

How to Make a Solar System Necklace

A M.A.R.S. Resource Document



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for the
Museum Astronomical Resource Society

Introduction

This craft began in the latter half of April 1998 when I was trying to think of astronomy activities that were entertaining for young children and yet informative. The Solar System appeared to be a good subject. I hit upon the idea of using beads of different sizes and colors to represent the different planets, and then added representations for the often overlooked asteroids and comets. The use of the string to represent the Sun fit so well in my mind that I grew very excited about the idea. I spent hours in the local craft stores with my six-year-old daughter, Allison, as we tried to find the best bead for each part of the Solar System. When I finally got together a collection of beads that I was happy with, I wore my prototype necklace to our club's Saturday evening observing sessions. The response from club members and the general public was very positive and so I was even more encouraged in my project.

The necklace went over very well at our club's Astronomy Day festivities on May 2, 1998. We made a total of 68 necklaces. The only reason we did not make more was that I ran out of some of the more critical necklace components. Several scout leaders and teachers were also excited by the concept. One person who teaches the blind thought that the concept would translate well for blind students with only slight modifications (different textures of the beads rather than different colors, etc.).

I hope that you will also be interested in this unique way of teaching astronomy to young children. I also hope that you will be inspired to develop other creative projects that our young children can easily and eagerly grasp.

James M. Thomas
May 8, 1998

Astronomical Measurements

It is a good idea to review certain measurements which are used throughout this document. A **mile** (abbreviated: mi) is a unit of length which is well known in the United States. It is also known as a statute mile, and is equivalent to 5280 feet or 1760 yards. The **kilometer** is not as well understood. Those currently studying the metric system in school or having recently completed their schooling, can probably understand its use. A kilometer (abbreviated: km) is equivalent to 0.621 mile, or 3280.8 feet. To convert a distance from miles to kilometers, multiply the number by 1.609. For quick, rough conversions from kilometers to miles, a distance stated in kilometers is approximately 2/3 of the number in miles (example: 100 km is *roughly* 66 mi and *exactly* 62.1 mi). The large distances within our Solar System are often given in **AU** or **astronomical units**. This is equal to the mean distance between the Earth and the Sun (92,900,836.17 mi or 149,598,770 km). Most people might be familiar with the rough approximation of 93 million miles. This number is good for making rough conversions as long as you are not using the figure for something important, like a school paper or a space flight E.T.A.! For longer distances, astronomers use such units as a **light-year** (abbreviated: lt-yr or l-y). This is the distance which light travels in one mean solar year, and approximately equivalent to 5,880,000,000,000 mi (5,800 billion miles) or 9,460,000,000,000 km (9,460 billion kilometers) or 63,240 AU. This unit of measure relies upon the **constant velocity of light** (commonly referred to as the "speed of light"), which is equivalent to 299,792.5 kilometers per second, or about 186,282.3976 statute miles per second.

How did the Solar System Form?

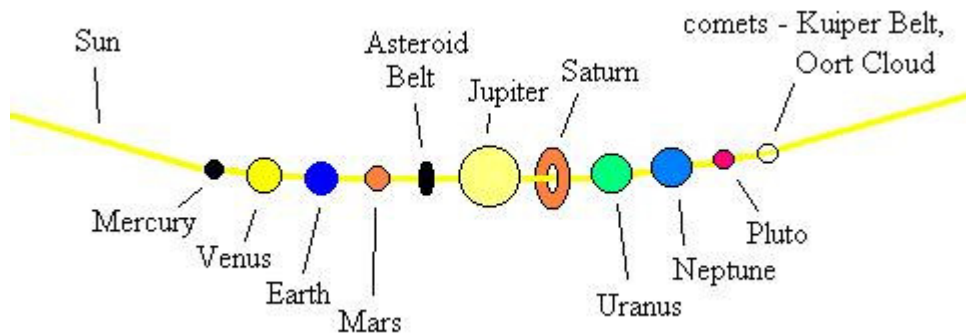
Astronomers believe that the Solar System condensed out of a cloud of gas and dust (a mixture which author James Muirden calls "gust"). The most common ingredient in this cloud was hydrogen gas. The dust included solid grains of iron, carbon, silicon, and many other familiar elements. When the cloud began to condense, much of the material gathered at the center, pulled by gravity. A kind of "runaway attraction" began: the greater the amount of material accumulating at the center, the greater the pull and the appetite for more. As the supply of material began to run out, thermonuclear reaction started at the center. The concentration at the center eventually became hot enough to strip hydrogen atoms and rebuild them as helium, releasing great amounts of energy. This is how our Sun was born. The energy at its center keeps the nuclear reaction going and prevents the Sun from shrinking smaller under the pull of gravity.

The planets condensed out of smaller clouds of this gas and dust mixture. These protoplanets became hot enough to melt the mixture. The heavier elements concentrated in the core. The lighter elements formed the outer layers of crust and atmosphere.

The bodies which melted into small chunks of rock that are called asteroids, minor planets, or planetoids. The clumps of material which did not become hot enough to melt, because they were much smaller, became what we call comets.. Their material is crumbly rather than solid.

What is a Solar System necklace?

A Solar System necklace is a fun and fashionable way for young astronomers to remember the main parts of our Solar System. Each piece is a wonderful reminder of something in our solar neighborhood. The necklace is also a great teaching tool. Just by wearing the necklace you are ready to give an impromptu lesson that is informative and entertaining. Below you will find all you need to make a necklace and give a talk on our Solar System. The **Necklace** column provides suggestions on what beads and string to use for the necklace. Try to follow the suggestions as closely as possible so that the wearer can more easily associate the necklace part with the related Solar System part. The **Explanation** column explains the main associations between the necklace part and the Solar System part. It also provides interesting information on that part of the Solar System. You should share the information in this column with the maker as they are putting the necklace together. The **Facts** column provides more technical information for the astronomer who wants to learn more. Have fun making and sharing your Solar System necklace with your friends.



<u>Necklace</u>	<u>Explanation</u>	<u>Facts</u>
small bead, black or gray in color	"The first bead is small and dark . It reminds us of Mercury , the closest planet to the Sun. It is also small, dark and has many craters."	Diameter: 4,878 km, 3,029 mi Average distance from the Sun: 57.9 million km, 36 million mi, 0.387 AU Length of Year: 87.97 Earth days
larger bead than Mercury, yellow in color	"The next bead is larger and yellow . It reminds us of Venus , the next planet. Venus has a very thick atmosphere and is covered with clouds. Much of the Sun's light is reflected by the clouds, making Venus look like a yellow ball."	Diameter: 12,104 km, 7,517 mi Average distance from the Sun: 108.2 million km, 67 million mi, 0.723 AU Length of Year: 224.7 Earth days
bead the same size as Venus, blue in color	"The next bead is blue . It reminds us of Earth , our own planet. Water covers 2/3 of Earth and so from space it looks like a pretty blue ball."	Diameter: 12,756 km, 7,921 mi Average distance from the Sun: 149.6 million km, 92.9 million mi,

		1 AU Length of Year: 365.26 Earth days
bead the same size as Earth or smaller, either orange or red in color	"The next bead is orange . It reminds us of Mars , the fourth planet from the Sun. We often call Mars the Red Planet, but telescope views and images from spacecraft show it to be bright reddish-orange in color. That is because there is more iron in the Martian soil that has oxidized, or rusted!"	Diameter: 6,787 km, 4,214 mi Average distance from the Sun: 227.9 million km, 142 million mi, 1.524 AU Length of Year: 686.98 Earth days
small bead, dark, not necessarily round	"The next bead is small, dark and roughly-shaped . It reminds us of the asteroid belt, and area between Mars and Jupiter where many big and small rocks orbit the Sun. Asteroids are also called minor planets. Thousands of asteroids have been discovered throughout our Solar System, but most are located in the asteroid belt. The first asteroid was discovered in 1801 and was named Ceres. Ceres is the largest asteroid found to this point. It is 1,025 kilometers, or 637 miles in diameter."	Distance from the Sun: The asteroid belt orbits between 227.9 million and 778.3 million km, or between 364.6 million and 1,245.3 million mi
largest bead on the necklace, round	"The next bead is larger . It reminds us of Jupiter , the largest planet in our Solar System. Jupiter is so large that, if it were hollow, it could hold 50 Earths within its shell. Jupiter is composed mostly of gas and most of that gas is hydrogen."	Diameter: 142,794 km, 88,676 mi Average distance from the Sun: 778.3 million km, 483 million mi, 5.203 AU Length of Year: 11.86 Earth years
ring-shaped bead	"The next bead has the shape of a ring . It reminds us of Saturn , a planet with the large ring around it. Saturn has the largest system of rings in our Solar System. The rings are made of pieces of ice and rock, all moving around Saturn together. Like Jupiter, Saturn is composed mostly of hydrogen gas."	Diameter: 120,660 km, 74,930 mi Average distance from the Sun: 1,424.0 million km, 886.2 million mi, 0.539 AU Length of Year: 29.46 Earth years
smaller bead than Jupiter, green or blue-green in	"The next bead is green in color. It reminds us of Uranus , which has a greenish-bluish color. Like Jupiter	Diameter: 51,118 km, 31,744 mi Average distance from the Sun:

color	and Saturn, is composed mostly of hydrogen."	2,871.0 million km, 1,781.8 million mi, 19.18 AU Length of Year: 84 Earth years
same size bead as Uranus, blue or light blue in color	"The next bead is bluish in color. It reminds us of Neptune , the last of the outer gas planets. Neptune is also composed mostly of hydrogen, but the methane in its outer atmosphere helps to provide its bluish color."	Diameter: 49,528 km, 30,757 mi Average distance from the Sun: 4,497.1 million km, 2,792.6 million mi, 30.06 AU Length of Year: 164.8 Earth years
small bead, reddish in color	"The next bead is small and reddish in color. It reminds us of Pluto , the planet with the largest orbit around our Sun."	Diameter: 2,300 km, 1,428 mi Average distance from the Sun: 5,913.5 million km, 3,672.3 million mi, 39.53 AU Length of Year: 247.7 Earth years
bead as small as Pluto or smaller if possible, clear	"The last bead is small and clear . It reminds us of the icy comets that originate in the outer reaches of our Solar System. Comets are made of rocky material and frozen gases. Because of this, comets are sometimes called "dirty snowballs". Scientists believe that there are two sources for the cometary material The closest is called the Kuiper Belt (pronounced "KI -per belt"), a doughnut-shaped ring of material that extends from the about the orbit of Pluto out to 3.7 billion miles from the Sun. The other source of comets is called the Oort Cloud (pronounced "ORt cloud"), a sphere of material that extends from the edge of the Kuiper Belt out to 9.3 trillion miles - almost 2 light years from the Sun. Astronomers now believe the cometary material is divided into an Inner Oort Cloud and an Outer Oort Cloud. Each of these clouds are believed to contain trillions of comets."	Average distance from the Sun: Kuiper Belt - from 35 or 40 AU to several hundred AU Inner Oort Cloud - from about 3,000 AU to 20,000 AU Outer Oort Cloud - from 20,000 AU to 100,000 AU (almost 2 light years)
yellow string	"The string holding all of the beads together is yellow . It reminds us of our yellow Sun which holds the	Diameter: 1,392,000 km, 864,000 mi

	<p>family of the Solar System together."</p> <p>Craft notes: A string length of 30" works well for all wearers. You may want to pre-cut the lengths. If your string frays easily, put a dab of glue one of the ends and twist it. Not only will this keep the string from fraying, but it will also make a great built-in needle for threading the beads. Tie a knot in the other end to keep the beads from falling off as you thread them.</p>	<p>Temperature:</p> <p>Chromosphere (above the Sun): about 14,000° F</p> <p>Photosphere (surface layer): 10,300° F</p> <p>Core (center): about 27,000,000° F</p>
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After stringing the beads, review all of the parts before tying the necklace. Call off of the parts by their Solar System name. This is a check to be sure that all of the beads are strung and in the right order. It also helps to reinforce the Solar System parts and their distance from the Sun.

Companion Memory Sentence

Here is a sentence to help remind you of the parts of the Solar System: "My very energetic mother, Ann, just served us nine peach cobblers." The first letter of each word reminds you of the first letter of each Solar System part. The parts are ordered by the size of their orbit around the Sun, from smallest to largest. When you say the sentence you remember: Mercury, Venus, Earth, Mars, asteroid belt, Jupiter, Saturn, Uranus, Neptune, Pluto, comets.

Document History

- March 2, 1998 First distributed as a craft during the M.A.R.S. Astronomy Day activities at MOSI in Tampa, Florida.
- March 8, 1998 Revised the text and included an illustration of the necklace for better understanding.
- February 17, 1999 Revised into an on-line document which is accessible over the Internet from the M.A.R.S. web site.

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