

BEAM

Bridge to Enter Advanced Mathematics

SUMMER
REPORT
2017

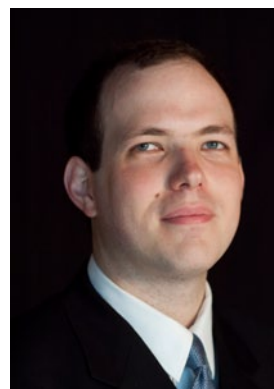


A Project of the Art of Problem Solving Initiative, Inc.

Dear friends and supporters,

When I was a kid, I took an astronomy class that changed my view of science. I went from “here are a bunch of facts about how the world works” to “here’s how we *discover* things about objects that are thousands of light years away from us.” There weren’t easy explanations and nothing was certain, but we could still build a consistent explanation of these outrageously distant events.

At BEAM, every summer, we provide the same to our students: an opportunity to change their view of mathematics (and applied math as well!).



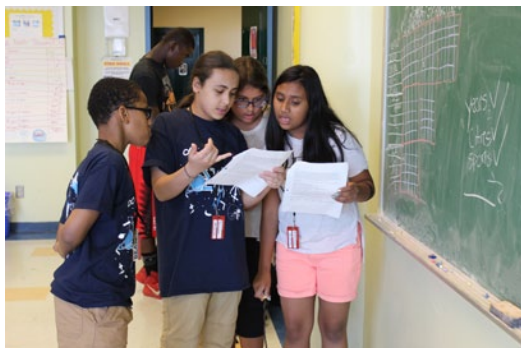
Watching our students have this experience has been hands down the most fulfilling part of my life. This summer, I even snuck away from my director responsibilities a bit to co-teach an astronomy class for our 6th graders.

As a program, BEAM is expanding tremendously so that more students can access advanced study. You will read in this report how we received a \$1,000,000 grant from the Jack Kent Cooke Foundation to expand our programs to Los Angeles beginning summer 2018. You will read about the continued success of our pilot BEAM 6 program, and new pilots such as BEAM Next, a 9th- and 10th-grade program that helps smooth the transition to selective high schools. This summer we served 175 students between our 6th- and 7th-grade programs, and next year will be even bigger. We offer support to over 400 summer program alumni.

With my busy schedule, I probably *shouldn't* have taught any classes this summer, but I'm glad I did. It helps to keep me connected to what we're doing, the tremendous impact we have on each student's life, and the overall mission of making STEM careers and pathways accessible to students regardless of background. As BEAM gets bigger, and as my role shifts to leadership, administration, and fundraising, it means a lot to me to continue to see some of the students at that moment when their lives start to change.

I hope that this letter will serve as your invitation to do the same. Visit a BEAM program and see this change for yourself. We want you excited: if we're going to keep growing, we need everyone on board, advocating for us, and providing your support.

So thank you for supporting this program. Thank you for making dreams a reality: not just our shared dreams of equal access for all, but also our students' personal dreams for what they can and will achieve with their lives. Let's keep pushing onward.



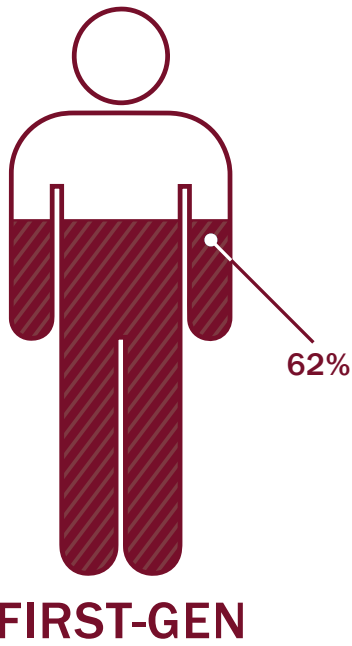
Sincerely,

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

Daniel Zaharopol

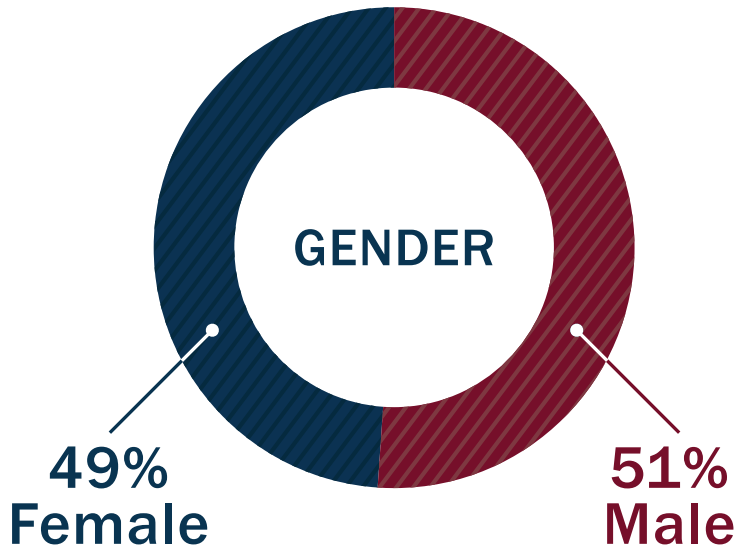
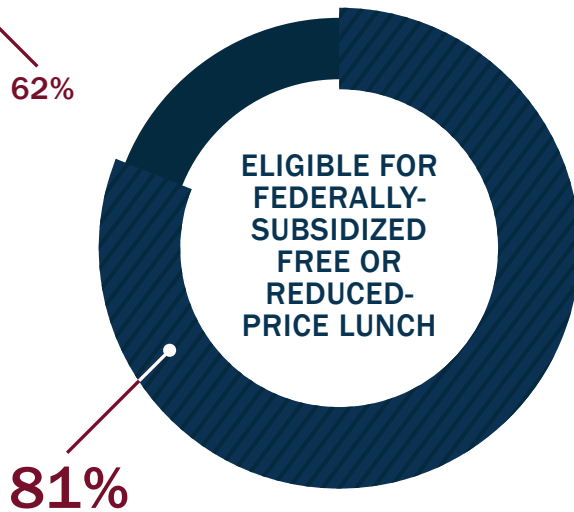
BEAM Founder and Executive Director of
the Art of Problem Solving Initiative, Inc.

Get to Know Our Students



\$27,000

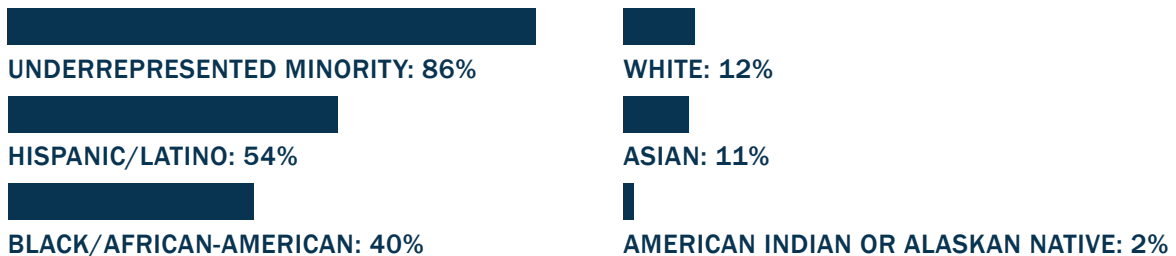
MEDIAN FAMILY INCOME OF A BEAM STUDENT



BEAM SERVES 35 PARTNER SCHOOLS, MARKED WITH A • BELOW



STUDENT SELF-REPORTED RACE/ETHNICITY
 (students may select more than one)



Inside BEAM 6

At BEAM 6, students spend seven hours per day building problem solving and logical reasoning skills, and making friends who love math. During the program, students and staff build community over mathematics, activities, and field trips.

Here is what students had to say about BEAM 6 2017:



I learned more about math and its possibilities. I have also, somehow, become more social, which was never a goal, but I achieved it nonetheless.

Yilin

I grew from liking math to loving it.

Elvis



I now understand math's not about the answers it's about the understanding.

Lilly



Jeremiah displays his functioning radio, constructed with a week-long activity group that explored snap circuits.



Po-Shen Loh, Associate Professor of Mathematics at Carnegie Mellon University, coach of the USA International Math Olympiad Team, and founder of expii.com, visits BEAM to give a guest talk on fair and unfair dice.

What's math like at BEAM 6? Try out one of our problems of the week to see for yourself.

Is there a 10-digit number where the first digit is equal to how many 0s are in the number, the second digit is equal to how many 1s are in the number, the third digit is equal to how many 2s are in the number, all the way up to the last digit which is equal to how many 9s are in the number? If yes, can you find all of them? If no, how do you know for sure?

- # of 0s
- # of 1s
- # of 2s
- # of 3s
- # of 4s
- # of 5s
- # of 6s
- # of 7s
- # of 8s
- # of 9s

BEAM 6 was piloted in summer 2016 and reaches students earlier than BEAM ever has before. Thanks to BEAM 6, we can recommend 7th-grade students to other programs and scholarships, such as the Jack Kent Cooke Foundation's Young Scholars Program.

This year, two of the 65 Young Scholars chosen nationally are BEAM students. Camila and Thays were both encouraged to apply by BEAM, and now they've won five-year scholarships that support the costs of academics and extracurriculars including school, technology, study abroad, and more. The scholarships also provide students with a dedicated high school and college advisor. Camila and Thays are a product of BEAM's earlier reach: in the past, only one BEAM student, Aishat, has won the scholarship (after applying on her own). Aishat's funding supported tuition at the Brooklyn Friends School, four summers of academic programs, and a six-week study abroad program in France!



Anthony, Yeramis, Veronica, Lismary, Thays, Camila, and David (from left to right) are pictured here with Stephen Wolfram who visited BEAM 7 at Bard College this summer to give a guest talk. Dr. Wolfram is the Founder and CEO of Wolfram Research, which donated Mathematica licenses to every BEAM student.

We sat down to talk with Camila and Thays about math, BEAM, and winning the scholarship.

BEAM: *What is math?*

Camila: Math is the ability to understand the world around you using numbers and ideas.

Thays: Math is my shield. Math is what makes me, me. Without math, I wouldn't have so many open doors and I wouldn't be who I am.

How have you grown thanks to BEAM?

Camila: I found that, in just the span of three weeks, I have matured a lot. I learned to express my ideas, instead of keeping them to myself. I feel more independent.

Thays: Before BEAM 6 or 7, I was just a girl who was nicknamed calculator in school. I was just a girl who was really ahead of her class. But after BEAM 6 and 7, I am a girl part of a community: a family of people who love math.

What will this scholarship help you do?

Camila: I want to keep studying math and now I know I can do that each summer from now until college.

Thays: I love math, but I also want to try writing, maybe playwriting. I also want to study abroad; I would love to see the world.

“What’s the longest you’ve spent on a math problem?”

We asked students before and after BEAM 6 to see how their experience of math had changed.

	Before BEAM 6	After BEAM 6
Shortest Answer	1 minute	4 minutes
Median Answer	30 minutes	2 hours
Longest Answer	1 week	3 weeks
Number of Students Who Said a Day or Longer	10	29

Inside BEAM 7



Rashik and Teo share their thoughts on infinity with Aaron.

Aaron Hill is an Assistant Professor of Mathematics at the University of Louisville. Aaron taught at BEAM 7 in 2014 and again in 2017. Recently, we sat down with him to talk about the contrast between teaching at BEAM and teaching college students.

BEAM: *What does teaching college math to BEAM 7th graders look like?*

Aaron: This semester at the University of Louisville, I am teaching an introduction to proofs course. The first day of this proofs course was nearly identical to the first day of my BEAM 7 course this summer: Exploring Infinity. Both classes explored the same core question: Is the set of natural numbers the same size as the set of integers? And in both my college class and BEAM 7, the discussion took the same shape: we discussed what

same meant, what the terms meant, and then once those careful definitions were in place, we were able to address the question.

For the rest of the college unit on arguments, we will explore the same topics we explored during my BEAM 7 class (the Hilbert hotel, irrational numbers, etc.). The only big difference is that there are some topics I explain carefully with BEAM students that I will explicitly prove in the college course, such as showing that the decimal representation of every rational number is either terminal or repeating.

In what ways is it easier to teach BEAM students than college students?

It's way easier to get lively, interesting discussions with BEAM students. At BEAM, I don't need to worry about structure as much – fruitful comments and questions naturally pop up. The students have curiosity and real interest in being there. BEAM students are there in the moment.

Why BEAM? What brought you back this year?

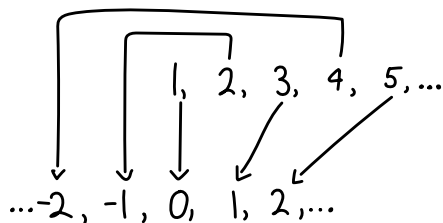
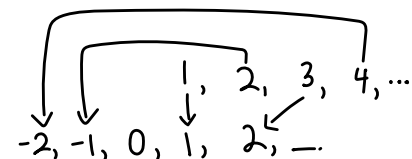
First, it's really, really fun. BEAM leads to rich intellectual explorations in the classroom. You can count on that always happening at BEAM, and it may or may not happen in the college classroom. BEAM students are just so happy to learn something new! I imagine BEAM classes are quite different than what they have access to in school. Second, BEAM does a tremendous amount of good for its students. For a substantial number of BEAM students, the program is a life changing experience, as students would otherwise have no chance to access similar opportunities.

Can you remember any particular highlights from teaching at BEAM this summer?

In the first day of Exploring Infinity, the class was initially pretty convinced that the naturals and the integers were not the same size, but they knew there was some ambiguity about the meaning of the word same. So, I explained the concept of bijection, which we referred to as a perfect matching in our course. Once we understood perfect matching, we went back to the original question. Five students raised their hands and said there was no perfect matching, and their argument boiled down to that if you matched 1 with 1 and 2 with 2 and so on, you would never account for the negative integers. Around the fourth student, I wrote their thoughts on the board.

Continued...

At that point, another student, Cynthia, suggested that you alternate back and forth with the integers, so you match 1 with 1 but then 2 with -1 and 3 goes with 2 and 4 goes with -2. You could see the students realizing how powerful this idea was; they were learning that just because one matching doesn't work



or impossible. Then, another student noticed that 0 was unaccounted for and the class worked together to manage that. Finally, we went back to the definition and decided that natural numbers and integers are the same size if by size we mean a perfect matching. Those 5-10 minutes of class were just perfect: the class was confused, Cynthia had an idea, the class felt certain, a student pointed out that 0 had been missed, the class came to a complete answer.



Joelvi and Cynthia display their truncated icosidodecahedron.

At BEAM 7, students spend three weeks living on an upstate college campus. This year, BEAM 7 was held at Bard College in Annandale-on-Hudson and Union College in Schenectady, New York. On weekdays, students spend seven hours per day on mathematics, with the rest of the time spent in activities and community building. Weekends feature off-site field trips.

Here is what students had to say about BEAM 7 2017:



I learned how planes fly and how to prove my conjectures. I feel like I grew a lot.

Deana

My favorite part of BEAM is the math. It is incredibly advanced and interesting and I loved every single minute of it.

Anthony



Math is something that sets you free and makes you think in a different way than other people.

Maryam



My favorite part of BEAM is the people. I've always wanted to work with other kids who excel in math.

Ethan



Inside BEAM Next

During 8th grade, BEAM’s extensive support ensures students have access to the best high schools in New York City. Each year, our students are admitted to selective and highly selective high schools, including Bard High School Early College, Bronx Science, Brooklyn Tech, Stuyvesant, and more.

Cohort	Selective High School Admissions	Highly Selective High School Admissions
2011	50%	38%
2012	47%	44%
2013	64%	56%
2014	53%	31%
2015	59%	43%
2016	61%	42%
Overall	62%	41%



Iroha Oti is now a 10th grader at Manhattan Center for Science and Mathematics in East Harlem. He attended BEAM 7 in 2015. This year, he is spending his Saturdays with BEAM at our new initiative, BEAM Next. BEAM Next students spend one hour working on “high school success” skills (how to study, how to manage email, how to use a planner, and much more) and two hours in their choice of math enrichment or computer programming.

BEAM: *In both 8th and 9th grade, BEAM helped you apply to high school. What support did BEAM provide?*

Iroha: When I started the process, I only knew the bare minimum about the good public high schools. BEAM showed me that there were great high schools beyond the specialized schools, other great schools also focused on math and science. I didn’t get into a specialized school for 9th grade, so BEAM helped me take the SHSAT again. BEAM then helped me make the decision to stay at Manhattan Center because it just made more sense for me than the specialized school I was matched to, Brooklyn Latin.

You made it through 9th grade without BEAM Next. Are there any things in 9th grade you wish you could have done better? How can BEAM prepare 9th graders for the challenge of high school?

Many BEAM students will be taking advanced courses. So BEAM should prepare them to be ready to accept that workload. For me, the challenges were organization, procrastination, time management, and studying.

Organization was my biggest flaw. When a class would end and I would have four minutes to walk to the next class, I would stuff materials into random folders and rush to the next class. Each week there would be more and more to do, so I got overwhelmed and couldn’t manage my time, especially given how tired I was after school. High school was the first time I ever had to really set aside time to manage my homework and all these challenges tie in together!

BEAM Next started a few weeks ago. Do you already see any impact it’s having on your 10th grade year?

This year I joined my school’s robotics team. Already, my programming class with BEAM Next has helped me get used to how to talk to the robots and control the projects. And the time on organization really helps. Now, each weekend I take out all my school papers and reorganize anything in the wrong folder. BEAM Next has given me something to look forward to each weekend.

Inside BEAM College Prep



Marquia, a senior math major at SUNY Oswego and BEAM summer staff member, discusses college with Mona and Vielka.

Vielka Rankin is now a 12th grader at Brooklyn Tech. She attended BEAM 7 in 2013. As a rising Junior and Senior, she joined BEAM's College Prep Week and she has studied for the SAT with BEAM. Vielka hopes to attend a liberal arts college where she plans to study chemistry.

BEAM: *Why chemistry?*

Vielka: At Brooklyn Tech, you're required to choose a major and I chose Environmental Science because it seemed really interesting to me. Unfortunately, I don't find that my classmates want to keep talking about environmental issues outside of class. I want to go to a relatively small college with other students who really enjoy the areas they study.

Last summer, with BEAM's help, I applied to and attended the University of New Hampshire's Project Smart summer program where I got to study marine and environmental science for four weeks. At one point, we spent three days on Appledore Island in

Maine, hiking and taking pond samples to understand what was in the water. It was great to actually see a more hands-on side of environmental science, but I plan to major in chemistry because it's more versatile.

What did you learn at BEAM College Prep this year?

Actually, the most useful thing was learning how to write a good email. That's always a good skill to have! Also, I appreciate the guidance in knowing what to look for when deciding which college to attend after I am accepted. I feel the process is much more accessible now. Overall, BEAM College Prep was the best college advice I've gotten.

When asked how BEAM College Prep changed her view on college, she said,

“I'm more ambitious and both hopeful and confident in my choices and options.”

This fall, she's focused on completing her essay and refining her college list with the aim of finishing everything in mid-December in advance of January 1 college deadlines. BEAM will be here to help her throughout!



This Year at BEAM



1. Crisleidy and Henry pose with their Posse brochure after finding out that they are Posse Scholar Semi-finalists (September 2017).

2. Frankie and Mouhamed play basketball at BEAM 7 (July 2017).

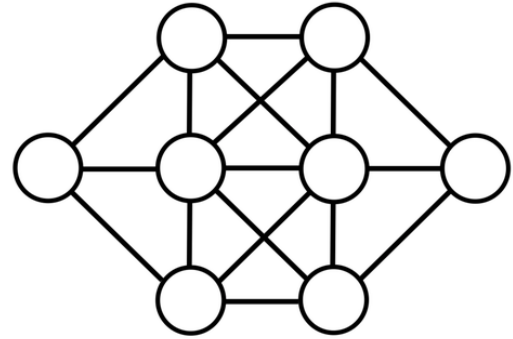
3. Lennin (BEAM '14, third from left) teaches BEAM 6 students how to play Settlers of Catan (August 2017).

4. Fred, Benjy, Chelsea, Cory, and Darleen, BEAM 7 staff, prepare to meet students at Bryant Park for the first day of the program (July 2017).

5. 8th graders Alex, Alexis, Nathaniel, Lauren, Zay, and Racquel pose with the NYC skyline during their tour of Google's NYC office (April 2017).

BEAM 6 Featured in the New York Times

“Beyond Hidden Figures: Nurturing New Black and Latino Math Whizzes”, an article by Amy Harmon for the *New York Times*, followed one travel group of three students (Emyr, JJ, and Thays) through the first summer of BEAM 6. The students discover math along with a community of like-minded peers and staff. An accompanying feature, “Are You Ready for Math Whiz Camp?”, allows readers to explore BEAM-style math questions. Try out the question on the right!



Place each of the numbers 1, 2, 3, 4, 5, 6, 7, and 8 in a circle in the diagram below so that no two numbers that are 1 apart are in connected circles. (For example, 2 and 3 cannot be in circles that are connected by a line.)

Solution: bit.ly/beamny



JJ, journalist Amy Harmon, and Thays at WNYC for an interview on “The Leonard Lopate Show.”

BEAM Wins the 2017 Richard C. Cornuelle Award for Social Entrepreneurship, Profiled in Forbes

This fall, the Manhattan Institute announced that they would be awarding BEAM and our founder, Daniel Zaharopol, with the 2017 Richard C. Cornuelle Award for Social Entrepreneurship. The award comes with a \$25,000 prize and will be presented to BEAM at a banquet in November 2017. Howard Husock, Vice President for Research and Publications at the Manhattan Institute, wrote about BEAM and the award for *Forbes*: “BEAM Me Up—To A Science And Math Career.”

What's new at BEAM?



Serigne, Joseph, Selina, and Greily: the CIS 303 math team at MATHCOUNTS Bronx (February 2017)

The biggest news is that BEAM will be opening BEAM 6 Los Angeles in summer 2018 and growing to serve BEAM's LA students all the way through their 12th grade graduation. You can also get a taste for BEAM Los Angeles on the next page.

Last year, BEAM matched a volunteer with a partner school, CIS 303, who wanted to create and support a math team. He designed a MATHCOUNTS curriculum for students new to math teams and coached four BEAM 6 alumni (then in 7th grade) to the Bronx chapter competition. One of them, Greily, even advanced to the state level as an individual contestant! This year, the math team is back at CIS 303 with a team of 7th and 8th graders and BEAM is training five new volunteers to coach math teams at other partner schools. We intend to expand this program in future years!

This fall, BEAM launched a new initiative for 9th and 10th graders—BEAM Next—which is designed to support students as they adapt to high school. BEAM Next is designed to fit in the gap between our existing 8th grade programming (high school admissions and Algebra 1 success) and our existing college programming for 11th and 12th graders.

A Special Thank You to Harold Levy, Executive Director of the Jack Kent Cooke Foundation

Harold Levy became Executive Director of the Jack Kent Cooke Foundation (JKCF) at a critical time for BEAM. For three years, JKCF had been funding BEAM's programs and expansion, and BEAM was applying for continued funding.

“When I first met Harold,” says BEAM Executive Director Dan Zaharopol, “he really encouraged us to think big. He pushed us to drive to do bigger things that would garner more attention for the work we are doing and the students we serve. That push really helped us move forward.”



Since that meeting, the Jack Kent Cooke Foundation, under Harold's leadership, has enabled BEAM to expand its year-round staff from three to eight and to create the BEAM 6 program that has become so important to our model. It was Harold who called us and proposed funding BEAM's expansion to a new city. For this and more, BEAM would like to extend its thanks to Harold and everyone at JKCF for having the enthusiasm to advance BEAM and for enabling us to bring that vision into reality.



Planning BEAM Los Angeles



Jacob talks with Anaya during Open Math Time at BEAM 6.

Meet Jacob Castaneda, Executive Director of BEAM's Los Angeles Programs.

BEAM: *What does BEAM mean to you?*

Jacob: Bringing advanced mathematics to an under-tapped community is an exciting prospect. As a student who benefited from extracurricular enrichment myself, I recognize the value of a program like BEAM in servicing populations underrepresented in STEM fields. BEAM is an agent of change in mathematics education, working with students that fly under the radar to build both their problem solving acumen and also their chances of entering into a STEM field of study.

After 4 years as a classroom teacher, you left to be the founding ED of BEAM's LA programs. Why BEAM? Why now?

Leaving the classroom was tough. I love the day in, day out with my students, and value the relationships I built with them. When the opportunity to join BEAM presented itself, I was conflicted because I love working with students day-to-day but I knew that a program like BEAM could have changed the lives of my students at an earlier age, and nurtured their mathematical growth. BEAM satisfies part of a critical need in our city for advanced mathematics enrichment, and that's something I wanted to be a part of.

What was it like to work at BEAM 6 in NYC this summer? What were the highlights? What did you discover?

I knew BEAM was a great organization when I applied for the job; I didn't realize the extent of awesomeness until I actually taught at BEAM 6 this summer. I had a fantastic time teaching counting principles to rising 7th graders this summer. The students were engaged and eager. Over the course of five weeks, you could see the culture of the program gel the students as they worked on challenge sets, problems of the week, and mathematically interesting puzzles. BEAM 6 ended two months ago and it is amazing to see the number of students emailing headquarters with crafty solutions to the BEAM 6 challenge sets and just staying involved.

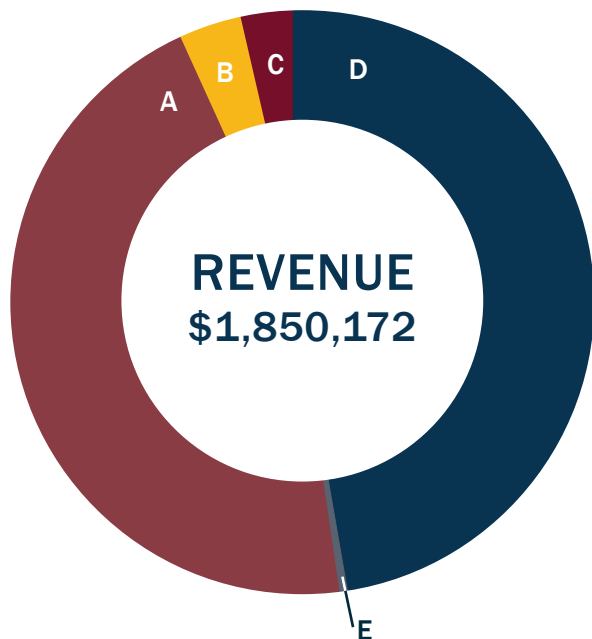
What do you have planned for BEAM Los Angeles?

I am getting BEAM LA up and running starting with BEAM 6 prep. The bulk of this entails partnering with middle schools and district officials in the Korea-Town/Downtown/Pico-Union neighborhoods of Los Angeles, as well as finding key staff members for our first summer. In addition, we are working with local stakeholders to build up our network of BEAM friends and collaborators in Southern California. Relative to BEAM NYC, BEAM LA will be quite geographically concentrated, which creates flexibility in working with students during the school year. One of my BEAM LA side projects is to provide middle schools with support in creating math teams or math clubs that continue the exploration of rigorous mathematics and problem solving.

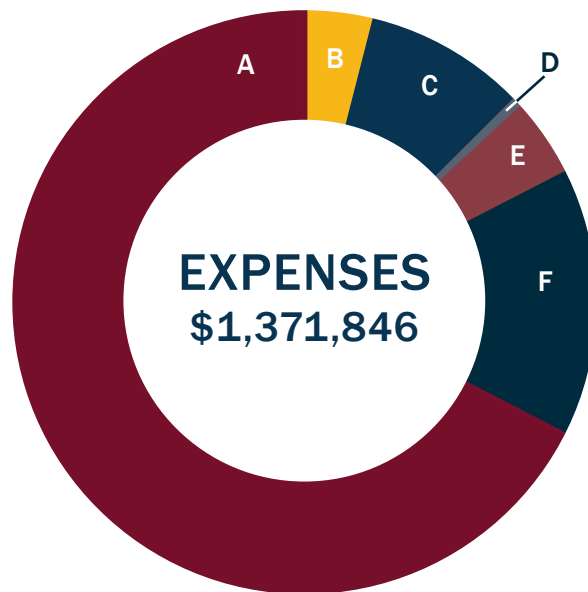
What are you most looking forward to as BEAM expands in LA over the upcoming years?

I am excited to see BEAM flourish in Los Angeles. As our cohorts of students begin to roll in, I look forward to their growth as they pursue study in a STEM field. I envision the mathematics work done by BEAM to leave a tremendous imprint on the city of Los Angeles.

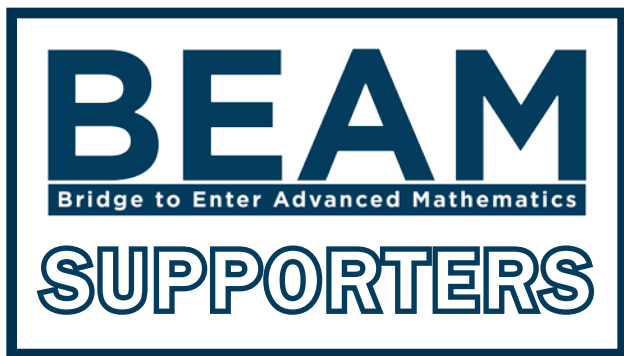
BEAM Financials, 2016



- A: Individual Donations: \$810,729
- B: Government Grants: \$59,409
- C: Corporate Contributions: \$37,323
- D: Foundation Grants: \$876,370
- E: Special Events Income: \$2,000



- A: BEAM Program Service: \$926,208
- B: Fundraising: \$52,778
- C: Management and General Expense: \$126,266
- D: Math Circle Program Service: \$7,748
- E: USA Mathematical Talent Search Program Service: \$47,346
- F: Math Foundation of America Fiscal Sponsorship: \$211,500



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!

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Our 2012 cohort is off to school!

Back row, left to right: Kiara D (Lehigh University), Kiara J (John Jay College, CUNY), Joel (Wesleyan University), Quentin (Ithaca College), Angelina (University of Rochester), Derek (Colby College), Dominic (Pace University), Dan Zaharopol

Front row, left to right: Ana (Barnard University), John (Fordham University), Jahdel (City Tech, CUNY)

Not pictured: Abdel (New York University), Abdoulaye (George Washington University) Amy (Fordham University), Ashlee (SUNY Albany), Christian (Fortis Institute), Emalee (Hunter College, CUNY), Greiny (SUNY Geneseo), Gustavo (Brooklyn College, CUNY), Isaiah (SUNY Potsdam), Jamila (Howard University), Loquan (SUNY Albany), Nathaniel (Bronx Community College, CUNY), Nicole (New York University), Nicy (University of Bridgeport), Salimatou (Baruch College, CUNY), Stephanie (SUNY Plattsburgh), Taylor (Allegheny College), Zereena (SUNY Binghamton)

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