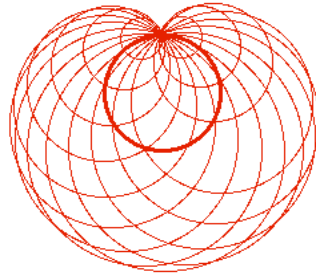


## A Cardioid for Valentine's Day



A cardioid (from the Greek καρδιά "heart") is a plane curve traced by a point on the perimeter of a circle that is rolling around a fixed circle of the same radius

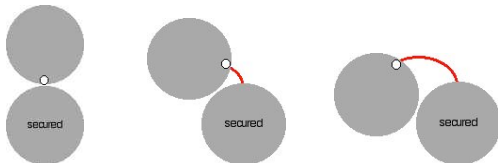
Several ways to create a cardioid with your class:

1. Have students plot points, on polar graph paper. Students should label the polar paper with  $r = \frac{1}{4}, \frac{1}{2}, \frac{3}{4}, 1$ , etcetera and graph the following equation for  $0 \leq \theta \leq 2\pi$ .

$$r = 1 - \sin(\theta)$$

$\theta$	0	$\frac{\pi}{6}$	$\frac{\pi}{3}$	$\frac{\pi}{2}$
R	1	.5	.134	0

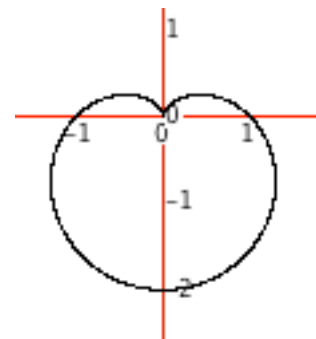
2. With two magnetic disks, put a dot on the edge of one of the disks with white-out or another marker. Secure one of the disks to white paper with a tape roll or putty. Place the second disk next to the first so that it is attracted with its dot resting at the conjunction of the two disks. Roll the second disk around the first one. Use a pencil to repeatedly mark the second disk's dot position on the white paper as the disk rolls completely around the first disk once.



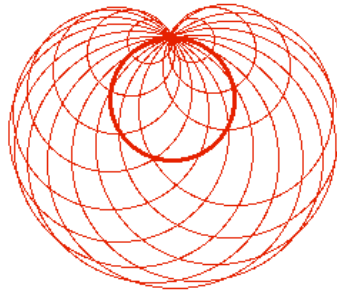
Voila, you've drawn a cardioid.

3. On a graphing calculator:
  - Set your calculator mode to work in polar coordinates.
  - On the Y= menu enter  $r = 1 - \sin(\theta)$
  - Change your window to allow:

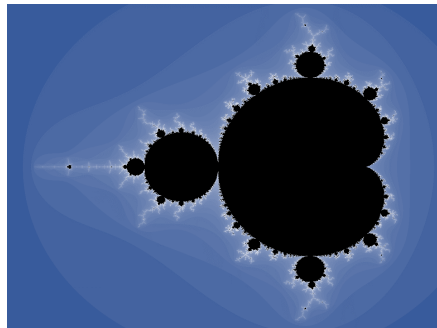
- $0 \leq \theta \leq 2\pi$
- $-2 \leq X \leq 2$  with an X scale of .01
- $-2.1 \leq Y \leq .5$  with a Y scale of .01



4. On the polar paper that is page 3 of this document, draw a circle with a compass and mark one point on the circle, P. Now continue around the circle at every  $\pi/12$  position on the circle, draw a new circle with its center on the circle and with a radius that is large enough to pass through P.



(The Mandelbrot set contains an infinite number of slightly distorted copies of itself and the central bulb of any of these smaller copies is an approximate cardioid.)



Sources:

<http://incompetech.com/graphpaper/polar/>

<http://en.wikipedia.org/wiki/Cardioid>

[http://www.exo.net/~pauld/activities/Cardiod\\_polar\\_plot.html](http://www.exo.net/~pauld/activities/Cardiod_polar_plot.html)

