



The Nature of Our Universe; The Formation of Our Solar System and the Planets

<b>Student Science Performance</b>	
<b>Grade or course: 9-12 Earth Systems</b>	<b>Title:</b>
<b>Topic: Using Scales to determine size (scale emphasis)</b>	Teacher, I Shrunk the Solar System
<p><b>Performance Expectation for GSE:</b>  <b>SES1. Obtain, evaluate, and communicate information to investigate the composition and formation of Earth systems, including the Earth’s place in the solar system.</b></p> <p>a. Construct an explanation of the origins of the solar system from scientific evidence including the composition, distribution and motion of solar system objects.  <i>(Clarification statement: The nebular hypothesis should be included in this element.)</i></p>	
<p><b>Performance Expectations for Instruction:</b>            The GSE for Earth Systems requires that students continually develop and use models in order to better explain concepts across the various instructional segments.            Investigate how models are used to model the solar system and celestial bodies in the solar system.</p> <p><a href="#"><u>Additional notes on student supports</u></a></p>	
<p><b>Materials for a class of 30</b>  <b>Based on three students per group</b>  <b>(note there are various versions of this activity, please feel free to adapt to meet the needs of your students)</b>            10 adding machine paper rolls or toilet paper            20 meter sticks (2 per group)            10 metric rulers            10 images Jupiter with the Great Red Spot visible such as <a href="#"><u>Cassini photo of Jupiter</u></a>            Data tables with distance to the Sun and diameters of planets</p>	
<p><i>Students will continuously obtain, evaluate, and communicate information. This is not a linear process. Students will communicate through writing and discussions to allow for formative assessment. This benefits the teacher, student, and whole group to guide instruction to clarify misconceptions or extend content.</i></p>	
<b>Engaging Learners</b>	<p><b>Phenomenon</b>            Scientists use scaled models to represent phenomena that are too large or small to study in a lab. The solar system is such a phenomenon.</p> <p>Research and watch <a href="#"><u>Maine Solar System Model</u></a></p> <hr/> <p><i>Obtaining</i>            Activity 1- Students obtain a picture of the Solar System.</p> <p><i>Teacher Notes: Make sure the image is not to scale, such as <a href="#"><u>Image of Solar System (not to scale)</u></a>.</i></p>



	<p><i>Evaluating</i>          Activity 1- Students discuss the accuracy of the image  <i>Teacher Notes: Students should notice the rings of Saturn and Jupiter will collide. Therefore, there is something wrong with the image.</i></p> <p><i>Communicating</i>          Each student should explain and justify their decisions. Ask students to determine what additional data they will need to make a better model of the Solar System.          Have students look in textbooks and on the internet to locate other solar system models that are not to scale.  <i>Ask: Why is a model of the solar system in an image a difficult thing to represent?</i></p>
<p><b>Exploring and Explaining</b></p>	<p><i>Obtaining</i>          Obtaining the data for the model of the solar system activity</p> <ol style="list-style-type: none"> <li>1. Students will obtain data tables with sufficient and appropriate data to sketch a model of the solar system.</li> <li>2. If space is available, a hallway, gym or outside will provide locations for easier models.</li> <li>3. Students will determine which scale that they want to use. This will determine the size of the Sun.</li> <li>4. From there, they can determine the distance to the planets and their diameters.</li> <li>5. Remind students that the same scale must be used for diameters as for the distance to the Sun.</li> </ol>
	<p><i>Communicating</i>          Using the data          Students will use the data to sketch the solar system on the long sheets of paper or toilet paper. The students will share their models with the class.</p>
	<p><i>Evaluating</i>          The solar system model:          Have students search for “Solar system model to scale” on the internet. There will be several resources for them to check their answer. One option has a java app where the students can insert the diameter of the Sun. The app calculates the diameters and distances.</p>
<p><i>Elaborating</i>          Applying Model to Solve a Problems</p>	<p><b>Phenomenon</b>          Jupiter’s Red Spot: How large is it?</p> <p><i>Obtaining</i> - Students obtain an image of Jupiter with the Great Red Spot visible, such as <a href="#">Cassini photo of Jupiter</a>. Knowing the scale between Jupiter and the Earth, the students will estimate how large the Great Red Spot is.</p>



	<p><i>Evaluating</i> - Students will compare their estimate with respect to NASA measured values.</p>
	<p><i>Communicating</i> - Students will explain their method in a poster with their results.</p>
	<p>Research: Origins of the Solar System</p> <p>An optional resource for students: <a href="#">NASA Solar System Exploration</a></p> <p>Have students use this information and other resources to construct an explanation of the origins of the solar system including composition, distribution and motion of solar system objects.</p> <p>Challenge them to share their explanations in a presentable format.</p>
<b><i>Evaluation</i></b>	<p style="text-align: center;"><b><i>Assessment of Student Learning</i></b></p> <p>Students should construct an explanation of the origin of the solar system. Students may need to conduct research to be able to use evidence to support their theories.</p>
<b><i>SEP, CCC, DCI</i></b>	<b>Science Essentials</b>
Science and Engineering Practices	<ul style="list-style-type: none"> <li>● Constructing explanations</li> <li>● Obtaining, evaluating, and communicating information</li> </ul>
Crosscutting Concepts	<ul style="list-style-type: none"> <li>● Patterns</li> <li>● Scale, Proportion, and Quantity</li> <li>● Systems and System Models</li> </ul>
Disciplinary Core Ideas	<p>From <a href="#">A Framework for K-12 Science Education</a>:</p> <ul style="list-style-type: none"> <li>● <b>ESS1.A: THE UNIVERSE AND ITS STARS</b></li> <li>● <b>ESS1.B: EARTH AND THE SOLAR SYSTEM</b></li> <li>● <b>ESS1.C: THE HISTORY OF PLANET EARTH</b></li> </ul>



**Additional Supports for struggling learners:**

**The following supports are suggestions for this lesson and are not the only options to support students in the classroom. These supports target students that struggle with science material, this lesson or a previous lesson. These are generalized supports and do not take the place of IEP accommodations as required by each student’s Individualized Education Program.**

**General supports for the following categories:**

<u>Reading:</u>	<u>Writing:</u>	<u>Math:</u>
<ol style="list-style-type: none"> <li>1. Provide reading support by reading aloud or doing partner reads</li> <li>2. Have the teacher model what they are thinking when reading the text</li> <li>3. Annotate the text with students so that they may refer to it as they work through the lab</li> </ol>	<ol style="list-style-type: none"> <li>1. The teacher can provide a sentence starter for the students.</li> <li>2. The teacher can give students an audience to write to (i.e. Write a letter to your sibling explaining this topic).</li> <li>3. The teacher can provide constructive feedback during the writing process to help students understand the expectations.</li> </ol>	<ol style="list-style-type: none"> <li>1. Provide calculators as needed.</li> <li>2. Provide graph paper as needed.</li> </ol>

**Supports for this specific lesson if needed:**

**Performance expectations for instruction:**

1. The teacher should provide information to students in various formats to reach as many students as possible.
2. The students should be given adequate time to complete each part of the lesson.
3. The students should be allowed to express their knowledge in various formats.
4. The teacher should be sure to provide multiple ways for the students to communicate their knowledge of the material.

**Engage:**

1. The teacher should have clear and consistent guidelines for discussion. This will make students feel safer and be more likely to participate.
2. The teacher should consider giving students sentence starters for any writing that they will complete.
3. The teacher should consider giving students resources to find solar system models and any other research that they need to complete.
4. The teacher should be sure to provide multiple ways for the students to communicate their knowledge of the material. These formats could include writing, drawing or creating a presentation.
5. Students may need additional time to complete their justifications.

**Exploring/Explaining:**

1. The teacher should consider giving students resources to use to guide their models and other research.
2. The teacher may have to remind students of scale and give examples of how scale may be used.
3. The teacher should consider letting students work together to complete their research and models.
4. The teacher should use flexible and intentional grouping. Best practice is to use data to drive student grouping.
5. The teacher should have clear and consistent grouping. This should help the students to feel more comfortable and be more willing to participate.
6. The teacher should be sure to provide multiple ways for the students to communicate their knowledge of the material. These formats could include writing, drawing or creating a presentation.
7. The teacher should consider a gallery walk rather than being put on the spot to present in front of their peers.
8. Then the teacher should consider letting students revise their models.
9. The teacher should provide a rubric for students to self-assess their work.
10. The teacher can consider giving students a to scale model for students to check their work.

**Elaborating:**

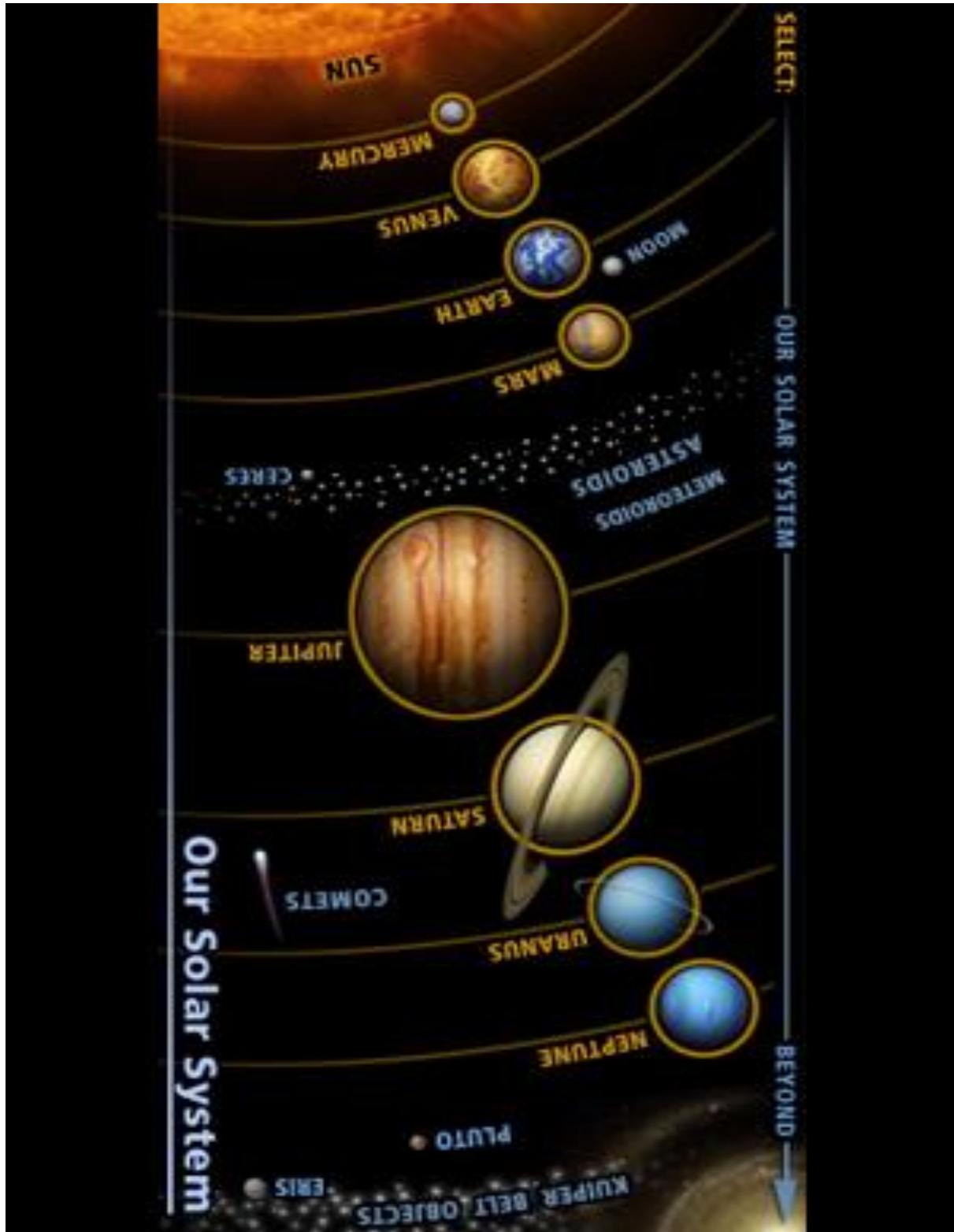
1. The teacher should consider showing a video or providing an image for students to view the red spot.
2. The teacher should have students check their answers against one another and decide which answer is most correct prior to checking against NASA's calculations.
3. Students may need additional time to complete their calculations and check their work.



**Evaluating:**

1. The teacher should be sure to provide multiple ways for the students to communicate their knowledge of the material. These formats could include writing, drawing or creating a presentation.
2. Students may need additional time to complete their explanations.

Solar System (Not to scale)



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