

A Quick-Start Guide to Using the Teacher File

The String Art teacher file allows you to quickly show how the various parameters relate to one another. The dashboard is shown below, but you should really have the file open as you read this. There is also a separate teacher version for File 1, but you can explain the material from that file here as well (by setting $S = P = 1$).

3

n # of possible vertices in n -gon

▲
▼

3

S , # of Subdivisions between vertices

▲
▼

2

P , # of subdivisions between Points

▲
▼

Here you control S and P independently

4

J vertex jumps between points

▲
▼

4

Show / Hide Teaching Aids Show (n,S,P,J) on image

Circle Equations

Vertices Labels

Vertex Frame (Polygon or Star)

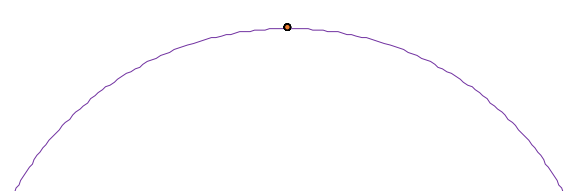
Subdivision Points

First k lines in image ▲
▼

For first S lines, type $k=$ 3

IMAGE Type # or ▲/▼ for k

Primes less than 100



This file has a number of **Show/Hide** toggle switches in the boxed green Teaching Aids area and one additional set of Up/Down \blacklozenge arrows that allows you to show the first k line segments from the image. Additionally, the **Vertices** and **Labels** toggles are separated in case you would prefer to show one but not the other.

These modifications allow you to create your own interactive teaching materials. The way to use the file depends on the grade level of students as well as what you are trying to teach in the specific session. The following are four suggestive ideas, just to get you comfortable with using the file as a teaching tool.

1. Showing the vertices of a regular polygon as points on a circle

Click **Circle** and **Vertices** on, turn all other toggles off. Increase n and watch what happens.

2. Showing how *continuously-drawn* stars are created from regular polygonal vertices by varying J

Set $S = P = 1$. Click **Image**, **Vertices** and **Labels** on, turn all other toggles off.

Set $n = 12$. There is only one distinct continuously drawn 12 point star.

$(J = 5$ and $J = 7$ produce stars that look the same but are drawn in a different order).

Set $n = 11$. There are 4 distinct continuously drawn 11 point stars (and $n = 13$ has 5).

3. Showing the distinction between **subdivisions between vertices, S** , and **subdivisions between points, P**

Set $n = 3$, $J = 1$ so we are drawing an equilateral triangle clockwise from the top. Set $S = 3$. This means there are 3 equal sized subdivisions on each side of the triangle.

Click **Vertices**, **Labels**, **Vertex Frame** and **Subdivision Points** toggles on, all other toggles off.

Click the **Vertex Frame** toggle on and off to highlight how subdivisions are placed along the frame.

Click **Vertices** on and off to note that each vertex is also a subdivision end point.

Now set $P = 2$ and $k = 1$ with all toggles except **Subdivision Points** and **First k lines in image** turned off.

This shows the first segment of the final image, two subdivisions away from the starting point.

The line segment is drawn from vertex **0** at the top to 2/3 of the way to vertex **1**.

Click **k** up to **2**. A second segment appears with endpoint 1/3 of the way from vertex **1** to vertex **2**.

Click **k** up to **3**. The third segment appears connecting to vertex **2**.

Once **k = 9**, the image is complete. **Note:** This image includes the vertex frame as part of the image.

Repeat the above, with **P = 4**.

The first segment ends 1/3 of the way along the vertex frame line from vertex **1** to vertex **2**.

The second segment ends 2/3 of the way from vertex frame line from vertex **2** to vertex **3&0**.

Once **k = 9**, the image is complete. **Note:** The vertex frame is NOT part of the image (toggle **Vertex Frame**).

4. To show why Cycles are useful to consider in understanding the final image

The complete image is typically made up of a number of cycles. A cycle is a set of connected line segments that starts and ends at a polygonal vertex. The value of **k** (**First k lines in image**) can be manually controlled by typing numbers in cell C11 or using the up/down arrows OR you can tie it to the length of a cycle by typing =M9 in cell C11 if **Equations** are visible or =C1 (as noted in the instructions next to cell C11). This shows one or more cycles based on the GCD(**S**, **P**). **NOTE:** Each equation has a comment tab, ▼, that provides the equation.

The setup below is particularly nice for showing how images are created from cycles. The image as shown is a 1-time around image because the endpoint of the first cycle is next to vertex **n&0** (at either vertex **1** or **n-1**).

If you click **IMAGE**, you will see this relationship very clearly here. The completed image is composed of 13 of these cycles created in a clockwise fashion (with the second cycle ending at **2**, etc.).

Next change to **P = 35** leaving all other values as is. Now the image is a 3-time around counterclockwise image because the end of the first cycle is vertex **10** (10 = 13 - 3). The next few cycles end at vertices **7, 4, 1, 11, 8, ...**

Next change to **P = 37** leaving all other values as is. Now the image is a 5-time around clockwise image because the end of the first cycle is vertex **5**. The next few cycles end at vertices **10, 2, 7, 12, 4, ...**

To see the relation most clearly turn off all toggles except **Equations**, **First k lines in image** and **IMAGE** toggles.

13 <i>n</i> # of possible vertices in <i>n</i> -gon	11 <i>S</i> , # of Subdivisions between vertices	36 <i>P</i> , # of subdivisions between Points
▲ ▼	▲ ▼	▲ ▼

Show / Hide Teaching Aids Show (*n,S,P,J*) on image

Circle Equations

Vertices Labels

Vertex Frame (Polygon or Star)

Subdivision Points

First *k* lines in image ▲
▼

For first *S* lines, type =C1, or general *k*= **11**

IMAGE Type # or ▲/▼ for *k*

Primes less than 100

Here you control **S** and **P** independently

Number of lines in the image, Lines

Vertex Common Factor, VCF

Subdivision Common Factor, SCF

143

1

1

Equations are visible by mousing over the numbers.

About Cycles

Lines / cycle, C **11**

of cycles, M **13**

1st cycle ends on vertex E **1**