



Patterns in Nature

Activities Introduction

dublin  council

Congratulations!

You now have in your hands a booklet to guide you in Dublin Arts Council's new park-based, self-guided *Patterns in Nature* project. This is an introductory educational booklet that explores the scientific and artistic properties of fractal patterns that create a sense of wellbeing. In the fractal box, you can find a companion activity booklet that goes along with this guide.

Activity booklets will rotate seasonally, offering visitors fun, fractal art activities that inspire connection to nature, promote well-being and nurture creativity. Visit Dublin Arts Council's *Patterns in Nature* webpage for more details and to find the activity schedule by scanning the QR code.

Use your
smartphone
to scan the
QR code



[DublinArts.org/fractals](https://dublinarts.org/fractals)



This educational booklet will explore fractals!

What are fractals?

They are extraordinary and exciting patterns that can be found in math, nature, art, and design. These patterns are beautiful and extremely useful! Learning about fractals can help us discover that many disciplines, or areas of study, are closely related. These disciplines are math, science, art, and technology.

Let's explore fractals in each of these areas of study.

- A Fractals in Math**
- B Fractals in Nature**
- C Fractals in Design**
- D Functional or Decorative?**
- E Why Fractals Matter**





What are Fractals in Math?

Fractals are complex patterns that are self-similar.

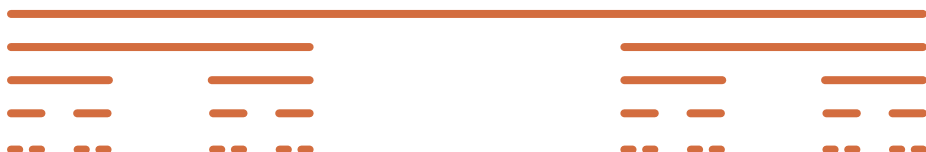
This means that as they repeat, they are identical but grow smaller or larger. As you zoom in or out, the pattern keeps looking the same, over and over again.

Fractal patterns in math can repeat FOREVER into infinity.

Let us look at how we can create a fractal in mathematics. Keep in mind that we cannot repeat things forever on a piece of paper because we would run out of space!

We can begin with a fractal called the Cantor Set.

Start with a straight line and mark it into three equal parts, then delete the center part. Notice that fractal patterns can be created using an easy set of instructions that repeat creating something very complex.



The Cantor Set

Here are the instructions for a Cantor set:

You will need a pencil and eraser for this activity.

1. Draw a straight line
2. Divide the line into three equal parts
3. Erase the middle part of the line
4. Use the resulting lines to repeat the process

Using this list of instructions, complete the cantor set on the next page.

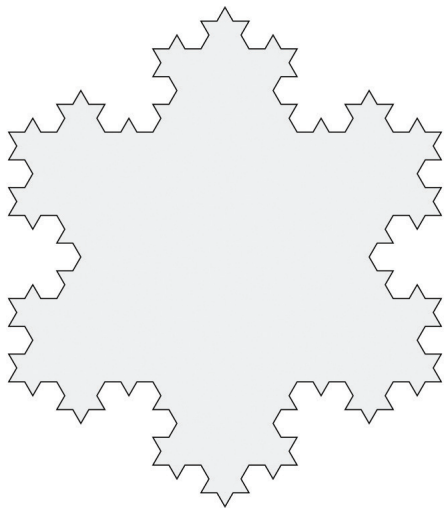
Draw a Cantor Set here ↴



More complicated patterns can be created using this fun method.

Try to guess the instructions for drawing the fractal patterns below, then complete the patterns for as long as you have space on the page.

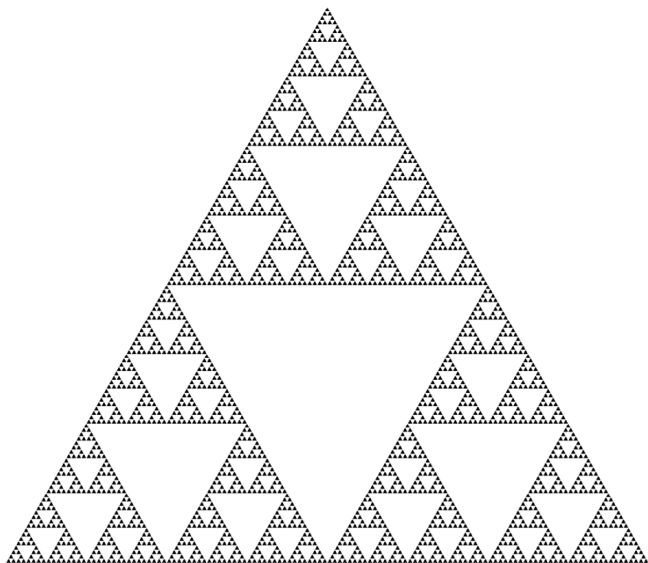
How was this fractal drawn?



What are the instructions for creating this fractal?

- 1. _____
- 2. _____
- 3. _____
- 4. _____

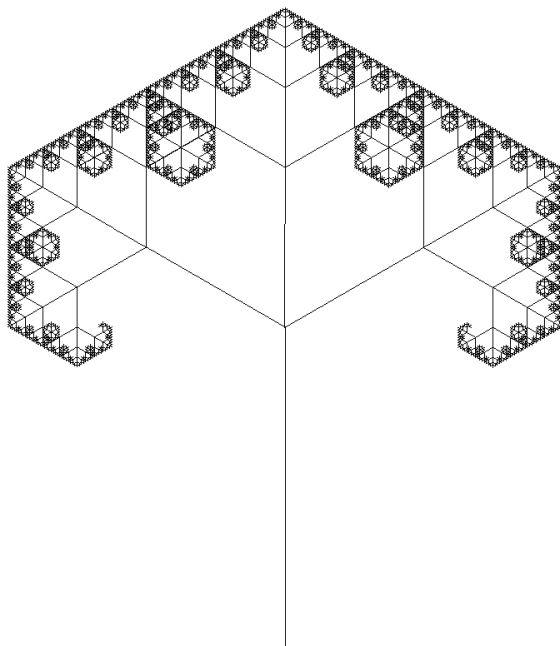
How was this fractal drawn?



What are the instructions for creating this fractal?

- 1. _____
- 2. _____
- 3. _____
- 4. _____

How was this fractal drawn?



What are the instructions for creating this fractal?

- 1. _____
- 2. _____
- 3. _____
- 4. _____

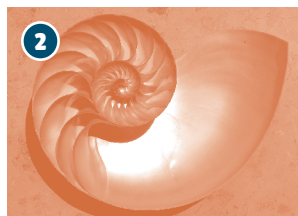
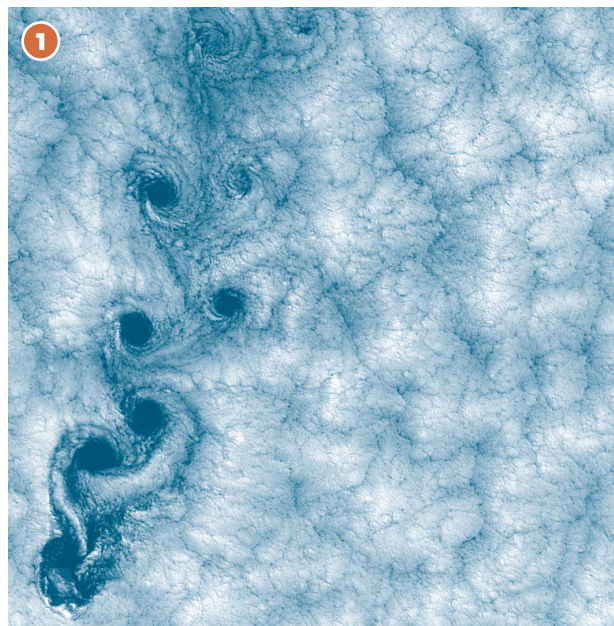
B What are Fractals in Nature?

This might not be the first time you have seen patterns like this. Why?

Because they might be familiar to you from nature! We can find fractals all over the natural world, from small leaves to giant trees. Patterns that follow a list of instructions like the ones we explored can be found in seashells, galaxies, clouds, rivers, mountains, lighting bolts, blood vessels, flowers, and many other places. Look at the nature images below and see if you can find the patterns. Try to think about the instructions that the patterns follow. Discuss your instructions with family and friends.

You might have noticed that fractal patterns in nature are less stiff, rigid, and fixed than patterns in math.

This is because nature is more dynamic, flexible, and irregular. However, that makes the patterns so much more beautiful!



1. The fractal motion of clouds; **2.** Nautilus shell; **3.** Fractal plants

By looking at fractals in nature, you can see the story of natural processes.

You can almost see the fern grow from little leaves to bigger leaves! Nature is full of fractals! We find them everywhere! High, Low, Far, and Close. You have been surrounded by fractals your whole life!



What are fractals in Design?



A Pagoda building common to East Asia.

You have been surrounded by fractals in nature, but also in your home and city!

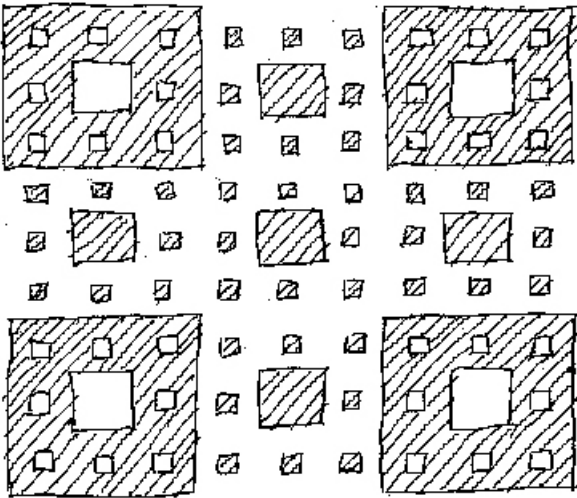
Buildings in the past all over the globe used fractal patterning in their design. You can see it in the images on these two pages. Sometimes the repetition of domes create a pattern and other times the repetition of tiles create a pattern. These patterns are fractal because the repetition includes a change in size. Modern buildings also have fractal designs.

The way buildings come together to form towns and cities also follows a fractal pattern.

You can see this in old cities and Madinas, in places like Morocco.



An aerial view of Morocco.



A drawing of a city plan where buildings are arranged in a fractal pattern.

As you can see in these images, fractal patterns are very beautiful! They are complicated and intricate, but at the same time they appear orderly and organized. Balance is what makes fractal patterns so exciting!



Functional or Decorative?



Fractal patterns can be incredibly beautiful, as you have seen in the images. Fractals are also functional.

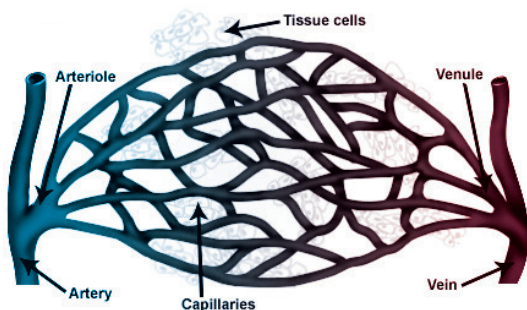
What does functional mean? Functional means that it has a purpose, and/or it is used for something.

Q: Write down other words you think have the same meaning as functional:

_____	_____
_____	_____
_____	_____

Blood vessels are fractal, and functional.

Vessels move the blood around to every cell in your body. Fractal patterns are an efficient way to make sure that blood arrives to every part of your lungs, fingers, and eyes.



Q: What is the opposite of functional? _____

A: Decorative! Decorative means that it is for decoration. It makes something look more attractive and beautiful. Decoration is done for aesthetic (or beautification) purposes.

Q: Write down other words you think have the same meaning as decoration:



Inside rooms, designers sometimes include plaster on the walls that is shaped into complex shapes.



Plaster Muqarnas on a ceiling

These shapes in some rooms create patterns that are fractal.

A good example are Muqarnas (*mo-kar-NAS*) decorations. These are extra additions to the room. If they were removed, you could still sit in the room, eat in it, and stay out of the rain and snow. Muqarnas decorations are included for aesthetic reasons.

Does that mean that something decorative is not functional?
Well, if it makes us happy when we look at it does it have a function?
If it makes us more relaxed and comforted, does it have a function?

Q: What do you think of these questions?



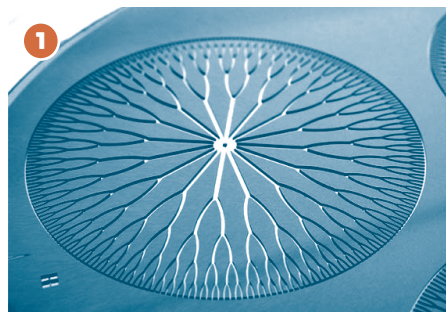
E

Why do Fractals matter?

Have you stared at clouds and felt calm, or watched the waves at the ocean and felt relaxed?

Nature's positive effect on our emotions and mind is real. Scientists call this biophilia. Many scientists think that the reason we feel good when in nature is because we like fractal patterns. They are complicated patterns, so they keep us interested. At the same time, they are organized patterns, so they are relaxing. The balance of both has a positive effect on our wellbeing! Feeling good is one reason fractals matter.

Another reason fractals matter is because they are very useful.

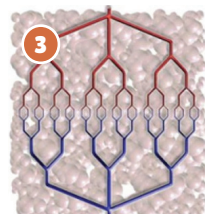


Fractal patterns are useful in many areas, such as in engineering, medicine, and electronics.

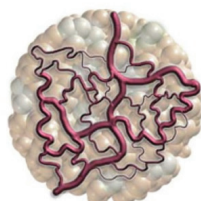
A computer chip uses a fractal pattern as a cooling circuit, since fractals can cool the heat very quickly in its branching pattern.



Fractal pattern can fill up space very efficiently, so it can fit a very long wire in a small space. That is why you find antennas made into fractal patterns. The longer the antenna, the better the antenna is at catching varied types of signals.



A. Normal



B. Abnormal

Since blood vessels in our bodies branch in fractal patterns, a fractal analysis can tell doctors if our vessels are healthy. Fractal analysis of vessels can uncover emphysema, tumors, and other medical issues.

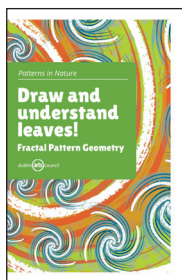
Fractals in 1. cooling chips; 2. antennas; and 3. blood vessel analysis

Remember your activity booklet!

Now that you have learned a few things about fractal patterns and their connection to nature, your body, and its wellbeing, it is time to get into some activities.



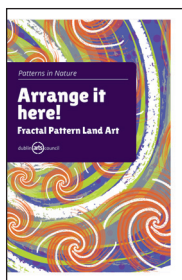
- 1**
Discover around you!
Fractal Pattern Hunt



- 2**
Draw and understand leaves!
Fractal Pattern Geometry



- 3**
Let your hand lead!
Fractal Pattern Doodles



- 4**
Arrange it here!
Fractal Pattern Land Art

These activities will encourage you to discover the Dublin park you are currently visiting. You can follow the instructions as closely or as loosely as you want. Remember that your aim is to have a good time and reflect on your natural surroundings. Keep an eye out for all the fractal patterns around you.

You can see fractals in the growth of tree branches, the edges of clouds, the bark of trees, cracks in concrete, and in the winding, branching path of a river.



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