Activity 2 The Great Student Solar System Model

Objectives
• Participants will demonstrate the ability to convert distance data into a large-scale model of the solar system (using the "Astronomical Unit" as a yardstick) with participants representing the planets.

Materials
• 10 white poster boards (Approximately 2 x 3 feet in size)
• thick black marking pen
• piece of brightly colored yarn, rope (corresponding to the length of your "A.U." (see below).
• table 1 C

Explore / Explain

Tell participants that they are going to measure distances to the various planets, and that some of them will "become" the planets, in an accurately-scaled representation of their correct distance from the Sun. Pass out copies of Table 1 C. Point out the distances in miles or kilometers: ask them if they have their walking shoes ready!

Procedure Explain that to build this model, the class will have to scale down the distances involved, to numbers that can be dealt with easily. Look at Table 1 C with them. Point out that if we try to deal with distances to planets in either miles and kilometers, we have to work with huge numbers. (Ask them if we could talk about distances to major cities around the world in inches? Ask them why we don't.) With this in mind, introduce them to a useful new unit of distance, the Astronomical Unit, which is the distance of the Earth from the Sun, just under 93 million miles or 150 million kilometers. This will become our new "yardstick." As a math exercise, have them calculate the distances from the Sun to all the planets in A.U.s, and then confirm their answers with the right-hand column of numbers in the table. Next, have them calculate the distance in A.U.s of each planet from its neighbor. Point out that now, when representing the solar system, instead of dealing with numbers in the hundreds of millions, we only have to worry about numbers up to about 40, at most.

Brainstorm where the class will create its Great Student Solar System. (Hint: Pick a space long enough to be impressive, and fun like a playground or athletic field.) Next, choose a reasonable length for the A.U. in your model. (Hint: Pre-measure the total length of the area likely to be selected for the model and divide this length by 40. This will mean that if the Sun is at one end of the space, Pluto will just neatly fit at the other, with all the other planets spaced out [sic] in between.)

Let participants choose to be the different planets and the Sun. If you are preparing this Activity one day and making the model the next, suggest that they wear clothing appropriately-colored for their celestial object. (Mars is a nice, fashionable, rust-color, but Jupiter might require something tie-dyed.)

Discuss having more than one student be each planet, with the number of participants indicating the relative size of the planet. Have participants make posters with the names of their celestial object in large letters, with a picture, created by them, or found in a magazine (being sure only to use ones that are ok to cannibalize!)

To construct your model, go to the designated place with participants, posters, and the piece of brightly-colored yarn cut to the length of A.U. chosen for your model. Start at the Sun and place that student in position. Select two or three participants as Official Solar

System Measurers (OSSMs). With A.U. yarn in hand, have them measure off the correct distance to each planet, using the numbers they have calculated. As the OSSMs reach the right position for each planet, have the student who will represent that planet take their place until the whole solar system is complete. Then, take a few pictures of your Great Human Solar System Model and return to class for discussion.

See also Carl Sagan's Pale Blue Dot for a discussion of how when Voyager left our solar system, beyond the orbit of Neptune, it turned to take a farewell snapshot which emphasized just how small our Earth was against the huge dimensions of our solar system: think about doing something rather similar, looking out from the Sun to distant Pluto, and vice versa.

When the participants reassemble, discuss what they discovered about how the planets were spaced. Most will probably be surprised to see how relatively close together the first four planets are, crowded around the Sun. Beyond Mars, however, the planets are vastly spread out.

Expand

Ask the participants who represented each planet to work with a small team of other participants to figure out how large each of their planets would be, if the actual solar system were really as small as the model you just created. Use Table 1B-1, and help them make scale cross-references as necessary. Ask them to figure out the distance their planet would be from the Sun if you used planets of that size in your model. As a math and social studies activity, using local maps, have them figure out where in your community their models would need to be, if they used this larger scale, and the planets were properly distanced from your school, which would represent the Sun. See if, as a "Science Expo," project wrap-up, or year-end activity, you could distribute planet models made by the participants around your town, at the right distances in public buildings for everyone to see. Invite the press, district administration, and parents to see math, astronomy, science and art in cooperative action!

"Moving Targets"
The position of any object on Earth can be plotted on a map using that object's unique longitude and latitude. In the same way, celestial objects can be plotted on maps of the sky using a similar set of coordinates. Declination (Dec.) takes the place of latitude and is measured in degrees and minutes of arc north (+) or south (-) of a line in the sky called the "celestial equator," which lies directly above the equator on Earth. Astronomers use Right Ascension (R.A.) in place of longitude. Just as longitude is measured from a line on Earth called the prime meridian, so Right Ascension is measured from a line that passes through a point in the sky called the "vernal equinox." Right Ascension keeps track of how the sky overhead rotates over time during the day and night, and so Right Ascension is measured in units of time (hours and minutes). The Right Ascension and Declination of stars don't change significantly on the time scales we need to worry about for contemporary astronomy. But the planets are all moving around the Sun at different speeds in different orbits so their Right Ascensions and Declinations are always changing along with that of the Sun (since the Earth, too, is moving).