Models and the Solar System

Use Google Maps (holding iPad horizontally) to find the actual distances between the following cities, then measure the distances on the map using centimeters on a ruler.

National City (current location) to:	Actual distance in miles	Distance on map in cm
Phoenix, AZ		
Albuquerque, NM		
Dallas, TX		
New Orleans, LA		
Jacksonville, FL		

1. Why is the actual distance so much different than the distance on the map?

2. Why does the distance on the iPad map stay about the same?

3. A globe is a scale model of the Earth. Sometimes using a globe is better than using a map. When is a globe better?

4. LEGOs can be used to build models of objects. Why would you want to build a model of something that is really big?

5. Why would you want to build a model of something that is really small?

6. In your own words explain what a scale model is.

Find the distance to each rock from the southwest door.

	Rock 1	Rock 2	Rock 3	Rock 4
Distance				

Now let's draw our own scale model of the position of the four rocks using the distances in the table. Fit them into this scale model of the classroom.
1 meter = 1 centimeter on the scale model.

southwest door

Find the distances between the starting line and each letter. Use meters.

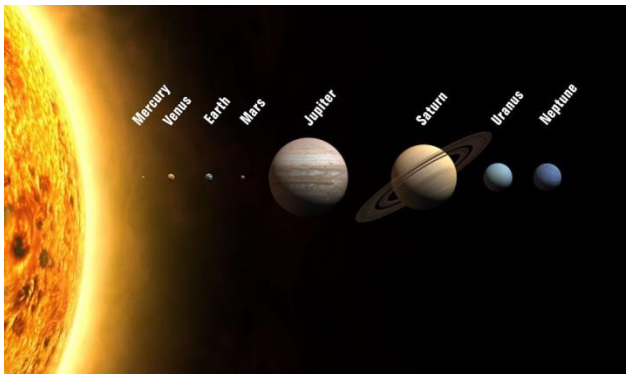
Letter	Distance Measured (meters)	Actual Distance (meters)
A		
B		
C		
D		
E		
F		
G		
H		
I		
J		
K		
L		
M		
N		
O		
P		

In your notebook make a scale model of the distances between each letter using one line which is 20 cm in length.

Using your model and the data table, copy and fill in the following sentences on the notebook paper with the model.

Letter B is ____ meters from the start line. Letter ____ is 4 times further from the start line than letter B. Letter J is ____ times further from the start line than letter E. Letter P is ____ times further from the start than letter B.

How big is the Solar System?



It is difficult to comprehend great distances. For example, how great a distance is 150,000,000 kilometers, or 1 AU, which is the distance from Earth to the sun? One way to get a sense of these distances is to create a scale model. A globe is a scale model of Earth and road maps are scale models of geographic regions. Scale models help us visualize the true sizes of objects and the distances between them. In this Investigation, you will make a scale model representing distances in the Solar System. The results may surprise you.

7. Explain one reason why a model of the solar system can be useful.

Now we will **guess** what our model might look like. (The teacher will help with this part.)

Look at the table below to compare the distances between the planets.

8. About how many times further is Venus than Mercury from the sun?

$$\frac{\text{Venus distance}}{\text{Mercury distance}}$$

9. About how many times further is Earth than Mercury from the sun?

$$\frac{\text{Earth distance}}{\text{Mercury distance}}$$

10. About how many times further is Mars than Venus from the sun?

$$\frac{\text{Mars distance}}{\text{Venus distance}}$$

11. About how many times further is Jupiter than Venus from the sun?

$$\frac{\text{Jupiter distance}}{\text{Venus distance}}$$

12. About how many times further is Saturn than Jupiter from the sun?

$$\frac{\text{Saturn distance}}{\text{Jupiter distance}}$$

13. About how many times further is Uranus than Saturn from the sun?

$$\frac{\text{Uranus distance}}{\text{Saturn distance}}$$

14. About how many times further is Neptune than Saturn from the sun?

$$\frac{\text{Neptune distance}}{\text{Saturn distance}}$$

15. About how many times further is Pluto than Uranus from the sun?

$$\frac{\text{Pluto distance}}{\text{Uranus distance}}$$

Now we will make adjustments to the scale model of the solar system. If you look at the table below you can see that Mercury is 58,000,000 km from the sun. In our scale model the distance to Mercury will be 10 cm.

Use questions 8-15 to fill out the proportional distances on the table.

Planet or Dwarf	Actual average distance from sun (km)	Proportional distance from sun (cm)
Mercury	58,000,000	10
Venus	108,000,000	
Earth	150,000,000	
Mars	228,000,000	
Jupiter	778,000,000	
Saturn	1,430,000,000	
Uranus	2,870,000,000	
Neptune	4,500,000,000	
Pluto	5,900,000,000	

16. After constructing your model, what is your impression of our solar system? Make three observations. Compare the distances or groupings with your previous ideas.

17. Explain two ways that seeing our model of the solar system is helpful.

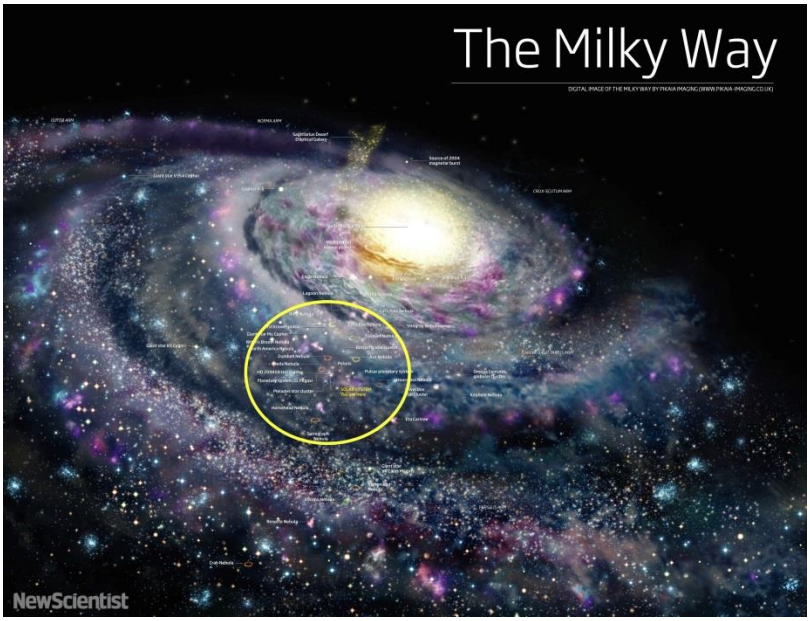
18. Proxima Centauri is the closest star to Earth at 271,000 AU or 39,900,000,000,000 km or 4.2 light years or about 7,000 times the distance to Pluto. Do you think it might ever be possible to travel there? How long do you think it would take to travel there?

We will now watch a short video clip about distances:
http://www.openculture.com/2010/07/powers_of_ten.html

19. Look at question 18. Do you still agree with the answer you wrote down? If not, what would you change it to?

Above is a picture of the Milky Way Galaxy (where you and I live). The arrow points to the approximate location of the earth. Remember that Proxima Centauri is the closest star to the earth, besides the sun. Draw another arrow to show where you think Proxima Centauri is.

20. Why did you place your arrow on that spot on the picture?



Here is another picture of the Milky Way Galaxy. The yellow circle shows the stars we can see with the naked eye from earth (that's only a small fraction of all the stars).

The yellow circle is approximately 15,000 light years across. The entire Milky Way is about 100,000 light years across. Pretend that you could travel at "warp speed," which is about 5,000 times the speed of light. That would be 1,498,962,290 km/second or 937,406,338 times faster than you are allowed to drive on the freeway!

21. Would it be reasonable to travel through the Milky Way Galaxy at "warp speed?" Explain your answer. Hint: How long would it take to travel from one side of the Milky Way to the other?

22. Would it be reasonable to travel from the Milky Way Galaxy to the Andromeda Galaxy (the closest galaxy to us, at 2,500,000 light years away) at "warp speed?" Explain your answer.