

THE MYSTERIOUS HARMONOGRAPH

Brief Description:

The harmonograph is a machine for creating mathematical drawings. Students begin by putting a piece of paper under the middle or one end of the bar and holding the paper down with a couple of magnets. The harmonograph is set in motion; once the bar has settled into a regular motion, pen(s) can be added to create drawings.

Objectives:

Students can explore fascinating wave motion in a two-dimensional plane with a pendulum that creates beautiful curved drawings similar to Lissajous figures. Several different variables can be manipulated to create unique drawings, and students can investigate the effect of changing each control.

Links to Websites:

<http://mathmidway.org/Training/harmonograph.php>

<http://ngsir.netfirms.com/englishhtm/Lissajous.htm>

<http://www.math.com/students/wonders/lissajous/lissajous.html>

Vocabulary:

Amplitude	Circle
Ellipse	Frequency
Lissajous figure	Pendulum motion
Plane	Sinusoidal equations
Square	Wave

Before:

- ⊙ (Level 1, 2, 3) Pair students so that one person moves a pen left and right while the other moves the paper up and down. Compare the class' drawings.
- ⊙ (Level 1, 2) Introduce the toy called Etch-A-Sketch. Try to draw a square and then try to draw a circle.

During:

- ⊙ (Level 1, 2, 3) Each student should make one drawing and record the position of the weights and the cables. Adjust either the weights or the cables and make a second drawing. Record the difference in the drawings. Share what each student noticed to discover how the weights and cables affect the wave motion.

After:

- ⊙ (Level 3) Study the following applet about Lissajous figures:

<http://ngsir.netfirms.com/englishhtm/Lissajous.htm>

How does changing the values of the frequency, initial phase, and amplitude affect the Lissajous figure?

Students can view more complex Lissajous figures at

<http://www.math.com/students/wonders/lissajous/lissajous.html>