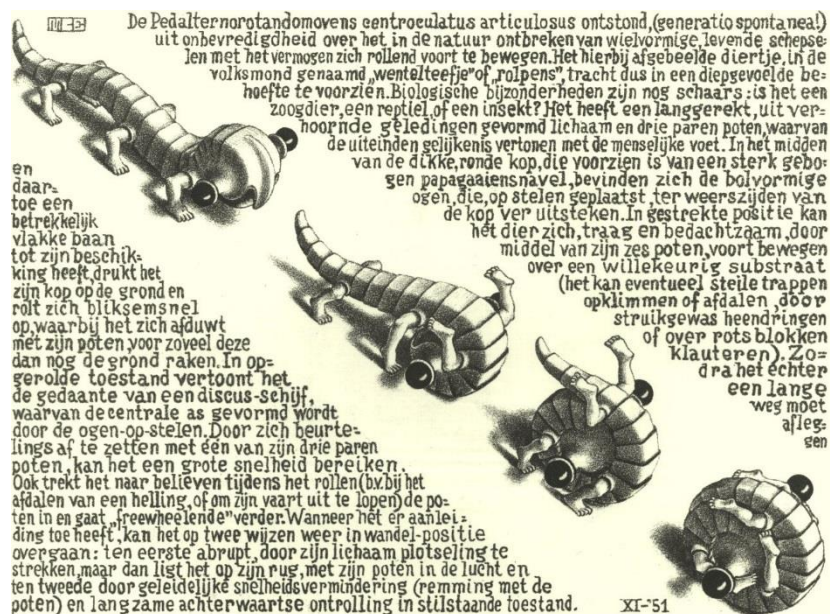


# MATH 161 EXTRA CREDIT ESSAY TOPICS (REVISED)



## Curl Up, M. C. Escher

Write a 3 – 5 page essay on one of the following topics. Your paper will be evaluated based on content, style, grammar, and originality. Be sure to give credit to all of your sources (including the web) at the end of the paper. Quality is far more critical than quantity. Avoid dullness.

*Due date:* 6 December 2019

1. Explore fractal music, <https://plus.maths.org/content/os/issue55/features/kormann/index> and <http://www.tursiops.cc/fm/>
2. Many people have heard of “History of Math,” but what about the “Mathematics of History”?

Jean-Baptiste Michel, TED talk:



[https://www.ted.com/talks/jean\\_baptiste\\_michel\\_the\\_mathematics\\_of\\_history](https://www.ted.com/talks/jean_baptiste_michel_the_mathematics_of_history)

<http://www.matematicadelahistoria.cat/llengua/the-mathematics-of-history>

<http://theconversation.com/maths-is-revolutionising-the-study-of-history-heres-how-85710>

3. *Mathematics in the Movies:*  
<http://www.math.harvard.edu/~knill/mathmovies/>  
<https://www.youtube.com/watch?v=zBuykQHFQIQ>  
<http://www.qedcat.com/moviemath/index.html>

4. *Mathematics in Poetry:*

[https://www.maa.org/sites/default/files/images/upload\\_library/4/vol6/Growney/MathPoetry.html](https://www.maa.org/sites/default/files/images/upload_library/4/vol6/Growney/MathPoetry.html)

Perhaps you would like to write your own poems?

5. Read John Allen Paulos, **Innumeracy: Mathematical Illiteracy and Its Consequences**, Hill and Wang paperback (2001). In reviewing Paulos' best-selling book, Douglas Hofstadter, author of **Gödel, Escher, and Bach**, wrote: "*To combat [innumeracy] John Allen Paulos has concocted the perfect vaccine: this book, which is in many ways better than an entire high school math education! Our society would be unimaginably different if the average person truly understood the ideas in this marvelous and important book. It is probably hopelessly optimistic to dream this way, but I hope that **Innumeracy** might help launch a revolution in math education that would do for innumeracy what Sabin and Salk did for polio.*" Do you agree with Hofstadter's statement? Justify your position, preferably drawing from personal experience.
6. Read George Pólya, **How To Solve It**, Ishi Press (2009). In this highly readable book, renowned mathematician Polya describes a four-step problem-solving procedure. Describe this process in your own words. Using *exercises from your homework assignments* as examples, show how Polya's process can be applied to design solutions to calculus problems.
7. We have already seen the value of identifying symmetry in the graphing of functions. Develop the theme of symmetry in mathematics, art, architecture, chemistry, human anatomy, or any other discipline. You may wish to read and incorporate ideas from Herman Weyl's beautiful (and short) book, **Symmetry**, Princeton University Press (1983).
8. D'Arcy Thompson's **On Growth and Form**, CreateSpace (2011), has been called by Nobel laureate P. Medawar "*the finest work of literature in all the annals of science that have been recorded in the English tongue.*" Others have called him "the first bio-mathematician." The central thesis of **On Growth and Form** is that zoologists of his time overemphasized the role of evolution, and underemphasized the functions of physics and mathematics as determinants of the form and structure of living organisms. Perhaps the most essential part of the work is Chapter IX (of the abridged version), "*On the Theory of Transformations, or the Comparison of Related Forms.*" Here Thompson explores the degree to which differences in the forms of related animals could be described employing relatively simple mathematical transformations. Choose a topic or an example from Thompson that particularly intrigues you; describe and discuss this example in your paper. Explain why you find this topic remarkable.
9. Read Nate Silver's critically acclaimed book, **The Signal and the Noise: Why So Many Predictions Fail -- But Some Don't**, Penguin Press (2012) in which "*Silver examines the world of prediction, investigating how we can distinguish a true signal from a universe of noisy data. Most predictions fail, often at great cost to society, because most of us have a poor understanding of probability and uncertainty. Both experts and laypeople mistake more confident predictions for more accurate ones. But overconfidence is often the reason for failure. If our appreciation of uncertainty improves, our predictions can get better too. This is the 'prediction paradox': The more humility we have about our ability to make predictions, the more successful we can be in planning for the future.*" Discuss how this book has influenced your views toward predicting the future.

10. Read Jonathan Swift's **Gulliver's Travels** (or at least several chapters). Write an essay in the style of Swift describing your adventures in visiting a new land that developed a reasonably advanced civilization that does not include calculus.
11. The great Argentine writer, **Jorge Luis Borges**, was fascinated by the infinite. Read several of the short stories in Borges' **Labyrinths: Selected Stories and Other Writings**. Discuss the relationship between the study of the infinite in the differential calculus and Borges' vision of the infinite. Alternatively, write a short story in the style of Borges that engages the reader in a particular encounter with the differential calculus.
12. Stephen Jay Gould, in his brilliant work, **The Mismeasure of Man**, Norton (1996), argues forcefully how the misuse of science and mathematics has been used as an instrument of discrimination, using the I.Q. test as a significant example. Read and discuss your personal reaction to this work that is regarded by many as "a major contribution toward deflating pseudo biological 'explanations' of our present social woes."
13. Write a creative and imaginative short story in which calculus plays a central role.
14. In the first paragraph of chapter I of **Mathematics in Western Culture**, Morris Kline states: "*The assertion that mathematics has been a major force in the molding of modern culture, as well as a vital element of that culture, appears to many people incredible or, at best, a rank exaggeration. This disbelief is quite understandable and results from a very common but erroneous conception of what mathematics really is.*" Develop this idea using calculus as your primary example.
15. Read David Berlinski's witty and entertaining book, **A Tour of the Calculus** (Vintage Books, 1995). Consider Berlinski's fanciful descriptions about how theorems are created:
  - Chapter 18, **Wrong Way Rolle**: "And since this is all nonsense, fabricated from scratch, I might as well have him composing his theorem – Rolle's theorem – in an attic garret, his mistress blowing gently on the beside candles in order to coax him to bed ..."
  - **Leibniz Mediates in His Room at Night** (pg. 109)

Try to compose such a sketch featuring the birth of a calculus theorem or technique that we have (or will) study this semester.

16. Read David Foster Wallace's quirky book, **Everything and More: A Compact History of Infinity**, W. W. Norton (2003). You will find fascinating discussions about the paradoxes of infinity. Explore his thesis that "However good calculus is at quantifying motion and change, it can do nothing to solve the real paradoxes of continuity..." (p. 145).
17. You may wish to choose a topic not listed here. If so, *you must obtain prior approval* from your instructor.



**Three Worlds, M. C. Escher**