**Planetary Orbits Around the Sun**

**Materials**: thumbtacks, pins, string, cardboard, metric ruler, pencil, paper, calculator.

**Purpose**: To make an ellipse using string and learn how varying the length of the string alters the shape of the ellipse; learn how characteristics of an ellipse relate to the orbits of the planets.

**Procedure .**

1. Place a blank sheet of paper on top of the cardboard and place two thumbtacks or pins about 3 centimeters (cm) apaprt.

2. Tie the string into a circle with a circumference of 15 to 20 cm. Loop the string around the thumbtacks. With someone holding the tacks or pins, place a pencil inside the loop and pull it taut.

3. Move the pen or pencil around the tacks, keeping the string taut, until you have completed a smooth, closed curve or an ellipse.

4. Repeat Steps 1 through 3 several times; first vary the distance between the tacks and then vary the circumference of the string. However, change only one of these each time. Note the effect on the size and the shape of the ellipse with each of these changes.

5. Calculate and record the eccentricity (e) of the ellipses that you constructed:

**e = distance between foci/length of the major axis OR e = d/L**

6. Construct an ellipse with the same eccentricity as the Earth, Mercury, and Pluto. Record the d and L required.

7. Using Kepler’s third law and the L from your chart for Earth, Mercury and Pluto, *calculate* the period of revolution for all three planets.

**P2 = a3 where P = period of revolution**

**where a = average distance from the Sun (L/2)**

**DATA and OBSERVATIONS**

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| --- | --- | --- | --- | --- |
| **Constructed Ellipse** | **d (cm)** | **L (cm)** | **e (d/L)** | **Period of Revolution (P)** |
| #1 |  |  |  |  |
| #2 |  |  |  |  |
| #3 |  |  |  |  |
| Earth’s orbit |  |  | **.02** |  |
| Mercury’s orbit |  |  | **.21** |  |
| Pluto’s orbit |  |  | **.25** |  |

ANALYSIS

1. *Explain* the effect a change in length of the string and the distance between the tacks has on the shape of the ellipse.

2. *Explain* what must be done to the string or placement of tacks to decrease the eccentricity of a constructed ellipse.

3. *Describe* the shape of Earth’s orbit. Where is the Sun located within the orbit?