

Name: _____ Date: _____ Number: _____

Planet Scaling using Extra Terrestrial Tools

Version II

Objectives: Calculate scale sizes of the planets and use a Safe-T compass to accurately draw planetary model equatorial diameters.

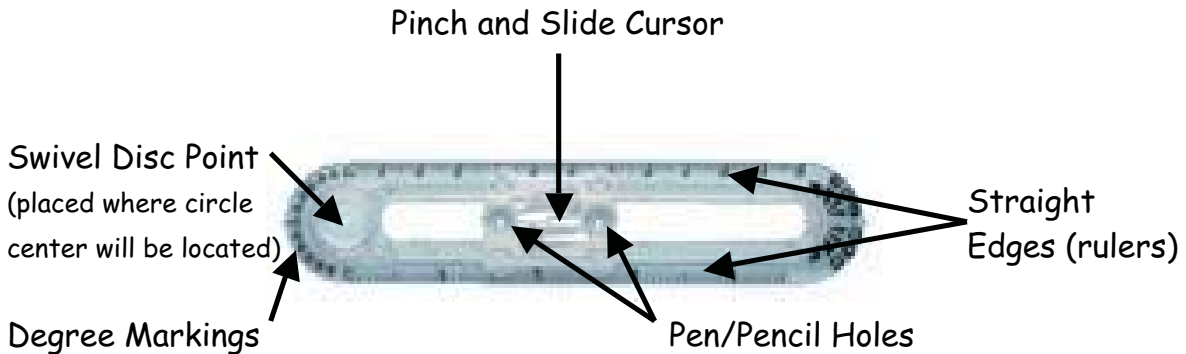
Materials: Copy of this lab (duh!), Safe-T Compass, Earth Science Reference Tables, calculator, and a pencil.

Part A: Pre Assessment Questions

*Answer the following questions to the best of your ability. These **DO NOT** count toward your grade within this lab. If you are certain an answer is correct, circle **TRUE**. If you are certain an answer is incorrect, circle **FALSE**. If you have never heard of anything the question is asking you, circle **UNSURE**. Please **DO NOT** guess.*

Q u e s t i o n	TRUE	UNSURE	FALSE
'Terrestrial Planets' refer to planets with life.	T	U	F
The planets have very little space between them.	T	U	F
Earth is larger than the sun.	T	U	F
All planets are the same size.	T	U	F
The Sun is the largest thing in our Universe.	T	U	F
Pluto is smaller than the Earth's moon.	T	U	F
Scales can vary when creating a scale model.	T	U	F

Part B: Anatomy and Physiology of the Safe-T Compass



Part C: How to work the Compass

Creating circles using the Safe-T Compass is very simple.

1. Place a dot on the paper where you want the center of your circle to be.
2. Adjust the 'Pinch and Slide Cursor' to the desired radial length by aligning the arrows to the proper length. Remember that the radius is one-half of the diameter ($D = 2r$).
3. Position the safety compass so the 'Swivel Disc Point' is centered over the dot from Step 1.
4. Place a finger from your non-drawing hand on the 'Swivel Disc Point' and apply gentle pressure.
5. Insert your pen/pencil into the 'Pen/Pencil Holes' on the 'Pinch and Slide Cursor' that corresponds to the arrow, which is set for the correct radial length.
6. Keeping your finger pressed on the 'Swivel Disc Point', begin to draw a circle by moving your pen/pencil with your drawing hand.



Words of advice!

- Please use a **Pencil** for this Lab!
- Please **TRY TO AVIOD** making the obnoxious noise by sliding the 'Pinch and Slide Cursor' up and down over and over and over and over and over again.
- Remember, when using a compass, you are drawing the **RADIUS** not the **DIAMETER!**

Part D: Plotting the planets

Mercury, Venus, Earth, Mars (a.k.a.: terrestrial planets)

A model is something that represents something else. In this laboratory you are going to model the sizes of the planets within our solar system. It is extremely important that when attempting to create a model, scientists (which we all are) be consistent with all aspects of the system. When working with scale models, a common scale must be determined and applied to all objects within that model. Remember, a scale model is a smaller or larger version of the real thing! Once a scale has been established it must remain constant from that point forward. In order to preserve the scale for use with other planets, use the equation below:

$$\frac{\text{Model Diameter (cm)}}{\text{Real Diameter (km)}} = \frac{\text{Model Diameter (cm)}}{\text{Real Diameter (km)}}$$

Using the scale established below and your Earth Science Reference Tables, **fill in the information in the table.**

$$\frac{\text{Model Diameter (cm)}}{\text{Real Diameter (km)}} = \frac{1 \text{ (cm)}}{1626 \text{ (km)}}$$

← This is the scale you will be using for this part!

$$\frac{\text{Mercury Model Diameter (cm)}}{\text{Mercury Real Diameter (km)}} = \frac{X \text{ cm}}{4880 \text{ km}} = \frac{1 \text{ cm}}{1626 \text{ km}}$$

$$(1626 \text{ km}) \times (X \text{ cm}) = (1 \text{ cm}) \times (4880 \text{ km})$$

$$X = 3 \text{ cm}$$

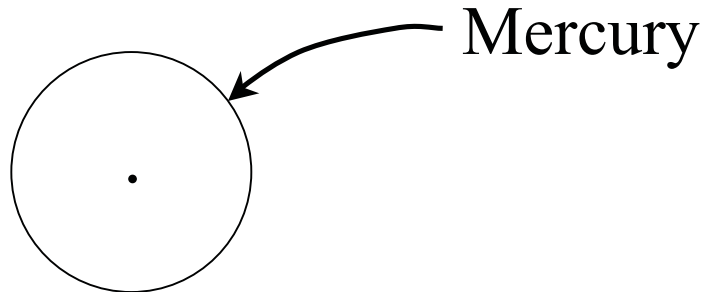
Where X is the model diameter of Mercury in centimeters.

Terrestrial Planet Scale Model Data Sheet			
Planet	Equatorial Diameter (km)	Model Diameter (cm)	Model Radius (cm)
Mercury	4880 km	3.0 cm	1.5 cm
Venus			
Earth			
Mars			

Round to the nearest tenth!

Using the data obtained from the 'Terrestrial Planet Scale Model Data Sheet' **fill in the chart to the right**. Then **draw a scale model** of each of the planets with the center of your Safe-T Compass **originating from the common point** below. Be certain to label each planet. Note: *Each planet's center will be drawn from the SAME point below!*

Planet	Model Radius (cm)
Mercury	1.5 cm
Venus	
Earth	
Mars	



Jupiter, Saturn, Uranus, Neptune (a.k.a.: the jovian planets) and Pluto

Using the **SAME** scale from the previous section (which is stated below), **determine what the scale equatorial diameter should be for each of the planets below.** Show all work in the designated section!

$$\frac{\text{Model Diameter (cm)}}{\text{Real Diameter (km)}} = \frac{1 \text{ (cm)}}{1626 \text{ (km)}}$$

Jupiter Equatorial Scale Diameter = _____ cm

Saturn Equatorial Scale Diameter = _____ cm

Uranus Equatorial Scale Diameter = _____ cm

Neptune Equatorial Scale Diameter = _____ cm

Pluto Equatorial Scale Diameter = _____ cm

1) Using the scale defined for the terrestrial planets, is it possible to draw scale models of each of the jovian planets on a single sheet of notebook paper? Why or why not?

2) When looking at a diagram or an image, scale is a very important concept to keep in mind. Many images include a scale so a proper size comparison can be made. However, some do not. Some even include the term 'NOT TO SCALE' in the caption. What does 'NOT TO SCALE' mean?

Part E: Looking at things through a different perspective


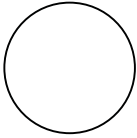
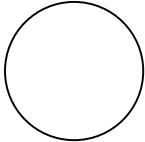

In order to fit each of the jovian planets on a sheet of 8.5” (21.5 cm) x 11” (28.0 cm) paper it requires the use of **ANOTHER SCALE**. Below are the terrestrial planets drawn to a new scale that will allow the jovian planets to fit onto a sheet of paper. **Determine what this new scale is by analyzing the scale drawings below and from information provided from your Earth Science Reference Tables.**



Be as **ACCURATE** as possible. A **MINOR** error in reading the ruler can cause **MAJOR** errors in your results!



Round to the nearest whole number. 345.567 would be 346.

Planets	Scale Model (drawn to scale)	Real Diameter (km)	Model Diameter (cm)	New Scale (Real/Model)
Mercury		4,880	0.7	6,971
Venus				
Earth				
Mars				
New Scale Average =				



‘Model Diameter’ is obtained from measuring the ‘Scale Model’. Measure the diameter through the center to get the best results.


By dividing the ‘real diameter’ by the ‘model diameter’, a new scale was established. Average the four (4) values in the ‘New Scale’ column to get your new scale.

$$1 \text{ cm} = \text{New Scale Average}$$

$$\frac{\text{Model Diameter (cm)}}{\text{Real Diameter (km)}} = \frac{1 \text{ (cm)}}{\text{New Scale Average (km)}}$$

Using the data you gathered from the previous page, the equation from Part C and your Earth Science Reference Tables, **complete the 'Jovian Planet Scale Model Data Sheet'**. Use the space provided below the data sheet to **show all work**.

$$\frac{\text{Model Diameter (cm)}}{\text{Real Diameter (km)}} = \frac{\underline{\quad 1 \quad} \text{ (cm)}}{\text{New Scale Average (km)}}$$

 **Your value goes here**

Jovian Planet Scale Model Data Sheet		
Planet	Equatorial diameter (km)	Model Diameter (cm)
Jupiter		
Saturn		
Uranus		
Neptune		
Pluto	2,300	0.3

Round to the nearest tenth!

----- **Work Area. Show All Work!** -----

Using the data obtained from the 'Jovian Planet Scale Model Data Sheet' fill in the chart to the right. Then **draw a scale model** of each of the planets with the center of your Safe-T Compass originating from the common point below. Be certain to label each planet. Note: *Each planets center will be drawn from the SAME point below!*

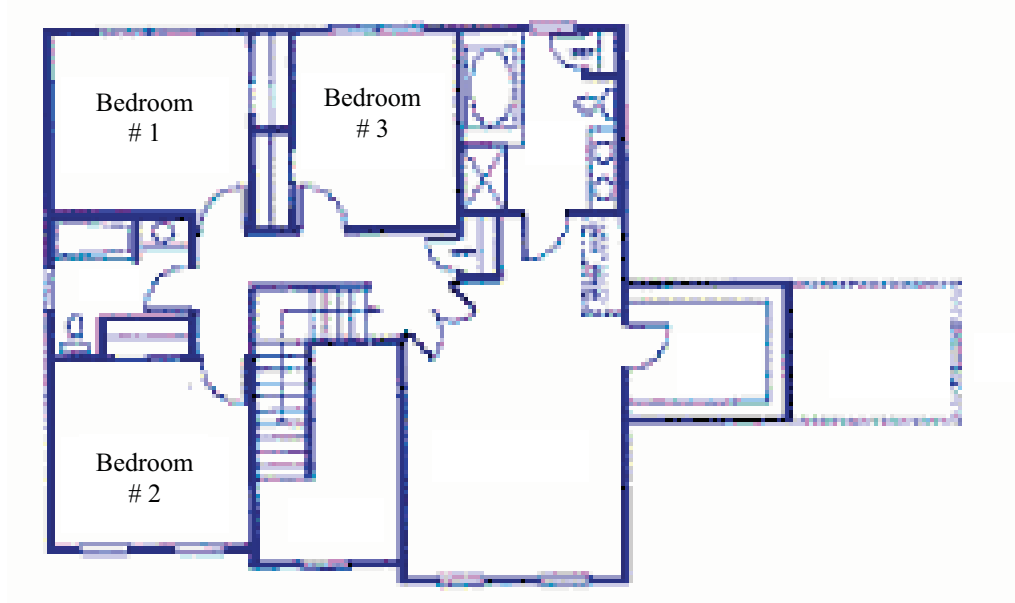
Planet	Model Radius (cm)
Jupiter	
Saturn	
Uranus	
Neptune	
Pluto	0.15

 **Pluto**

Part F: How does this stuff apply to Earthly beings?

Architects and engineers are some of the professions that often use scale models to see what their projects will look like prior to construction. In the past, blueprints and drawings were set to specific scales and used as models. Today, powerful Computer Aided Design (CAD) software programs have become popular which allow users to input data and create 3-D computer models. The basic idea behind all of these is to ‘scale’ the real thing down and make everything the same fraction of its real size. Model railroads and dollhouses are examples of scaled down versions of the real objects.

Below is the blueprint for a 4 bedroom, 2 bathrooms Ranch style home. Using the equation, $\text{Model/Real} = 1 \text{ cm} / 2 \text{ m}$, complete the data table.



Note: The semi-circle shown in each of the Bedrooms is the symbol for a door. Assume the wall continues straight. The rooms do not curve!

Room	Model Length ()	Real Length ()	Model Width ()	Real Width ()	Real Area of Room	Real Perimeter of Room
Bedroom # 1						
Bedroom # 2						
Bedroom # 3						



1. Why did we use a different scale when plotting the terrestrial and jovian planets?
2. Name one (1) pro and one (1) con of working with the Safe-T Compass?
3. Name two (2) possible sources of error when drawing the scale models.
4. Would it be possible to draw the distances between each of the planets using one (1) of the two (2) scales used in this lab? Why or why not?
5. Why was it important to average the data when determining the 'New Scale' in Part D?
6. Using the scale you determined in Part D; calculate how large the sun would be?
7. From data obtained in Part D, about how many model Earths would it take to go across a model Jupiter? How does this value compare to the valued obtained by using actual data from the Earth Science Reference tables? Show all work.



8. Define what a 'terrestrial' plant is and give one example.

9. Describe how much space is between each of the planets.

10. Using information from your Earth Science Reference Tables, select a scale and create a model of the Sun.

11. Provide evidence contradicting the following statement: 'All planets are the same size.'

12. Compare Pluto diameter to Earth's moon diameter.

13. Evaluate the importance of scales when working with objects in space.

TO BE COMPLETED FOR HOMEWORK!

Part G: In the space below, create a scale model drawing of your house similar to the one on the previous page. You must include at least 3 connecting rooms (it really doesn't matter which ones: Bedrooms, closets, bathrooms, etc.) and draw it to scale so it fits below. Include the name of the rooms, the actual dimensions and the scale used to create the model of your house.

1) My Scale is: $\frac{\text{Model}}{\text{Real}} = \underline{\hspace{2cm}}$

2) My Scale Drawing of my connected rooms is below:



I have included in my drawing: the units (e.g.: feet or meters), the actual size of each room (e.g.: 3 meters by 4 meters) and the name of each room (e.g.: kitchen).

I have made this drawing a scale representation of the rooms in my house based on ACTUAL measurements.