God's Omniscience

Lesson 1

Mathematics: Fractals and the attributes of God

The heavens declare the glory of God; the skies proclaim the work of his hands.
Psalm 19:1(NIV)

Introduction

God often points to creation when he wants to demonstrate his own power and position to man. Remember that science is the process and results of learning about things that we can observe. Thus, God encourages man to use science to discover God's attributes.

> *I form the light and create darkness, I bring prosperity and create disaster; I, the LORD, do all these things. (Isaiah 45:7, NIV)*
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> *My own hand laid the foundations of the earth, and my right hand spread out the heavens. (Isaiah 48:13, NIV)*
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> *With my great power and outstretched arm I made the earth and its people and the animals that are on it, and I give it to anyone I please. (Jeremiah 27:5, NIV)*
>
> *I am the LORD, who has made all things, who alone stretched out the heavens, who spread out the earth by myself. (Isaiah 44:24, NIV)*

Since God created the universe it follows that the universe declares the glory of God and that mankind can discover the glory of God revealed in the universe. But how are we to discover the glory of God revealed in the universe? What form will it take? What tools can we use to unlock this revelation? In some situations the answer to these questions are simple, yet amazing. Observation alone reveals the flight of a bird; the color of a flower; the friendship of a dog; the healing power of skin; and the sweetness of fruit. In other situations the answers are much more complex, but no less amazing. The use of sun light by flowers; the function of internal organs; the expanse of our solar system; the healing power of penicillin; and the birth of new life. All of these things are part of God's creation and reveal God's glory.

One answer to the questions, "How are we to discover the glory of God revealed in the universe?" and "What tool can we use to unlock this revelation?" is mathematics, specifically a field of mathematics called fractal geometry. It was not that long ago that the discipline of fractal geometry was developed. Benoit Mandelbrot, a scientist for IBM and the father of fractal geometry, published the first book on fractals in 1975. Considering that Euclidean geometry, the geometry that you studied in high school, dates back to circa 300 B.C., fractal geometry is very young indeed.

Seeing Fractals

To appreciate fractals you must see them. Descriptions and math alone cannot reveal their beauty as quickly and as efficiently as images. As you pause and look at image 1 for a moment contemplate that this image is a graph of a mathematical formula. The colors in the image represent how quickly a point on the plane approaches infinity. If you are curious about the mathematics behind fractals then see the Mathematics of Fractals section below.

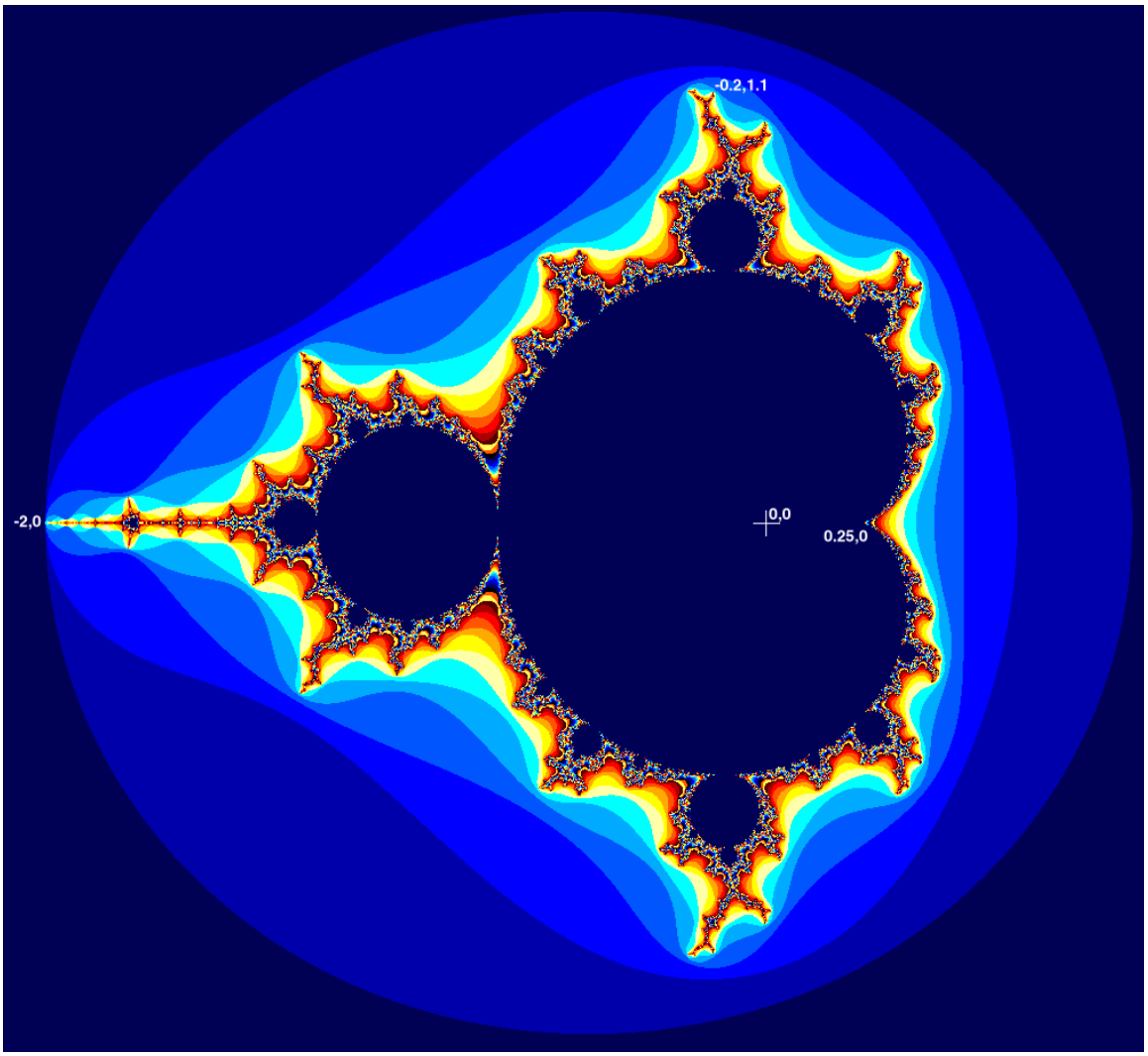

Image 1: The Mandelbrot Set (McGoodwin, 2000)

One of the characteristics of fractals is that they are self-similar which means their patterns repeat with some variation. Fractals have infinite detail that allows you to zoom in at any magnification level and see additional detail. Image 2 is an example of zooming in on a fractal. The arrows in image 2 indicate the zoom point for the next sequential picture.

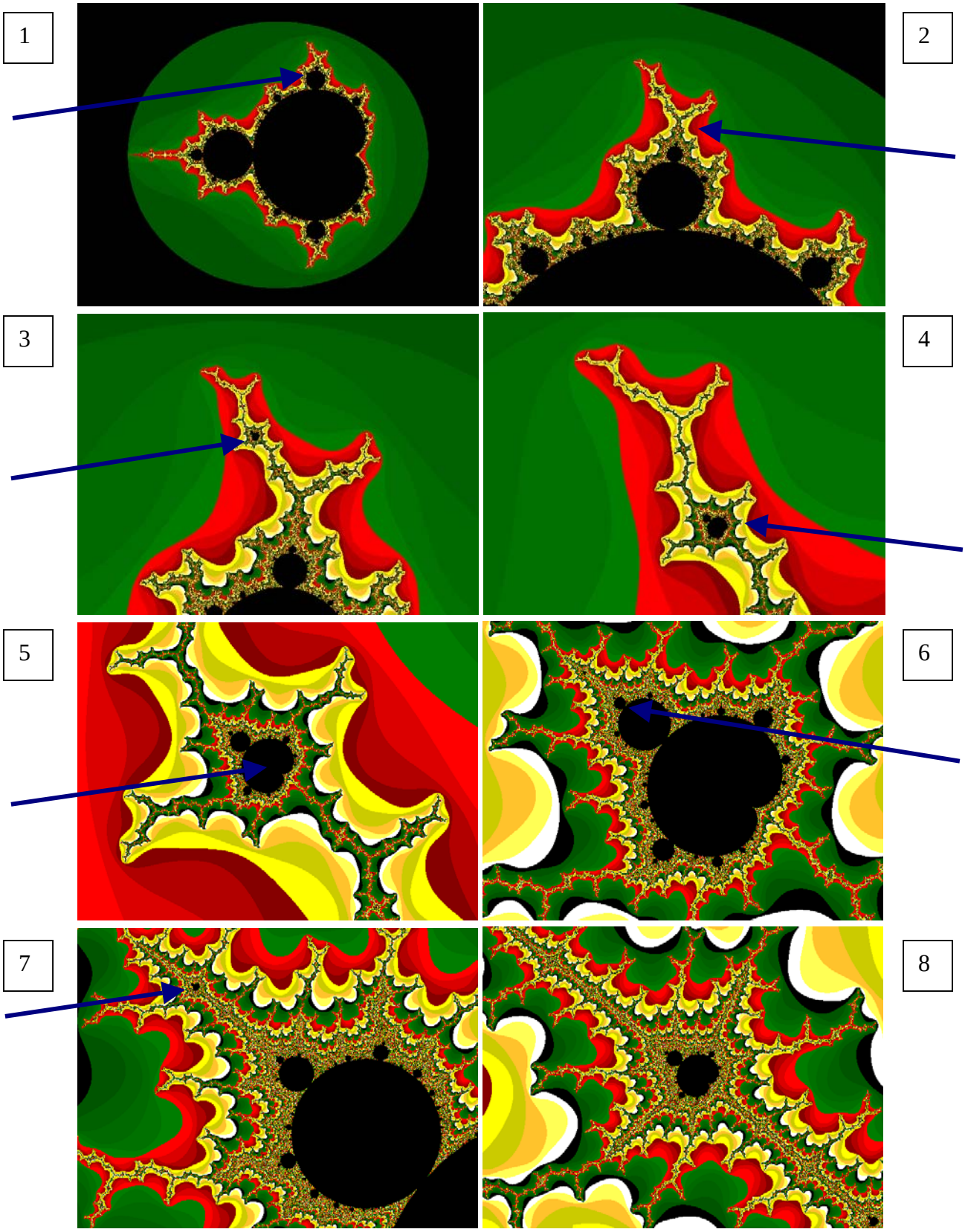

Image 2: Zoom Sequence (Adams, n.d.)

The self-similarity of fractals can be seen in nature. Consider these examples.

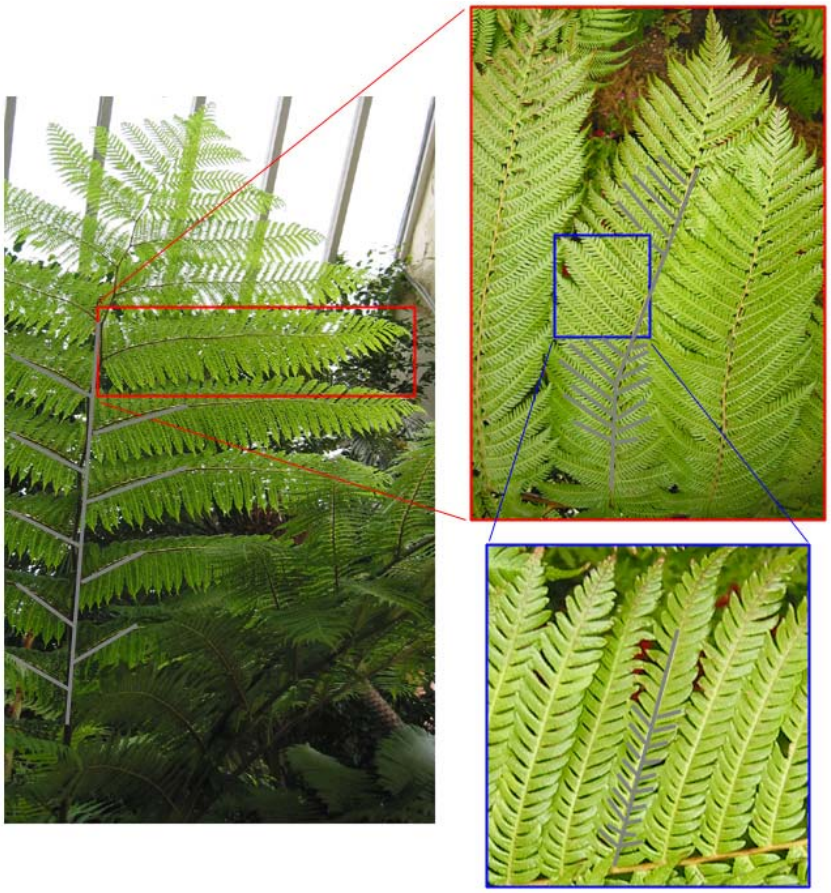

Image 3: Fern (Bourke, 2002)

Image 4: Cauliflower (Zito, n.d.)

Image 5: Satellite image of Finland (Virtual Finland, 2006)

Image 6: Landscape? (Brown, 2005)

Image 6 is actually a fake landscape generated using fractal equation and software developed by Andrew Brown (2005). Brown's website has a number of these very realistic looking landscapes for you to browse.

Mathematics of Fractals

This paper is not intended to be a lesson in mathematics. But this section is provided to answer questions you may have about how fractal patterns are generated. It is not necessary that you understand or even read this section. So, if math scares you, or you are not curious about how fractal patterns are generated feel free to skip this section. I am confident that by the end of this paper you will be able to witness God's glory in his creation through the tool of fractal geometry whether or not you read this section.

Do you remember plotting graphs in school? There is an x coordinate and y coordinate. If x=1 and y=2 then we put a point on the graph one unit to the right of the center and two units above the center. This kind of graph is plotted on what we call a real number plane. Real numbers are positive, negative, or zero. Fractals are plotted in a similar fashion, but they are plotted on the complex plain instead of the real number plane. Complex numbers are beyond the scope of this paper, but if you are really curious Joyce (1999) provides a great explanation.

The most well known fractal set is the Mandelbrot set. Here is the formula for the Mandelbrot set.

$$z \rightleftharpoons z^2 + c$$

The symbol $\rightleftharpoons$ indicates that the value z is run through the formula repeatedly over and over. We call this process recursion or iteration and it is the mathematical equivalent of eating an M&M because you just ate an M&M. If you eat an M&M because you just ate one then you will have to eat another because you just ate that one and so on into chocolate oblivion. That is the way recursion works in mathematics. The value of z is selected and then that value is put through the equation millions and even billions of times. If the value of z continually gets smaller, and thus approaches zero, then that point on the plane is in the Mandelbrot set and is colored black on the image. If the value of z continually gets larger, and thus approaches infinity, then that point on the plane is outside the Mandelbrot set and is given a color. The different colors represent the rate at which z increases. Thus, the colors serve as the border lines in a topographical map. The specific colors chosen to represent different levels in the topography do not affect the map, just like the colors chosen to represent different countries on a globe do not affect the actual countries.

Fractals have two key characteristics.

1. They are self-similar
2. They have a fractional dimension (1 dimension is a line, 2 dimensions is a plane, a fractal can have a dimension of 1.5).

The second item, fractional dimension, is beyond the scope of this paper. But the self-similarity of fractals is the key to understanding them. Self-similarity means that fractals look similar, or roughly the same, on multiple scales. This was demonstrated with

image 2 above. In mathematics self similarity is infinite. You could zoom in to the Mandelbrot set a billion, billion, billion times and still find self similarity.

The mathematical process of zooming in to a fractal is accomplished by increasing the resolution on the axis lines. Consider using the basic ***x***, ***y*** graph to plot stock market prices. If you were to use a single sheet of paper to plot the price changes over a 10 year period for a single stock you would not be able include much detail. If you decided to use a one-day period you would be able to include much more detail.

Fractals and the attributes of God

As illustrated by images three, four, and five we can see fractals in nature. These examples, and many others that you or I could think of, demonstrate self similarity that is recognizable. There is one major difference between mathematical fractals and natural fractals. Where as a mathematical fractal has infinite self-similarity, a natural fractal has limited self-similarity. If we were to zoom in to the coastline of Finland in image five we would eventually be looking at atoms and there would be no self similarity to the satellite picture in image five. Never the less natural fractals exist and can be replicated using mathematics as image six demonstrates.

How did the fractal of the fern in image three and the cauliflower in image four come to exist? I do not mean, how did ferns and cauliflower come to exist, but rather how did that specific fern and that specific cauliflower come to exist? The answer is that they grew from a seed. Fractals that occur in biological systems are very interesting because the fractals must be grown. In order to grow there must be some formula or code contained in the seed. We are just beginning to understand the microscopic details of DNA, but we do know that the codes for growth and cell activity are contained in the DNA strands inside the nucleus of every living cell.

This formula or code for growth does not occur just in plants. Many human systems are natural fractals either in their entirety or portions of the system. These systems include the kidneys, brain, respiratory, lymphatic, circulatory, and nervous systems (Flake, 1998).

The value of fractals in biological systems is due in part to the small size and simplicity of fractal equations. Remember the mathematical formula for the Mandelbrot set (see Mathematics of Fractals section above)? The formula requires one multiplication and one addition. Yet the result is a very complex image. Flake (1998) explains that biological systems "minimizes material requirements while maximizing functionality through ubiquitous use of fractals" (p. 77). A fractal code for growth of a fern, a brain, or a circulatory system can easily be contained in the DNA structure of the cells that start the growth process of each of these systems.

There are other reasons for the value of fractals in biological systems. For example the repeated branching structure in our respiratory and circulatory systems provide a high surface area to volume are making them incredibly efficient at exchanging oxygen and carbon dioxide.

"God used beautiful mathematics in creating the world"
Paul Dirac (Quoted in Flake, 1998, p. 61)

Our mathematical fractals are just a representation of the creative power of God. So before we get too excited about beautiful mathematics we should get really excited about who God is and how he has demonstrated his attributes through creating everything. Some people just do not see it though. While expounding on the evolutionary development of mankind, Driscoll (2005) stated, "what is noteworthy about [prenatal development of the brain] is the very orchestrated plan it requires" (p. 295). How can we attest to the complexities of the brain and not recognize the brain designer? How can we attest to the dual characteristics of fractals – simplicity of formula and complexity of organism – and not recognize the designer? The answer to both questions is we cannot. Science and logic require that we recognize "the heavens declare the glory of God; the skies proclaim the work of his hands" (Psalm 19:1, NIV).

Understanding fractals gives us a glimpse into the awesome knowledge and creative power of God. No one is saying that God calculated a formula on his HP calculator and stuck it into the DNA. But fractals provide a way for us to model and therefore better understand God's creative power. A better understanding of God leads to praising God more.

The attributes of God that can be most clearly seen in fractals include the following:

1. Omniscience – God is all knowing. Because we understand mathematical fractals we can understand the wisdom of using fractals in creation. Fractals create efficiency on many scales. God designed the universe based on his infinite knowledge.
   1 Samuel 2:3; Psalm 139:1-4; Hebrews 4:13
2. Infiniteness– God has always existed and will always exist. God's powers and abilities are without limits. The infinite scalability of mathematical fractals gives us a model for God's infiniteness. A simple formula can produce a graph with infinite scalability.
   1 Kings 8:27; Psalm 145:3; Hebrews 1:12
3. Omnipotence – God is all powerful. Natural fractals demonstrate God's creative power. Seeing and understanding fractals in nature helps us to see, understand, and appreciate God's omnipotence.
   Jeremiah 32:27; Matthew 19:26; Revelation 19:6

I form the light and create darkness, I bring prosperity and create disaster; I, the LORD, do all these things. (Isaiah 45:7, NIV)

My own hand laid the foundations of the earth, and my right hand spread out the heavens. (Isaiah 48:13, NIV)

With my great power and outstretched arm I made the earth and its people and the animals that are on it, and I give it to anyone I please. (Jeremiah 27:5, NIV)

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