A Scale Model of the Solar System

SKILLS MENU

- Questioning
- Hypothesizing
- Predicting
- Planning
- Controlling Variables
- Performing
- Observing
- Analyzing
- Evaluating
- Communicating

When scientists are dealing with very large objects, they often create scale models to help them view a system as a whole. Unfortunately, the enormous distances in space make constructing a scale model of the Solar System a challenging task. To put this into perspective, the distance between Earth and the Sun is almost 12 000 times the diameter of Earth!

In this activity, you w ill attempt to build a scale model of the Solar System to represent the distances between the Sun and the planets.

Purpose

To build a scale model of the Solar System using data and calculations.

Equipment and Materials

- calculator
- 100 m tape measure or trundle wheel
- pictures of objects in the Solar System

Procedure

SKILLS HANDBOOK 4.A.4.

1. Work in small groups. Your teacher will provide each group with a picture of a celestial object in the Solar System.
2. The radius of the Solar System is roughly 50 AU, which is the distance to the farthest dwarf planets that have been observed. In the scale model you will produce, 2 m will be equal to 1 AU. This means that if the Sun is placed at one edge of the model, then the farthest dwarf planet will be 100 m away (Figure 1).

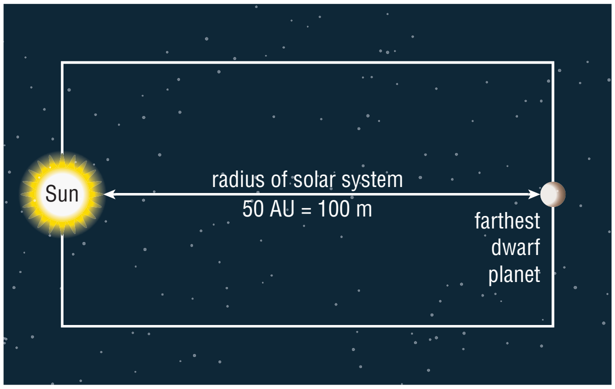

Figure 1

MATH TIP

To convert distances using a scale, remember that

$$\frac{2\text{ m}}{1\text{ AU}} = \frac{X\text{ m}}{\text{actual distance}}$$

Simply cross multiply to obtain the value for X in metres.

3. Copy Table 1 into your notebook. (Include only those objects that your class is working with.) Using the information given in step 2 and the values given in Table 1, convert the actual distance to your object into a scale distance. Record this value in the third column of Table 1.

Table 1 Planetary Distances from the Sun

Object	Actual distance (AU)	Scale distance (m)
Sun	0	
Mercury	0.39	
Venus	0.72	
Earth	1.0	
Mars	1.5	
asteroids	2.5	
Ceres	2.8	
Jupiter	5.2	
Saturn	9.5	
Uranus	19	
Neptune	30	
Pluto	40	

4. Share the values for your celestial objects with those of other groups in the class. Add the celestial objects and values found by other groups to Table 1 in your notebook.
5. Take the picture of your object to the location your teacher has designated as the model (your school football field, for example). Use the tape measure or trundle wheel to measure out the scale distance from the picture of the Sun to your object. Place your picture on the ground at that distance.
6. Once all of the groups in the class have placed their objects on the field, walk through the scale model of the Solar System as a class, identifying the objects as you go.

Analyze and Evaluate

(a) From your model, what do you notice about the distance between the terrestrial planets compared with the spacing between the gas giants? T/I

(b) Consider all the information presented in Table 2.

(i) Which planet is most similar to Earth? Which is most different? Explain your reasoning. T/I

(ii) Which planets have densities much lower than that of Earth? What can you conclude about these planets? T/I

(iii) What are some ways in which you could classify the planets, using the data presented in Table 2? T/I

(iv) Which planet is most different from the other planets? Explain how it is different, using examples from Table 2. T/I

Apply and Extend

SKILLS HANDBOOK 3.B.7., 5.C.

(c) All of the planets except Venus and Mercury have moons. Select one planet, and research how far one of its moon is. Then calculate how far its moon would be at this scale. T/I

(d) For the planet you chose in (c), determine whether it has a solid surface or a gaseous surface. Research three other physical properties of the planet, such as colour, the elements that make up its atmosphere, its temperature, and its density. Present your information to the class. T/I C

(e) The closest star to our Sun is Proxima Centauri. It is approximately 268 000 AU away from the Sun. How far away would this be from the Sun in your scale model? Convert your answer to kilometers. T/I A

(f) In your scale model, you likely placed the celestial objects in the Solar System in a straight line. Conduct research to find out if the objects actually line up like this in reality. What would be a more accurate way of depicting the objects in the Solar System? You may use a diagram to aid in your answer. A C

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UNIT TASK Bookmark

How can you apply what you learned about distances in the Solar System in this section to the Unit Task described on page 446?

Table 2 Properties of the Planets in the Solar System

Properties	Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune
Average distance from the Sun ($\times 10^6$ km)	57.9	108	150	228	778	1427	2870	4497
Time for one rotation	59 d	243 d	24 h	24 h 39 min	9 h 50 min	10 h 39 min	17 h 18 min	15 h 40 min
Average diameter (km)	4880	12 100	12 750	6790	142 980	120 540	51 120	49 530
Mass (kg)	3.3×10^{23}	4.9×10^{24}	5.9×10^{24}	6.4×10^{23}	1.9×10^{27}	5.7×10^{26}	8.7×10^{25}	1.0×10^{26}
Mass (Earth = 1)	0.06	0.8	1.0	0.1	318	95	15	17
Density	5.44	5.25	5.52	3.95	1.31	0.70	1.27	1.64
Surface gravity (Earth = 1)	0.39	0.90	1.0	0.38	2.53	1.06	0.90	1.14
Range of surface temperature (°C)	–173 to 427	462	–88 to 58	–90 to –5	–148	–178	–216	–214
Main substances in the atmosphere	none	carbon dioxide, nitrogen	nitrogen, oxygen	carbon dioxide, nitrogen	hydrogen, helium, methane	hydrogen, helium, methane	hydrogen, helium, methane	hydrogen, helium, methane
Number of moons (as of 2009)	0	0	1	2	63	60	27	13

The symbol "d" stands for one Earth day.