An Impossible Alignment: Building a Scale Model of the Solar System

Geology 1P Mr. Traeger

Name: ______________________ Period: ____ Date: ___________________

Purpose

The purpose of this assignment is to become familiar with the scale of the solar system. It shows visually the average distance of each planet from the sun if an impossible alignment of the planets were to occur. It also shows the relative diameters of the planets and their angle of tilt.

Materials

- 400 cm of 7.5 cm (3") Adding Machine Tape
- Drawing Compass
- Meter Stick
- Textbook
- Colored Pencils
- Protractor

Part 1: Drawing the distances from the sun in the solar system to scale

1. Convert each of the following planetary distances into astronomical units (AU).
2. Once you have converted into AU's, then determine a ***scaling factor*** that will allow your farthest distance away from the sun to fit on to your 400 centimeter long tape.
3. Convert your distances into centimeters using the scaling factor.
4. Unroll your adding machine tape. Draw in the sun to its appropriate size. Measure the distance that each planet would be away from the sun. Mark these distances on your adding machine tape.

Planet	**Average Distance from Sun in Km**	**Scaling Factor to convert to AU's**	**Average Distance from Sun in AU's**	**Scaling Factor to convert to cm**	**Scale Average Distance from Sun in cm**
Mercury	**58,000,000**				
Venus	**108,000,000**				
Earth	**150,000,000**				
Earth's Moon at Full Phase	**150,384,400**				
Mars	**228,000,000**				
Asteroid Belt	**400,000,000 to 600,000,000**				
Jupiter	**778,000,000**				
Saturn	**1,430,000,000**				
Uranus	**2,870, 000,000**				
Neptune	**4,500,000,000**				
Pluto	**5,900,000,000**				
Quaoar	6,510,000,000				
Eris	1.0×10^{10}				
Heliopause	1.5×10^{10}				
Sedna	7.9×10^{10}				
Oort Cloud Comets	1.5×10^{13}				
Alpha Centauri, our nearest star	4.114995×10^{13}				
Center of Milky Way Galaxy	2.46×10^{17}				
Andromeda Galaxy	2.08×10^{19}				
Oldest Galaxies	1.23×10^{23}				

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Part 2: Drawing the diameters of each planet to scale

1. We will need to make a separate scale to calculate the scale diameter of each of the planets. This is because the planets would appear extremely small if we were going to draw them according to the previous scale that we calculated.
2. We will convert the actual diameters into Earth diameters, or how each planet would compare to the Earth.
3. We want to determine another scaling factor that will allow our largest planet to fit within the confines of a 7.5 cm wide adding machine tape.
4. Once we scale down the diameter of our planets to fit on the adding machine tape, we will draw each planet (using a compass) on our tape. We will draw each planet at the exact location that was determined in Part 1.

Planet	**Diameter (Km)**	**Scaling Factor to Convert to Earth Diameters**	**Earth Diameters**	**Scaling Factor to convert to cm**	**Scale Diameter in cm**
Sun	1,392,000				
Mercury	4,880				
Venus	12,104				
Earth	12,756				
Earth's Moon	3,476				
Mars	6,787				
Jupiter	142,800				
Saturn	120,000				
Uranus	51,800				
Neptune	49,500				
Pluto	2,300				

Part 3: Drawing the Axes of Each Planet

1. Using a protractor, draw the axis of each planet. Note that any planet that has an angle greater than 90° is spinning in the opposite direction of Earth.

Planet	**Angle From Vertical**	**Planet**	**Angle from Vertical**
Mercury	2°	Jupiter	3°
Venus	177.3°	Saturn	27°
Earth	23.5°	Uranus	97.9°
Earth's Moon	7°	Neptune	30°
Mars	25°	Pluto	122°

Part 4: Making it Look Good

1. Now, using pictures from your book make your Solar System Scale a work of art! **Don't forget to draw the asteroid belt!**

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Part 5: Questions

1. Why is this activity titled ñAn Impossible Alignment?òWhat is impossible about it?

2. The Astronomical Unit (AU) is not an appropriate unit for measuring distances to stars and galaxies. The appropriate unit is the light year. This is defined as the distance that light travels (at the speed of light) in one year. The speed of light is 3×10^{5} km/s and one light year is 9.47×10^{12} km. Use the following chart to convert the following distances to light years.

Planet	**Average Distance from Sun in Km**	**Scaling Factor to convert to light years**	**Average Distance from Sun in light years**
Mercury	58,000,000	9.47×10^{12}	
Venus	108,000,000	9.47×10^{12}	
Earth	150,000,000	9.47×10^{12}	
Earthõs Moon at Full Phase	150,384,400	9.47×10^{12}	
Mars	228,000,000	9.47×10^{12}	
Asteroid Belt	400,000,000 to 600,000,000	9.47×10^{12}	
Jupiter	778,000,000	9.47×10^{12}	
Saturn	1,430,000,000	9.47×10^{12}	
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Pluto	5,900,000,000	9.47×10^{12}	
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Oldest Galaxies	1.23×10^{23}	9.47×10^{12}	

3. How small do you feel now? Explain in a paragraph of no fewer than 50 words on the back of this sheet.