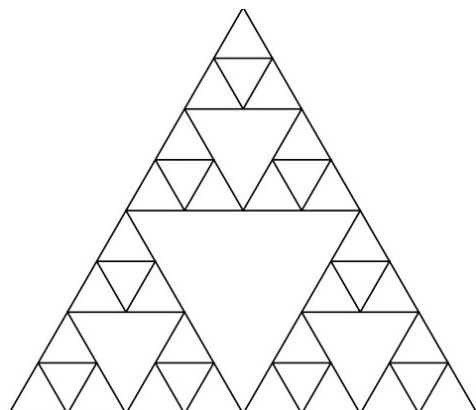
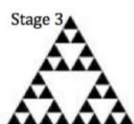


THE 30-MINUTE FRACTALS LESSON

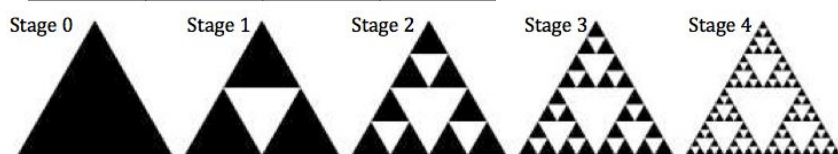


Start by watching the video <https://youtu.be/CWdmkoZgIoA>



Each student should have a stage 3 Sierpinski triangle of edge length about 6.5 cm and a colouring pen, and should colour their triangle as shown by the black filling in the small diagram.

The class will make poster of a stage 6 Sierpinski triangle using 27 of the triangles that the students have coloured in. You can see how, at each stage, 3 triangles are used to make up the Sierpinski triangle at the next stage.



A fractal is infinite and these triangles are just building blocks. Imagine this process going on forever to form the Sierpinski fractal, by growing out getting bigger and shrinking in getting smaller.



If you want to extend the 30-minute lesson, and if you have enough time and space, if you have a big class, or if several classes combine, you might make a stage 7 poster with 81 triangles or even a stage 8 poster with 243 triangles.

This activity should help learners to appreciate how fractals are self similar repeating at different scales. In the activity a fractal pattern is made that grows outwards getting bigger. A true Sierpinski fractal is the result of a similar process that repeats infinitely many times by making triangular holes (like the white triangles) at smaller and smaller scales inside itself. As humans we cannot actually complete a task that goes on forever or see the infinitesimally small structure inside the fractal but we can try to imagine it.

NOTES FOR TEACHERS

RESOURCES NEEDED

- Copies, already cut out, of stage 3 Sierpinski triangles (edge length about 6.5 cm) for students to colour, one each and some to spare, see page 3.
- Colouring pens, one for each student.
- Backing sheet for the poster - flipchart paper (A0 size, 1189Å~841 mm) is ideal for a stage 6 (27 students' triangles). You need 2 sheets for a stage 7 (81 students' triangles). A larger Sierpinski triangle might be assembled from 3 stage 7's. Draw a faint line in pencil parallel with the bottom edge and about the width of a ruler up.
- Fix your backing sheet up with Blu tack or Prestik or drawing pins on the wall or on a stand ready to paste the coloured triangles on it.
- Glue (Pritt or UHU sticks or similar).
- Globe or map of the world (optional)
- Broccoli (optional) to break up to demonstrate fractal structure if you can't show the video in the lesson.
- Copies, already cut out, of stage 4 Sierpinski triangles (edge length about 13 cm) to be coloured and stuck into notebooks while the poster is being finished, see page 2, and/or more copies of the stage 3's to make a bigger poster as follow-up to the 30-minute lesson.

	Stage 6		Size backing sheet	Stage 7		Size backing sheet	Stage 8		Size backing sheet
Number stage 3's	27		A0 841 × 1189 mm A1 594 × 841 mm	81		2 A0 sheets 	243		4 A0 sheets 
Height	451 mm	18 in		902 mm	36 in		1804 mm	72 in	
Width	520 mm	21 in		1040 mm	41 in		2080 mm	82 in	

Why do this activity?

Each year a 30-minute lesson on an important cross curricular theme is taught on the same day in thousands of schools around the world. Learners of all ages enjoy a one-world experience with other young people. A collection of follow-up activities for all ages, relating directly to the school curriculum, enable teachers to plan exciting lessons to deepen their students understanding of the topics that they need to study and to explore applications of school mathematics. The Fractals in Maths, Science, Nature and Art collection provide activities on number patterns, sequences, algebra, area, perimeter, properties of 2D and 3D shapes, geometric series, iterative processes, limits and applications to science.

Learning objectives

Number patterns, Geometric Patterns, Appreciation of an infinite iterative process. Visualisation

Generic competences

Teamwork. Ability to work systematically. Experience and appreciation of belonging to one human family. Visualisation.

Suggestions for teaching

ACTIVITY	Duration in minutes	Time
1. Try to distribute the triangles to be coloured in and the pens before the lesson. Tell the class that today's lesson is special because thousands of schools around the world will be doing the same lesson. You could show a globe and talk briefly about time zones.	2	2
2. Either show the video	3	5
Or watch the video several times yourself before the lesson and prepare to tell the class about fractals. You could use broccoli as an example and break it into pieces to show similarity on different scales. Explain that the class will make a poster of a Sierpinski triangle that would be come a fractal if it continued to grow outwards and inwards forever.	3	5
3. Each student should have a stage 3 triangle and a colouring pen. Explain that they must colour their triangle in one colour, exactly as shown (draw one on the board or show a slide).	3	8
4. As soon as the first coloured in triangles are ready start inviting the students to cover the back with glue, and bring their triangle to stick on the poster, starting at the bottom left hand edge. Complete a stage 4 triangle with 3 stage 3 triangles before sticking any more to the right. Stop the class and very briefly draw their attention to the stage 4 triangle just completed . Appoint the first 3 students who have already stuck their triangles on the poster as monitors to organise 3 queues to come to the board with glued triangles ready to stick them on the poster with guidance from the teacher.	5	13
5. Stick 6 more stage 3 triangles on the backing sheet so that the 9 stage 3's together make a stage 5 triangle. Briefly draw the attention of the class to this stage 5 Sierpinski triangle .	5	18
6. Stick another 9 stage 3 triangles at the same level and another 9 above so that the 27 stage 3's together make a stage 6 triangle. Draw the attention of the class to this stage 6 Sierpinski triangle they have completed .	7	25
7. Take a photo of your class with their poster. If time, students should stick a stage 4 Sierpinski triangle into their notebook and write a brief account of what they have learned in the lesson.	5	30
You will not have time for what follows in the 30-minute lesson but, as follow up...		
8. If several classes can work together, and you have enough space, then 3 stage 6 triangles (81 children's triangles) can be combined to make a stage 7 and so on and on forever...		

Key questions

What do you notice?

Can you explain what happens from one stage to the next?

What happens to the number of **coloured in triangles** from one stage to the next?

What do you notice about the number pattern for the numbers of **coloured in triangles** at each stage?

Can you find the number of triangles at the 10th stage or the 100th stage without calculating all the numbers of triangles up to 100?

Possible extension

<https://aiminghigh.aimssec.ac.za/years-9-to-12-pascals-triangle-and-fractal-patterns/>

On the AIMING HIGH website use the TOPIC SEARCH and select Fractals and GML to find more activities on Fractals for different age groups.

Possible support

To suit students of all abilities the class could make a Stage 4 or Stage 5 poster instead of a stage 6 poster. See the Teachers Notes for Early Years and Lower Primary

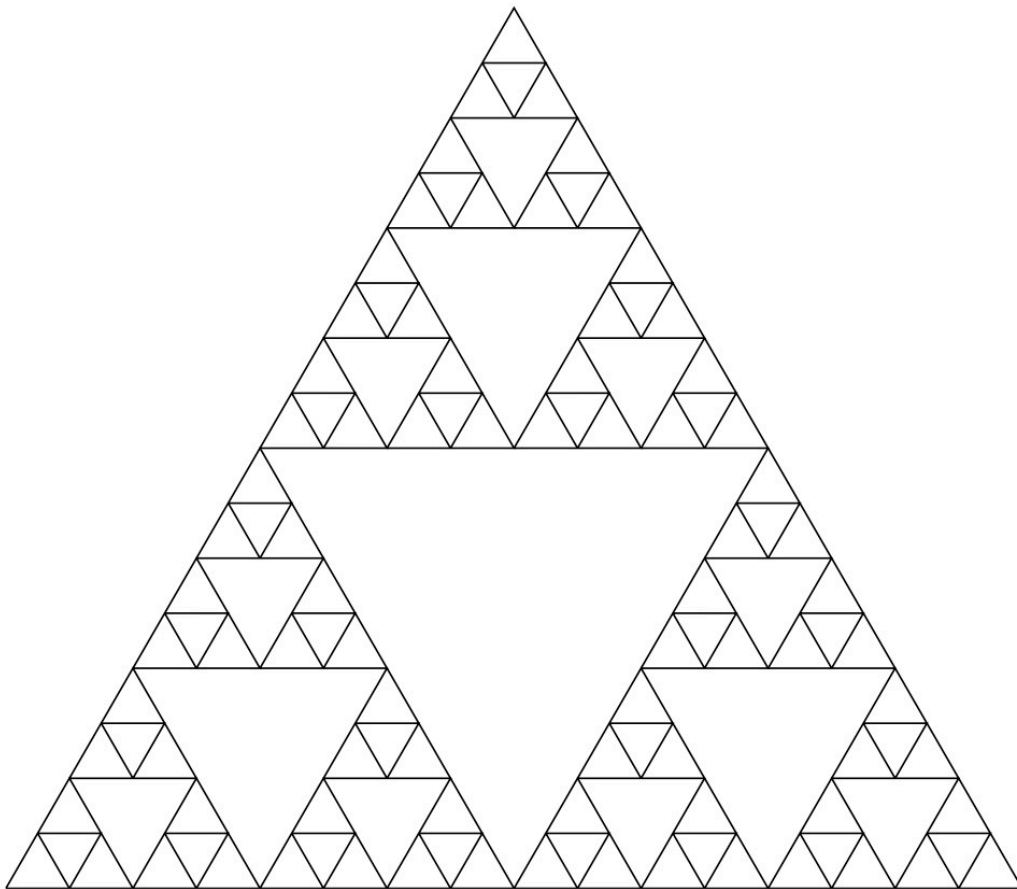
Note: The Grades or School Years specified on the AIMING HIGH Website correspond to Grades 4 to 12 in South Africa and the USA, to Years 4 to 12 in the UK and up to Secondary 5 in East Africa. New material will be added for Secondary 6.

For resources for teaching A level mathematics see <https://nrich.maths.org/12339>

Note: The mathematics taught in Year 13 (UK) and Secondary 6 (East Africa) is **beyond** the school curriculum for Grade 12 SA.

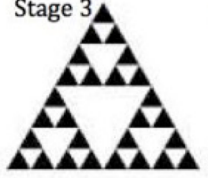
	Lower Primary or Foundation Phase Age 5 to 9	Upper Primary Age 9 to 11	Lower Secondary Age 11 to 14	Upper Secondary Age 15+
South Africa	Grades R and 1 to 3	Grades 4 to 6	Grades 7 to 9	Grades 10 to 12
USA	Kindergarten and G1 to 3	Grades 4 to 6	Grades 7 to 9	Grades 10 to 12
UK	Reception and Years 1 to 3	Years 4 to 6	Years 7 to 9	Years 10 to 13
East Africa	Nursery and Primary 1 to 3	Primary 4 to 6	Secondary 1 to 3	Secondary 4 to 6

Stage 4 Sierpinski Triangle for students to colour and stick in their notebooks.



8 stage 3 Sierpinski triangles to cut out and colour.

Stage 3



Use 3 to make a stage 4 Sierpinski Triangle
Use 9 to make a stage 5 Sierpinski Triangle
Use 27 to make a stage 6 Sierpinski Triangle
Use 81 to make a stage 7 Sierpinski Triangle and so on

