

Klein's Beer: *Futurama* Comedy and Writers in the Classroom

Sarah J. Greenwald

Abstract: Here we explore the educational implications of classroom activities related to the backgrounds and motivations of talented Hollywood comedy writers and the mathematical moments they created for the Emmy Award-winning animated sitcom *Futurama*.

Keywords: *Futurama*, reducing math anxiety, pop culture, humor in the classroom, history of mathematics in the classroom, Hollywood writers, David X. Cohen, Ken Keeler, Jeff Westbrook, career options, benefits and usefulness of mathematics, representations of mathematicians, the joy of mathematics, sum of cubes, geometry of the universe.

INTRODUCTION

Futurama [1] is an animated science fiction comedy with mathematics, science, or programming jokes in almost every television episode. In the same way that history can provide context to mathematics in the classroom, the rich mathematical history of the show's writers, and the stories of their writing motivations can engage students. A combination of comedy references from the show and quotes from the writers is especially effective in helping to alleviate math anxiety and motivate students to learn and connect to mathematics. In this article we will examine numerous *Futurama* activities for the classroom, including discussions related to the writers and the representation of mathematics in popular culture, as well as activities related to humorous *Futurama* mathematics references, including computational number theory and geometry.

Address correspondence to Sarah J. Greenwald, 121 Bodenheimer Dr, Department of Mathematics, 326 Walker Hall, Appalachian State University, Boone, NC 28608, USA. E-mail: greenwaldsj@appstate.edu.

WRITERS AND HUMOR IN THE CLASSROOM

In the course of earning an undergraduate degree in the mathematical sciences, students study a broad range of mathematical techniques and disciplines. The need to master the fundamental skills of mathematics leads in many instances to a perspective in which mathematics exists unconnected to anything else. Students can become so focused on the present that they perceive mathematics as “closed, dead, emotionless, all discovered . . . [Teachers] can rescue students from the island of mathematics and relocate them on the mainland of life that contains mathematics that is open, alive, full of emotion, and always interesting” [3]. In the same way that real-life applications and technology can help students connect to mathematics, humorous popular culture references and the related history of the writers who create them can also foster connections.

Many authors have written about the benefits of including comments and stories about mathematicians in the classroom (e.g., [18]). The same benefits can occur within the context of popular culture with classroom activities related to the backgrounds and motivations of the writers, but this pedagogy has not previously been explored, probably because it can be difficult to find information about the people who are responsible for the mathematical references. The benefits of humor in the classroom are perhaps not as well known as the benefits of history in the classroom to the mathematical community. Numerous studies and individuals suggest that humor helps students connect to the professor and the material, alleviates anxiety and encourages creativity, and leads to an increase in evaluation ratings [5, 14, 16], although only a few references address humor in the mathematics classroom specifically (e.g., [2, 13, 15]).

FUTURAMA WRITERS IN THE CLASSROOM

Futurama is a rare exception in broadcast television – a satirical science fiction cartoon that aims its jokes squarely at the top of the brow (e.g., see Figure 1), yet allows those brainy zingers to thrive among gags that fall further below. *Futurama* follows the exploits of Fry, who accidentally falls into a cryogenic chamber and awakens 1000 years later, in the year 3000. Fry and his friends Leela, a beautiful one-eyed mutant, and Bender, an easily corrupted robot who drinks *Olde Fortran 800 Malt Liquor*, take jobs with Fry’s great-great- . . . -great nephew Professor Farnsworth, a senile scientist with a soft spot for wacky inventions and the owner of the Planet Express Delivery Company. They journey between the far reaches of the universe (see Figure 2) and the well worn couch in the employee lounge.

In the science fiction show *Futurama*, the opportunity for scientific references arose naturally, but the number and depth of the references are quite

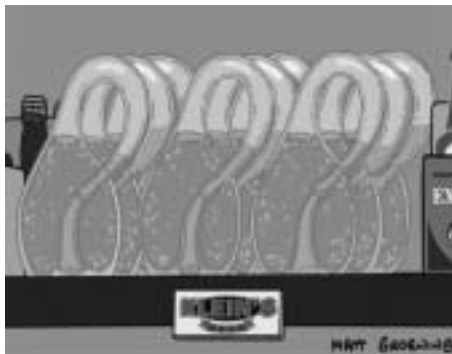


Figure 1. Klein's Beer [1, 3ACV12 (*The Route of All Evil*)]. *Futurama*TM and © 2006 Twentieth Century Fox Film Corporation. All Rights Reserved.



Figure 2. Historic $\sqrt{66}$ [1, 3ACV02 (*Parasites Lost*)]. *Futurama*TM and © 2006 Twentieth Century Fox Film Corporation. All Rights Reserved.

remarkable. They reflect the talent and interests of writers: J. Stewart Burns has both a bachelor's and master's degree in mathematics; David X. Cohen has a bachelor's degree in physics and a master's degree in computer science; Ken Keeler has a bachelor's degree in applied mathematics, a master's degree in electrical engineering, and a PhD in applied mathematics; Bill Odenkirk has a PhD in inorganic chemistry; and Jeff Westbrook has bachelor's degrees in physics and the history of science and a PhD in theoretical computer science [11].

Students are interested in the writers and often ask about them. Capitalizing on this curiosity in the classroom can help students examine what mathematics is, why it is useful, and can help them explore the representation of mathematics in society. The following quotes from the writers have been used very successfully in an introduction to mathematics class

to generate discussion. They require very little class time and students find them memorable and thought provoking. When we explore a mathematical reference in class, we often include an interview comment from a writer in the same way that teachers tell stories about mathematicians as they explore related mathematics. For maximum benefit, remarks from the writers about the mathematical references themselves are used (e.g., Appendix). In the classroom, the quotations successfully engage students and so there is no need for an introduction, other than information about the writer's scientific degrees. Here we provide a summary of the benefits of each quote.

Remarks from the writers about their transition to comedy writing can help students see that the path to a career is not as linear as they often believe and that mathematicians have many career options.

Jeff Westbrook: It is a little funny in retrospect. He [Ken Keeler] and I had actually been working together on science. We had written this paper together. And then he was like, "Well, I've got this job offer from Letterman." And I actually gave him this long impassioned lecture about how wrong it was for a man of his skills and training and how society needed mathematicians doing hard work, and how could he abandon that and go off to TV. And he said, "Well, I just think I've got to try it." And then eight years later or whatever, it was like, "Do you want to come over to *Futurama*?" "Yes! I will be there. I am there – count me in!" ... I thought that this was a chance maybe to bypass the peer review process and get some of my results right out there on the screen where you could see them, so I wrote a spec script and got hired on that basis. [8]

Students are surprised that significant mathematics is embedded in an animated sitcom, because they do not usually associate humor with mathematics, nor do they usually think of mathematicians as funny people. The humorous nature of the references is one reason that they are so effective in the classroom and students are curious about their creation. They are very interested to find out that it is David X. Cohen who we must thank for many of the wonderful mathematical moments in *Futurama*:

David X. Cohen: On *Futurama* I was the head writer [see Figure 3], so I could set the tone ... Matt Groening could have theoretically overruled me, or the Fox studio, but usually the mathematical references were more of a background joke than the center of attention. It was basically the kind of thing where any kind of background jokes that we wanted to do, we were going to get away with. Because I was interested in the math, it was pretty easy for me to wedge the things in there. [7]

Comments about the similarity between mathematics and comedy writing show students that scientists and mathematicians struggle with mathematics



Figure 3. Head Writer David X. Cohen [1]. *Futurama*TM and © 2006 Twentieth Century Fox Film Corporation. All Rights Reserved.

in much the same ways they do, and the comments also highlight the benefits and usefulness of mathematics in other fields. The message is the same as the one we see in liberal arts mathematics courses [4], but it is more effective and engaging for students when it comes from Hollywood writers.

David X. Cohen: If you are writing, especially comedy, there is not a formula where you can generate the next joke – or if you are using one anyway, then it is not going to be a very good joke – and I think it is kind of the same if you are trying to prove something. If it was obvious where to go, then it would have already been proven. So the one thing I think they have in common is that these are professions where you are flying blind a little bit, and you might have gotten into an area where you are not going to get the answer, or you are not going to get the joke, and you are just working from your own self-confidence, that it is a fruitful area to work in or there might be something funny happening here. [7]

Jeff Westbrook: The most fun I had working on computer science and math problems was sitting around with a bunch of other people working on a problem but at the same time bullshitting and joking around – that shared sense of working on something together and coming up with an interesting solution to a problem. Solving story problems is very similar in some ways. Given a problem, how can you fit all the pieces together to make it work? There are a lot of analytical parts to writing and analytical ability is as useful in that as in any field. That's the plus about mathematics. Nothing trains you better and gives you more analytical skills than mathematics. That skill is useful in the craziest places you might imagine: writing a TV show, writing a cartoon, and lawyering perhaps. [8]

The use of comments from the writers can also encourage students to examine and analyze representations of mathematicians in Hollywood and their own perceptions of mathematicians.

Ken Keeler: Many of us are really bothered by the way that mathematicians are portrayed in movies and television, like in *Good Will Hunting* and *NUMB3RS*. The biggest obstacle to portraying mathematicians and math accurately is that there's usually not enough at stake in math problems to interest a general audience. While we as mathematicians know that the nature of the problem itself is completely absorbing and fascinating, I don't know why it is hard to transfer that to the screen – it's a mystery to me. I spend a lot of time thinking about this problem, because it is the reason why, when people do have mathematics stories, they say, "Well let's make it more interesting by making the guy crazy, or maybe somebody is going to die if the guy doesn't solve the problem," and they end up making the story completely phony. [12]

David X. Cohen: There is rarely a suggestion that interest and hard work have anything to do with mathematical skill, which is instead almost always presented as magic . . . I think it is a very bad lesson and demoralizing for would-be mathematicians. It especially annoys me because these things often get critical praise for "letting us peer inside the mind of the mathematician." One could argue that having any show involving math is better than nothing. That is probably true. I wouldn't mind having one movie or show about a magic genius if there were others that presented the mathematician as a normal human being. [7]

FUTURAMA MATH IN THE CLASSROOM

Looking for amusing mod 26 code messages, a Heisenberg uncertainty principle joke, a humorous P versus NP reference, string theory jokes, and more? There is a wealth of scientific topics in *Futurama* episodes, on the DVD audio commentary, and in interview comments from the writers [1, 6, 7, 8]. A few of our favorites follow below.

Cross Section of a Cube

"Madison Cube Garden" is seen in a number of episodes of *Futurama* (see Figure 4). The following comment is a good example of the kind of mathematical discussion that is regularly found in *Futurama* interviews and DVD commentaries:



Figure 4. Madison Cube Garden [1, 1ACV09 (*Hell Is Other Robots*)]. *Futurama*TM and © 2006 Twentieth Century Fox Film Corporation. All Rights Reserved.

Ken Keeler: Stu Burns and I spent an hour or two trying to figure out what the cross section (the intersection of a cube with a plane orthogonal to one of its main diagonals) was going to look like so we could instruct the animators, and to prove that at the midpoint of the diagonal, the intersection is a perfect hexagon. In fact, Stu ended up constructing a cube and taking the planar cross section. It was that kind of environment – the others were happy to goof off if those of us with math backgrounds had something we wanted to talk about, and so there was lots of goofing off. [12]

This comment could lead to an effective classroom activity, although it has not yet been class tested in the context of *Futurama*. First, ask students to demonstrate why the intersection is indeed a perfect hexagon. Next, have them write out an explanation that is aimed at the animators and includes diagrams. Finally, depending on the class level, challenge students to come up with a proof. A cube made of clear plastic and a rubber band around it to simulate the plane cutting through it may be helpful for visualization purposes.

Sum of Cubes

The best use of references often arise naturally in the classroom. We designed a three-week segment called *What Is a Mathematician?* [10] to expose students to a survey of topics in mathematics and to mathematicians with diverse research styles. We wanted to engage students with Srinivasa Ramanujan and topics in number theory that are still of interest today. Student groups presented information about each mathematician, but we created the mathematical activities for the class. We chose to highlight computational number

theory related to the sum of cubes via an exploratory activity sheet that examined a number of related *Futurama* references and comments from the writers (reproduced as Appendix).

Ken Keeler: We didn't have the agenda of putting a mathematical reference in there, other than that we needed a number for plot reasons (e.g., see Figure 5). We could have picked one at random, but there was no reason not to make it an interesting one, and that's how many of these references found their way in. [12]

An early version of the worksheet had different wording for Question 2, but students misinterpreted the question and spent large amounts of time trying to prove that 1,729 is the smallest number that can be written as the sum of two cubes in two different ways. The activity sheet has been refined and it now works extremely well (see Appendix 1). Students find the combination of mathematics history, *Futurama* references, and web research on easy-to-state problems that are still unsolved both eye-opening and fun.

Shape of the Universe

To visualize a finite universe in three dimensions, students can watch a small portion of a *Futurama* episode [1, 1ACV03 (*I, Roommate*)] (see Figure 6):

[Fry and Bender are looking for housing. Leela, Fry, Bender, and the manager enter into a cubical shaped apartment that resembles Escher's 1953 "Relativity."]

Fry: I'm not sure we wanna pay for a dimension we're not gonna use.



Figure 5. 1729 [1, 2ACV04 (*Xmas Story*)]. *Futurama*TM and © 2006 Twentieth Century Fox Film Corporation. All Rights Reserved.

[Bender, the robot, falls down the staircase, exits the screen, comes back into view on a different staircase, and continues to fall “down” the other staircases in many different directions.]

Students watch the robot Bender, use his position to explain which openings are identified, and give gluing instructions for the space (see Figure 6).

One *Futurama* episode has a short portion related to Pac-Man and the lack of an edge in the square fundamental domain view of a 2-D torus [1, 3ACV18 (*Anthology of Interest II*)]. Another episode jokes about the edge of our universe [1, 3ACV15 (*I Dated A Robot*)]:

Fry: I wanna see the edge of the universe!

Amy: Ooo! That sounds cool.

Zoidberg: It’s funny. You live in the universe, but you never do these things till someone comes to visit.

[The Planet Express spaceship approaches the edge of space and white nothingness is seen on the other side.]

Professor Farnsworth: There it is! The edge of the universe!

[The ship lands in a parking space on the edge, and Leela, Fry, and the Professor walk towards the boundary wall. A sign reads: Universal Forest Service – Edge of Universe Scenic View. Fry puts some money into a Coin-Operated Viewing Device and looks through it. A Planet Express crew in cowboy attire wave from the other side as his own ship’s Planet Express crew wave back.]

Fry: Far Out . . .



Figure 6. Escher-like Apartment [1, 1ACV03 (*I, Roommate*)]. *Futurama*TM and © 2006 Twentieth Century Fox Film Corporation. All Rights Reserved.

We ask students what this suggests about the edge and shape of the universe, and to relate their answer to current theories about the geometry of the universe.

The combination of visual movement and auditory humor helps students learn. These examples have been used as a review in a liberal arts segment on the geometry of the universe [9], and it is these clips that students often say help them best understand the visualizations. Because they are short, they take very little time – but they are very effective, especially when combined with comments from the writers (see the *Futurama* Writers in the Classroom section). Jeff Weeks has created games and movies that also contain cartoon-like characters in order to help visualize the possible shape of space [17], but it is the *Futurama* clips that seem most engaging to the students, probably because of the humor, the high quality of the animation, and that fact that many of the students are fans of the show.

CAUTIONS AND THE FUTURE OF *FUTURAMA*

Original episodes of *Futurama* aired on the Fox broadcasting network from 1999–2003. Even though *Futurama* is very popular among college students, as many of them watch it nightly in repeats on Cartoon Network’s Adult Swim block or own their own *Futurama* DVDs [1], the show is not presently as well known to students without cable, and so some introduction might be needed to put a reference in context. For example, specifying “Watch the robot Bender” (see Figure 6) instead of “Watch Bender” is helpful. Just directing them to “Watch the robot” is also not sufficient, since students are curious about his name. In fact, sometimes students will be so curious about details like this that it takes effort and direction in order to keep them on task. They may also request additional *Futurama* clips, but we only use mathematical references that relate to content that we would have covered in class anyway. We do not offer a course on mathematics in *Futurama*. Instead, the popular culture references are just one of the many tools we use to help students succeed. Point-set topology students might wish for *Futurama* in the classroom, and having heard about its use in other classes they sometimes ask for it, but this will not happen unless the writers put in a reference that would help the students learn course content at least as well as other classroom techniques.

Some of the references themselves introduce topics that may be complex, and it is helpful to consider how to address these in the classroom. For example, while the visual of Klein’s Beer (see Figure 1) is very amusing and memorable to students, its introduction does bring with it the topic of alcohol. The instructor must decide how to handle the related topic of underage drinking, especially since students may joke that they wish they had such a beer. One can prepare an introduction or afterthought such as “Of course I don’t condone underage drinking.” In this way, the teacher can use the reference to proactively address or respond to the issue.

The representations of scientists on the show, especially regular characters Professor Farnsworth and Amy Wong, can also be problematic in the classroom. Professor Farnsworth is shown as a stereotypical mad scientist in many ways. In addition, while Amy is an engineering student at Mars University who is currently doing her internship with Professor Farnsworth, she almost never contributes to the scientific discussions. Instead, she is very social and fashion conscious. There is an amusing Globetrotter's physics team made up of Black players [1, 3ACV14 (*Time Keeps on Slipping*)], who do significantly help Professor Farnsworth, but it is not clear what kind of message the Globetrotter component relays to students. The purpose of the program is to entertain, and fictional shows should not be held to some kind of role-model standard; instead it is our responsibility as educators to be proactive about these representations and to make an effort to include real-life history or other role models to balance them. We have done this in our classroom, and also used the representations of Amy and Professor Farnsworth as a way to discuss women in mathematics issues. Careful thought is required to address the challenges.

The rewards are well worth the time and energy it takes to address the difficulties. David X. Cohen remarked [7], "Just moments ago I started laughing out loud at the very idea that Bender's serial number has become a math assignment. I love it!" Students feel the same way and they note that *Futurama* makes class and learning fun. Humorous mathematical references from *Futurama* and comments from the writers help students conquer math phobia and get them interested in mathematics. The rich engaging history connected to these talented writers reinforces the fact that people with mathematics degrees have many options after graduation, and that mathematics itself can be as much fun as the *Futurama* jokes:

Jeff Westbrook: Well you know the message is that math is actually fun to think about. Mathematics is a very playful field and once you get the hang of it, it is like play, and so people who like to play and write cartoons for TV also like to play with math because they are both fun things to do. Hopefully the students will get the idea out of that. [8]

Students are excited to find out that four new direct to DVD releases are planned, and that the show will move from the Cartoon Network to the Comedy Central cable station in 2008. David X. Cohen has promised to put in some more mathematical references, so keep your eye out for the future of *Futurama*.

ACKNOWLEDGMENTS

Thanks to David X. Cohen, Ken Keeler, and Jeff Westbrook for allowing their comments to be reprinted here, and to Fox Home Entertainment for allowing

their images to appear here. Thanks also to Ann Bies, Tom Georgoulis, and Marc Wichterich for helpful conversations.

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APPENDIX 1: *FUTURAMA* SUM OF TWO CUBES ACTIVITY SHEET

Ken Keeler has a PhD in applied mathematics from Harvard. When he was finishing up, there were very few jobs, so he applied to both academic and TV writing jobs. After a year at Bell Labs, he decided to try TV writing. In a gotfuturama.com (CGEF) interview, when he was asked about his many years at school, Ken Keeler joked that a *Futurama* reference to 1729 was worth six years of grad school.

Ken Keeler: . . . I felt like if I didn’t try writing now, I’d regret it the rest of my life. So after a year at Bell Labs, I went to Letterman. I’ve regretted it the rest of my life.

CGEF: Did it ever pay off to go through all these years of education?

Ken Keeler: Well, sure. For example, Bender’s serial number is 1729, a historically significant integer to mathematicians everywhere; that “joke” alone is worth six years of grad school, I’d say.

Keeler refers to the episode *Xmas Story* written by David X. Cohen in which Bender the robot receives a card from the machine that built him wishing “Son #1729” a Merry Christmas. Answer the following questions on a separate sheet of paper.

Question 1 Use an effective web search to find out what Ken Keeler means when he says that 1729 is “a historically significant integer to mathematicians everywhere.” Your answer should include information about the

mathematicians Ramanujan and Hardy and a calculation statement about the number 1729.

Question 2 Verify that the related computation statement holds, but do not prove that it is the smallest such number. Show work. Next discuss a general proof method or technique one could use to show that 1729 is the smallest such number but do not prove the statement.

The number 1729 also appears in many episodes of *Futurama* on the hull of the space ship called the Nimbus and as the reference number of the universe populated by “bobble head” characters in the episode *The Farnsworth Parabox*. The sum of two cubes comes up again in the episode *The Lesser of Two Evils*. Read the following from the audio commentary and look carefully for David X. Cohen’s calculation hint.

Professor Farnsworth: This is Flexo.

Hermes: Sweet llamas of the Bahamas! Except for that stylish beard, he look just like Bender!

Flexo: No duh dreadlock, we’re both bending units.

Bender: Hey brobot, what’s your serial number?

Flexo: 3370318.

Bender: No way! Mine’s 2716057.

[They both laugh. Then Fry laughs, but stops and looks confused.]

Fry: I don’t get it.

Bender: We’re both expressible as the sum of two cubes.

Flexo: Wooh!

[DVD audio commentary begins]

Matt Groening: Now whose joke was that?

David X. Cohen: Well I imagine that either me, Ken Keeler, or Jeff Westbrook, the staff mathematicians, had something to do with it, I forget who – that’s true though.

Matt Groening: Wait a second, so let me see, one of you made it up and two laughed uproariously . . .

David X. Cohen: But I invite the zealous viewer to check that claim. It is true and there’s a little trick to it so it’s not as easy to figure out as it seems.

Matt Groening: Really?

David X. Cohen: Yes. It’s mathematically accurate, all integers, but it’s a little tricky.

Question 3 Express each of Bender and Flexo’s identification numbers as the sum of two cubes. Use a successful web search to help you, and then use a computer algebra system or calculator to verify that each number is indeed expressible as the sum of the cubes of the numbers you found.

Question 4 In David X. Cohen’s calculation hint (see his comments above) what did he mean when he said that “It’s a little tricky”? Specifically,

what kind of numbers do mathematicians usually look for when they express numbers as the sum of two cubes, and which serial number was “a little tricky” in this sense?

Question 5 Search the web to find recent results about the sum of two cubes (within the last five years) and summarize what you found.

In an interview with frontwheeldrive.com, David X. Cohen said that they try to put in as much science as possible with the hope of making die-hard fans out of those that appreciate it. Thanks to the cleverness and mathematical backgrounds of the writers, *Futurama* can be especially fun to watch. David X. Cohen was correct in my case, as researching the mathematics in *Futurama* for an article I was asked to write did indeed make a die-hard fan out of me.

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BIOGRAPHICAL SKETCH

Sarah J. Greenwald is Associate Professor of Mathematics and a Women’s Studies core faculty member at Appalachian State University. She received her PhD from the University of Pennsylvania. Her scholarship areas include geometry, popular culture and mathematics, and women and minorities in mathematics. She and Andrew Nestler co-created the educational website SimpsonsMath.com that is unaffiliated with the show. Her work has been mentioned in the audio commentary of the *Homer*³ segment of *The Simpsons* season 7 DVD, and she was thrilled when the writers put a mathematical reference into the May 2006 season finale in honor of her and Nestler. A member of *Hollywood Math and Science Film Consulting*, she has spoken about the effects of scientific popular culture representations nationwide and on NPR’s *Science Friday*. She is a 2005 Mathematical Association of America Alder Award winner for distinguished teaching and extraordinary influence beyond her own classroom.