Using the Cardioids (*n* as a Linear Function of *k*) Excel file

Explainers 11.5a and 11.5b showed how to connect *n* to *k* via an equation in cell B1 of the Cardioids file in which *n* and *k* can be manually adjusted. Since some users may not want to work their way through those instructions, a version of the file, Cardioids (*n* as a Linear Function of *k*), is provided that does this for them.

This file is less flexible than the other file (since *n* and *k* can no longer be independently adjusted). But, because *a* and *b*, the parameters that link *n* to *k*, are controlled by scroll arrows it is quite simple to use and it allows users to rapidly explore patterns using scroll arrows for *a*, *b*, and *k*, based on the equation *n*(*k*) = *a·k* + *b*.

The strategy for finding patterns is simple. Set *a* and *b* and then use the *k* scroll arrows to see how the pattern expands (vertices) and replicates itself. For example, set *a* = 2 and *b* = 1 and note that the same pattern occurs every third *k*.

Scroll limits. The scroll arrows for *a* allow values from 1 to 18, and *b* allows values from -18 to 18. Of course, there is no inherent restriction on *a* and *b* to remain within this range. These parameters were set so that the image is complete whenever *k* < 20 because this file (like the manually adjusted Cardioid file) provides a maximum of 360 line segments (note that 18·19+18=360). If *n*(*k*) > 360, a partial image emerges because only the first 360 starting vertices are used to create images in the cardioid file. These image can, nonetheless, be quite interesting. The image below shows a "one-third" complete version since 360/1080 = 1/3. By contrast, *k* = 39 is a 1/2 complete version, and *k* = 29 is 2/3 complete.

1080 *n* = a*k* + *b*   **59 *k*, Multiplier**
18 *a*
18 *b*