Modeling Orbits and Distances in the Solar System

Prep Time: 15 minutes	**Grades:** 5-8	**Lesson Time:** 50 mins

Essential Questions:

- What does our solar system *really* look like?

Objectives:

- SWBAT create a model for planets' distance from and orbit around the Sun.

Standards:

- MS-ESS1-2: Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.
- MS-ESS1-3: Analyze and interpret data to determine scale properties of objects in the solar system.

Teacher Prep:

- Prepare any supplies being used for this lesson. Students will likely need poster boards or cardboard to display their planet distances and orbits. The size of the poster board could be used as an additional challenge; students must fit their model on the poster.

Teacher Notes/Background:

- This lesson is flexible based on the supplies and time available. Students can draw or use string for the distances and orbits and beads or their scaled models from the Modeling Planet Size lesson.

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Engage (3 minutes)	**Appropriate Units** Introduce the idea of using appropriate units when measuring different things. For example, what units would students use if they were measuring the length of their pencil? What about length of the classroom? The distance to California? The distance to Jupiter? While you're measuring the distance in all of these, it's best to use different units.	**Materials:** N/A
Explore (10 minutes)	**Review Let's Launch! and planet distances** Review that many distances in our Solar System are measured in AUs (astronomical units). One AU is equal to the distance from the Sun to the Earth, or 149,597,870.7 km. Review the distances of each planet from the Sun in AU. This can either be provided during instruction or students can do the research independently. Have them complete the chart on the worksheet. The distances are: Mercury: 0.39 AU Venus: 0.72 AU Earth: 1 AU Mars: 1.52 AU Jupiter: 5.2 AU Saturn: 9.5 AU Uranus: 19.2 AU Neptune: 30.1 AU	**Materials:** • Computers for research (if using) • Attached handout
Explain (7 minutes)	**Creating a Scale for Your Model** Having all the distances in AU is like already having a scale, but, depending on the size of the model your students are making, they may need to make an additional scale. Depending on the size, they can either make models that are strictly distance, or once that model the orbits, as well. If they are modeling the orbit, remind students that the distance from the Sun will be the radius of the orbit.	**Materials:** • Attached handout • Calculator, if needed

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Elaborate (20 minutes)	**Create the Models** Students will now create their models. Students should use the attached worksheet to help guide them. This can be done with many different materials: • Pen/Markers, paper • String, beads • The scaled models from the Planet Size Model lesson with lines or orbits drawn by string or marker You could even create a class model where students pair up, one acts as a planet, one acts as the Sun. They cut a string with the appropriate scaled distance. All the "Suns" stand in the middle and the other partner holds the other end and orbits around the middle.	**Materials:** • Poster board • Other materials being used for models

Evaluate (10 minutes)	**Presentation of Models** Students will be evaluated based on the completeness and accuracy for their solar system size models. Ask reflection questions, such as "what do you notice about the size of all the planets compared to the entire Solar System?" and "are you surprised by the differences in planets' years now that you've seen their orbits?"	**Materials:** • Completed models

Extensions and Enrichment:

- The activity of students modeling the Solar System can be an extension or act as an activity for before they create their models. It is best if this is done outside on a large field. Each student can then physically follow their planet's orbital path around the Sun and see why a year on Neptune is significantly longer than a year on Mercury.

Additional Resources:

- **NASA eClips video: Real World: Scaling the Solar System**
  Paul Chodas, Manager for NASA's Near-Earth Object Program, explains Astronomical Units (AUs) and how this unit of measure helps simplify an understanding of distances within the solar system. To further simplify thinking about these vast distances, distances within the solar system are explained scaled to the size of a football field.
  https://nasaeclips.arc.nasa.gov/video/realworld/real-world-scaling-the-solar-system

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Directions: Complete the chart with the planets' distance from the Sun in AU (astronomical unit). Then, use those distances to make the scale for your model.

	Mercury	Venus	Earth	Mars
Distance from Sun (AU)				
	Jupiter	**Saturn**	**Uranus**	**Neptune**
Distance from Sun (AU)				

Create a scale: _____ AU = _____

	Mercury	Venus	Earth	Mars
Scaled Distance				
	Jupiter	**Saturn**	**Uranus**	**Neptune**
Scaled Distance				

Now, create your model! Be precise with your measurements to make sure it is as accurate as possible. Don't forget to put your scale on your model. If you are including the orbits of the planets, remember that the distance is the radius of the orbit.