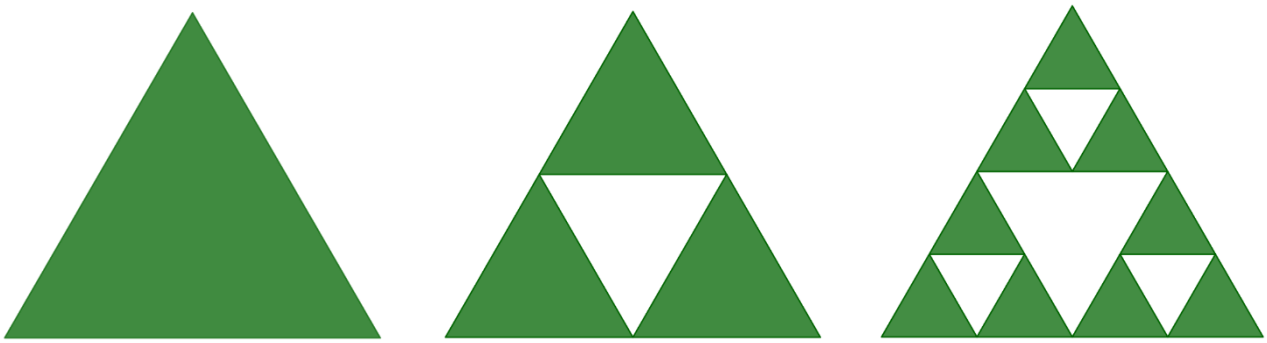
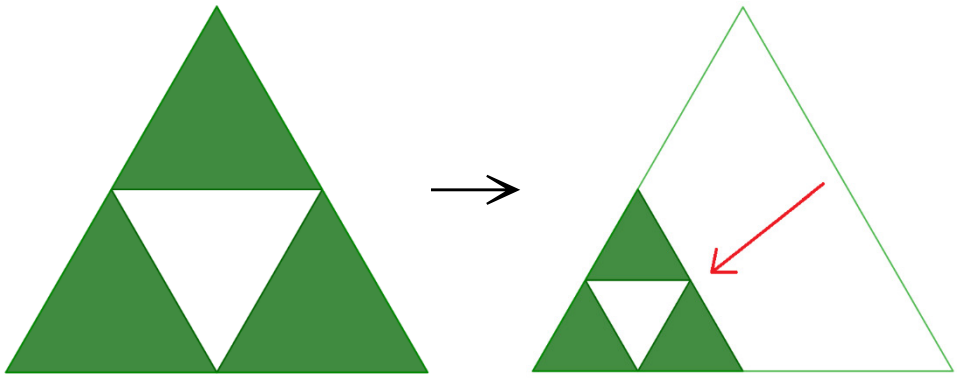
Task X: <u>Construction of the Sierpinski triangle</u>

Fractals are infinitely patterns that are self-similar across different scales. To construct a dynamic worksheet to create the first few patterns of the Sierpinski triangle.

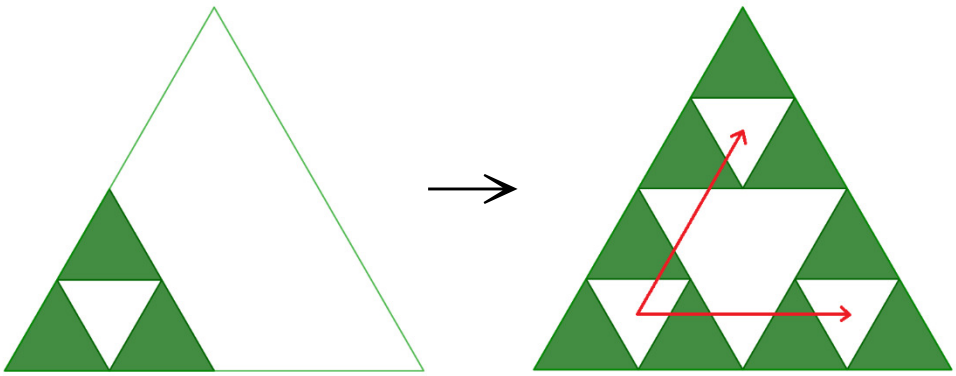


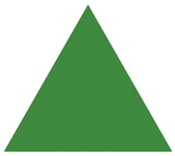
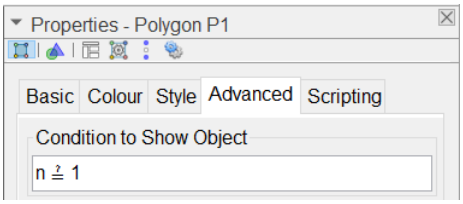
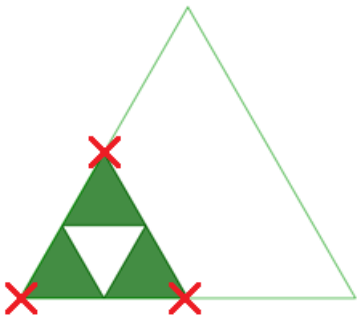
Basic strategy for the creation:

1. Contract the present pattern.



2. Copy and translate the contracted pattern to create the next pattern.



Steps	Objects to be created	Action
1.	Slider n	◆ Select "  Slider" button and click on the graphics window ◆ Set the name of the slider as n; min = 1; max = 3; increment = 1 ◆ Click "OK"
2.	An equilateral triangle with length 1 (the 1st pattern) 	◆ Type the following command in the input bar: **P1 = Polygon((0, 0), (1, 0), 3)** ◆ In the Advanced Tab of the properties of polygon P1, input "n = 1" as the condition to show object. 
3.	3 translation vectors	◆ Type the following command in the input bar: **TV = {(0, 0), (1 / 4, sqrt(3) / 4), (1 / 2, 0)}** ◆ Remark: The points in TV correspond to the positions of the translation of the contracted patterns in the next few steps 

4.	The 2nd pattern	◆ Type the following command in the input bar: **P2 = Flatten(Sequence(Translate(Dilate(P1, 1 / 2), Element(PT, i)), i, 1, 3))** ◆ Remark: Several functions are combined to create the next pattern: ■ Dilate: enlarges or contracts an object ■ Translate: translates an object by a vector ■ Element: yields an element in a list ■ Sequence: creates a list of objects followed by an index ■ Flatten: combines all lists into one list ◆ In the Advanced Tab of the properties of polygon P2, input "n = 2" as the condition to show object.
5.	The 3rd pattern	◆ Type the following command in the input bar to create the 3rd pattern: **P3 = Flatten(Sequence(Translate(Dilate(P2, 1 / 2), Element(PT, i)), i, 1, 3))** ◆ In the Advanced Tab of the properties of polygon P3, input "n = 3" as the condition to show object.
6.	Checking of the first 3 patterns	◆ Move the point on the slider of n to check that the first 3 patterns can be shown correctly.
7.	Adjust the max of slider of n	◆ Change the max of slider of n to 6.
8.	The 4th, 5th and 6th pattern	◆ Type the following command in the input bar to create the 4th, 5th and 6th pattern respectively: **P4 = Flatten(Sequence(Translate(Dilate(P3, 1 / 2), Element(PT, i)), i, 1, 3))** **P5 = Flatten(Sequence(Translate(Dilate(P4, 1 / 2), Element(PT, i)), i, 1, 3))** **P6 = Flatten(Sequence(Translate(Dilate(P5, 1 / 2), Element(PT, i)), i, 1, 3))** ◆ In the Advanced Tab of the properties of polygon P4, P5 and P6, input "n = 4", "n = 5" and "n = 6" respectively as the conditions to show objects.

Exercise:

Try to construct a GeoGebra file that can create the Sierpinski carpet.