

BY DAVID AUBURN

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WORDS TO THE WISE



Prime number—A number other than zero or one that is not divisible without a remainder by any other number than one and the number itself. For example, five is a prime number because no numbers other than one and five divide evenly into it.

Graphomaniac—Catherine describes her father as a graphomaniac, or someone who writes obsessively.

***i*-Imaginary Number**—In mathematics, an imaginary number is a complex number, such as $(3 + 2z)$ in which the coefficient of the imaginary unit is not zero. Hal reveals his mathematical mind when he explains that his band plays a song by this name.

Lucid—Hal discovers that little, if any of Robert's writings during his illness demonstrated clear or lucid thought.

Game theory—This area of mathematics is applied to fields such as economics and military strategy in which conflicting interests work against each other based on potential gains and losses.

Algebraic geometry—This branch of mathematics uses the tools of both geometry and algebra to address questions such as the famous Fermat's Last Theorem.

Astrophysicists—These scientists are able to use some of Robert's mathematical discoveries in their study of the physical and chemical makeup of bodies in space.

Proof—While this word takes on a variety of meanings in the play, in mathematics, a proof is the process of establishing the truth of a statement based on a logical assembly of already accepted statements or theorems.

Protege—This is an individual who is trained or guided by a more experienced or influential person in the field.

Institutionalized—Catherine and Claire disagree over whether or not Robert would have benefited from being placed in a mental hospital, or institutionalized.

Prolific—It is commonly thought that mathematicians are most prolific, or productive in their twenties and thirties and that after that point they are no longer able to generate substantial works.

Sophie Germain—This 18th century French mathematician attended school and wrote proofs under a man's name, Monsieur Le Blanc, because women were not regarded as scholars at that time. One of her most notable accomplishments is the discovery of a new set of prime numbers which are now known as Germain primes.

Gauss—An 18th century German number theorist, Carl Friedrich Gauss is commonly regarded as the world's greatest mathematician.

Remission—This is a period in which someone suffering from a disease

or illness, such as Robert, experiences relief from the symptoms.

Theorem—In mathematics, this term refers to a statement that can be reasoned from other formulas.

Euphemism—This is a word or phrase that is substituted in place of something that may be considered offensive or rude. For example, plump is a common euphemism for fat.

Northwestern—The site of Catherine's brief college career, Northwestern is a prestigious university in Evanston, Illinois, a suburb of Chicago.

Dissertation—The final benchmark in most doctoral programs, this is a lengthy paper in which a student tries to present a new idea about his or her field of study.

Lithium—This powerful medication is often used in the treatment of manic depression.

Electroshock—A controversial treatment for depression, this therapy uses an electric current to shock the patient's brain.

Elliptical curves—A component of algebraic geometry, this field is connected to several different areas including number theory.

Incoherent—Robert's work during his illness was unable to be understood or incoherent.



Robert was once a pioneer in mathematics research and a professor at the University of Chicago, but a lengthy struggle with mental illness has debilitated him.

Catherine is Robert's twenty-five year old daughter, who is both dismayed and delighted that she has inherited her father's gift.

Hal, a professor at the University of Chicago, is one of Robert's former students and is eager to make his own mark on the world of mathematics.

Claire is Catherine's super-organized older sister who has taken her mathematical ability to Wall Street.

< WHAT'S THE STORY >

Act I

The story of *Proof* begins just after midnight on Catherine's twenty-fifth birthday. She sits alone on the back porch of the Chicago home in which she grew up and is startled when her father, Robert, enters with a bottle of champagne to celebrate the first few minutes of her birthday. As they talk, we learn that Catherine has little or no social life, that Robert recommends doing math as a cure for insomnia and that Catherine has a difficult relationship with her sister Claire, who will be arriving from New York later in the day. We also discover that Robert's work as a mathematician is famous and that he believes Catherine is as gifted, if not more so than him. He chides her for spending her days sleeping until noon, eating junk food and reading mindless magazines instead of developing her mathematical potential, but she reminds him that he has also had nonproductive periods, brought on by mental illness. He explains that for him, those periods were productive; he did what he wanted to do. As she questions him about when his episodes of illness began, we realize that she is not afraid of doing math; she is afraid of inheriting her father's madness along with his skill. He tries to console her, explaining that if she is capable of asking: "Am I crazy?," she probably isn't. This brings her little comfort though, because moments later, he reminds her that he is, in fact, dead—that he died a week ago and that Claire is not coming from New York for a visit, but instead for his funeral.

As Catherine tries to process what all of this reflects about her mental state, Robert leaves her, and Hal, a former student-turned-professor, comes onto the porch. Hal has been upstairs in Robert's study, reviewing the hundreds of notes that his mentor left behind, looking for new or revolutionary work that might otherwise go undiscovered. He apologizes for staying so late and offers to take some of the notebooks with him so that he won't have to work in the house any longer, but Catherine is adamant that nothing should leave the house. She tells him that he is wasting his time, that Robert's last years were fruitless, that the notebooks are filled with gibberish—not works of genius. Hal, however, insists that he will eventually review every page, on the off chance that there might be some lucid work. Catherine becomes suspicious and demands to search his backpack for notebooks, but feels foolish when she finds nothing more than gym clothes and a pair of drumsticks. When Hal starts to leave

though, a notebook falls out of his coat pocket and Catherine is outraged. He tries to defend his actions, but she is not interested and calls the police, accusing him of trying to steal the notebook. While she is on the phone, he manages to show her that the notebook contains a touching entry written by her father about her. He explains that he wanted to wrap it for her and give it to her as a birthday gift. She realizes that she probably overreacted, but the police are already on their way.

The next morning, Claire arrives and immediately begins trying to tidy both Catherine's house and her life. With everything from breakfast to hair care to wardrobe, Claire sets about organizing her sister and evaluating her mental and physical state, but Catherine resents being treated like a delicate child and quickly moves to the defensive. They are in the midst of this fight when Hal comes in, hoping to review some more notebooks before the funeral. His arrival temporarily diffuses the tension and prompts a backwards apology from Claire.

Later that night, Catherine sits alone on the porch, away from the loud party inside. Claire has invited "a few" people to the house to "relax in a low-key way" after the funeral, but it has evolved into

something a little larger and more enthusiastic. Hal comes out to check on her and the two ease into a comfortable conversation, covering everything from the pressure to perform in mathematics to the challenges of being a woman in a male dominated field to Robert's approach to research. Along the way, Hal confides that at twenty-eight, he fears that he is already on the downhill slide of a young man's profession, which seems to strike a chord with Catherine because she generally fears that she is on the downhill slide mentally. Hal also confesses that he has had a crush on Catherine for several years, since he first met her while Robert was his doctoral advisor. Awkward, yet comfortable with one another, the two embrace in a kiss.

The next morning, Catherine decides to share a secret of her own with Hal and gives him the key to a drawer in her father's desk. She will not tell him what he will find but sends him to the study to investigate. Claire, hungover from the previous night's excitement comes out and is surprised to find Catherine in a chipper mood. The tone shifts quickly though when Claire reveals that she is selling the house and wants

...if she
is capable
of asking:
"Am I crazy?,"
she probably
isn't

Catherine to move to New York with her and her fiancé. Catherine is furious, but Claire claims that she is only thinking of Catherine's best interest. Again, Hal's entrance interrupts their feud as he returns from the study with a notebook containing what appears to be a groundbreaking proof. He is ecstatic and tells Catherine that if it "checks out" she will be in the limelight as the person who discovered it. She leaves both Hal and Claire in a daze when she declares that she did not find it; she wrote it.

Act II

From here, we flash back four years, to Catherine's twenty-first birthday. She is at home with Robert, who has recently shown great improvement, both mentally and physically. Encouraged by this, Catherine announces that she has enrolled for the fall quarter at Northwestern and will be moving to nearby Evanston at the end of the month. As Robert tries to adjust to this new idea, Hal—now a doctoral candidate under Robert's supervision—arrives with a draft of his dissertation for his advisor's review. Hal and Catherine share a moment of what appears to be chemistry, but it passes without consequence. While Catherine goes to change her clothes for an evening out, Robert writes in his notebook, the same entry that Hal discovers and gives Catherine as a gift in Act I.

Back in the present, Hal and Claire skeptically examine Catherine's claim to have written the proof. They assume that she means she transcribed it for him, but she tells them that he never even knew about it. According to her, Robert was far too ill to have discussed the proof with her, much less to have done the work himself, but this does not convince Claire or Hal. In fact, Claire claims that the handwriting is her father's. Hal is clearly uncomfortable, as Catherine looks to him for support and finds only more questions. He suggests that he should take the proof and have a team of people in his department review it to "figure out exactly what we've got." Claire is pleased with this idea, but Catherine is crushed by what she considers to be a betrayal of trust.

The next day, Hal returns, hoping to speak to Catherine, but instead finds Claire. She reports that Catherine has been sleeping since the day before and refuses to speak or eat. When Hal asks to see Catherine, Claire turns him away, saying that it's his fault that she is in such a funk in the first place. Hal protests, but to little

effect. He is both surprised and relieved when Claire agrees to give him the notebook for further research.

Another flash back takes us three and a half years into the past, where Catherine arrives home from Evanston to find Robert sitting on the porch in a T-shirt in the middle of winter. She tries to persuade him to go inside, but he insists that it is too hot and that he can't work in there. He is very excited about a new problem that he has undertaken and tells Catherine: "I'm back in touch with the source—the font, the—whatever the source of my creativity was all those years ago." He invites her to work on the problem with him and shows her his outline for a proof, insisting that she read it aloud. Finally, she consents, but the proof is nothing more than gibberish. As she shuffles him inside, he pleads with her to stay, and she promises that she will.

In the present again, a week after Catherine reveals the proof, Claire waits outside on the porch for Catherine. Claire has arranged for both of them to fly to New York today and when Catherine comes out, begins reminding her of all the amenities

the city has to offer. Catherine is not impressed though and mocks her sister, saying that what she really looks forward to is the psychiatric care that Claire has inevitably arranged for her. Exasperated, Claire leaves, throwing Catherine's plane ticket on the table as she goes. Catherine does not follow, though.

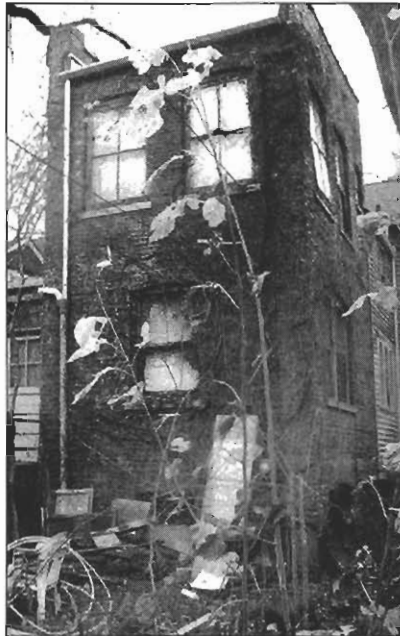
A moment later, Hal rushes around the side of the house, carrying the notebook. He tells her that after days without sleep and thorough reviews with two different teams of experts, he has concluded

that the proof "checks out." Catherine is unmoved and replies simply: "I already knew." She tells him to do whatever he wants with the proof: publish it, have a press conference, pass it off as his own work. He declines, because he no longer thinks her father wrote it and offers several pieces of evidence to support this claim. This leaves her cold though because she wanted to be trusted on her own merits, not those of the proof. Hal tries to convince her to stay in Chicago, but she admits that maybe being taken care of is what she needs, that maybe she is like Robert. Hal agrees that maybe she is, but not in a bad way. She tentatively takes the notebook and begins to look at it. She talks about how difficult the work was and how "lumpy" her end result is. Hal asks her to talk him through the proof, suggesting that maybe she will improve her work that way. Finally, she opens the notebook, flips the pages and begins to explain.

she wanted
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proof

(SHOP + TALK)

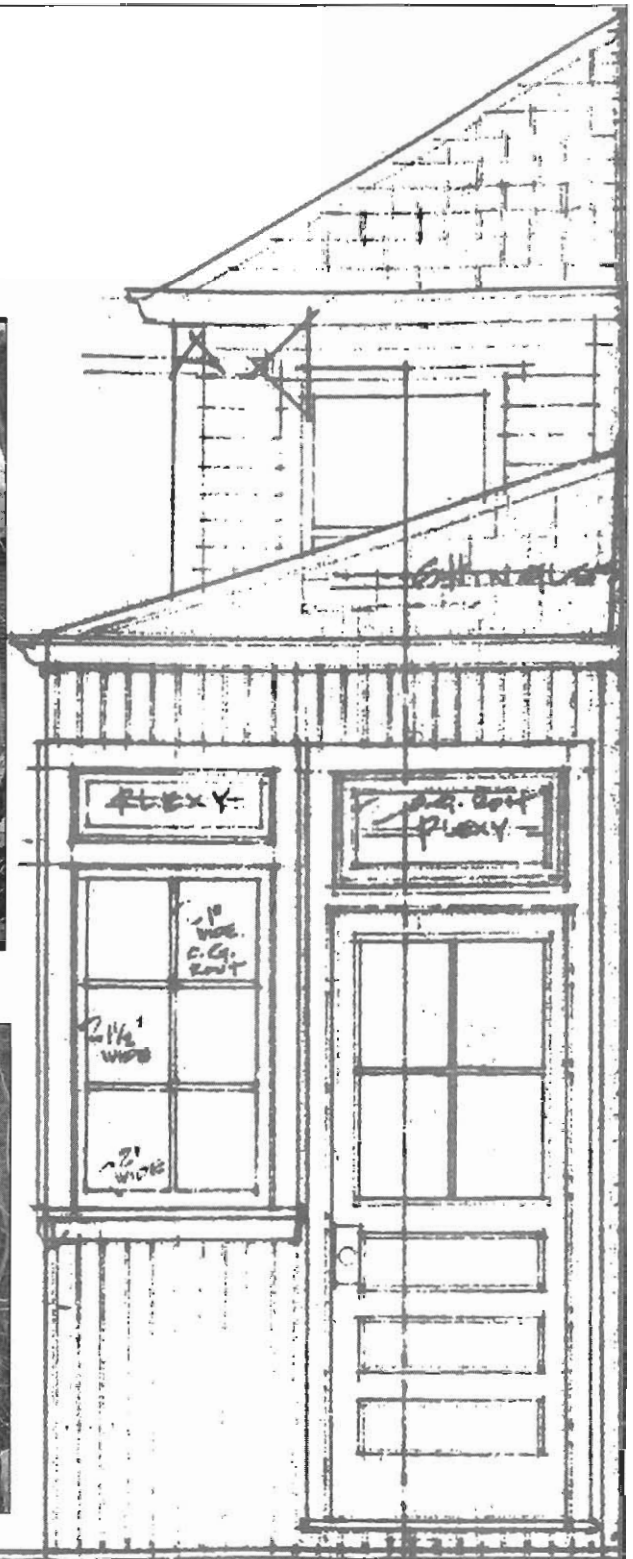
Disney-gothic—that's how scenic designer Todd Rosenthal describes the environment that he has created for The Rep's production of *Proof*. Set in the eclectic neighborhood of Chicago's Hyde Park, the action of *Proof* is centered around the back porch of Catherine and Robert's house. Researching this show was actually a part of daily life for Rosenthal who makes his home in Hyde Park. In planning for this set, he visited several homes in the area and observed that all of the houses in that neighborhood are unique; no two are alike. So he synthesized elements of several buildings to create the desired effect, hence the Disney-gothic label.



One of the key elements of the design is a sense of age and isolation which mirrors the psychological world that Robert and Catherine have built for themselves. For this father and daughter, the external world is far-removed and unimportant. This is reflected in the set design in that the focus is very specific. We see only Robert and Catherine's house, no others, and the cyc background is pixilated, suggesting that the rest of the world is distant and perhaps unstable.



At the same time that he makes these subtle symbolic statements, Rosenthal also demonstrates meticulous attention to realistic detail in the design. Although the action all takes place on the outside of the house, primarily the porch, much effort is put into creating the interior of the house as well. Through the back windows, we can see into a fully furnished kitchen and the upstairs study. And because the play takes place in fall and winter, a blanket of leaves covers the ground around the porch. We can also see remnants of Claire's and Catherine's childhood scattered throughout the yard. An old swing hangs downstage left and



other toys long since abandoned rest around the base of the house.

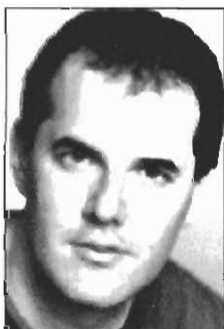
This combination of elements helps the audience to instantly focus on the nature of the world in which Catherine and Robert live and at the same time, allows us to relate to them as real people.

Lα

[BiO + BEyOND] π

A Conversation With David Auburn

Moderated by Christian Parker



Excerpted from *The Dramatist Magazine* May/June 2001 Volume 3, Number 5

In February, Christian Parker moderated a conversation with Dramatists Guild member David Auburn in the Guild's Frederick Loewe Room in New York. Auburn recently won the Dramatists Guild's Hull-Warriner Award and Pulitzer Prize for *Proof*, which transferred from Off-

Broadway at MTC to Broadway at the Walter Kerr. Auburn's other plays include *Skyscraper* (Greenwich House), *Fifth Planet* (New York Stage and Film), *Miss You* (HBO Comedy Arts Fest), and *The Next Life* (Juilliard School). His short play *What Do You Believe About the Future?* appeared in Harper's magazine and has been adapted for the screen. This year, he also received the Helen Merrill Playwriting Award and a Guggenheim Foundation Fellowship.

CHRISTIAN PARKER: I'm Christian Parker, literary manager and dramaturg at Manhattan Theatre Club, which was the original producer of *Proof*, so I've known David for a few years and am quite familiar with the history of the show.

David, I'd like to start by talking a little bit about your background in theater before *Proof* came along, about how you started writing plays.

DAVID AUBURN: I was born in Chicago and grew up in Columbus, Ohio, and in Arkansas, then I went back to Chicago for college. I did theater as an extracurricular activity as a kid, and in college, in Chicago, I started working with a group that did improvisational and sketch comedy. I performed with that group and wrote for them, and I found I liked writing short comic scenes.

Gradually, the scenes got longer, and I wrote a one-act play, which I put on at college with friends. Eventually, I thought I'd try my hand at a full-length play, which I wrote the last year I was at college. I didn't know what to do with it, but I'd seen a

poster advertising a writing fellowship with Amblin Entertainment at Universal Studios, where Steven Spielberg brought ten writers to L.A. each year. I sent the play to them and forgot about it, because I didn't think anything would come of it, but I got into the program.

Getting the fellowship caught me by surprise. I hadn't expected to pursue a writing career, but I ended up learning to write movies. When the fellowship ended, I found myself in L.A., going broke. It was a moment of clarity, as they say. I decided that, if I were going to go broke trying to be a writer, I'd rather do it as a playwright in New York than as a screenwriter in L.A. So, I moved to New York and took a succession of boring jobs. [laughter]

I also worked in a theater company I formed with friends, while I kept trying to write. I had plays done in tiny venues. Then I spent two years in Juilliard's playwriting program, and my first full-length play, *Skyscraper*, was done Off-Broadway in 1997. It had a short run, but people from MTC saw it and said, "Keep us in mind for your next play and send it to us," and I did. That was *Proof*.

CP: Was there a point when you felt "I am committing myself to being a playwright"? In L.A.—where your career might have diverged into something else—did you ever reach a point when you doubted that playwriting would be your long-term pursuit?

DA: Making the decision to come to New York was the "I want to be a playwright" decision. That decision felt good, but in the eight years it took to begin to earn any money from playwriting, there was always a lot of doubt. I had all the troubles that most writers have trying to build a career, trying to figure out "Can I do this? Am I going to wind up sorry that I did this, in ten years?" At times, I thought I'd quit writing and just concentrate on my day job, but when I did, I usually found I was unhappy enough that I went back to writing. I found some way to keep going.

CP: How did Juilliard play into that? Did you seek out the opportunity to be among that group of writers, in particular? It was a new program, when you were there, right?

DA: I was in the program's second year. It was the first time I ever had any professional commentary on my work. Christopher Durang and Marsha Norman ran—and still run—the program. Having people with their level of experience talk about what you're doing is validating. Having

actors as good as those at Juilliard do your work forces you to think seriously about how professional actors will approach the material you wrote. That was one of the best things about the program: learning what kinds of questions actors ask when they approach a new script and being able to think through those problems before you get it into rehearsal. That was invaluable.

CP: Do you feel that your attitude has changed, in light of the success of *Proof* and the situation that has put you in? Has it changed your sense of the work you do on a daily basis or your interest in writing and how you feel about the work?

DA: When I wrote *Proof*, I had no idea if it would be produced or, if so, at what level. It's very nice to think there's a good chance that someone will be interested in doing my next play, whatever that is. Although there's still no certainty, of course, and you can't anticipate a production while you're writing. That would paralyze you. Apart from a vague sense of having a little more opportunity, I don't know that anything's changed.

CP: Before we discuss the production, I'd like to talk about where *Proof* came from, how it originated, and how quickly you wrote it.

ODA: In 1998, I moved temporarily to London to live with my girlfriend, who was working there. After my first play was produced in 1997, I thought, "Don't quit your day job." Well, I did quit my day job, moved to London with all my savings, and took another stab at writing. [laughter] Over the course of that summer, I wrote *Proof*.

I felt that I wanted to write a more naturalistic play than my first play, which was a more conceptual, absurd comedy. I wanted to write something more realistic and grounded in character. The two specific ideas I started with were: the idea of two sisters fighting over something that a parent had left behind after their death; and the idea of a character worried about inheriting their parent's mental illness. Those seemed like interesting dramatic ideas I could get going in some way, but I didn't know if they belonged in the same play.

As I began looking for "the thing" that the children could find, I thought about some mathematical or scientific document. That appealed to me for a number of reasons. One was that I thought the authorship of a mathematical proof could be called into question in some interesting ways that, say, a

painting or a book manuscript couldn't be. Another was the historical fact that a number of well-known mathematicians have suffered from mental illness, which gave me a bridge between my two ideas. Once I had that, I wrote the play quickly.

The first draft took about a month to get down on paper. It was a very rough draft, but it sketched out the plot. All the incidents in the final draft are in that first draft, in roughly the same order, but the characters were sketchier. Then I spent about six months revising the play, trying to think through the relationships and flesh out the sketch. After that, I had a draft substantially like the one I sent to Manhattan Theatre Club and what's in production now. Of course, it did change a little bit along the way, but when I finished that first revision, I mostly had the play.

CP: Yes, as I recall, it has not been radically reconceived or revised from what I first saw.

Talk a little bit about your experience of working with an institution like MTC. You sent the play soon after you finished it, and MTC very quickly put it into the pipeline, although the theater certainly didn't immediately decide to put it into production. First, it was scheduled for the spring reading series. Talk about your experiences from sending the play in fall 1998 to the reading in spring 1999.

DA: It happened fast. Originally, it was scheduled for the new play reading series, but before that took place, [Artistic Director] Lynne Meadow decided it was a possibility

for production, so the theater scheduled an earlier reading with Mary-Louise Parker. That went very well, and the next day, I got a call that MTC would do it the following season. I was surprised. I'm sure Mary-Louise's performance in the reading, and her wanting to do the show, made the difference. Then I had to wait a year for the show to be produced.

During that year, you [Christian] had some ideas, and the theater had some ideas. We found [director] Daniel Sullivan rather quickly, and I had a meeting with him. I did some minor tweaking, but I didn't do much work on the play until we went into rehearsal, some nine months later. I spent most of the year at my day job, writing documentaries for VH1. Writing about Van Halen's career kept me from thinking, "I've got this show coming up." [laughter] It was a nice way to stay distracted.

At times,
I thought
I'd...just
concentrate
on my day job,
but when
I did...I found
I was
unhappy

Read More About It

We encourage you to examine these topics in-depth by exploring the following books and Web sites.

A Beautiful Mind: A Biography of John Forbes Nash Jr. by Sylvia Nasar. New York: Simon & Schuster, 1998. Don't just see the movie; read the book that tells the story of this contemporary mathematician and his struggle with mental illness.

Arcadia by Tom Stoppard. 1993. Meet another young brilliant female mathematician in this beautiful play.

Celebrating Women in Mathematics and Sciences edited by Miriam P. Cooney. This collection of biographies is a project of the National Council of Teachers of Mathematics and offers an excellent starting point for basic research.

Mathematics: A Human Endeavor by H. Jacobs. New York: W.H. Freeman and Co., 1982. Discover the wonder and humanity that Catherine and Robert see in math with this very accessible book.

Women and Mathematics: The Addition of Difference by Claudia Henrion. Indiana University Press, 1997.

Explore the lives of several contemporary women mathematicians and learn how gender has affected their professional lives and how math has affected their personal lives.

www.cs.nyu.edu/faculty/berger/proof/ Watch RealVideo streaming footage of a conference featuring speakers such as *Proof* playwright David Auburn, *A Beautiful Mind* author Sylvia Nasar and Broadway cast member Ben Shenkman.

www.cut-the-knot.com/proofs/index.html This page offers several fun and challenging puzzles as well as lots of great math quotes and links

www.history.mcs.st-and.ac.uk/~history/ For biographies of famous mathematicians, the development of math through history and interesting new problems in the field, visit this site.

<http://mathforum.org/isac/mathhist.html> This site provides an introduction into math history by outlining some of the most famous problems faced by mathematicians.

www.math.harvard.edu/~mathclub/women-in-math.html Get resources and links regarding professional women in mathematics at this site.

www.pbs.org/wgbh/nova/proof/germain.html Learn more about Catherine's heroine, Sophie Germain, on this PBS page.

Math: A Young Man's Game?

At twenty-eight, Hal, a researcher and professor of mathematics, already considers himself on the downhill side of achievement, and Robert, twice his age fears that he will never do math again. Though fictional, these men are not alone in their fears. Over the years, many myths have developed about the lifestyles of mathematicians—from the idea that they work in strict isolation to the geeky stereotype of taped glasses and pocket protectors. But two of the most persistent perceptions are that mathematicians (at least the successful ones) are men and, that they are young men. While it would seem to be little more than an old wives' tale, this idea has been articulated by such respected scientists as Alfred Adler:

Such consuming commitment can rarely be continued into middle and old age, and mathematicians after a time do minor work. In addition, mathematics is continually generating new concepts, which seem profound to the older men and must be painstakingly studied and learned. The young mathematicians absorb these concepts in their university studies and find them simple. What is agonizingly difficult for their teachers appears only natural to them. The students begin where the teachers have stopped; the teachers become scholarly observers.

However, research indicates that this is not necessarily the case. In her 1997 book, *Women and Mathematics: the Addition of Difference*, Claudia Henrion cites a study by Nancy Stern which shows that contrary to the popular belief that the most productive years of a mathematician's life are between 20 and 35, the greatest number of papers was produced by researchers aged 35–39, and the number of papers published by mathematicians over age 60 was still greater than that of researchers under 35. Henrion suggests that quantity does not necessarily equal quality, but Stern's study shows no direct relationship between a decline in quality of work and an increase in age. In fact, the quality of work produced by those over the age of 60 was twice that of those 35 and younger. Why, then, does this notion of youth still thrive?

Perhaps it is for the same reason that women continue to be viewed as the exception rather than the norm in mathematics. Despite the fact that numerous women have made and continue to make meaningful

contributions to this field, the common belief is that virility is the driving force in math, which implies a certain advantage for men, particularly young men. A standard joke among mathematicians reiterates this view: "There have been only two women mathematicians; one wasn't really a mathematician and the other wasn't really a woman." Obviously, this sort of ideology is disheartening, but what sort of lasting effect does it have?

Unfortunately, the consequences are widespread. Much of the structure of the academic world is affected by this premise. The traditional expectation is that students will go directly from an undergraduate to a graduate program and that they will pursue their studies full-time, with few family distractions, while their "genius is budding." This is typically a greater burden on women than on men, as women are more likely to delay their education for a number of reasons. They may have less initial encouragement to seek a career in mathematics, they may follow a spouse's career path or they may take time out to raise children. Regardless of the reason, women are often not working on the standard academic timeline. What is interesting is that according to Henrion's research, most women reported that they felt they did their best work later in life. However, they are not necessarily rewarded for this work in the same way as their younger counterparts because the paradigm is not constructed this way. Some of the most notable awards given in the field are limited by age, such as the Field's Medal, (the mathematical version of the Nobel Prize). No one over the age of forty may even be considered for this award. This is limiting to men as well as women, since, according to Stern's study, the greatest accomplishments of many mathematicians would not be eligible because they were completed after age forty. As both Hal and Catherine demonstrate in *Proof*, this sort of pressure can be counterproductive, as it creates a set of unrealistic expectations for the first portion of researchers' careers rather than promoting creative development throughout their professional lives.

It is becoming increasingly apparent that mathematical talent is limited neither by gender nor by age, but until the mathematical community as a whole acknowledges this, researchers will have to continue to prove that math is not a young man's game.

{Q+A}

These questions and activities are designed to help students anticipate the performance and then to build on their impressions and interpretations after attending the theatre. The activities and questions are divided into “**Before the Performance**” and “**After the Performance**” categories. While most of the exercises provide specific instructions, please feel free to adapt these activities to accommodate your own teaching strategies and curricular needs. To assist you in incorporating these materials into your existing curriculum, we have provided the numbers of some of the corresponding Missouri Knowledge Standards and Illinois Learning Standards.

[COMMUNICATI*o*N ARTS]

Before the Performance

1 Think about the word “proof.” What are the different ways that it is used in society? How many unique definitions does the dictionary offer? Record each of these definitions in a journal entry and cite an example scenario for each. Save this journal for future use. (MO: CA1, CA3, CA4 IL: 1, 2, 3, 5)

2 According to English novelist E.M. Forster: “One is certain of nothing but the truth of one’s own emotions.” Of what are you certain? What do you know without a doubt? What do you wish you knew with certainty? Do you have proof of these things, or do you agree with Forster that your emotions are the only real source of truth. What do you think is most challenging about trying to discern whether or not something is certain? Do you think that these beliefs will change over time? Address these questions in a letter to yourself. Tell your future self what you know now. Place your letter in an envelope, seal it and store it in a safe place. In five years, open your letter and see how many of your certainties survived. (MO: CA1, CA3, CA4, CA7 IL: 1, 3, 4)

3 Have you ever considered a future career in a field in which there are currently few other people like you (gender, ethnicity, etc.)? Find someone who has experienced this situation and interview him or her. Be sure to ask what the challenges, as well as the rewards of his or her decision are. (MO: CA1, CA4, CA5, SS6 IL: 1, 3, 5, 18)

4 Read the following quotations pertaining to proof and certainty. Decide which of these best represents your own beliefs. Then write a two-minute persuasive speech advocating this view. In support of your argument, include examples of this principle in action in your own life. (MO: CA1, CA3, CA4, CA5, CA6 IL: 1, 2, 3, 4, 5)



Henry David Thoreau

“No way of thinking or doing, however ancient, can be trusted without proof.”

“It is certain because it is possible.” Tertullian

“A demonstration supposes that the contradictory idea is impossible; a proof of fact is where all the reasons lead to belief, without there being any pretext for doubt; a probability is where the reasons for belief are stronger than those for doubting.” Andrew Michael Ramsay

“With this new way of providing a foundation for mathematics, which we may appropriately call a proof theory. I pursue a significant goal, for I should like to eliminate once and for all the questions regarding the foundations of mathematics, in the form in which they are now posed, by turning every

mathematical proposition into a formula that can be concretely exhibited and strictly derived, thus recasting mathematical definitions and inferences in such a way that they are unshakable and yet provide an adequate picture of the whole of science. I believe I can attain this goal completely with my proof theory.”

David Hilbert

“The quest for certainty blocks the search for meaning. Uncertainty is the very condition to impel man to unfold his powers.” Erich Fromm

“Of the modes of persuasion furnished by the spoken word there are three kinds. The first kind depends on the personal character of the speaker; the second on putting the audience into a certain frame of mind; the third on the proof, provided by the words of the speech itself.” Aristotle

“We are not certain, we are never certain. If we were we could reach some conclusions, and we could, at last, make others take us seriously. In this world nothing can be said to be certain, except death and taxes.”



Benjamin Franklin

After the Performance

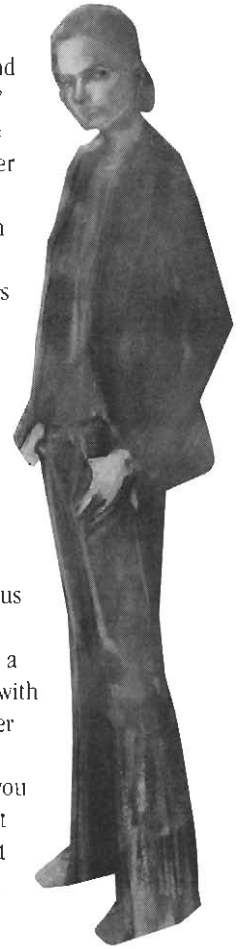
5 Catherine suffers from self-doubt throughout the play. She questions her mathematical aptitude and keeps it a secret from her family and Hal. When Catherine begins to develop feelings for Hal, she gives him the key that unlocks the drawer that holds the proof of her mathematical genius. It is only once she begins to develop enough confidence and trust in herself, that she can attempt to share her secrets, and trust another person with them. Break into groups of two. Take turns telling one another what you like about yourself. Re-group with the rest of the class and discuss the following:

- What did people say that they liked about themselves?
- What kinds of things were not very frequently mentioned?
- Was there a reluctance to express a positive self-image to others? Why? (MO: CA1, CA2, CA6 IL: 1, 4, 5)

6 Catherine has a great deal of respect for her father, but at the same time is fearful of inheriting his mental illness with his genius. In a new journal entry, discuss in what ways you look up to your parents and in what ways you are afraid of becoming like them. (MO: CA1, CA2, CA5, CA6 IL: 1, 3, 5)

7 “She’s not my friend, she’s my sister. And she’s in New York. And I don’t like her.” Before we even meet Claire, these words from Catherine indicate that she and her sister share a difficult relationship. Write a scene featuring these sisters not actually depicted in David Auburn’s script, but implied by Catherine’s words. Set your scene several years earlier than the action of the play, before Claire leaves home. In the course of the scene, try to establish a point of origin for Catherine and Claire’s adversarial relationship. Cast the roles from your classmates, rehearse the scene and perform it for the class. (MO: CA1, CA2, CA4, CA5, CA6, FA1, FA4 IL: 1, 3, 4, 5, 25, 26)

8 Catherine keeps her mathematical genius a secret for a long time and only reluctantly shares it. Have you ever had a gift or a skill which you were afraid to share with your friends or family? Write a brief newspaper article announcing your hidden talent to the world. Write the article in third person, as if you had interviewed yourself. Be sure to note what the skill was, why you concealed it and how it feels now to reveal the secret. (MO: CA1, CA2, CA4 IL: 1, 3, 5)



[F i N Σ A R T s]

Before the Performance

1 Every day, we make thousands of statements, and in almost every case, we expect those who listen to us to believe what we say without question—without proof. There are times, though, when we must offer evidence to support what we think or believe. Have you ever been in a situation in which you knew something was true or correct, and yet you could not convince someone else to believe you? To get a sense of how elusive proof can sometimes be, find a partner with whom you are comfortable working. One of you will be “A” and one of you will be “B.” “A” must make a statement that he or she knows to be true, such as, “I live on Chestnut Street.” “B” will then respond by asking, “How do you know that?” “A” must give a truthful answer, thinking about how he or she knows that the statement is true. “B” will again ask, “How do you know that?” and “A” must think

of another truthful answer. Continue with this same pattern for about two minutes; then switch roles. When you have repeated the sequence, discuss the following questions as a class. How did it feel to be forced to defend something that you knew was undoubtedly true? Did you ever feel that there was no point in trying to prove anything to your partner, or did his or her repeated questioning make you more determined to prove your case? (MO: FA1, FA3, FA4, CA1, CA2, CA5, CA6 IL: 1, 4, 5, 25, 26)

HOW
DO YOU KNOW
THAT?

2 Improvise or write the following scene: In the course of a budding friendship or romantic relationship, Character A entrusts Character B with a personal secret which could have a significant impact on B's life. Improvise or write a second scene in which A feels betrayed by the way B is reacting to or acting on the information. Among other things, B should want proof of A's claim. Can A provide it? Will A provide it? Why or why not? It is important that A and B now make a decision about the course of their relationship. (MO: FA1, FA3, CA1, CA2, CA5, CA6 IL: 1, 4, 5, 25, 26)

3 Discuss the traditional roles that family members assume over time. Give each a simple name, i.e. "The Fixer," or the "Black Sheep," or "The Princess," etc. which identifies the behavioral role of the family member (not "mom" or "dad"). Write the behavioral roles on index cards.

Then, create "family snapshots" or "in tableau." Do not assign the behavioral roles yet, but arrange the portraits according to biological relationships—for example, "Mom," "Dad," "Big Brother," etc. In order to define the poses, choose a significant moment in the family history—for example, "Big brother's graduation from college," or "Mom's retirement party."

Create four or five of these, together at first, so that each group can work privately. Then create a "sculpture garden." Let the groups, one at a time, break their pose and wander through the other groups until each sculpture has been assessed. Let the viewing group discuss what they are "reading" in each tableau. After everyone has gone, let each group say who they were playing and what their tableau depicted.

Now take each group one at a time. But, each member of the family randomly chooses a "behavioral role" card. Let the tableau come to life and create an improvisation. What happens when traditional roles become reversed or confused, i.e. what if Mom is really the "Black Sheep" and the youngest child is "The Fixer?" (MO: FA1, FA3, FA4, CA1, CA2, CA5, CA6 IL: 1, 4, 5, 18, 25, 26)

4 Build on the above exercise. Identify a "family problem" that came up in the improvisation. Which member of the family seems to be most "at risk?" If nothing arose in the improvisation, invent something. For example, "Brother wants to drop out of high-school to focus all his time on his garage band," or "Mom plans to sell the family house to cover her gambling debts." It is important not to change the behavioral cards. It may be that Mom-the-Gambler is also the "Family Jewel." Give the "at risk" character a secret that has always been kept hidden. The secret should involve the claim that the speaker has hidden some extraordinary trait or ability that he or she possesses, and the revelation should be an attempt on the speaker's part to defend or justify himself or herself before the rest of the family. Explore the reactions of all

others in light of their family roles. Who in the group might demand proof that the extraordinary claim is true? Is proof possible? (MO: FA1, FA3, FA4, CA1, CA2, CA5, CA6 IL: 1, 4, 5, 18, 25, 26)

5 Divide the class in half and form two lines, facing one another. The person across from you is your partner. One line is the "A" line, and the other the "B" line. Taking each pair in turn so that everyone has a chance to go, have one A and one B meet in the middle. A appears to be having some problem or difficulty, and B offers help. But A does not want B's help (A decides why not). Play a two-line exchange and move back into the line. Now improvise a longer scene with two willing participants:

Character A and Character B have known each other for some time. B thinks A has been acting strangely, and wants to help. But A doesn't want to be helped, at least not by B.

Before the improvisation begins, be clear on these points:

- 1) What is the relationship between Character A and Character B (friends, sisters, etc)?
- 2) How has Character A been behaving, and why does it seem so strange to Character B?

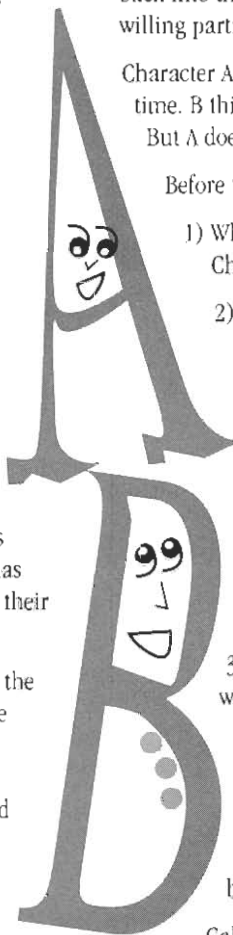
During the improvisation, make sure to address the following points:

- 1) Why doesn't Character A want help from Character B? Would A refuse help from anyone, or just from B?
- 2) How can B prove that A needs help? How can A prove that he or she doesn't?
- 3) Explore motives: Why is it so important for B to want to help? Why is it so important for A to refuse B's help? Send Character A out of the room. The class helps Character B come up with a prior circumstance that will affect the outcome of the scene—some irreversible action that Character B has already taken which must change things in a big way for Character A, like it or not.

Call Character A back into the room, and announce: "Scene 2; the next morning" (or whenever). Character B reveals the prior event. How does Character A react? (MO: FA1, FA3, CA1, CA5, CA6 IL: 1, 4, 5, 25, 26)

After the Performance

6 Break into groups of four. Have each person assume the identity of one of the four characters in the play. Prepare a dramatic monologue to read to your classmates that states your position on who wrote the proof. Your monologue should try to arouse sympathy for your position. Following the presentations, discuss the different positions that have been presented. (MO: FA1, FA3, FA4, CA1, CA2, CA5, CA6 IL: 1, 4, 5, 18, 25, 26)



7 One of the major issues of *Proof* is the perception that the mathematics profession is biased against women. To get a sense of what this might be like, set up an improvisation in which a talented new member of a skilled group (any skill will do), is being demeaned, ostracized, or kept down because he or she does not fit the traditional model of such a group. For example, a female plumber, a male nurse, or a female or ethnic minority presidential candidate

Why is the establishment skeptical of or threatened by the newcomer? How does the prejudice of the group show itself in actions, not just words? How does the newcomer react to the group's prejudicial behavior? Can the newcomer prove him or herself? Is the newcomer willing to prove him or herself? Why? Why not? (MO: FA1, FA3, FA5, SS6, CA1, CA2, CA5, CA6 IL: 1, 4, 5, 18, 25, 26)



8 In discussing her preparation for the rehearsal period, *Proof* director Susan V. Booth said:

In casting it became very clear that I had to cast a Claire that was capable of playing Catherine. It's actually in a way, the harder role, because they have to have Catherine in them and then they have to construct Claire around it.

What do you think Booth meant by this? Considering the performance that you saw at The Rep, do you think that Rhoda Griffiths, the actor portraying Claire, was successful in layering her character in this way? Does her performance give evidence for Claire having the same original potential as Catherine? Discuss these questions in a group of no more than five. (MO: FA1, FA3, CA1, CA2, CA5, CA6 IL: 1, 4, 5, 25, 26)

[SOCIAL STUDIES]

Before the Performance

1 Consider the concept of proof within the framework of the following disciplines. Form a group of four and assign each member to research one of the disciplines below. How are proofs used in each discipline? How does the principle of proof differ from one discipline to the other? Share your findings with the group and from this, create a presentation for the class.
 • Science/math • Law • History • Art/Photography
 (MO: SS2, SS6, SS7, CA1, CA3, CA4, CA5, CA6, CA7
 IL: 1, 2, 3, 4, 5, 18)

2 Divide into small groups. Look through your local newspaper and identify a story in which "proving" was a central factor to the story, (i.e. proving a historical or scientific theory, proving one's innocence or guilt in a court case). Assume the identities of the main players in the situation. Discuss the problem and possible solutions. Select one of your solutions and role-play the situation dramatically to a final outcome.
 (MO: SS2, SS7, CA1, CA3, CA4, CA6 IL: 1, 2, 3, 5, 16)

3 Research the history of mathematics. Use the resources listed in "Read More About It" to help you. Choose one famous mathematician to be your focus. Using what you learn about his or her life, write a press release about the greatest accomplishment in this researcher's career. Be sure to explain what impact this individual's work has had on the field of mathematics. (MO: SS2, SS6, SS7, CA1, CA3, CA4
 IL: 1, 2, 3, 5, 16)

After the Performance

4 Robert, Catherine, Hal and Claire all have their own personal experiences with mathematics. Robert is a pioneer, an innovator, and a "magician" with numbers. Hal has great respect for its potential and strives for greater understanding. Claire, a Wall Street executive, is defined by the finite concreteness of numbers and their potential for financial and materialistic dividends. Catherine endures a more complex relationship with the discipline of mathematics. She tries to hide her passion for the abstract poetry of numbers, as she is apprehensive of her potential—afraid of where her genius could lead. Given these examples, it is clear that mathematicians are a diverse group of people. They are not all nerds, men or hermits, but what is the common link among them? Research the "mind of the mathematician" and try to determine what skills and mindsets are needed to be a successful mathematician. Use information about current and past researchers, psychological studies and any personal insights that you have gained from *Proof* to create a mental and psychological profile of "the mathematician." Share your findings in a group of no more than five. (MO: SS6, SS7, CA1, CA2, CA3, CA4, CA6 IL: 1, 2, 3, 5, 16, 18).

