

# BEAM

Bridge to Enter Advanced Mathematics

## SUMMER REPORT 2016

A Project of the Art of Problem Solving Foundation

Dear Friends,

Five years ago, BEAM was an experiment. We brought 17 kids to Bard College, ran a summer program where we taught them advanced math, and then stayed in touch to see what would happen next.

Those students are in college now, at public and private colleges including, yes, Bard College itself! (You can read more about that later in this report.) Many of them are planning on careers in science- or math-related professional fields, such as computer programming and medicine, and they have a leg up—they already have advanced training through extracurricular study. In other words, they're on a pathway that makes their career goals realistic.

Since that first year, we've added tremendous year-round support for students and families. Now, we help our students gain admission to top high schools and summer programs. We advise and guide students through middle school, high school, and the college application process. As we iterate the design of our program, we've launched new programs for younger students, beginning as early as 6th grade. Soon, we'll start a pilot program for elementary school students.

Those first five years of BEAM provide a proof of concept. We've shown that students from underserved communities can, with the right support, do truly remarkable things. Now, we look to the future. How much more could they achieve if we start earlier, or if we provide more engagement opportunities in 9th and 10th grades? Can we expand our program to another city or area of the country? The next five years will be a time when we will develop our model further, experimenting, gathering data, and refining our approach to make sure that every student can reach their potential. We're raising the bar even higher for what our students can achieve.

One of the defining ideals of our society is opportunity, no matter the resources or educations of your parents, the community you live in, or the school you attend. Access to opportunity means that everyone can contribute their talents to society, and it raises all of us up. You don't have to look far—from colleges to tech companies—to see that we're not there yet. But I know we can bring that opportunity to more students who want to pursue science- and math-focused careers.

Thank you for bringing us here over the past five years. Here's to five more years of providing a comprehensive, realistic pathway for our students to enter science and math careers, a pathway that we intend to develop and grow so that all our students can achieve their full potential.



Sincerely,

A handwritten signature in red ink that reads 'Daniel Zaharopol'. The signature is written in a cursive, flowing style.

**Daniel Zaharopol**

BEAM Founder and Executive Director, the  
Art of Problem Solving Foundation





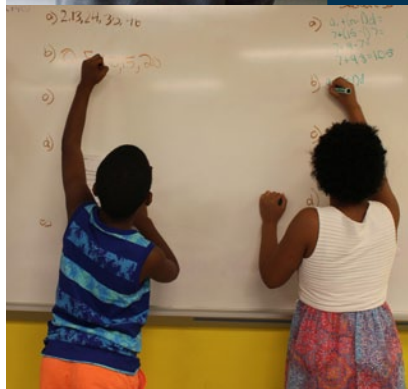
This summer, **156** middle school students spent a collective **13,698** hours working on mathematics and honing their skills.

They were joined by **10** BEAM alumni who returned to serve as Junior Counselors for BEAM 6.

In August, **20** rising 11th and 12th graders spent a total of **405** hours learning about college and preparing to apply.

At the end of the summer, BEAM's first cohort went off to college, attending schools including Bard College, Northeastern University, and SUNY Albany.

On the next few pages, take the journey that our students take, and learn about how BEAM encourages passion for mathematics and a love of learning, all while preparing participants for success in high school, college, and beyond!







**Look how we've grown!**  
**BEAM 6, Summer 2016**



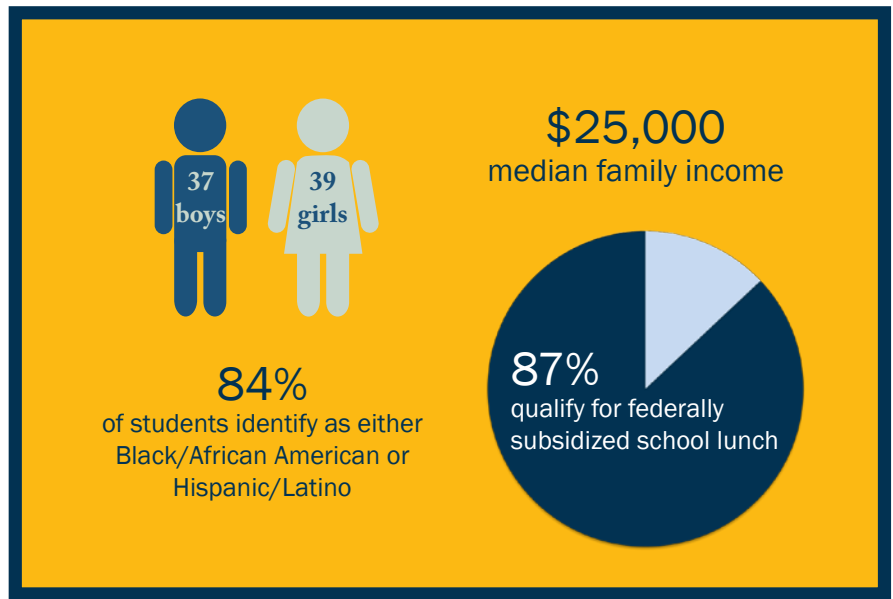




# The BEAM Pathway

## Apply!

Students are nominated by staff from their schools and get challenging math puzzles as an admission test.



## 6th Grade



During the summer, BEAM 6 students take four-week courses in Logical Reasoning, Math Team Strategies, Math Fundamentals, and Applied Math such as Astronomy or Computer Programming. Afternoon math circles give a break to explore other fun corners of mathematics.

*Above, Klaudia and Jayline work with Professor Caleb Ashley. Right: Students play basketball in the park, one of the many activities and field trips that give them the chance to form a tight community centered around math.*



# BEAM 6 Program

Students spend four weeks learning mathematical reasoning skills and building preparation for advanced study. They form a tight-knit community that binds them together as young mathematicians.

Daily average summer program attendance was **94%** of students.

When asked to rate how much they learned on a 1-7 scale, **91%** of students gave a response of 5 or higher.

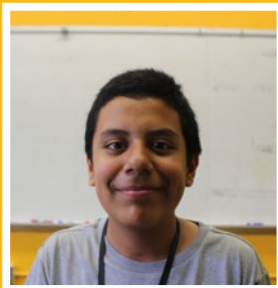
To date, **31** students have engaged in enrichment mathematics after attending BEAM 6 during the summer.

## Summer After 6th Grade



"I want to do math and science in high school. [BEAM] changed my way of thinking for my career."  
- Paris

"Math is something everyone should learn. It's amazing and I hope I can keep on learning more math. ... I want to get a PhD in math." - David



## Next Steps

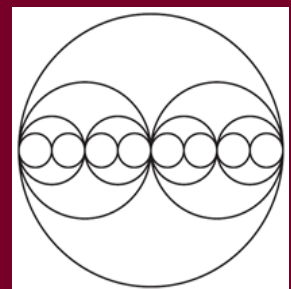
We send out monthly "challenge sets" filled with interesting problems, offer free online Art of Problem Solving classes, and suggest next steps for students... including an application to BEAM 7!

*Try out this problem from our 7th grade challenge sets!*

How many different ways are there to choose three circles of different sizes from the image at right so that the smallest circle you chose is inside the medium circle you chose, and the medium circle you chose is inside the largest circle you chose?

*(Problem courtesy MATHCOUNTS.)*

Want to check your work? Go to: <https://www.beammath.org/solution>



Right: Stephanie presents her discovery of a projective plane with seven points and seven lines, the Fano plane, in a BEAM 7 Course on projective geometry taught by Professor Dan May.



Students live in a college dorm at BEAM 7 (Vassar site, pictured left). Along with field trips, including a day-long hike, a visit to a water park, and a day at Six Flags, students gain experiences that are comparable with those afforded by their more affluent peers.

## 7th Grade

### Mosaics, Symmetries and Dancing?

a BEAM 7 Class by Javier Ronquillo-Rivera  
Summer 2016, Bard College Site



Javier works through a problem with Karoline.

Have you noticed that the New Year's Eve ball that comes down every year in Times Square is not perfectly round? It is really made out of a bunch of smaller triangles! Could we make a ball like this using just stop signs? Have you noticed that soccer balls are hybrids of pentagons and hexagons? Could we do a hybrid ball with stop signs and triangles?

All these questions have to do with arranging regular polygons together into patterns called mosaics. Throughout history, mosaics have been some of the most beautiful pieces of art, and mathematics is used to create the harmony and beauty that they possess.

We will explore all of these questions and many more—including the relationship between dancing and the way we can move mosaics without changing their shape! (Students should be prepared to dance!)



On the AMC 8, a national contest taken by top students:

**35th percentile:** ranking of median student at the start of the summer

**46th percentile:** ranking of median student at the end of the summer

We asked BEAM 7 students, "What is the longest amount of time you've ever spent working on a math problem?"

The average student response jumped from

**15 minutes... all the way to 2 days!**



"Math is like an infinite building with doors on each floor, which you need knowledge keys to unlock. BEAM gave me keys to help unlock the doors to go higher." - María

Site/Year	Median National Ranking on Pre-test	Median National Ranking on Post-Test
Bard 2014	36	46
Siena 2014	25	36
Bard 2015	36	57
Siena 2015	35	46
Bard 2016	36	46
Vassar 2016	25	36

## Summer After 7th Grade



*Left: Ana works on a problem in her BEAM 7 class, Math Team Strategies. Students work with one another, with instructors, and on their own to hone their skills and increase their confidence.*

*Below: Professor Karen Taylor helps Gabe, a BEAM student in her "Squares and the Sum of Two Squares" class at the Bard campus site, summer 2016.*

## BEAM 7 Program

Accepted students spend three weeks living on a college campus, learning advanced math from college professors and expert teachers. BEAM students build a close intellectual community with their peers. They gain both academic and social preparation to succeed in advanced programs in high school and beyond.



# Critical Milestones - High School Admissions

Admission to a great high school and algebra in 8th grade are essential for success—but without mentoring and support, too many students would miss these goals. We step in to make it happen.

BEAM tracks admission to selective and highly selective high schools, which provide invaluable preparation for college. Many of these schools have few minority and low-income students. BEAM helps open the doors to these schools. Of the members of our 2015 cohort, 40% were admitted to highly selective schools and an additional 18% were admitted to selective schools. In total, 78% of the students in that group were admitted to schools BEAM considers "trusted" to provide a strong education.

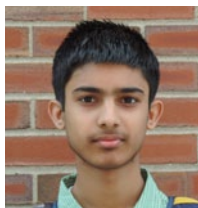
Cohort	Selective School Admissions	Highly Selective School Admissions
2011	50%	38%
2012	47%	44%
2013	58%	50%
2014	53%	31%
2015	58%	40%

## 8th Grade



There are over 400 high schools to choose from in New York City. Students must navigate a variety of tests, interviews, portfolios, essays, and open houses during the highly competitive admissions process. It's an incredible opportunity to attend a great school, assuming you know the process and what resources are required to complete it. BEAM mentors our students and their families every step of the way.

*At left, Naya and Racquel prepare for the Bard High School Early College admissions essay.*



*Ahmed ('15) was admitted to Bronx Science.*



*Adrienne ('15) was admitted to NEST+m.*



*Rebecca ('15) was admitted to Beacon High School.*

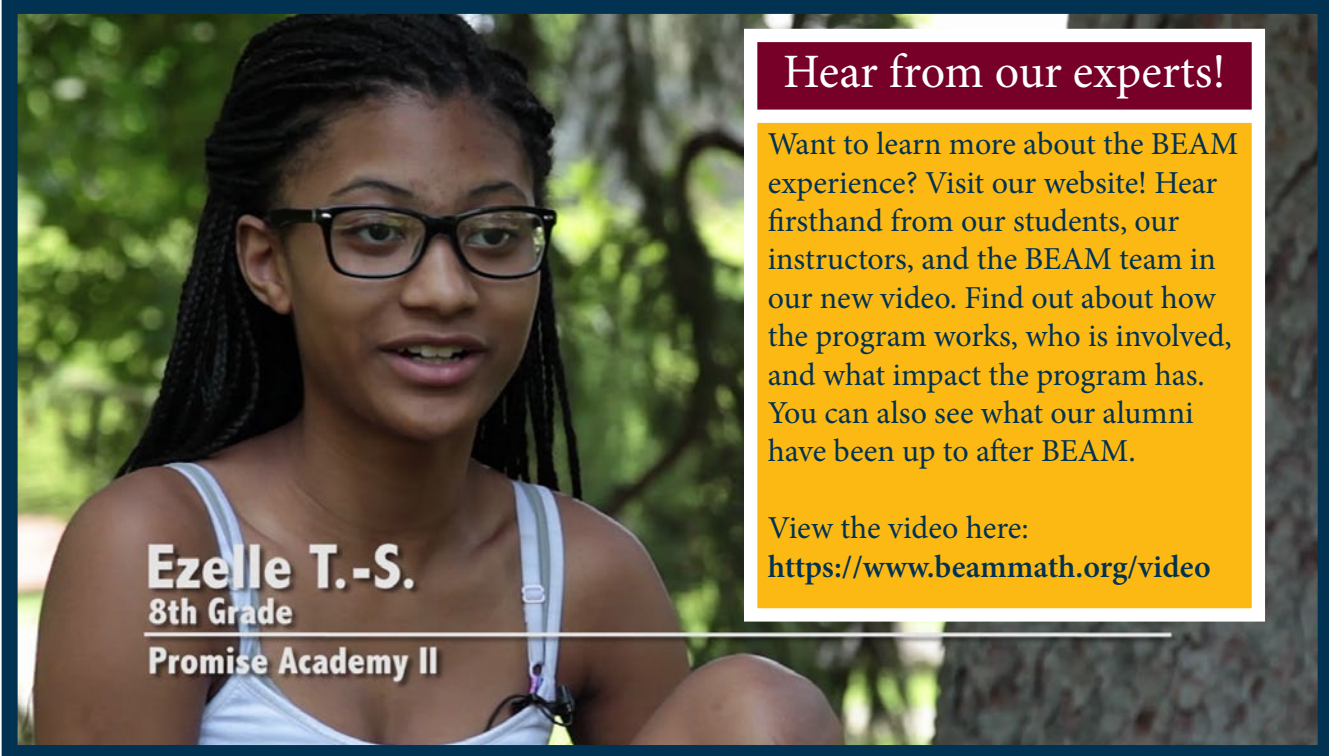


*Jesus ('15) was admitted to Brooklyn Tech.*



*Kaya was awarded Honorable Mention in the 2016 Bronx MATHCOUNTS contest.*





**Ezelle T.-S.**  
8th Grade  
Promise Academy II

### Hear from our experts!

Want to learn more about the BEAM experience? Visit our website! Hear firsthand from our students, our instructors, and the BEAM team in our new video. Find out about how the program works, who is involved, and what impact the program has. You can also see what our alumni have been up to after BEAM.

View the video here:  
<https://www.beammath.org/video>

## Summer After 8th Grade



## New Programs

With our help and recommendations, students apply to top summer programs around the country and in New York City, earning scholarships to complete the same advanced studies as their more affluent peers.

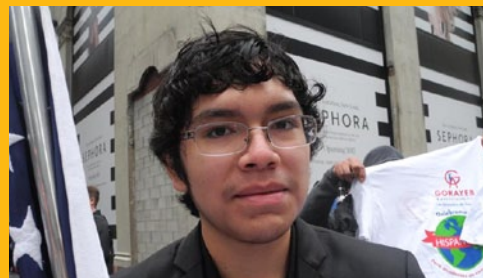
Visits to companies and organizations like the New York Stem Cell Foundation (top left), Google, and Microsoft Research show students the career paths that use math.

*Above: Crisleidy shows off her Johns Hopkins University Center for Talented Youth shirt, a program she attended for two summers after she completed BEAM 7.*

*"BEAM has helped me to come closer to my future goals than anything else (aside from my family) ever has. They have given me the best of advice and have referred me to countless new opportunities. I owe a lot of my current and future success to BEAM, and I hope to one day return the favor."*

With BEAM's help, James was admitted to the Center for Talented Youth (CTY), which he has attended for the last three summers. He has taken courses on Whales and Estuary Systems, Introduction to Logic, and Volcanoes. He currently plans to study law in college.

- James Sucuzhanay, 11th grade High School of Math, Science, and Engineering at City College



**Meet James**

## 9th Grade

BEAM students like Angelina, James, and Crisleidy take what they learned in BEAM to other summer academic programs to continue to grow. Here are some of the programs our students attended with help from BEAM during summer 2016:

Barnard STEP (Science and Technology Entry Program)  
BEAM 6 Junior Counselor\*\*  
Carleton College Summer Quantitative Reasoning Institute  
Carleton College Summer Science Institute  
Center for Talented Youth\*\*\*  
College Bound Program at Legal Outreach  
Columbia University S-Prep\*  
CTY Scholars\*  
CUNY College Now  
Enlace at Lehman College  
Fordham STEP (Science and Technology Entry Program)  
Franklin & Marshall College Prep  
Georgetown University Summer College Immersion Program  
GOALS for Girls  
Mathworks Honors Summer Math Camp at Texas State  
Minds Matter  
MIT MOSTEC  
New York Math Circle\*\*  
Sponsors for Educational Opportunity\*  
Tech Flex Leaders Program  
University of Maryland Terp Young Scholars

\* indicates attendance by 2 or more students

\*\* indicates attendance by 10 or more students

\*\*\* indicates attendance by 15 students

## 10th Grade

*Vielka shows off her Brooklyn Tech pride; she started at Brooklyn Tech in 2014 after attending BEAM 7 in 2013.*



## Advising

From choosing classes, to accessing tutoring, to knowing when to take their SAT Subject Tests, we make sure students stay on track and have the opportunity to excel.



# BEAM College Prep

Each August, BEAM invites rising 11th and 12th graders to College Prep Week. Students attend 10 workshops on topics including college essays, the Common App, standardized testing, early decision, financial aid, scholarships, and more. They also attend daily work sessions to either prepare for the SAT or workshop their application essays.



When asked about her experiences in BEAM College Prep, Angelina (pictured left with Quentin, 12th grade) said: *"I learned so much about the Common App, and especially my essay. Without all this help, I may not have started my essay this early, and it would have greatly affected the quality of my application. I'm now more confident that I will be able to get into and pay for college."*

## 11th Grade

### Meet Tanasia

*"Last summer, I went back to BEAM to work as a Junior Counselor at BEAM 6. It was a great experience; the kids were so nice and interesting and fun to get to know. I felt like they really respected me because they knew that I had been there and had advice for them. I got to TA for the "Logic with KenKen" class, and KenKen I first learned to do at BEAM in 2013.*

*The first day that I had to chaperone students on the subway was terrifying. What if someone got lost? But by the third day, we all knew each other, and we spent the commute talking about video games or what they had learned in class.*

*Next summer, I want to go to Cornell University to take summer classes. I am interested in going to college there and plan to apply early*

*decision because of their excellent psychology and food science programs. I am going to apply to two or three other college summer programs and see what happens. Of course, I would also love to come back as a Junior Counselor again!*

*I don't know what I want to be when I grow up... Maybe a child psychologist? Or a chef? Maybe I can find some way to combine those!"*



- Tanasia Gordon, 11th grade  
MS/HS 223: The Laboratory School of Finance and Technology  
(pictured above with Jack, BEAM 6)

# College Apps

BEAM provides the help students need to apply to and pay for college. From studying for the SATs to writing essays to finding the best fit universities, we give students the best possible college advice.

Nicole (pictured right, 12th grade) attended the MOSTEC program at MIT where she worked on mobile app development. She wrote to us to say: "[BEAM] really did help me later on in my life because it did make me pursue educational programs like this and explore outside my comfort zone.."



## 12th Grade

QuestBridge is a non-profit that offers scholarships to low-income, high-achieving students and connects them with colleges and universities. Their mission is increasing the diversity of economic backgrounds in the nation's leaders and decision-makers. Through QuestBridge's National College Match, two BEAM alumni from our second cohort already know where they are going to college! Joel (left) will attend Wesleyan University, and Derek (right) is going to Colby College. Both were awarded full scholarships. Congratulations to them!

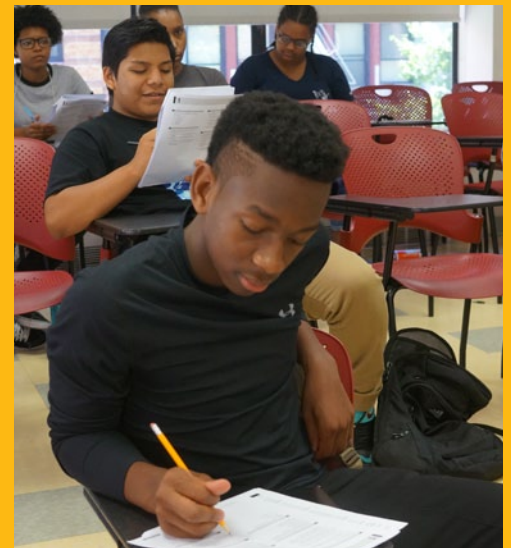


## Decisions

BEAM helps students understand their college options and financial aid packages, to pick the best college for their future.

Since BEAM, Malachi has spent one summer at MathPath and two at Mathworks Honors Summer Math Camp at Texas State. Malachi told BEAM this about his summer:

*"The highlight of being at Texas would have to be my analysis and research periods. I went back to HSMC for a second time because I knew that I'd regret not going. I wanted to get the experience of working on a Siemens Competition. The topic of my research was on minimal prime graphs and working toward generating them, besides using the 5-cycle method. The work was very interesting considering the amount of research on the topic is already limited, so we had to come up with new methods. BEAM prepared me for Texas by expanding my knowledge on math. There's more to math than just your school classes, [and] being in an environment where you're around other people who love math is like nothing else."*







Zavier Jenkins, a freshman at SUNY Albany, was a member of the first BEAM cohort in 2011. Recently, BEAM sat down with him to talk college, computer science, and BEAM.

*How is college going?*

Well, for the most part. Calc is tough. I took it in high school, but this is much harder, with a different teaching style. My current computer science class, Elements of Computing, is more about problem solving than coding, which isn't my favorite, but I plan to take a coding class in the spring. I love my writing class, so I think I will keep taking writing classes.

*Do you know what you plan to declare as your major?*

Likely, computer science. But I also enjoy writing. I would consider a double major or a major and a minor.

*Other than classes, what's college like?*

I finally understand why people can't describe what college is like! I had to start over, in a new environment, which is tough. I have freedom to figure things out, and I like that. When I think about the freedom of college, you have to really decide what to do with your time. So, that's an adjustment, but it's going well.

*Do you have a work-study job?*

Yes, I am working in the library, in the systems department. We troubleshoot, set up drivers for certain devices, set up student computers, and update operating systems. They hired me based on my earlier technical experience, both at Microsoft and at a makerspace. I find this to be interesting; it's my first work with computers apart from coding. There's a lot of elements of computers you don't know about until you need to understand them.

*How did BEAM prepare you for college?*

Before BEAM, I used to just focus on school work. When I was younger, I felt if I had an idea, I had to wait until I was an adult to figure it out. Thanks to BEAM, I know there's resources out there where I can learn for myself or try something new out. If I have an interest, I actively pursue it now. Also, I worry about "why" a lot more. At BEAM, I found math questions that didn't have obvious answers, and I had to think more. When I am learning, I need new ideas explained, and, thanks to BEAM, I know there are people who will answer my "why" questions.

*How did BEAM support you when you applied to college?*

BEAM was the primary support I had during the application process. It was really hard for me to do everything myself. I was so stressed, and my parents weren't always available to help. There were so many things I didn't know that I needed to do, like sending my SAT score reports. And I was so confused by FAFSA; I didn't know how to file it. So I came to the BEAM office. I credit most of my success to BEAM.

*What was it like to work for BEAM 6 last summer?*

Really great! It was one of the best summers of my life. I loved attending BEAM, and I wished school was more like BEAM, but it wasn't. It was really great to be able to go back to BEAM and be in that interesting learning environment again. Also, the kids at BEAM actually understood the concepts! They wanted to learn more than was required, which made me feel like everything I was teaching mattered. I wish I had BEAM 6. The BEAM 6 kids have a lot going for them. I have a decent amount going for me, but another year of BEAM... There would be more time to settle into math, more time to figure things out.

*What do you want to do next summer?*

I really want to work for BEAM!

# BEAM IN THE NEWS

Bridge to Enter Advanced Mathematics

This year, the media took notice of the work that BEAM students and staff have been doing. Here are a few pieces of coverage that BEAM has gotten recently. You can find links to the full texts of all of these pieces at <http://www.beammath.org/media> .

## The Atlantic

Peg Tyre's "The Math Revolution" investigates the growing trend of extracurricular math programs and the impact on the brightest young mathematicians in the country. Tyre calls this the "advanced-learning revolution." Tyre discusses the fact that programs aimed at 'gifted-and-talented' students are typically populated by affluent students, and she highlights BEAM's mission to identify students who haven't had the resources or opportunity to develop their natural skills. She quotes Dan: "I look for kids who take pleasure in resolving complicated problems... Actually doing math should bring them joy."

## Education Week

Liana Heitin also explores the diversity issues in high performance student mathematics in her article "Elite Math Competitions Struggle to Diversify Their Talent Pool." She features BEAM as an example of a program actively engaged in reaching out to a wider range of underrepresented and underserved students. Dan discusses with Heitin the fact that most existing programs center on improving grades rather than helping students access opportunities they might not otherwise. "We want to reach parents who are not plugged into the system," he said. "We're trying to create that pathway."

## Bloomberg View

Our very own Dan Zaharopol had his op-ed, "An Equation That Subtracts from Inequality" featured on *Bloomberg View*. In the article, Dan makes the cases for why programs like BEAM are essential tools for students who would otherwise be without the support to achieve their full potential in mathematics and beyond. "BEAM students are not the exception," he writes. "There are highly capable students from low-income backgrounds all over the country whose potential goes untapped. We need to figure out how to make resources for advanced math study systematically available to every student in the country." Dan also notes that supporting low-income students by opening doors to STEM fields can encourage those students to pursue STEM careers, an important step in addressing income inequality.

*Pictured: Keita and Ghania listen closely in their BEAM 7 class in 2015.*





# BUILDING THE PATHWAY

Over the past five years, BEAM has demonstrated that our students are capable of learning and doing advanced mathematics. Even while they are achieving at high levels, we are left wondering...

... what *more* is possible?

Imagine if we engaged with students while they were in 3rd grade instead of 6th. What new doors could we open?

Imagine if we brought BEAM to a new city. How much untapped potential could we unlock?

Imagine if we provided mathematical employment opportunities to students, so they wouldn't have to decide between providing for themselves and their families and continuing their involvement in mathematics. How much further could they go?

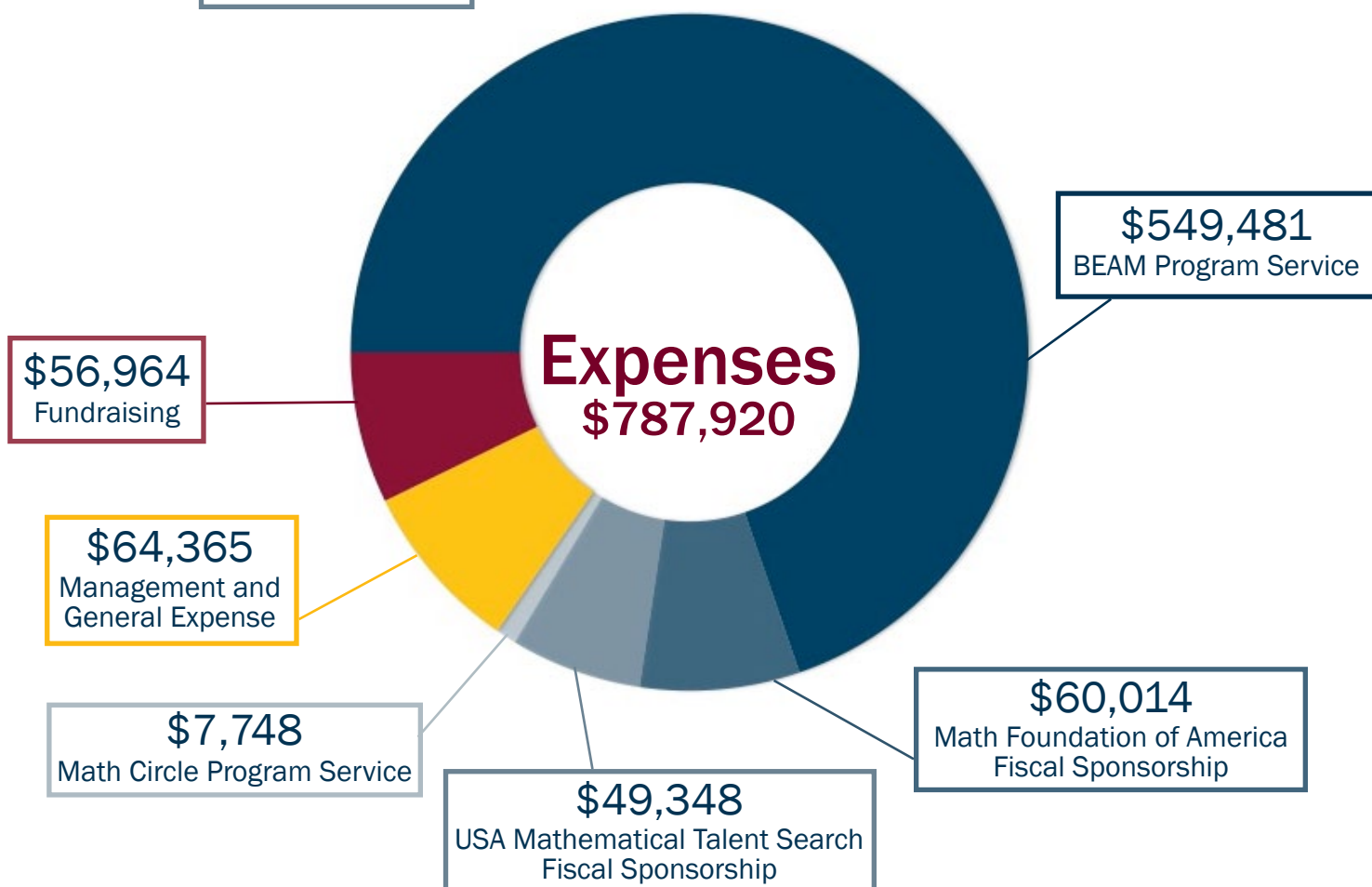
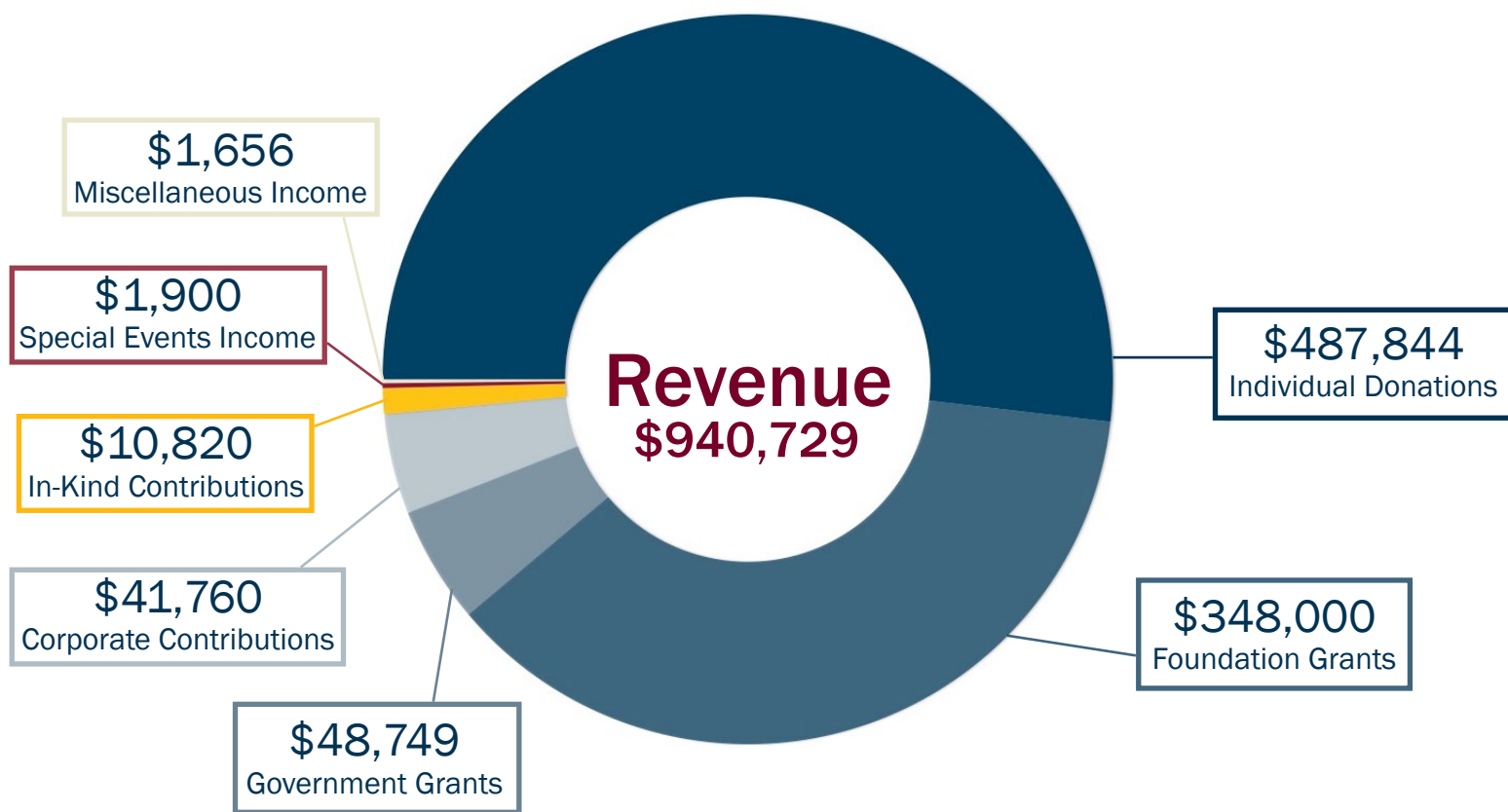
For the next five years, BEAM will be experimenting, trying new pilot programs and iterating them to determine how we can best enable students to achieve success and foster a love for mathematics, problem solving, and learning.

Your support will enable us to spend 2017 opening our new programs for 3rd - 5th graders, launching a citywide math contest to identify and challenge talented students, and selecting a city for a new BEAM location.

Join us. You can make a tax-deductible donation to the Art of Problem Solving Foundation in support of BEAM through our website or by mailing a check to the address on the back cover.

Imagine if!

# Art of Problem Solving Foundation 2015 Financials





# BEAM

Bridge to Enter Advanced Mathematics

# HONOR ROLL '15

BEAM's programs are provided at no cost to students and families. We rely on the support of the following foundations, companies, and individuals to continue achieving our mission of creating a realistic pathway for underserved students. A big THANK YOU to everyone who supported BEAM this year and every year!

## MAJOR SPONSOR

**JACK KENT COOKE**  
  
FOUNDATION

## ADDITIONAL SUPPORT



## 2015 HONOR ROLL

### \$100,000+

Anonymous (x2)  
The Jack Kent Cooke Foundation  
The Lehoczky Escobar Family

### \$10,000 - \$99,999

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Larry Guth  
National Security Agency STEM  
Education Partnership Program  
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Richard and Vanessa Rusczyk  
Manoj Susarla

### \$5,000 - \$9,999

American Mathematical Society  
Epsilon Fund  
David Vincent and Maxine Lee

### \$1,000 - \$4,999

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Gee Eng  
Amy Estersohn  
Victoria and Kyle Fritz  
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Akash Patel

### Up to \$199

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Marisa Debowsky  
Marisa DeFay  
Brian Edwards  
Eve Drucker Egelhof  
Chris Gilbert  
Sachi Hashimoto  
Ruthi Hortsch  
Reva Kasman  
Scott Kominers

### In Kind Contributions

Art of Problem Solving  
Bard College  
Center for Mathematical Talent at the NYU Courant Institute of  
Mathematical Sciences

### Pentlandians

Chris Shabsin  
Tara Smith  
Robert Speer  
Craig Sutton  
Karen Taylor  
Zandra Vinegar  
Susan Schwartz Wildstrom  
Japheth Wood

### Wei Liu

Stephen B. Maurer  
Matthew Maycock  
Sanjay Padaki  
Elena Pavloff  
Ye Ping  
Harold Reiter  
Michael Rowley  
Michael Schubert  
Debra Seidell  
Jill Singer  
Andrea Smith  
Latha Venkataraman  
Lauren Weiss  
Nina White  
Radu Zaharopol



*Our 2011 cohort is off to school!*

*Back Row, left to right: Denny (gap year), Wilson (SUNY Buffalo), Franklin (Ithaca College), Zavier (SUNY Albany), Mirai (Northeastern University)  
Front Row, left to right: Tejaswee (Bard College), Diamond (Lehman College), Kapi (SUNY Albany)  
Not pictured: Caitlyn (University of Rochester), Ilearys (Lehman College), Fatimatou (Manhattan College), Raissa (Concordia University)*

**BEAM**  
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