The Mathematician News

January Edition

Graham's Number

You've probably heard a lot about Graham's Number if you're a fan of googology. It's a huge, almost incomprehensible number. However, it is finite. Basically, it uses a sequence of iterations. The pattern is as follows: g = iteration. g0 = 4; gN = 3 [(g(N-1))(^)] 3. So to find g1, we need to find g(1-1), which is g0. We already know that g0 is 4, so now we need to find 3 [4(^)] 3, which is 3 ^^^^ 3. This is 3 hexated to 3. Hexation is an iteration of the hyperoperation sequence, which will be explained on another page of the article. Anyway, since 3 ^^^^ 3 is such a big number, googologists have a name for it: triteto. Triteto is also known as grahal, because it is the answer to the first iteration of the sequence used to calculate Graham's Number. Since you know how big a number triteto is, imagine how big g2 will be. It would be 3 [triteto(^)] 3. This is 3 raised to the triteto-th up-arrow hyperoperation 3 times. That is one BIG number. Now imagine how big g64 would be. That's how big Graham's Number is. You can see why Graham's Number can't be calculated completely. However, mathematicians can use simple algorithms to calculate its digits. Googologists have computed the last 13 digits of Graham's Number: ...7262464195387. But who knows? Maybe one day in the future you'll be spending your whole life computing Graham's Number, like the other mathematicians have dedicated their lives to single topics in the past. I encourage you to follow your dreams. Goodbye!

Hyperoperations

You already know all about the basic operations: addition, subtraction, multiplication, division, and orders. But have you ever considered that some of these basic operations might be part of something bigger? Well, it's true. These other operations are called hyperoperations, and they're all iterations of the hyperoperation sequence. The first three iterations of the hyperoperation sequence are operations that you're familiar with: addition, multiplication, and exponentiation. Then it goes to higher iterations, that you've probably never heard of before: tetration (iteration 4), pentation (iteration 5), hexation (iteration 6, used to calculate Graham's Number (see previous page)), heptation (iteration 7), etc. Do you notice a pattern in this sequence? Well, each iteration is the repeated operation of the iteration below it. For example, multiplication is repeated addition: $3 \times 3 = 3 + 3 + 3$. This is the same anywhere else in the sequence: exponentiation is repeated multiplication, tetration is repeated exponentiation, and on and on... We can call each iteration the hyperoperation of the iteration before it. Basically, multiplication can be called hyperaddition, exponentiation can be called hyper-multiplication, tetration can be called hyper exponentiation, etc. We talked about Graham's Number on the previous page, and explained how hexation is used to represent the first iteration of the sequence used to find Graham's Number. Remember how big of a number that was? It was so big, mathematicians had to come up with a name for it! Hyperoperations are often used to represent googolisms instead of using scientific notation. It's a good thing you learned about them early. You're already becoming a googologist!

Infinity Plus Anything

What is the largest number? One hundred? five thousand? Graham's number? or maybe infinity? If you say infinity is the largest number. What's infinity plus one? Is it bigger? Well, infinity plus one is actually infinity. For example, if you have all the numbers possible, (that's basically infinite numbers). But if you add one more number, you still have infinite numbers. Therefore infinity plus one is still infinity. Isn't that weird? We can add any number to infinity, and it will still equal infinity. Infinity is not a number because a number plus one can't be itself. Mathematicians call infinity a concept. Then you know that.....INFINITY IS NOT A NUMBER!!! So, what is infinity plus the Graham's number? Well we learned that infinity plus anything equals infinity. So, infinity plus the Graham's number equals infinity! But wait! Didn't we say infinity was not a number? So, actually infinity plus the Graham's number is an error or, not possible because infinity is not a number. But if you pull out your calculator, and type the Graham's number plus infinity. It would probably say it equals infinity. Infinity is not a number because something plus one cannot be itself. Infinity breaks this rule, that's why infinity is not a number. So, Graham's number plus infinity is an error.

infinity is not a number!!!

Infinity is a concept and an idea.

Defining Rayo's Number

The definition of Rayo's number is a variation on the definition: The smallest number bigger than any finite number named by an expression in the language of first-order set theory with a googol symbol or less. It is so large that it cannot be expressed using standard notation. The number is defined in such a way that it is larger than any definable number in the language of set theory. As a result, it is impossible to directly state the number of digits in Rayo's number using conventional notation. You might ask how to calculate Rayo's number. If F(n) = The least number that cannot be uniquely described by an expression of first-order set theory that contains no more than n symbols. Rayo's number is then just F(10^100 or a google). So one way to answer the question would be to construct a function G(n) such that G(n) grows more quickly than F(n). And if you think this is too confusing, here is a video link to watch: https://www.youtube.com/watch?v=X310fPHZja8.

All in all, I think it's safe to say that Rayo's Number is super big. So are many many other googlisms.

Game Time!

Our game time today is going to be five fives. The basic rule is that you have five fives. And you want to make as many numbers as you can. You can't use any extra numbers. But, you can do whatever operation is needed. But for something like $\sqrt[3]{\ }$, it wouldn't work because there is a three. So, here are some numbers for you to brainstorm five fives for. Good luck. (Please write in your head, not on the newspaper.)

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

Math Comics!

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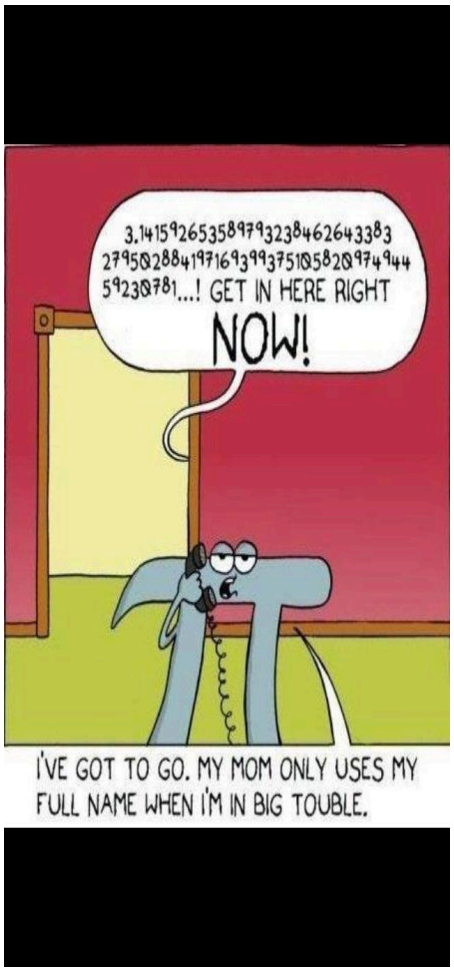

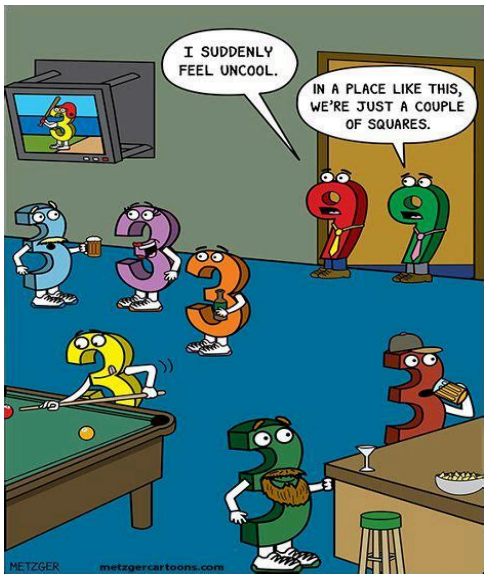

About the Authors

A couple of Math Club colleagues wrote these Mathematician articles: Sooriyan Thiruchelvam wrote 'Graham's Number', Brooks Wang wrote 'Hyperoperations', and Eddie Yang typed up 'Infinity Plus Anything ' and 'Defining Rayo's Number'. Thanks to all the Math Club staff for helping organize Math Club and planning out its newspapers. Thank you for reading!