Unit 11 – Fractals

1. Read the text, underline definitions and answer the following questions:

a) Who was the first to use the term “fractal?

b) Where can fractals be useful?

c) Where can you find fractals in nature?

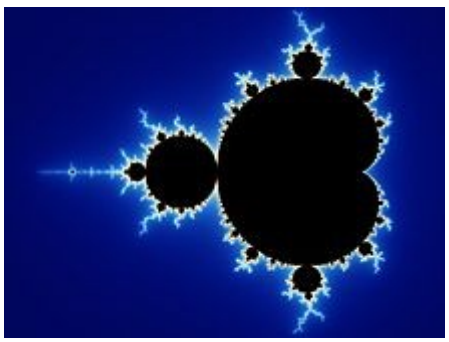
d) Is a straight Euclidean line a fractal? Why Y/N?

A fractal, by definition, is “a rough or fragmented geometric shape that can be split into parts, each of which is (at least approximately) a reduced-size copy of the whole”. The properties of fractals include self-similarity and scale-independency. Self-similarity is the idea that as an object is magnified the original shape of the whole is repeated over and over again. Scale-independency means that by zooming in on a fractal a person cannot determine whether they are looking at the smallest or largest part of the shape, since the shape is being repeated.

Roots of the idea of fractals go back to the 17th century, while mathematically rigorous treatment of fractals can be traced back to functions studied by Karl Weierstrass, Georg Cantor and Felix Hausdorff a century later in studying functions that were continuous but not differentiable; however, the term fractal was coined by Benoît Mandelbrot in 1975 and was derived from the Latin fractus meaning "broken" or "fractured." A mathematical fractal is based on an equation that undergoes iteration in a form of feedback based on recursion. While fractals are a mathematical construct, they are found in nature, which has led to their inclusion in artwork. They are useful in medicine, soil mechanics, seismology, and technical analysis.

Natural objects that are approximated by fractals to a degree include clouds, mountain ranges, lightning bolts, coastlines, snow flakes, various vegetables, and animal coloration patterns. However, not all self-similar objects are fractals—for example, the real line (a straight Euclidean line) is formally self-similar but fails to have other fractal characteristics; for instance, it is regular enough to be described in Euclidean terms.

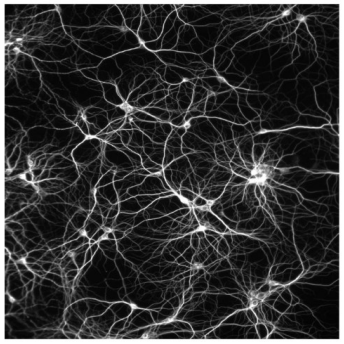
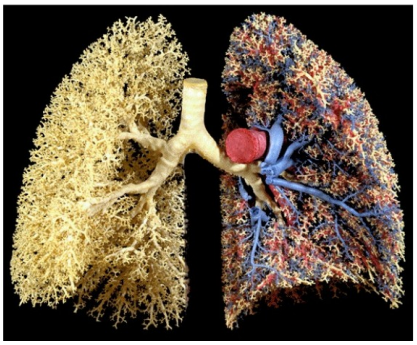
The text is based on: ***http://jwilson.coe.uga.edu/EMAT6680Fa11/Frailey/FractalEssay.htm***, ***http://blog.world-mysteries.com/science/fractal-nature/***



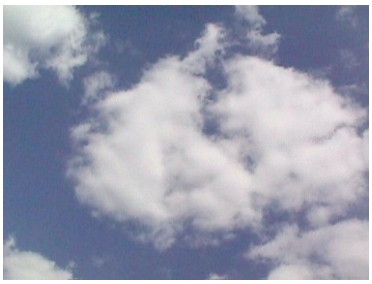
The Mandelbrot set is a famous example of a fractal

2. Look at the pictures and discuss what they are/might be and which fractal features you can identify there.




https://fractalfoundation.org/fractivities/FractalPacks-EducatorsGuide.pdf

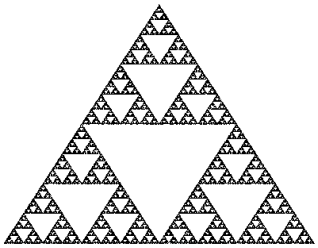


http://sprott.physics.wisc.edu/fractals/natural/?C=M;O=A

3. Analyze the definitions from the text in Ex. 1. Do they have the same structure? What is a typical "definition formula"?

4. Define these terms:

Iteration



Recursion

4. LISTENING.

https://www.ted.com/talks/ron_eglash_on_african_fractals

a) Pre-listening. Match the words with their explanations:

	a wrinkle or crease on the surface of something
mission	an important assignment typically involving travel abroad, can be of religious character
social scaling	a complex „hill“ of soil which is constructed by small tropical insects that live there in large colonies
altar	sorting people into different levels, from lowest to highest
termite mound	a table or flat-topped block used as the focus for a religious ritual
crinkle	

b) Listen to Ron Eglash is talking about his project and answer the questions.

1. What did Georg Cantor discover? What were the consequences for him?

2. What did von Koch do?

3. What did Benoit Mandelbrot realize?

4. Why does Ron ask the audience to look at their hand?

5. What did Ron get a scholarship for?

6. In what situation did Ron use the phrase “I am a mathematician and I would like to stand on your roof.” ?

7. What is special about the royal palace?

8. What do the rings in the village in southern Zambia represent?