Spacing Out the Solar System

Summary

Students will apply their problem-solving skills as they measure circular objects and make connections to planets.

Materials

For each group:

- *Planet Cutouts*

  Measuring devices (metric rulers, measuring tape, string or yarn, etc.)

For each student:

- *It's All Relative 1* worksheet
- *It's All Relative 1* Answer Key

  Calculator

Background for Teachers

This activity encourages students to apply their problem-solving skills to measurement as they measure circular objects and make connections to the planets. Measuring circular objects can sometimes be challenging. One way to measure the circumference of an object is to use a piece of yarn or string. Measure around the object using the yarn. Then lay the yarn against a ruler to find the correct distance. Once the circumference is found, the diameter can be found by dividing the circumference by . Likewise, if the diameter of an object is known, the circumference can be found by using the formula: c = x d.

The interrelationship between circumference and diameter allows us to make valuable conjectures in science. Astronomers measure the diameter of distant objects in space and then use the c = x d formula to estimate that object's circumference and architects must use the relationship of circumference and diameter whenever creating circular objects.

Vocabulary terms used in this lesson:

circumference - The *perimeter* of a circle.

diameter - A *chord* that goes through the center of a circle.

metric system - A system of measurement based on tens. The basic unit of length is the meter. The basic unit of mass is the gram. The basic unit of *capacity* is the liter.

pi - The ratio of the *circumference* of any circle to its *diameter*, approximately equal to 3.14.

Intended Learning Outcomes

5. Make mathematical connections.

Instructional Procedures

Invitation to Learn

Hold up an object 1 cm in diameter. Show the students that the diameter of this object is 1 cm and explain that it represents Mercury. Have a quick scavenger hunt to find objects that represent Jupiter, Pluto, and Earth. Students search the room and record objects in their journal.

Answers:

Jupiter: 28.6 cm

Pluto: 0.5 cm

Earth: 2.5 cm

Instructional Procedures

Divide the class into nine groups for this activity.

Give the *It's All Relative 1* worksheet to each student.

Display a packet of *Planet Cutouts*. In each packet are cutouts for the nine planets, but they are not labeled. Each planet has a line drawn through the center of it (the diameter) and we know (from our worksheets) the circumference of each planet. *Is there any way we can figure out what planet each circle corresponds to?* Allow the students to discuss their strategies in their groups. Then hand out one set of cutouts and several measurement supplies to each group and encourage them to match each cutout to the correct planets.

Circle around the room as students work on this problem. Make sure that students understand the connection between diameter and circumference (c = x d) and that they are using metric units of measurement.

Once groups have made the connections, have them complete the blank column on the *It's All Relative 1* worksheet. After all groups have matched the circles to the planets, go around the room and have groups quickly present the strategies they used while you check for understanding.

Extensions

For teacher:

Yellow helium balloon on a string

For each group:

Roll of toilet paper

Scissors

Tape

For each student:

- *It's All Relative 2* worksheet
- *It's All Relative 2* Answer Key

Assign a planet to each group. Have each student record their assigned planet on the top of their *It's All Relative 2* worksheet. Tell the students that they will now use their planet to construct a class-sized scale model of the solar system.

Display the sun (helium balloon). Ask the students the following questions:

Is the sun accurately drawn to scale? (No)

What are some of the problems with the size of this sun? (It's too small. A sun accurately drawn to scale would fit more than 1,000,000 Earth's inside it. It's three-dimensional and our planets are only two-dimensional. A scale model of the sun would have a diameter of 270 cm.)

What is true about the sun? (It's yellow in appearance. It contains helium. It is the center of our solar system., etc.)

Once you have resolved the sun-scale issue, tell the students that we need to figure out how far each planet is from the sun.

Direct the student's attention to the *It's All Relative 2* worksheet. Tell each group to find his/her planet and practice reading the actual distance from the sun (e.g., "Jupiter is seven hundred seventy eight million, four hundred twelve thousand, ten kilometers from the sun."). This is a good opportunity to teach students not to use the word "and" when reading whole numbers.

Ask students to convert the distance from the sun to a form of scientific notation using a base of 106. Once students have completed the measurement for their planet, encourage them to do the same for the other planets.

Note: What the students are doing here is not technically referred to as scientific notation. True

scientific notation would be written with whole numbers between 0 and 10.
As a class, divide the prefix of each scientific notation by 30 to find the number of toilet paper sheets from the sun.
Hand out a roll of toilet paper to each group. Model how to count and cut sheets. You may also want to model how to make estimates for partial sheets. Encourage students to be very accurate in their measurements by using various estimation strategies.
Find a large open area outside. Place the sun at the center of the model. Have groups stand around the sun and roll their toilet paper outward. Students tape their planet cutouts to the end of each toilet paper roll.
After the model is constructed, students write a reflective journal piece about what they learned from this activity.

Family Connections

Students create a scale object for the planetoids Quaoar and Sedna at home.
Create a scale model of the sun using yellow chart paper and art supplies at home.

Assessment Plan

Circulate around the room and make informal assessments while the students work. Make sure you aren't moving too quickly through this activity and that the students understand why this activity requires so many steps. You may wish to take notes on specific misconceptions or questions that arise. You can address these questions at the end of the lesson.

- *It's All Relative*

worksheets.
You may choose to assign one of the curriculum extensions as an assessment piece.

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