NAME: _____ DATE:_____

DARE TO BE

ECCENTRIC

INTRODUCTION:

Have you ever heard the phrase "dare to be different?" Well that's what eccentricity is all about: deviating from the norm - or in other words, being different! Different is a relative term though, isn't it? To be different means that there has to be something you are different from. Sometimes the thing we are compared to is what is considered "normal" or "standard." It's been said that when you're poor and just a little bit "out there", they call you crazy, but when you're rich, they call you eccentric.

So how does eccentricity relate to this laboratory? Well, since you asked ... The planets travel around the Sun in a path called an orbit. Many people might say that these orbits are circular. Those people would be wrong because the orbits are different. The planets' orbits have a special geometric shape called an ellipse. An ellipse is an oval-shape that can be described by its eccentricity value. Some orbits are slightly eccentric, while others might be more so. An ellipse has two "center points". Each one is called a focus. The Sun is not in the exact middle of the Earth's orbit. Rather, it is found off-center at one of the foci points.

OBJECTIVE:

Be bold, be daring, and complete this lab on time! You will be able to compare the shape of the Earth's orbit and orbits of other planets with the shape of a circle.

PROCEDURE:

(lots of steps !!!! check off as you go along…)

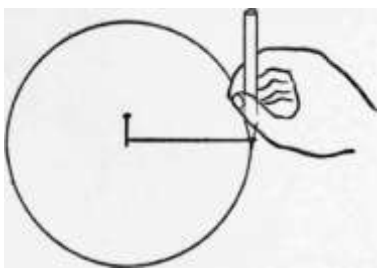
____ 1. Cut a piece of string about 22 cm in length and tie the ends together to form a loop. I have this already done for you (although I do enjoy watching some of you spaz out while trying to tie a piece of string into a loop …)

____ 2. On plain white paper, use a ruler to draw a straight line long-ways down the middle. (to find the middle of the paper without measuring, fold the paper in half and then unfold it) This line is known as the major axis.

____ 3. Make a dot in the middle of this line.

____ 4. Place the paper on a double-piece of cardboard, and put a thumbtack in the dot that you made.

____ 5. Loop a string around the thumbtack and then draw a circle by placing your pencil inside the loop. (see diagram to the right) Label this *Ellipse #1*



_____ 6. Since there is only one point of focus (one thumbtack), there is no distance between foci. Record "0" for the ***distance between foci (d)*** for Ellipse #1 on the report sheet.

_____ 7. Remove the thumbtack and measure the length of the major axis to the nearest tenth of a centimeter (the major axis, in the case of a circle, is the diameter). Measure along the line from one side of the circle to the other. Record the ***length of the major axis (L)*** for Ellipse #1 on the report sheet.

_____ 8. Calculate the eccentricity value of Ellipse #1 (the circle) by using the eccentricity formula:

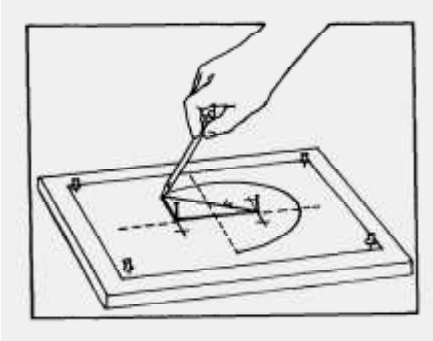
$$\text{eccentricity} = \frac{\text{distance between foci}}{\text{Length of major axis}} \qquad \text{or abbreviated … } e = \frac{d}{L}$$

Record your calculation on the report sheet.
Eccentricity values are rounded to the nearest thousandths place – 3 places to the right of the decimal and have no units

_____9. Make two new dots on the major axis; each dot must be 1.5 cm away from the center dot (for a total of 3 cm between the two new dots). Record this as the distance between foci for Ellipse #2 on the report sheet.

____ 10. Put thumbtacks in the two new dots you made (remember, these dots represent the two foci).

____ 11. Loop the string around the thumbtacks and draw the ellipse by placing your pencil inside the loop as shown to the right. Label this *Ellipse #2*.



____ 12. Remove the thumbtacks and measure the length of the major axis (L) of this ellipse to the nearest tenth of a centimeter. Record this on the report sheet for Ellipse #2.

____ 13. Calculate the eccentricity value of Ellipse #2 by using the eccentricity formula.

____ 14. Make two new dots on the major axis; each dot must be 1 cm away from each of the foci used to draw ellipse #2. Replace the thumbtacks, and draw a new ellipse. Label it *Ellipse #3*.

____ 15. Remove the thumbtacks, measure and record d and L, and calculate the eccentricity of Ellipse #3.

____ 16. Make two new dots on the major axis; each dot must be 1 cm away from each of the foci used to draw ellipse #3. Replace the thumbtacks, and draw a new ellipse. Label it *Ellipse #4*.

____ 17. Remove the thumbtacks, measure and record d and L, and calculate the eccentricity of Ellipse #4.

____ 18. Answer the summary questions and staple the white paper with your ellipses to the back of this lab packet.

REPORT SHEET

Rounding Rules for the Report Sheet:

1. Round distance between foci to nearest whole cm (if you performed the procedure correctly, these should be whole numbers
2. Round length of major axis to nearest tenth of a cm
3. Round eccentricity calculation to nearest thousandths place (there are no units associated with eccentricity)

Ellipse #1 (Circle)

distance between foci (d)	Length of major axis (L)	substitutions into formula e = d/L	Eccentricity (e)

Ellipse #2

distance between foci (d)	Length of major axis (L)	substitutions into formula e = d/L	Eccentricity (e)

Ellipse #3

distance between foci (d)	Length of major axis (L)	substitutions into formula e = d/L	Eccentricity (e)

Ellipse #4

distance between foci (d)	Length of major axis (L)	substitutions into formula e = d/L	Eccentricity (e)

SUMMARY QUESTIONS: (write in complete sentences where appropriate)

1. What happened to the shape of the ellipse as you moved the foci farther apart?

2. What change takes place in the numerical eccentricity value of the ellipses when you increase the distance between the foci?

3. a. What is the minimum eccentricity an ellipse can have? _____

   b. What is the name of the geometric figure that has the minimum eccentricity? _____

4. What was the eccentricity you calculated for Ellipse #2? _____

5. What is the eccentricity of Earth's orbit? (Use ESRT page 15) _____

6. Which orbit is more eccentric: Ellipse #2 or Earth's orbit. Explain your answer using the data collected.

7. If you were to describe the true shape of the Earth's orbit, which phrase would you use: it is slightly elliptical or it is very elliptical?