Futurama Math: ''The Numberland Gap'' Activity Sheet

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## 1   Danica McKellar's mathematical contributions

Bender attends a math fair to talk to Danica McKellar because he is afraid of most numbers, with the exception of 0 and 1.

- Research the mathematical contributions of Danica McKellar and report back on what you found.

2   Definitions of numbers

- In Numberland, the number 55 suggests that the whole numbers and their fractional children make up all the numbers that exist. What are the differences between the whole numbers, integers, rational numbers, irrational numbers, and imaginary numbers? Give illustrative examples of each type of number.
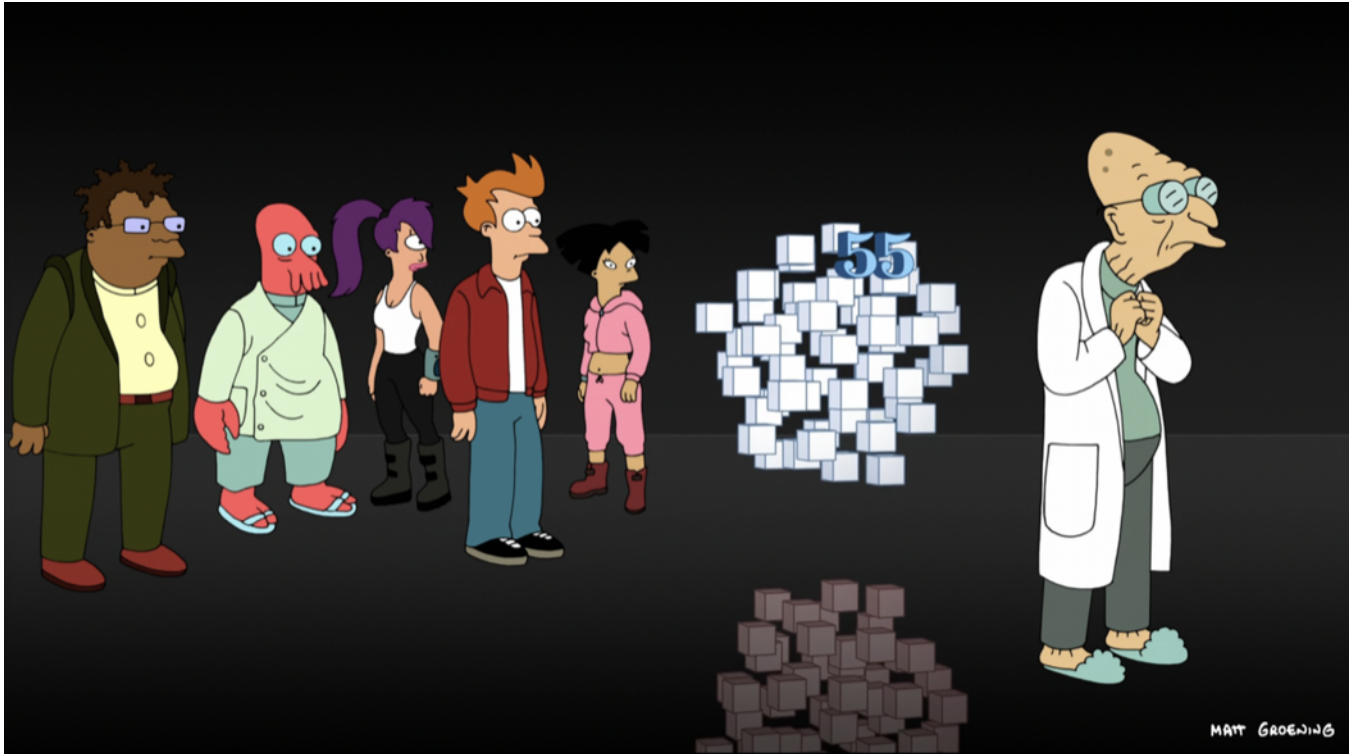
3   Representations, Decompositions and Properties of 55

- First, examine the various representations and decompositions of the number 55 in the episode:
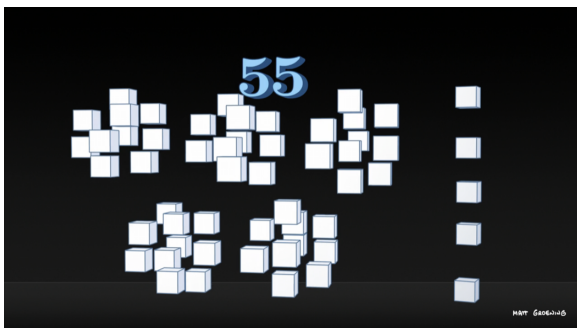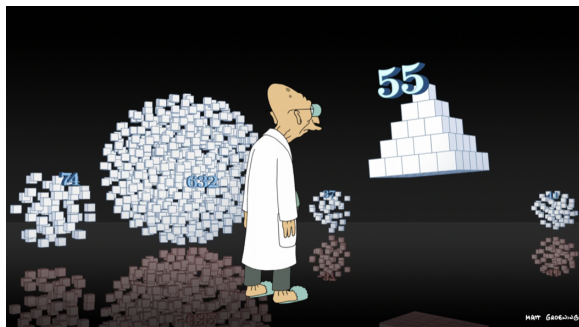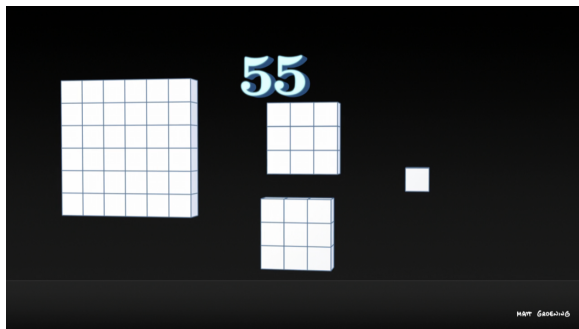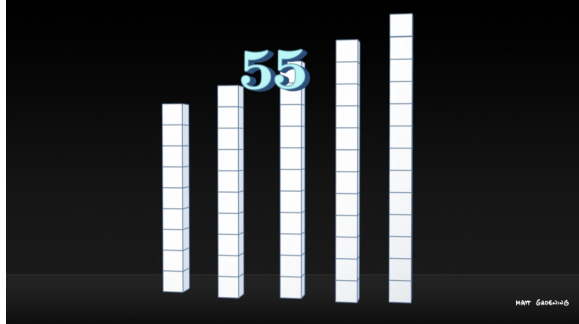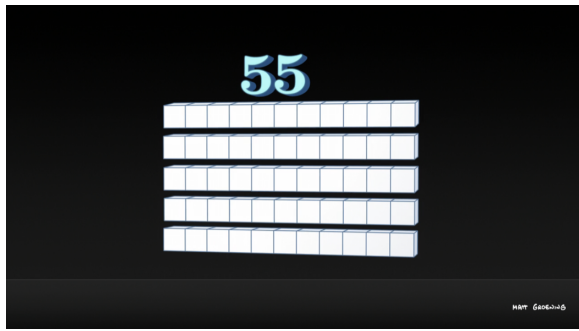
- Next, consider that 55 is semiprime, deficient, Fibonacci, triangular, pyramidal, heptagonal and centered nonagonal. Each group will investigate one of these characteristics and disseminate your findings, which need to include diagrams and examples of other numbers with your assigned property.

4   Interesting numbers

Dr. Zoidberg wants to be introduced to ''some of the more interesting numbers'' in Numberland. Professor Farnsworth argues: ''Every number is interesting. Otherwise there'd be a smallest uninteresting number and that would make it interesting.''

- Consider Professor Farnsworth's argument. What might be considered problematic about it? Next, select a number from the folded slips I've brought. What could be considered interesting about your number?

Try to bring in diverse connections to your analysis and prepare to share them with the class when we come back together.

5 Goldbach conjecture

Professor Farnsworth asks the number 55 if he knows whether even numbers are always expressible as the sum of two prime numbers. Even though Farnsworth forgets to exclude the number 2, 55 asserts they are but doesn't understand why Farnsworth would like a proof: ''Why should I prove it? What would that prove?''

- Consider the first few even numbers. Can they be expressed as the sum of two primes? If so, express them as such and if not, explain why not. Next, research the Goldbach conjecture and summarize progress made on it. Lastly, what benefits would a proof of the Goldbach conjecture bring?

6 Fractional children, Cantor's diagonal argument and the continuum hypothesis

One fractional child in Numberland is $\frac{3}{7}$:
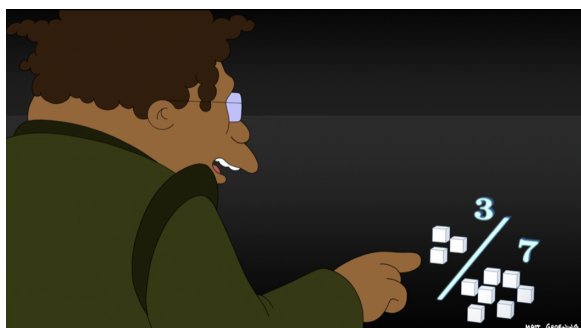

The child $\frac{3}{7}$ has parents 3 and 7:

- What are the fractional children of 2 and 3? What is interesting about these fractions? Are there any identical twins from different parents? Explain why or why not?

- Next, consider how George Cantor lists the fractions $\frac{1}{2}$, $\frac{1}{3}$, $\frac{2}{3}$, $\frac{1}{4}$, and $\frac{2}{4}$ and their decimal expansions. What would come next in the list?
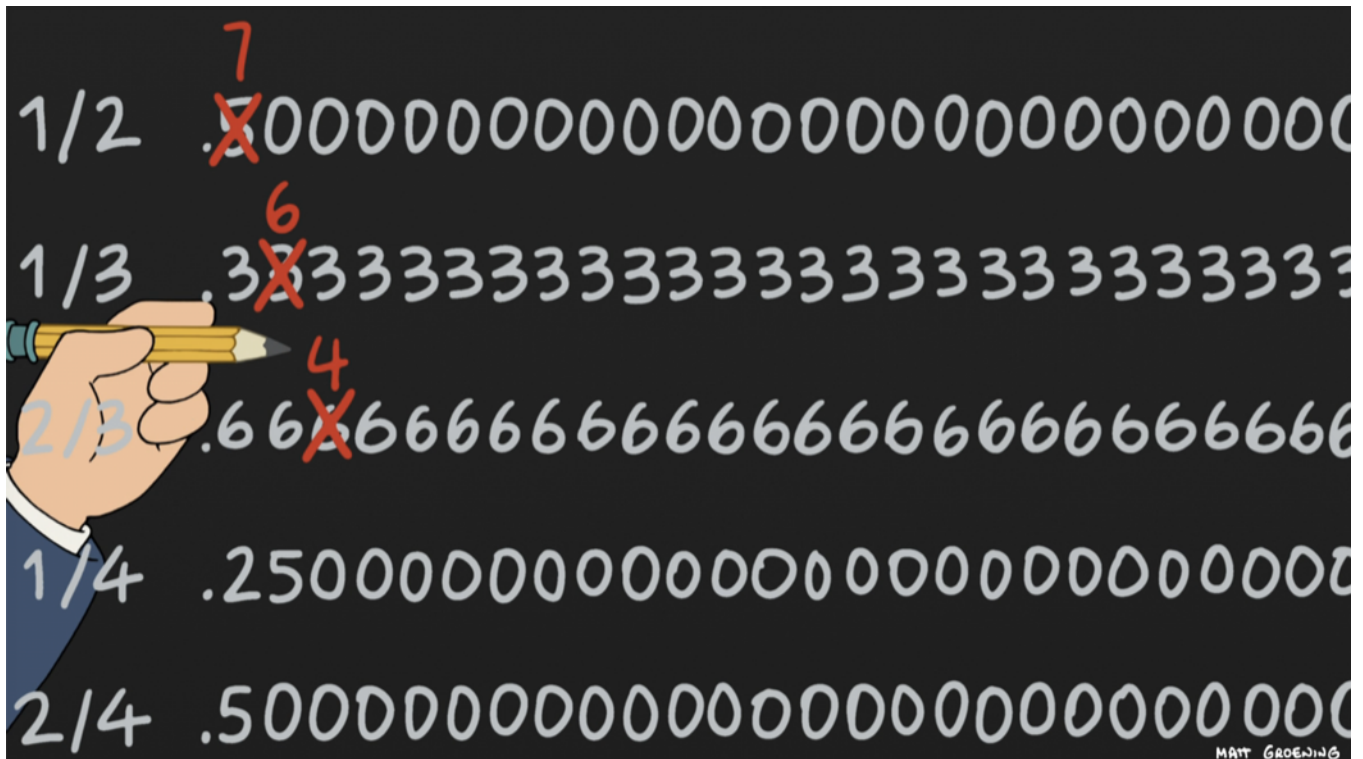
- Examine and interpret Georg Cantor's argument in terms of children. What are the first few digits of the child that isn't in Numberland? Why is the child missing? Why is the argument referred to as a diagonalization argument?
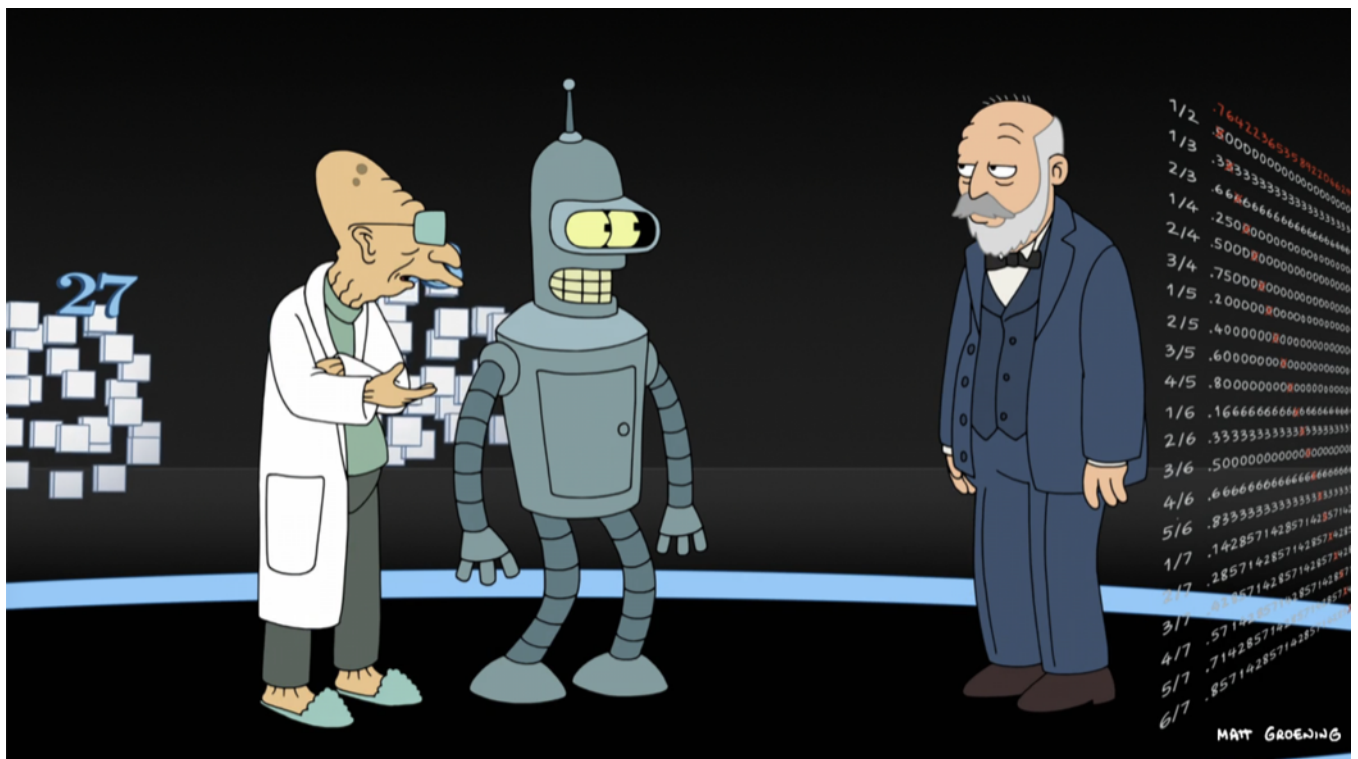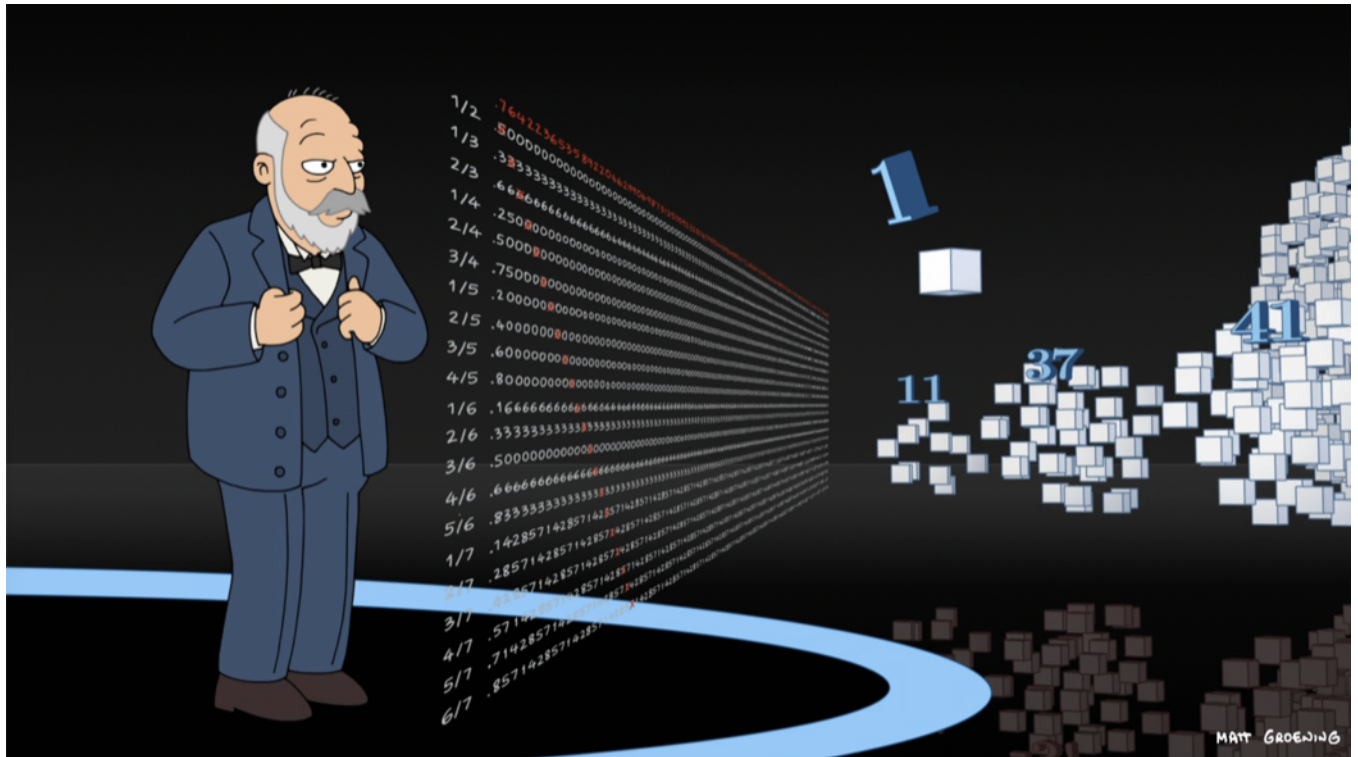
- Now, use a similar argument but change it so that you create a different child missing from Numberland.

- Research Georg Cantor and summarize what you found about his life and contributions.

- What is the continuum hypothesis and how does it relate?

7 What is Mathematics?

- Summarize the applications of numbers and mathematics in the episode and reflect on the representation of mathematics overall.

- David X. Cohen told us that the motivation for "The Numberland Gap" came from show co-developer Matt Groening, "Groening was inspired by an old Disney cartoon called *Donald in Mathmagic Land* and asked if we could do our version, but with a lot more actual math" (personal communication, June 5, 2025). Compare and contrast the way mathematics is represented in these two cartoons.