A Scale Model of the Solar System

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Background: From 1959 to the present the National Aeronautics and Space Administration has sent a number of spacecraft to explore our solar system. Many different types of spacecraft are used and many different kinds of scientific instruments gather data about the objects in our solar system. Spacecraft have flown by all of the planets except for Pluto and have encountered comets, asteroids, and all of the larger moons except Pluto's moon Charon. Satellites have been placed in orbit around Venus, Earth, and Mars. Landers have explored the surfaces of Mars, Venus, and the Moon. Men have landed on the Moon and brought back samples of lunar rocks and soil. Many of these spacecraft continue to send back new information about our solar system. Close-up photographs of distant planets and moons will be taken on future missions and detailed radar maps of the cloud-hidden surface of Venus are still being received.

Purpose: Construct a scale model of the solar system to familiarize the student with the relative sizes and positions of the planets in the solar system and the vast distances between them and between the Sun and other stars. A convenient scale has 1 foot representing 1 million miles. This same scale has 1000 miles representing 1 light-year.

Materials: See table on following page for representative objects. Saturn's rings can be constructed by photocopying the ring diagram below the table onto transparency material, cutting around the outside and cutting out the inside to fit over the 7/8 inch ball that represents Saturn. For additional realism paint the planets and Saturn's rings with appropriate colors and details. (Mercury: gray; Venus: white; Earth: blue, white, brown, and green; Mars; red; Jupiter; off-white with reddish-brown bands and a red spot; Saturn: yellowish-white with white rings; Uranus: light blue-green; Neptune: deep blue; Pluto: gray.)

Procedure: Place the basketball representing the Sun at the "center" of your solar system. The pinhead representing Mercury is placed about 12 yards (12 adult paces) from the Sun. The map-pin representing Venus is placed about 22 yards from the Sun and the map-pin representing Earth is placed 31 yards from the Sun. One can usually get the inner solar system, out to perhaps Mars, to fit within a long hallway or inside a gymnasium. If at all possible, it is quite informative to go outdoors and include at least Jupiter. For the rest of the outer planets it is best to simply note where they would be. For example, use a car to measure 0.7 miles from the "Sun" and find a suitable landmark for the orbit of Pluto. Finally, note that the nearest stars, the Alpha Centauri system, are represented by a basketball and two other somewhat smaller balls placed some 4300 miles away.

Questions: If you place yourself at the position of the model Earth, how large does the model Sun appear to be? (Hold up your thumb at arms length for comparison.) How does this compare with the apparent size of the real Sun as seen from Earth? (Don't look directly at the real Sun. If the Moon is visible you can use it for comparison since both the Sun and Moon **appear** to be the same size.) How large do the other model planets appear to be as seen from the position of the model Earth? Do you think you could see the pinhead sized model Pluto placed 0.7 miles away? With modern spacecraft it takes about 10 years to travel from the Earth to just beyond Pluto (about 1 mile in our scale model). How long would it take one of these spacecraft to travel to the nearest stars (4300 miles away in our scale model)? All these planets travel in nearly circular orbits with the Sun at the center. When the Earth passes between Mars and the Sun, Mars is only 16 yards away (47-31 yards). When the Earth and Mars are on opposite sides of the Sun, Mars is 78 yards away (47+31 yards), about five times farther. How much larger will Mars appear at its closest compared to its appearance at its farthest? Jupiter is almost five times as far from the Sun as the Earth, is so its orbital path around the Sun is nearly five times as long. Because of its greater distance from the Sun Jupiter travels around the Sun in its orbit at about half the speed that the Earth travels. If it takes the Earth a year to travel around the Sun, how long does it take Jupiter to travel around the Sun?

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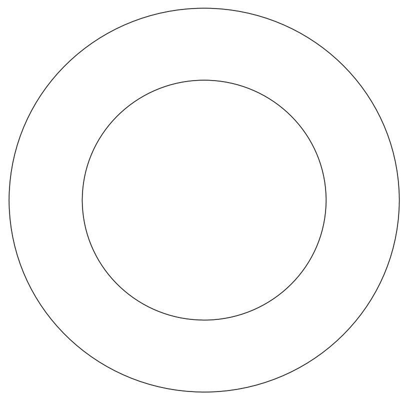
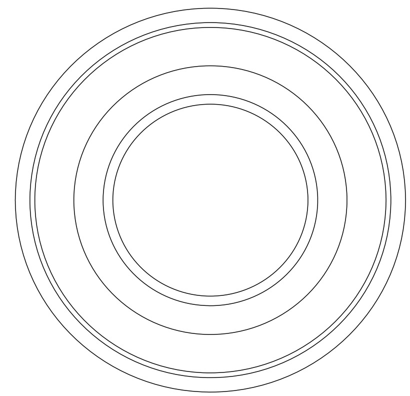
[Scale: 1' (12") = 1,000,000 miles]
equivalent to
[Scale: 1000 miles = 1 Light Year]

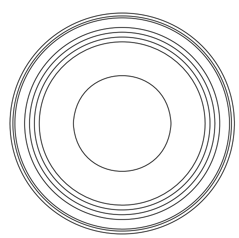
Object & Scale Size	Representative Object	Distance from Sun Model
Sun = 12"	**(Basketball)**	**@ Center**
Mercury = $^{1}/_{28}$"	**(Pinhead)**	**@ 36' (12 yd)**
Venus = $^{1}/_{11}$"	**(Quilting Pin)**	**@ 67' (22 yd)**
Earth = $^{1}/_{10}$"	**(Quilting Pin)**	**@ 93' (31 yd)**
Moon	**(Pinhead)**	**3" from Earth**
Mars = $^{1}/_{20}$"	**(Pinhead)**	**@ 142' (47 yd)**
Asteroids	**(Dust)**	**@ 258' (86 yd)**
Jupiter = 1 $^{1}/_{15}$"	**($1^{1}/_{4}$" Ball)**	**@ 486' (162 yd)**
Saturn = $^{9}/_{10}$"	**(1" Ball)**	**@ 891' (297 yd)**
Rings	**(2" Diameter Disk)**	
Uranus = $^{4}/_{10}$"	**($^{1}/_{2}$" Ball)**	**@ 1794' (0.3 mi.)**
Neptune = $^{4}/_{10}$"	**($^{1}/_{2}$" Ball)**	**@ 2810' (0.5 mi.)**
Pluto = $^{1}/_{58}$"	**(Pinhead)**	**@ 3695' (0.7 mi.)**
Nearest Star	**(Basketball)**	**@ 4300 miles**



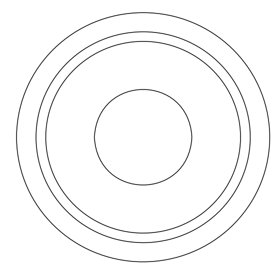
Jupiter



Saturn



Uranus



Neptune