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## Introduction to Active Learning: The Scale of the Solar System

## Pre-Lab Quiz

Record your team's answers as well as your reasonings and explanations.

1.

2.

3.

4.

5.

## Part 1: Exploring Astronomical Topics

1. Read and learn about active learning and active learning roles on the main page of the lab webpage for this lab. On the first page of this lab where you wrote your lab group members' names, write the active learning role each person will play today next to their name. Going forward, always note the week's role assignments each time you list your lab partners' names at the top of your lab.

2. With your group members, write down three interesting questions that you think Astronomy is capable of answering. You may share your questions with the class. How did your lab group Manager keep your group on track as you decided on your three questions?

3. Choose a question from the list on Part 1 of the lab webpage for this lab. Using the internet, research it and prepare to lead the class in a discussion of your question by writing a brief summary of the answer to the question in the space below. How did your lab group Scribe ensure you agreed on your conclusions? What potential weaknesses were present in your proposed answer that your Skeptic probed your group members about?



2. Let's take the Solar System and shrink it down. If we scale Jupiter so it is the size of a watermelon, what fruit could be used to represent the size of Earth in this model? Guess how many of these Earth-fruits would fit inside the Jupiter-watermelon. For the Skeptic of your lab group, can you think of any experience that would lead you to believe that your group members might be overestimating the size of the Earth-fruits? Underestimating them? Share any concerns you may have.

**Note:** Use your intuition – don't search the internet for answers. We'll calculate the actual value in the next problem and see how good your guess was.

3. Using the equation for the volume of a sphere,  $V = 4\pi r^3/3$ , and the radius of Jupiter in Earth radii from Question 1, estimate how many Earths would fit inside Jupiter. Show your work.

**Hints:** Round the radius of Jupiter in Earth radii to a nice number to make the calculation easier. Do not look up the radius of Earth in any other unit; leave these parts of the equation in Earth radii as they should cancel out in the end. Remember from math that  $(x^a / y^a) = (x / y)^a$ . See Part 2 of the lab webpage for this lab for more help.

4. We're going to take these objects in our Solar System and their true distances from the Sun in AU and shrink things down a different time so that their scaled distances from the Sun can fit onto this page. The standard size of a piece of paper that these words are typed on is 8.5x11-in, or 8.5 inches from left to right. Below this length of this page is diagrammed:

I	I	I	I	I	I	I	I
1 in	2 in	3 in	4 in	5 in	6 in	7 in	8 in

We'll put the Sun on the far left of the diagram on our paper. Go ahead and label the Sun above now. The scaling for our model will be 1:20 trillion, or every one inch on our paper diagram representing 20 trillion real inches. The true distance of the Earth from the Sun is ~5 trillion inches. How many inches to the right of the Sun would Earth be in this scaled down Solar System? Explain your reasoning. Go ahead and draw Earth on the diagram above now. For the Manager of your lab group, how is your group doing on time? Is there enough time left in the lab period for your group to slow down and consider questions more carefully? Or do you need to try to speed up to finish on time? Share this information with your lab group members.

5. How can we convert the distances of the planets from the Sun in AU (from Question 1) to our scaled distances of the planets from the Sun in inches? For all the planets, fill in the table below with the planets' distances from the Sun scaled for the model. For the Scribe of your lab group, take notes on each group member's initial ideas on approaching this problem before you all read the hint below.

**Hint:** From Question 1, what is the true distance of the Earth from the Sun in AU? From Question 4, how many inches to the right of the Sun is Earth in our scaled down Solar System? What number must the true distance of the Earth from the Sun in AU be multiplied by to obtain how far away from the Sun the Earth is in inches in our model? This number will be your 'scale'. Take this number and multiply it by each planet's distance from the Sun in AU to obtain that planet's distance from the Sun in the model, in inches.

Planet	Scaled Distance from Sun (inches)
Earth + Moon	

6. In the diagram below, again label the Sun and place the Earth at its scaled distance from it. Then, place all the other planets at their scaled distances from the Sun that you calculated in Question 5. After looking at this scale model of the Solar System, write down some of your thoughts and observations.

I	I	I	I	I	I	I	I
1 in	2 in	3 in	4 in	5 in	6 in	7 in	8 in

7. The nearest star to our Sun is Proxima Centauri, which is ~1,500,000 trillion inches away. In our scaled system from Problem 6, how far away from our scaled paper Solar System would Proxima Centauri be in inches? If 1 mile is ~50,000 inches, is Proxima Centauri less than a mile away from the Sun on our scaled Solar System? Much less? More? Much more?