A Guided Inquiry For Younger Users PART II Start from: https://www.playingwithpolygons.com/

PART II deals with using jumps to create stars and seeing what VCF means

Using Jumps The url above has ***n*** = 4, ***S*** = 12 and ***P*** = 30. Change ***P*** to 29.

If *Total Jumps* says 0, then we automatically just move around the polygon, one vertex at a time.

We can change that, and the smallest ***n*** for which we can make a star is 5.

Therefore, increase ***n*** by 1 to ***n*** = 5.

The result is a *porcupine pentagon* (because there are now 60 **dots** at 29 is close to half).

Click *Total Jumps* up to *Total Jumps* = 1.

Notice that a new box underneath appears that says *Jump 1*.

The number 1 is always the starting point so notice that this looks no different than when *Total Jumps* = 0.

Click *Jump 1* up to 2.

DO NOT click *Total Jumps* up to 2, that does something different.

Before looking at what this does, it is best to learn the basics.

The resulting image no longer has **dots** on the outside. Now they skip a vertex and create a star of **dots**.

If you find that hard to see, set ***P*** = 12 and it will be obvious.

VERY IMPORTANT NOTE: When we say *J* = 1, or 2, ... 7, or whatever, we mean *Jump 1*.
We look at multiple jump sets in Part III of ESA. This is when *Total Jumps* > 1.

With ***P*** = 29, all subdivision points are used but the image is very different if ***J*** = 2 than if ***J*** = 1.

With ***J*** = 2, you have a star with curves between each point, and a spiky center.

Also check ***P*** = 30 and note that you have a vertical line just like you did with ***J*** = 1.

The line is shorter now because halfway around is on the flat part of the star between 1 and 4.

If numbered vertices are not visible, click *Toggle Vertices* to see numbered vertices.

If you check other ***P*** between 28 and 24 you will find that there are always less than 60 lines since SCF > 1.

Setup to see what VCF means

With ***n*** = 5 and ***S*** = 12, set ***P*** = 18 and ***J*** = 1 (recall, ***J*** = *Jump 1*).

You get a 10-sided star with 10 lines.

Points of the star are at pentagon vertices or midway between pentagon vertices when ***J*** = 1.

If you set ***J*** = 2, you get a star inside a star image.

In both images, every 6th subdivision is used because SCF = 6.

Set ***J*** = 1 and change to ***P*** = 17 . Now every subdivision is used and there are 60 lines because SCF = 1.

The inside looks like a curvy upside down (point on bottom) pentagon.

Change ***n*** to 6. Now you have a curvy hexagon with 72 lines because SCF = 1.

Toggle Vertices and *Toggle Subdivisions* on (so you see vertices 0 1 2 3 4 and 5 and **purple dots**).

Visualizing VCF

VCF stands for *Vertex Common Factor*.

In a geometric sense, **VCF means: What portion of the vertices are you using?**

Change *Jump 1* to ***J*** = 2.

Even though you have a hexagon (***n*** = 6) the image only uses vertices 0, 2, and 4.

Half of the vertices (1, 3, and 5) **are not used. This is because VCF = 2.**

The total number of subdivision points in this instance is 36 = 12+12+12.

The image is a *porcupine triangle* because 1 more ***P***, ***P*** = 18, is a single line (VCF = 2 and SCF = 18).

Like above, it just looks like 1 line, but it is 2 because you have to get back to the top, so 18+18 = 36.

However, if you set *Jump 1* = 1 with ***P*** = 18 and ***n*** = 6, you have a 4 line diamond since 18+18+18+18 = 72.

Note that this uses all vertices (VCF = 1) but only 1/18th of the subdivisions (SCF = 18).

And if you change to ***n*** to 4, you once again have the star we started out with.

Change to ***n*** = 8 and you have a 16-point star if ***J*** = 1, and the 8-point star on a square if ***J*** = 2 (since VCF = 2).

Change ***J*** = 3 and you have an interesting 16-line, 16-point star where every other point is much shorter.

Click *Toggle Subdivisions* on and note that the **dots** almost coincide for one smaller ***P***.

Check what this means by noting the very spiky 96-line, 8-point star at ***n*** = 8, ***S*** = 12, ***P*** = 17, and ***J*** = 3.