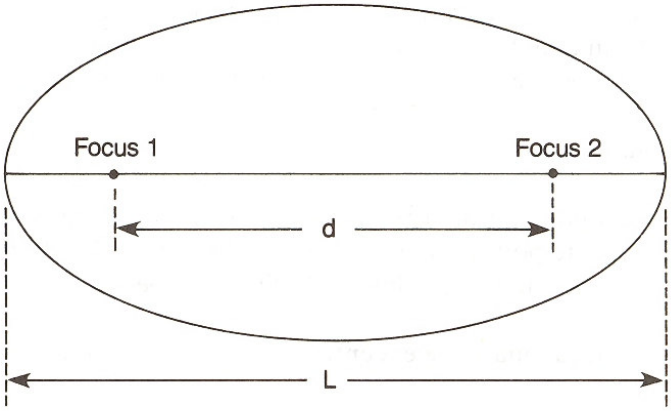
Name: _____ **Earth Science**
Lab 12: Ellipses **Date: _____**

Introduction: Earth revolves around the Sun in an orbit which is a special geometric figure called an ellipse. An ellipse has two "center points". Each one is called a focus (plural of focus is foci). The Sun is not in the exact middle of Earth's orbit. Rather, it is found at one of the foci.

Objective: You will be able to compare the shape of Earth's orbit and orbits of other planets with the shape of a circle.



Vocabulary:

Ellipse:

Eccentricity:

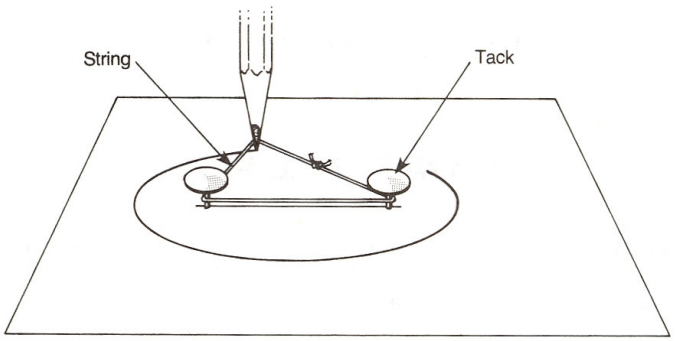
Focus:

Major axis:

Circle:

Materials:
Piece of string tied in a loop 2 tacks 2 pieces of cardboard ruler

Procedure:
1. On a piece of plain paper draw a straight line across the center of the paper oriented in landscape.
2. Near the center of the line, draw two dots 3 cm apart.
3. Place the paper on the stacked cardboard, put a tack in each dot (focus).
4. Loop the string around the tacks and draw the ellipse by placing your pencil inside the loop and keeping the string taut.



5. Label this ellipse #1.
6. Measure the distance between the tack holes (d). Record this on Data Table 1.
7. Measure the length of the major axis (L) and record this on Data Table 1.
8. Move each tack out 1 cm and draw a new ellipse. Label it ellipse #2 and measure and record d and L.
9. Move each tack out 1 cm and draw a new ellipse. Label it ellipse #3 and measure and record d and L.
10. Move each tack out 1 cm and draw a new ellipse. Label it ellipse #4 and measure and record d and L.
11. Place a dot in the exact middle of the first two foci and put a single tack on it. Using a red pencil, construct ellipse #5, which will be a circle.
12. Using the given equation, calculate the eccentricities of each of the five ellipses. Show all work on Data Table 1.

$$e = d / L$$

Eccentricities of the Planets and Dwarf Planets

Planet	**Eccentricity**
Mercury	0.206
Venus	0.007
Earth	0.017
Mars	0.093
Ceres	0.080
Jupiter	0.048
Saturn	0.056
Uranus	0.047
Neptune	0.008
Pluto	0.247
Haumea	0.189
Makemake	0.159
Eris	0.442

Data Table

Ellipse #1	d = _____	L = _____	e = _____
Ellipse #2	d = _____	L = _____	e = _____
Ellipse #3	d = _____	L = _____	e = _____
Ellipse #4	d = _____	L = _____	e = _____
Ellipse #5	d = _____	L = _____	e = _____

Discussion Questions:

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

2. Which of the four ellipses you drew (not including the circle) was the most eccentric?

3. Which of the four ellipses you drew (not including the circle) was the least eccentric?

4. What is the minimum eccentricity an ellipse can have?

5. What is the name of the geometric figure which has the minimum eccentricity?

6. How does the numerical value of "e" change as the shape of the ellipse approaches a straight line?

7. Where is the Sun located on a diagram of Earth's orbit?

8. What was the eccentricity you calculated for Ellipse #1?

9. Which is rounder (less eccentric), the orbit of Earth or Ellipse #1?

10. In the table *Eccentricity of the Planets*, the planets are listed in order by their distance from the Sun. Is there a direct relationship between the eccentricity of its orbit and the distance a planet is from the Sun?

11. List the planets (including dwarf planets) in order of increasing eccentricity of orbit.

12. Describe the true shape of Earth's orbit.