. Remind students that 4cm is the diameter and in order to create a circle we will need to use the radius or 2cm.
13. Explain that this circle represents the size of Uranus compared to Earth. Have students label the circle Uranus.
14. Have students read information from readworks about the other six planets and have them predict the sizes of each planet by drawing prediction circles.
15. Project the Planet Size Chart (SD1) and have students draw each planet to scale. Put the equation 1 cm (earth) x diameter = scale size on the board to help students figure out the diameters of the other planets.
16. Have students compare their drawings with other students and lead a discussion about the results. The discussion can include questions such as "How does the size of Saturn compare to Earth?" and "How does Mercury compare to Mars?"

Content Connection

1. Ask students to predict how big they think the Sun would be in our model.
2. Inform the class that the Sun would have a diameter of 109 cm in our model. Hold up a meter stick and draw a circle. This will represent how big the Sun is in our model. Ask "How does the size of the sun compare to the largest planet? How does the size of the sun compare to Earth?"

Part 2 — Distance From The Sun

Materials

Materials for whole class

- ability to project information from the internet
- ability to project Distance From The Sun Chart (SD 2)

Materials for groups of 8 students

- planet cards, 1 set
- tape measure, 100'

Procedure

1. Ask students, “Have you ever wondered how far the Earth is from the Sun? Or how far away is the furthest planet from the Sun?” In this activity, you will build a scale model to demonstrate the distances of planets from the Sun.
2. For Part 1 we used a 1cm circle to represent the size of the Earth. For this part we will use 1 meter to represent the distance of the Earth to the Sun. The actual distance is 150 million Kilometers, or 93 million miles. Show students a meter stick to explain the scale. This distance represents the distance for Earth to the Sun.
3. Inform students that they will have a team challenge. Say "Your team will become a model of our solar system. Each team member will represent one of the planets. Your challenge is to be sure all planets are the correct distance from the sun. Remember, for our model Earth will be 1 meter from the Sun."
4. Before going outside to build their model, have students read information about each planet from Readworks (https://www.readworks.org/article/Planets-of-the-Solar-System/f0ba2fd8-a604-4c4e-876a-67b8c5996f7b#!articleTab:content/contentSection:e75f9457-45ab-4d99-add8-1d78aa49cc7b/) and:
    a. Determine the order of the planets from the Sun.
    b. Predict how far each planet will be from the Sun, using our scale.
5. Hand each team a wind-up meter tape and a set of planet cards.
6. Inform the class that they will be going outside to build their model. Each team will need 30 meters of space. We suggest using the football field or an empty parking lot. Establish what line will be used to represent the Sun.
7. Hand out the Distance From The Sun Chart (SD 2). Explain this chart will be used to determine how far each planet will be from our Sun in our model.
8. Help the class fill out SD 2. First, explain AU stands for Astronomical Unit. In our scale 1 AU = 1 meter. Therefore, Earth will be 1 meter from the sun in our model.
9. Work with the class to complete SD 2.
   Student may need help converting meters to centimeters when needed.
10. Give each team a few minutes to plan their model
11. Take the class outside, establish where the Sun is located and have the teams begin.
12. Once all teams are done, have them look at the other team’s model and compare.

Content Connection

Once inside hold a class discussion and answer the following questions:

a. What does our model show us about the distances of the planets from the sun?
b. Which planet is closest to Earth? How do you know?
c. Which planets are farthest apart from each other?
d. What are some things this model doesn't show us about the planets?

SD 1

Planet Size Chart

Planet	Size Compared to Earth (diameter)	Scale Size (centimeters)
Mercury	0.4	
Venus	0.9	
Earth	1.0	1.0
Mars	0.5	
Jupiter	11.2	
Saturn	9.5	
Uranus	4.0	4.0
Neptune	3.9	

SD 2

Distance From The Sun Chart

Object	AU	Scale Value (meters)
Sun	0.0	
Mercury	0.4	
Venus	0.7	
Earth	1.0	1.0
Mars	1.5	
Jupiter	5.2	
Saturn	9.6	
Uranus	19.2	
Neptune	30.0	