

INTERNATIONAL YEAR OF ASTRONOMY 2009 GALILEO ACTIVITY

PROPERTIES OF THE ELLIPSE

From *Galileo for Kids: His Life and Ideas* by Richard Panchyk (Chicago Review Press, 2005). There is extensive background information and many more activities in this book recommended by the National Science Teachers Association (NSTA).

Background

In their search for the truth about the way the universe works, scientists have always had to call into question existing theories and ideas. Galileo's friend Kepler proved Copernicus wrong in one regard. Planets do not orbit the Sun in perfect circles as was thought, but rather in slightly flattened-out circles called ellipses. Kepler sought to explain the way planets revolved around the sun, so he looked to the ellipse for a mathematical and scientific explanation of the laws of the planets observed.

A circle has one central point. A planet whose orbit was a perfect circle would orbit around the central point. An ellipse has two central points called foci. An ellipse that is almost a perfect circle has two focal points very close together. The flatter (or more stretched out) the ellipse, the farther apart the focal points are from each other.

Kepler's first planetary law is that the distance (A) from the first focal point to any point along the ellipse plus the distance (B) from the second focal point to the same point along the ellipse will add up to the same number. The formula is: $A + B = \text{constant}$.

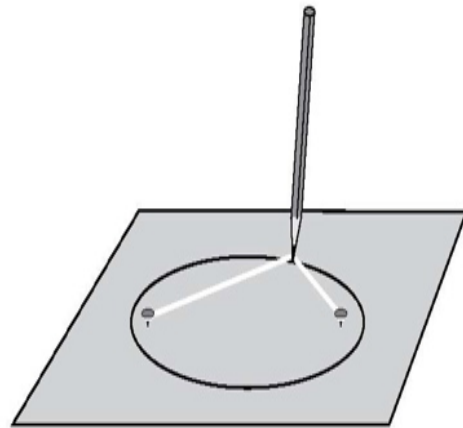
Materials

- Thin string (about 8 inches)
- 2 pins with colored heads
- Corkboard (bulletin board)
- Sheet of 8 1/2 x 11 white paper
- Sharpened pencil
- Color marker
- Ruler

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Activity

Tie one end of the string to a pin, and the other end to the other pin. Place the white paper on the corkboard so that the long side of the paper is on top, and the board is flat on a flat surface. Now, stick one pin into the paper and corkboard about 1 inch left of the center of the paper. Place the other pin about 1 inch to the right of the center of the paper. Tuck the pencil point under the string and move the pencil toward the top of the paper until the string is taut. Now, begin to draw a line to the right, keeping the string taut as you go. If you keep the string taut and let the pencil guide you, you will see an arc-shaped line develop. Work back to the middle and then go left. Replace the pencil tip so it is above the string and move the pencil toward the bottom of the paper until the string is taut again. Draw the rest of the ellipse by following the taut string as far as it takes the pencil in both directions. Remove the pins and draw dots with the colored marker where the pins were; these are the foci of the ellipse. Pick any two points along the ellipse and stick your pins there. Measure the distance from each focal point to pin 1 and then from each focal point to pin 2. Does $A = B =$ the same? It should, because you already demonstrated the principle with the string. After all, you used string of a fixed length that was attached to each focal point, and you drew the ellipse. As you drew the ellipse, the distances from the foci to the line you drew changed, but the total length of the string remained the same.



Extension

- NASA MESSENGER Mission to Mercury teaching module for grades 5-8 – Lesson 5: Round and Round We Go – Exploring Orbits in the Solar System http://btc.montana.edu/messenger/teachers/MEMS_CompPlanetology.php

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