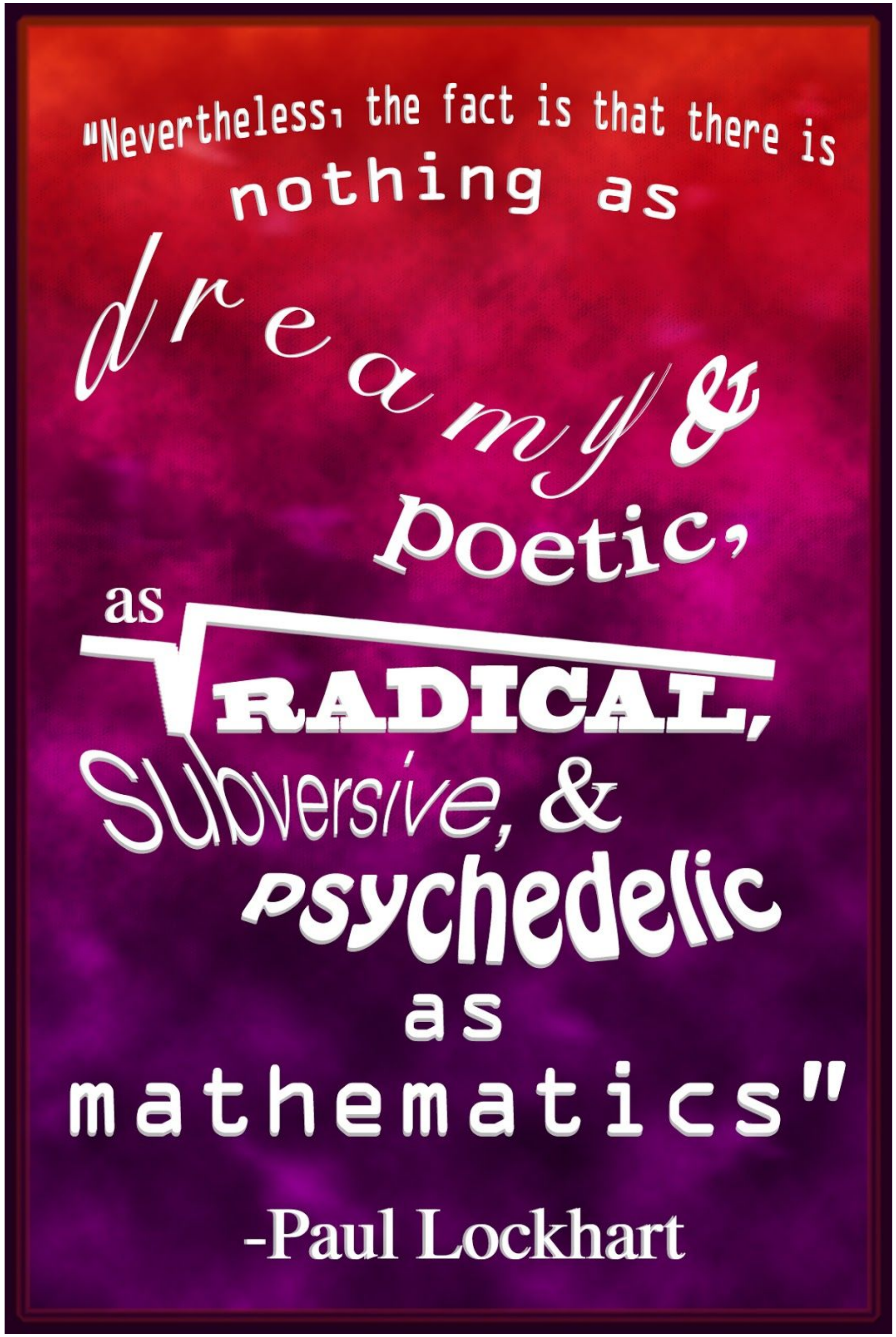
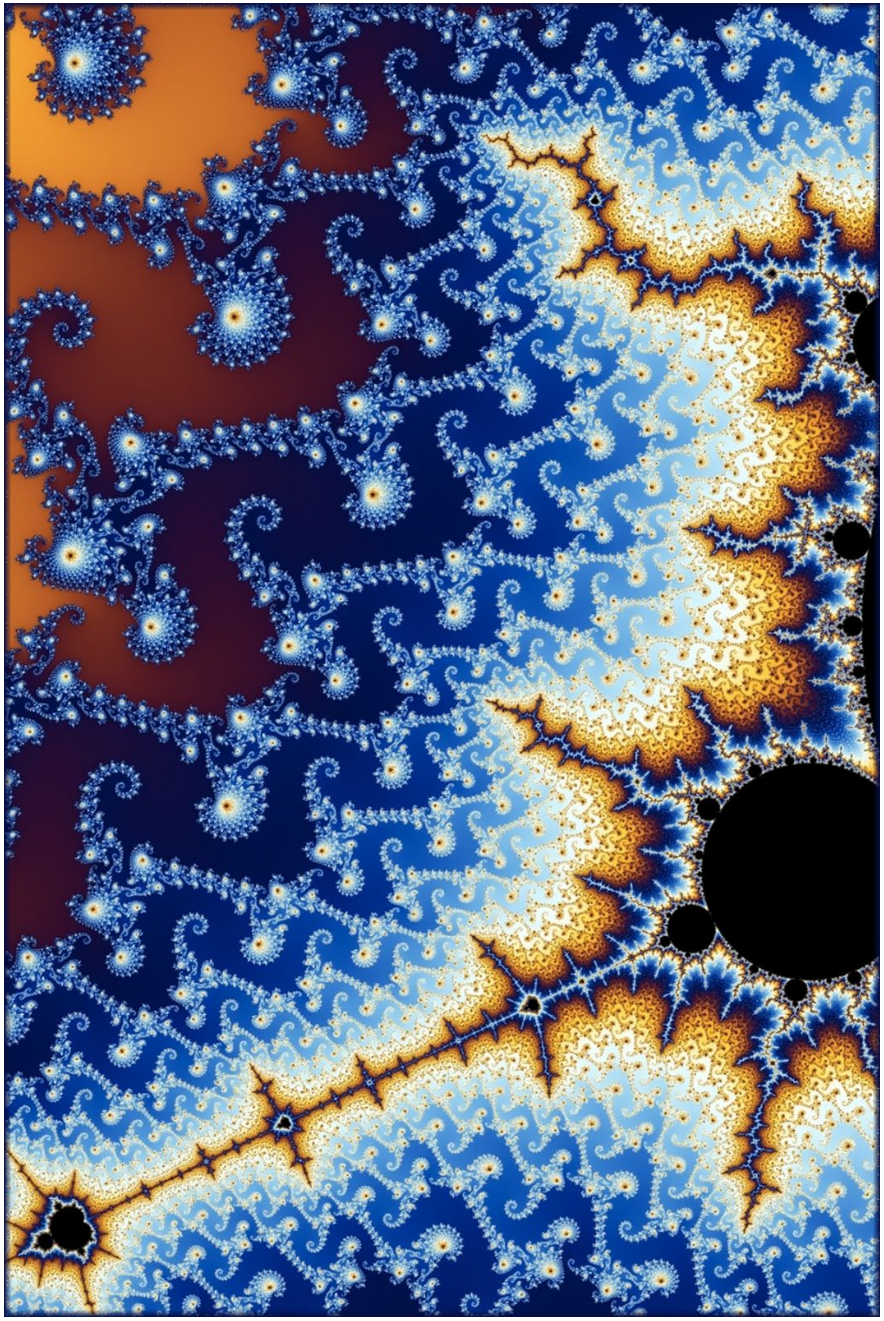
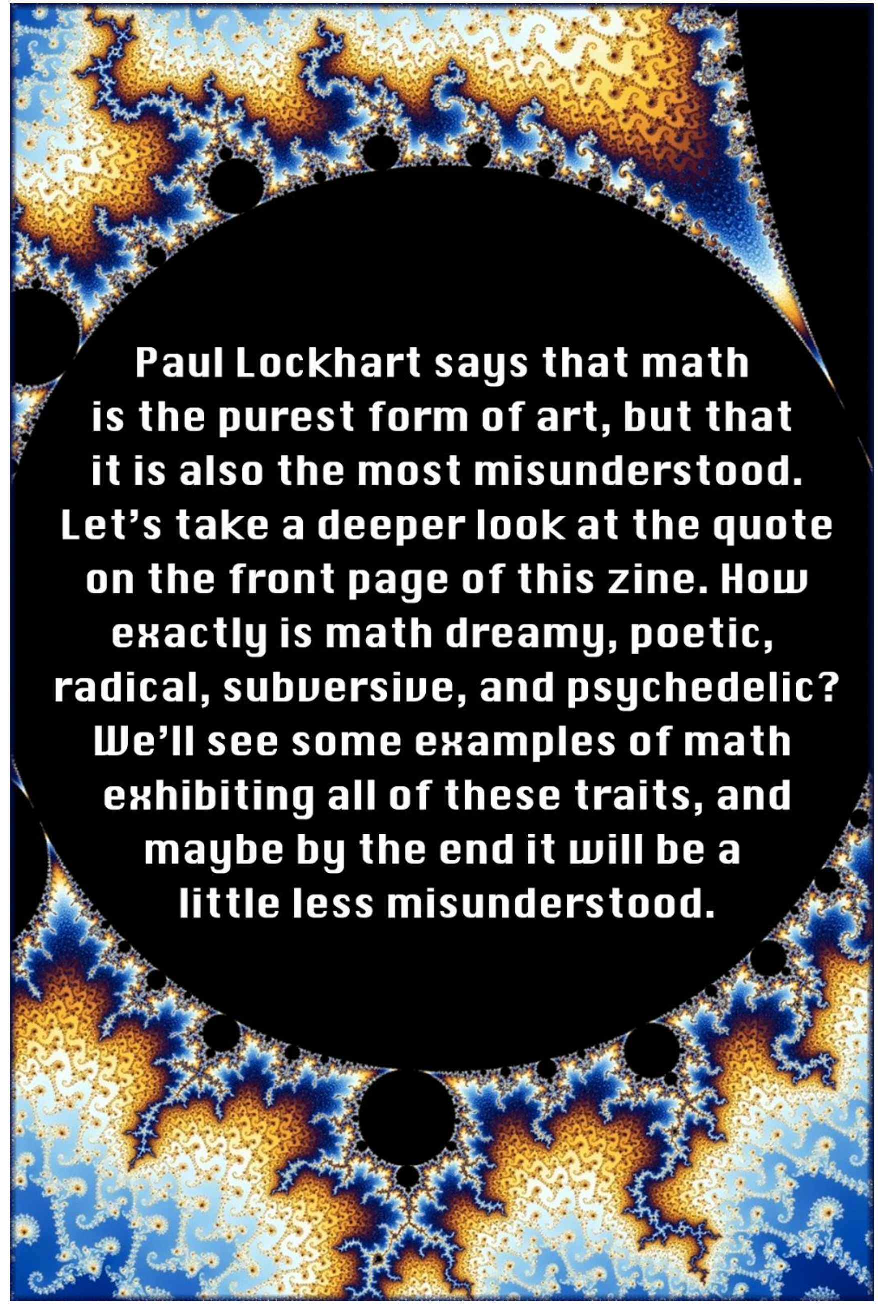

"Nevertheless, the fact is that there is
nothing as
dreamy &
poetic,
as
RADICAL,
Subversive, &
psychedelic
as
mathematics"
-Paul Lockhart





Paul Lockhart says that math is the purest form of art, but that it is also the most misunderstood. Let’s take a deeper look at the quote on the front page of this zine. How exactly is math dreamy, poetic, radical, subversive, and psychedelic? We’ll see some examples of math exhibiting all of these traits, and maybe by the end it will be a little less misunderstood.

dreamy

Dreamy = having a magical or pleasantly unreal quality; dreamlike

Math is dreamy because it can be used to think about things that don't exist in our world. A mathematician's daydream is a visit to a world where they control all the rules.

Perfect circles don't exist in real life because there will always be tiny imperfections, but they do exist in math. It is easier to work with a circle that is perfect in your imagination, and it makes solving problems easier. We can use imaginary perfect shapes as an approximation of their real life, imperfect counterparts.

The square root of -1 is technically impossible. There is nothing that, when multiplied by itself, equals -1. However, mathematicians still needed to solve problems that involved negative square roots, like $\sqrt{-4}$ and $\sqrt{-49x}$. These problems had real answers, but mathematicians had to make an imaginative leap and invent i before they could solve them.

$$\sqrt{-1} = i$$

poetic

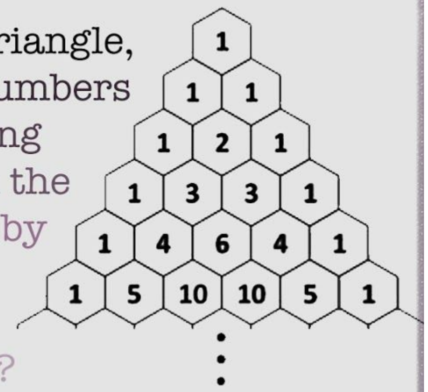
= Relating to or
Used in
Poetry

OR

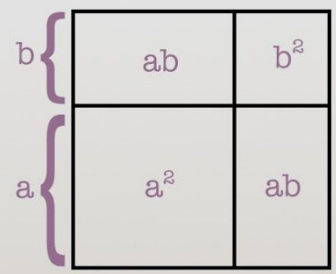
= Having an imaginative or
Sensitively emotional
Style
Of expression.

Math is poetic;
Rests on rhyme,
Rhythm,
And balance.
It is rife with
Patterns that repeat
Like the melody
Of a
Song;
What a feat
Of tremendous imagination
To reduce
Complicated
Concepts
Down to
Simple terms.

First, there is Pascal's Triangle, an endless pyramid of numbers that reveals an interesting pattern. The numbers in the triangle are determined by 11^0, 11^1, 11^2, and so on. What patterns can you find in Pascal's Triangle?



Just as a poet seeks to express some truth of their world or their being through exactly the right words, mathematicians express truth through proofs. A well-worded, elegant proof, which is economical with its expression and which clearly communicates the truth it is intended to present, is therefore quite beautiful and poetic.



A visual proof of
$(a+b)^2 = a^2 + 2ab + b^2$

RADICAL

Radical = (especially of change or action) relating to or affecting the fundamental nature of something; far-reaching or thorough

Many things that seem counterintuitive can be proven true using mathematics. It can help us go far beyond our basic understanding to reveal the surprising reality of our world.

Many things that seem counterintuitive can be proven true using mathematics. It can help us go far beyond our basic understanding to reveal the surprising reality of our world.

Humans didn't start using zero as a number in its own right until 1,500 years ago. Before that, the idea that "nothing" could be a number made no sense because numbers denoted quantity or size. Researchers have even found evidence that humans do not instinctively understand the concept of zero; we must learn to understand it as we learn math. Can you imagine what math would be like without zero?

One of the most baffling concepts that mathematicians play with is infinity. Infinity exists in real life, in the form of anything that goes on forever, like space. Imagining it helps us solve complicated problems, but it is very hard for humans to truly understand infinity. Not only does infinity refer to things that are endlessly big, but also to the ability to cut finite things into an endless number of smaller parts. There are infinite whole numbers, but there are also an infinite quantity of numbers in between 1 and 2. Can you imagine which infinity is bigger? Why?

sub•ver•sive

Subversive = seeking
or intended to undermine the power and
authority (of an established system or institution)

The debate over whether math is discovered or created by humans has long raged in mathematics classrooms.

Whichever side of the argument you fall on, it is undeniable that the way we talk about math was created by humans.

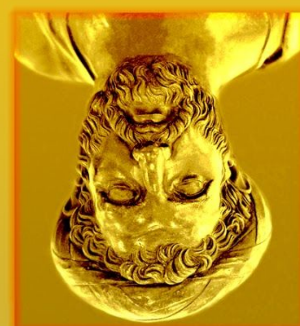
Math is subversive because we must establish the rules before we can talk about it.

Florence Nightingale is one of the most famous nurses of all time, but she also ifluenced statistics. While working in a hospital during the Crimean War, Nightingale realized many of the deaths did not happen on the battlefield–they happened in the hospital due to ineffective care. She made this graph to illustrate her point. Nightingale's work showed how statistical visualizations could be used to enact change.

Causes of Mortality

in the Amy in the East

Pythagoras, an ancient mathematician whose influence lives on to this day, said that "all is number." This was the basis of his philosophy of mathematics; Pythagoras believed that everything in the universe could be represented with numbers. This surely is a subversive view of the world. Can you think of an ordinary thing that can be represented with math? What about something that can't be?

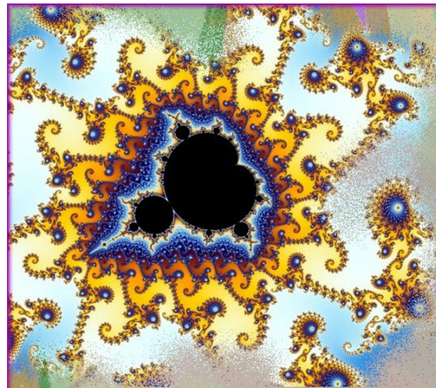


Pythagoras (c. 570 - c. 495 B.C.E.)

PSYCHEDELIC

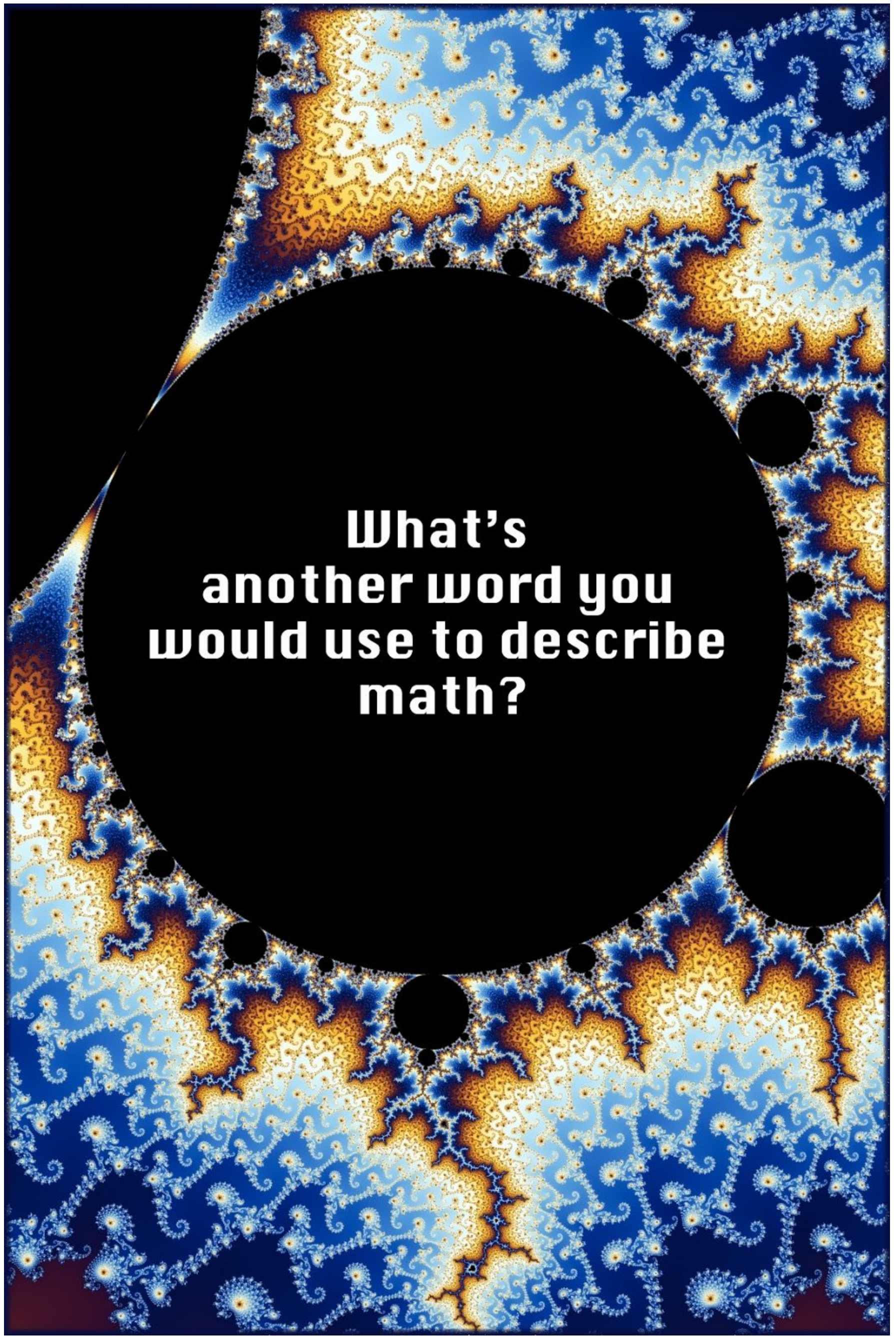
psychedelic = denoting or having an intense, vivid color or a swirling abstract pattern

Math is full of mind-boggling concepts that can be depicted using psychedelic imagery. From colorful fractals to winding curves, we use mathematics to expose the psychedelia hiding in plain sight.



The mandelbrot set is a color-coded graph on the complex plane, which includes real and imaginary numbers, like i. All numbers that fit into certain criteria are shown on the graph, and the intensity of their color is determined by how nearly they fit the criteria. The swirling fractals repeat forever.

This funky fractal is called Sierpinski Triangle, or Sierpinski Gasket. You begin with a triangle, then draw upside-down triangles to fill its spaces. Even as the triangles become infinitely small, the pattern continues repeating. It goes on forever, getting smaller and smaller!


What's
another word you
would use to describe
math?

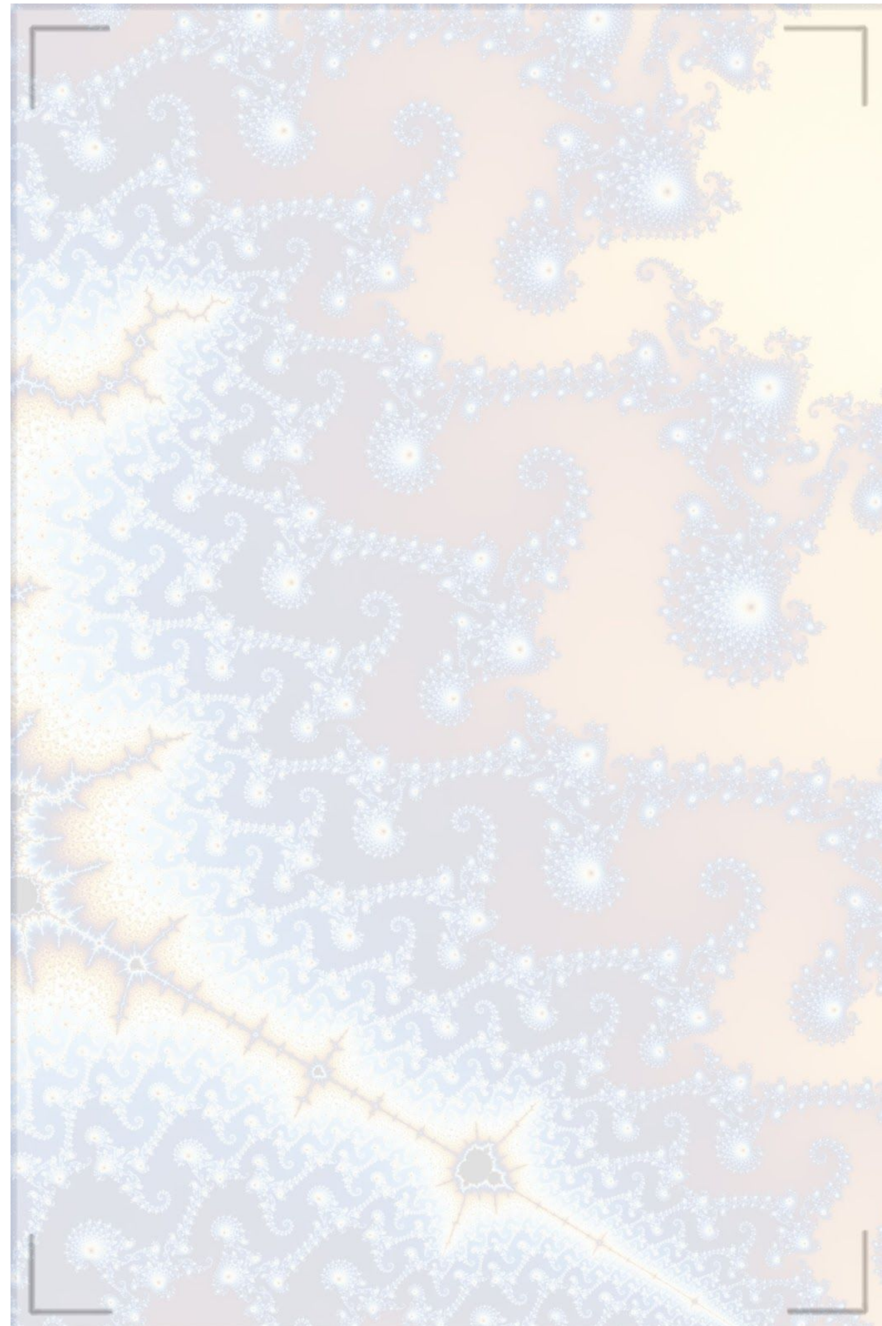


Image Credit

Pascal's Triangle: Image created by Robert J. Coolman

Mandelbrot Set Images: Created by Wolfgang Beyer with the program Ultra Fractal 3

Image of Pythagoras: Original Photograph by Marie-Lan Nguyen. Image licensed under the Creative Commons Generic Attribution 2.5. The colors of the image have been altered.

Causes of Mortality in the Army in the East: Original Graph created by Florence Nightingale. The colors of the image have been altered.

This zine was made by Kyna Airriess, a math nerd, artist, and senior at High Tech High.