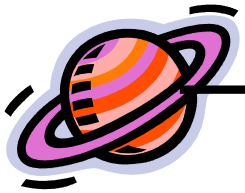


The Planets and Scale

Elementary grades

Lesson Summary
Students practice reading data about the planets from a table and making numerical comparisons.

Prior Knowledge & Skills
- Comparing numbers
- Reading data tables

AAAS Science Benchmarks
The Physical Setting
The Universe

NSES Science Standards
- **Earth and space science:** Properties of earth materials, Objects in the sky
- **Physical science:** Properties of objects and materials, Position and motion of objects

NCTM Mathematics Standards
- **Number and Operations:** Understand numbers, ways of representing numbers, relationships among numbers, and number systems
- **Data Analysis and Probability:** Formulate questions that can be addressed with data and collect, organize and display relevant data to answer them

Teaching Time: One 45-minute period

Materials
Each student will need:
- Copy of "The Planets and Scale"

Advanced Planning
Preparation Time: 20 minutes
1. Copy handouts
2. Review lesson plan

Why Do We Care?
This activity gives students some intuition about the relative sizes and distances of the planets in our solar system. Students see that the outer planets, especially Jupiter, are huge compared to the inner, rocky planets. Scientists believe this disparity has to do with how the planets formed: in the rotating "protoplanetary disk" of the early solar system, chunks of debris collided with neighboring chunks to form baby planets big enough to attract debris gravitationally. Far from the sun, an orbiting protoplanet sweeps out a larger orbital path than a protoplanet close to the sun will, and captures more material (think of a snowplow running in a tight circle—the edge of the plow's shovel picks up the most snow).

Suggested background reading
Bode's Law
Planetary Physical Data
Planetary data sheets

Source: Eileen V. Ryan NOAO/ Planetary Sciences, University of Arizona, Tucson AZ.

LASP
LABORATORY FOR ATMOSPHERIC AND SPACE PHYSICS
UNIVERSITY OF COLORADO AT BOULDER

THE PLANETS AND SCALE

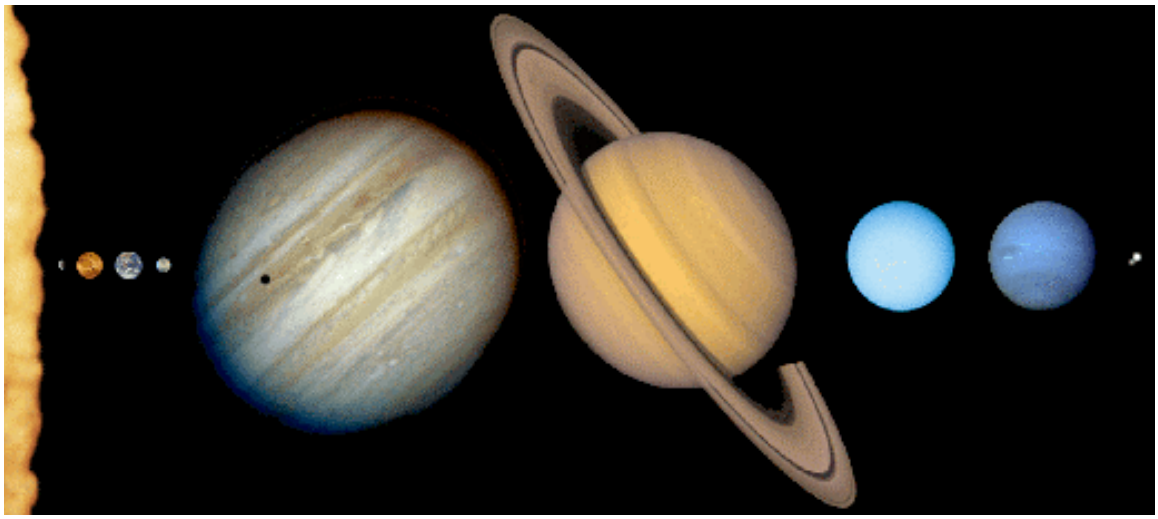
Concepts:

- size scales
- geometry
- graphing
- analyzing data

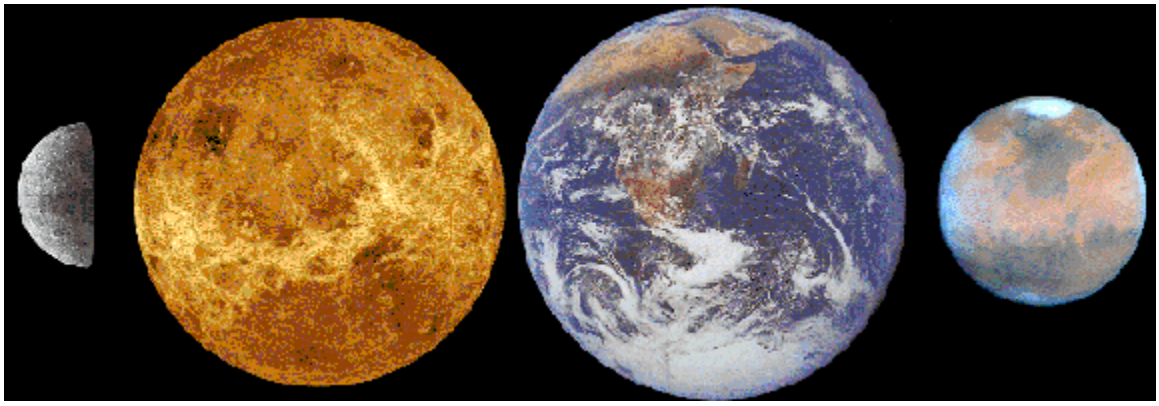
INTRODUCTION

Our solar system has at its center, an average star we call the Sun. In orbit around the Sun are the nine planets: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, and Pluto. There are also many comets, asteroids, satellites of the planets, and background dust in the solar system. The Sun contains 99.85% of all the matter in the Solar System. The planets, which condensed out of the same disk of material that formed the Sun, contain only 0.135% of the mass of the solar system. Jupiter contains more than twice the matter of all the other planets combined. Satellites of the planets, comets, asteroids, meteoroids, and the interplanetary medium constitute the remaining 0.015%.

Below is an image containing pictures (from spacecraft missions) of the nine planets (drawn to scale, that is, the relative sizes of one planet to another planet are correct).



The terrestrial planets are the four innermost planets in the solar system, Mercury, Venus, Earth and Mars. They are called terrestrial because they have a compact, rocky surface like the Earth's. The planets, Venus, Earth, and Mars have significant atmospheres while Mercury has almost none. Below is a close-up picture of the four terrestrial planets.



Jupiter, Saturn, Uranus, and Neptune are known as the Jovian (Jupiter-like) planets, because they are all gigantic compared with Earth, and they have a gaseous nature like Jupiter's. The Jovian planets are also referred to as the gas giants, although some or all of them might have small solid cores.

Planetary Data:

The following table lists statistical information for the planets:

	Orbital Distance (10^6 km)	Radius (km)	Mass (10^24 kg)	Rotation Period (hours)	# Moons	Orbital Period (days)	Density (g/cm^3)
Mercury	57.9	2439	.3302	1407.6	0	88.	5.43
Venus	108.2	6052	4.869	5832.5	0	224.7	5.25
Earth	149.6	6378	5.975	23.93	1	365.2	5.52
Mars	227.9	3393	0.6419	24.62	2	687.	3.95
Jupiter	778.3	71492	1898.6	9.92	16	4330.6	1.33
Saturn	1427	60268	568.5	10.5	18	10747.	0.69
Uranus	2869.6	25559	86.83	17.24	15	30588.	1.29
Neptune	4496.6	24766	102.43	16.11	8	59800.	1.64
Pluto	5913.5	1137	0.0125	153.1	1	90591.	2.03

Activity: The Planets and Scale

Using the information from the table (and images), please answer the following questions:

Q: Which planet is about the same size as the Earth?
A: Looking at the Radius column of the table, and the picture of the terrestrial planets, the answer is Venus .

Q: Which planet is just a little smaller, and has about the same rotation period as the Earth?
A: Mars. The period of rotation is the time it takes for the planet to spin 360 degrees on its axis--- in other words, it's the length of our day. A day on Mars would be just about as long as it is on the Earth.

Q: Which planet is the largest in the solar system?
A: Jupiter.

Q: Using the Radius column of the table, How many times larger than the Earth is Jupiter?
A: Jupiter's radius is 71492 km and the Earth's is 6378 km, making Jupiter more than 11 times larger than the Earth.

This module was written by Eileen V. Ryan NOAO/ Planetary Sciences, University of Arizona, Tucson AZ.

Student Worksheet: The Planets and Scale

Using the information from the table (and images), please answer the following questions:

Q: Which planet is about the same size as the Earth?

_____

Q: Which planet is just a little smaller, and has about the same rotation period as the Earth?

_____

Q: Which planet is the largest in the solar system?

_____

Q: Using the radius column of the table, how many times larger than the Earth is Jupiter?

_____