



Planetary Orbits

Lab Preview

Directions: Answer these questions before you begin the Lab.

1. What does the hand icon mean?

2. What must be changed to produce ellipses of different sizes and shapes?

Planets travel around the sun along fixed paths called orbits. As you construct a model of a planetary orbit, you will observe that the shape of planetary orbits is an ellipse.

Real-World Question

How can you model planetary orbits?

Materials

thumbtacks or pins (2)
cardboard (23 cm × 30 cm)
paper (21.5 cm × 28 cm)
metric ruler
string (25 cm)
pencil

Goals

- **Model** planetary orbits.
- **Calculate** the eccentricity of ellipses.

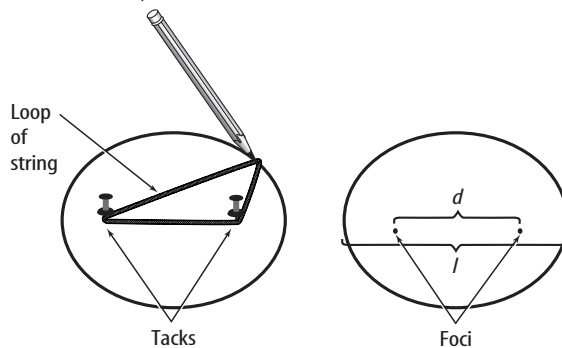
Safety Precautions



Procedure

1. Place a blank sheet of paper on top of the cardboard and insert two thumbtacks or pins about 3 cm apart.
2. Tie the string into a circle with a circumference of 15 cm to 20 cm. Loop the string around the thumbtacks. With someone holding the tacks or pins, place your pencil inside the loop and pull it tight.
3. Moving the pencil around the tacks and keeping the string tight, mark a line until you have completed a smooth, closed curve.

4. Repeat steps 1 through 3 several times. First, vary the distance between the tacks, then vary the length of the string. Make a data table to record the changes the sizes and shapes of the ellipses.
5. Orbits usually are described in terms of eccentricity, e , which is determined by dividing the distance, d , between the foci (fixed points—here, the tacks) by the length, l , of the major axis.



6. **Calculate** and record the eccentricity of the ellipses that you constructed.
7. **Research** the eccentricities of planetary orbits. Construct an ellipse with the same eccentricity as Earth's orbit.



(continued)

Data and Observations

Constructed Ellipse	d (cm)	l (cm)	e (d/l)
1. Ellipse A	1		
2. Ellipse B	3		
3. Ellipse C	5		
4. Ellipse D	7		
5. Ellipse E	9		
6. Earth's Orbit			.017

Conclude and Apply

1. **Analyze** the effect that a change in the length of the string or the distance between the tacks has on the shape of the ellipse.
2. **Hypothesize** 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?

Communicating Your Data

Compare your results with those of other students. For more help, refer to the Science Skill Handbook.