BEAM

Bridge to Enter Advanced Mathematics

SUMMER REPORT 2018

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

BEAM
Bridge to Enter Advanced Mathematics

Photo Credit: Erin Patrice O'Brien

Dear friends and supporters,

This year at BEAM, a magical thing happened. It was a moment I'd been waiting for since our first summer in 2011.

You see, I grew up going to a program called Canada/USA Mathcamp, and I later returned there as a counselor. Being a counselor at a program that shaped me so deeply had a powerful impact on both my development and sense of self. From the first day when we started BEAM, I was looking forward to the moment when we'd have BEAM students returning as counselors. I wanted to see the community come full circle.

This summer, Raissa, Joel, John, and Quentin — yes, four of our students — returned to Bard College to be counselors for younger students just like them. None of them had been back to our program at Bard since their time as students six or seven years ago. BEAM has changed a lot in that time, and so have they, but it was the same program. The same magic. When I visited (alas, BEAM is now large enough I can't spend my whole summer in the idyllic setting of Bard College), I just felt my heart fill with joy to see our alumni there. I have so many memories from when they were first students, and now I got the pleasure of late-night conversations about their journeys — without even violating curfew!

After this summer, John wrote to me that this was "probably one of the best summers I have had so far. I grew to appreciate BEAM and my counselors from 2012 a lot more because I got a taste of everything they did to make the summer the best it can be for us.... There were times where I was exhausted but I felt like this summer was truly rewarding. I am so happy that I was able to give back to this community that gives me so much and continue to be a part of it."

Many of our students call BEAM another family, and it's really true. Just like a family, we've grown up together through many of the same experiences. We've lived together and watched each other mature over the years. That sense of family gives our students a home, a group they can go back to, a sense of belonging that can carry them through the many obstacles that life might throw at them.

In this annual report, you'll read about how much we've grown. We've expanded in New York and Los Angeles. We've added college support, we've expanded year-round support to include more of the key elements of the STEM pathway, and we're planning new initiatives for next year. These are all important: they all speak to the growth and maturity of BEAM as an organization.

But for me, seeing these students come back to BEAM was just as important. I got to watch their transition to adulthood, and I saw the same feelings of joy and recognition in their faces as they returned to a place that shaped them, just like the feelings I had all those years ago.

John, back right, and Quentin, front and center, pose with BEAM 7 students on a field trip to Blithewood Garden.

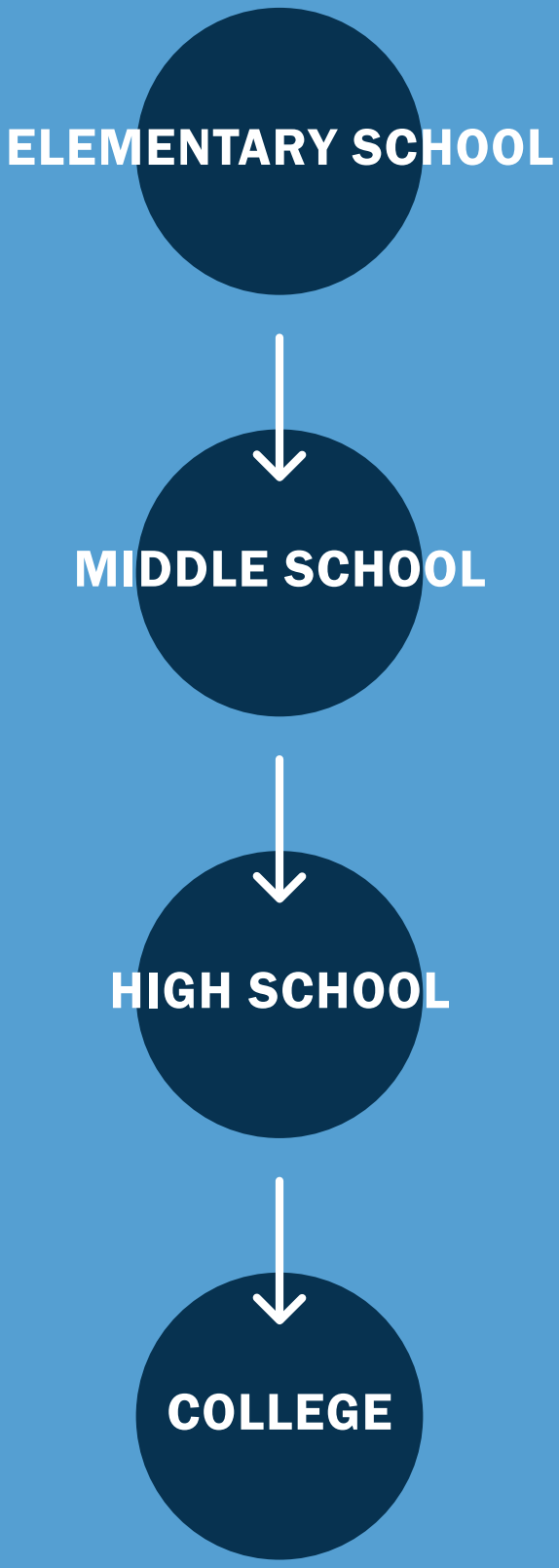
As ever, all I can do is thank you for making this possible. Thank you for your help enabling our students' success. We're here because of you.

Sincerely,

Daniel Zaharopol
Executive Director
The Art of Problem Solving Initiative, Inc.

IS EDUCATION A LINE?

When we first meet BEAM students, they view education as a line. Success in middle school leads to success in high school, which prepares for success in college.



In fact, we know the educational pathway is much more complex...

NO: IT'S A LANDSCAPE.

For those who successfully go on to careers in STEM fields—for those who love math—their passion drives them to do much more.

ONLI

EXTRA MATH PRACTICE

INDEPENDEN

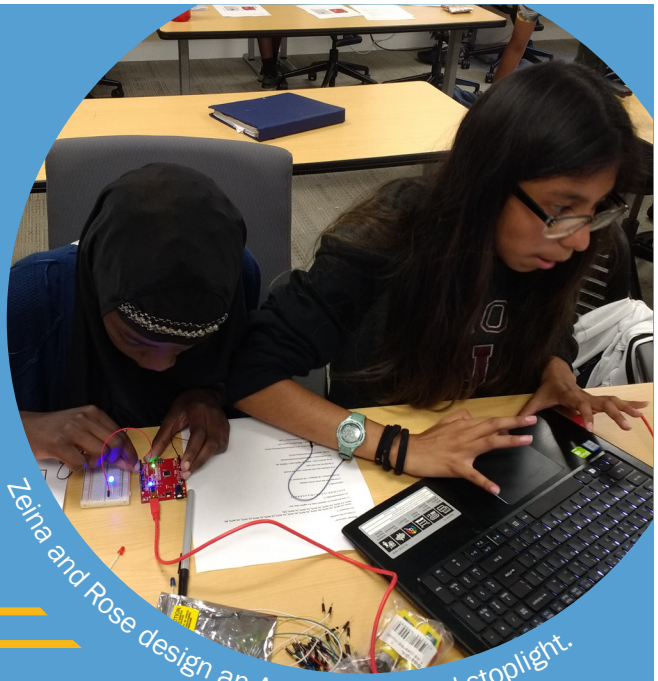
ELEMENTARY SCHOOL → MIDDLE SCHOOL

MATH CIRCLES AN

ROBOTICS CO

Between 11th and 12th grade, Maria had an internship with Lenox Hill Hospital in the pathology department.

Elvis competes at Bronx MATHCOUNTS 2018.



Zeina and Rose design an Arduino powered stoplight.

NE FORUMS AND COMMUNITIES

COMPUTER PROGRAMMING

IT READING/VIEWING

HIGH SCHOOL → COLLEGE

ND COMPETITIONS

OMPETITIONS

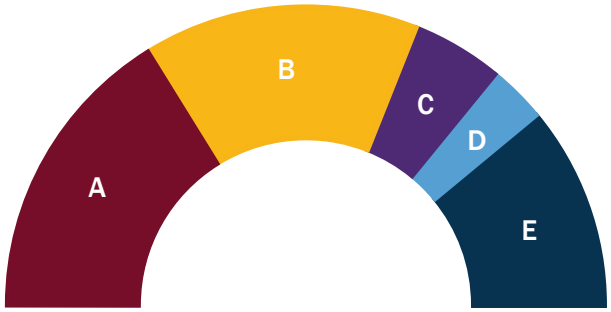
ACADEMIC SUMMER PROGRAMS

RESEARCH AND INTERNSHIPS

BEAM ensures that our students have access to the same opportunities for enrichment already available to their most well-prepared peers.

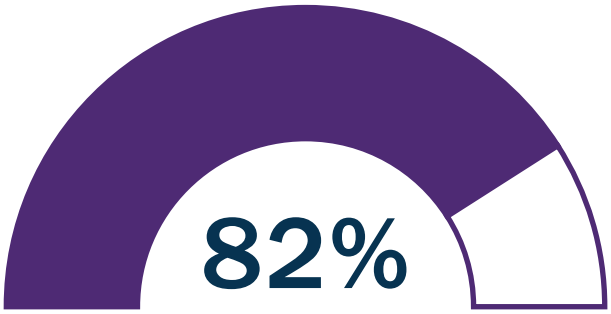
MEET THE STUDENTS: *DEMOGRAPHICS*

Get To Know Our Students



ETHNICITY

A. 32% Hispanic/Latinx
B. 30% Black/African-American
C. 10% Asian
D. 6% White
E. 22% Mixed

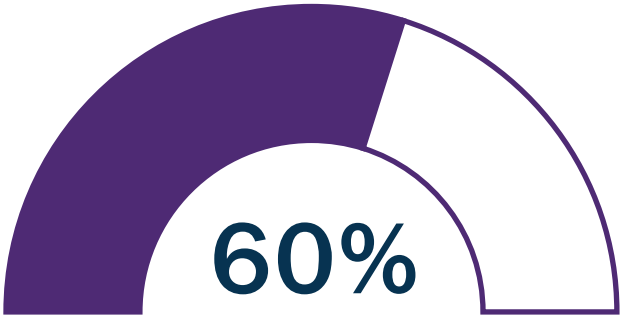


UNDERREPRESENTED MINORITY

This includes Hispanic/Latino, Black/African-American, American Indian or Alaskan Native, Native Hawaiian/Other Pacific Islander.

GENDER

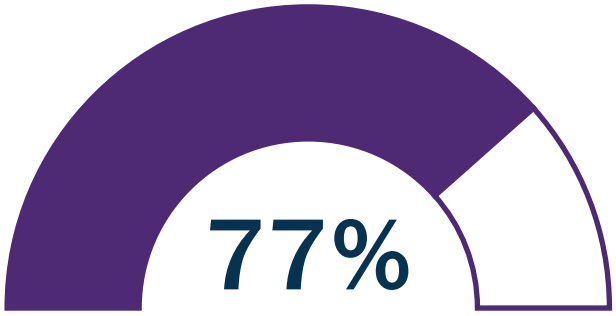
A. 50% Female
B. 50% Male
One BEAM student also identifies as genderfluid, neither female nor male.



FIRST-GEN

First-gen students will be in the first generation of their family to graduate college; no parent or guardian in the household has a college degree.

High school students Elijah, Sam, and Tanasia give advice to rising 9th graders Emyr, Ryan, Deana, and Storm on how to prepare for high school, June 2018.



LOW-INCOME

This counts the percentage of students whose family is eligible for federally-subsidized free or reduced-price lunch. The median family income for a BEAM 7 student is $31,000.

MEET THE STUDENTS: CAREER ASPIRATIONS

What kind of career did you hope for in 7th grade?

Maybe you wanted to be a scientist, or maybe an astronaut, or maybe a musician or an athlete. Maybe you didn't know. Most middle school students don't know the breadth of options available to them, or what they entail. But because early interest has been shown to have a strong relationship to future, we want to know the experience of BEAM students.

	% Who Reported a Career Goal	Of Those, % Who Require Advance STEM Training
Before BEAM 7	98%	71%
After BEAM 7	84%	75%

Thus summer, we discovered something interesting. BEAM left more students undecided about their career plans—but for us, this was a victory. Not just did a higher fraction of students with career plans choose STEM-intensive plans, but we also saw our students become more thoughtful about what they want to be and do. Just look at Asiel's comment below.

Our data on career plans is driving us to change our programs. We are incorporating more career elements into BEAM 6, with career day visits and guest speakers. We are adding more tours of STEM-related workplaces. We will continue to guide students to summer internships or other programs that allow exploring new topics. Moreover, our new college advising program will help students find the majors that best suit them.

In total, 15 students specifically expressed an interest in math or applied math (23% of those with stated career goals). Of those, five said they want to be a mathematician, and in another sign of BEAM's impact, four of those five were students who attended both BEAM 6 and BEAM 7.

"I'm learning to code and I'm going to become a programer [sic]. (You can can get a free... whatever I make.)" — Jimmy

Jimmy wants to be a programmer. He knew that before BEAM 7, and stated it again at the end of BEAM 7. So why are we so excited? Jimmy actually learned to program at BEAM 7! He took a course where he learned how to code in the Arduino environment.

When you think about yourself as an adult, what kind of career or work do you see yourself doing? (You can list more than one if you're not sure!)

I see myself doing something difficult, I don't know what it is.

-Asiel

Brianny is also undecided, but she knows she'll do something in the STEM zone; she's considering doctor, surgeon, engineer, and scientist among her career options. She wrote this about how BEAM will help her get there:

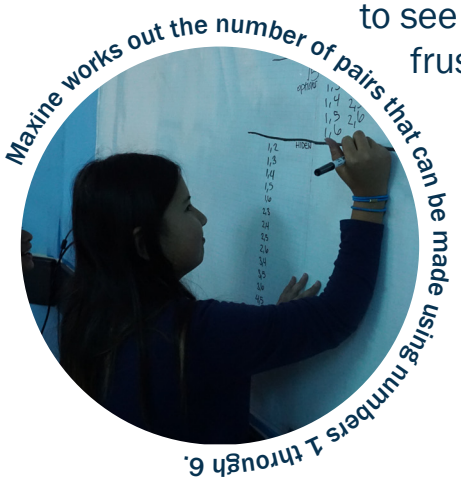
BEAM will help me achieve my goals in life because...

They helped me learn math that might one day help get the job of my dreams and go to the college of my choice

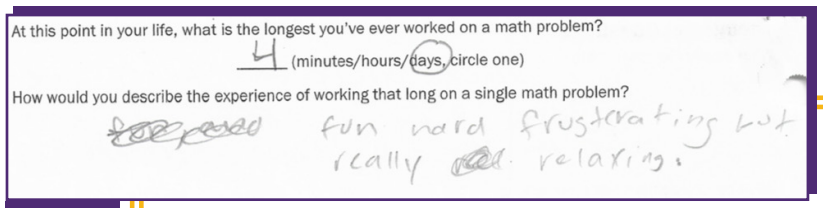
Read more about our students' career plans: **beammath.org/careers**

Paradox: a seemingly absurd or self-contradictory statement or proposition...

BEAM opened in Los Angeles this summer, our first launch in a new city. The final surveys are full of students discovering the joy of math and the depth of their new friendships. But they also tell a story filled with paradox. Students were surprised to see the juxtaposition of difficulty and fun, of wonder and frustration, and of the impossible becoming possible.



Maxine works out the number of pairs that can be made using numbers 1 through 6.



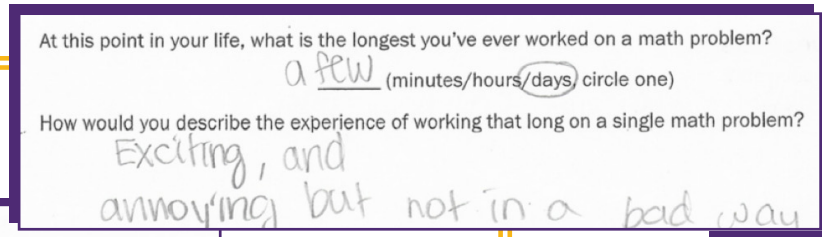
At this point in your life, what is the longest you've ever worked on a math problem?

4 (minutes/hours/days, circle one)

How would you describe the experience of working that long on a single math problem?

fun hard frustrating but really relaxing.

- Valerie



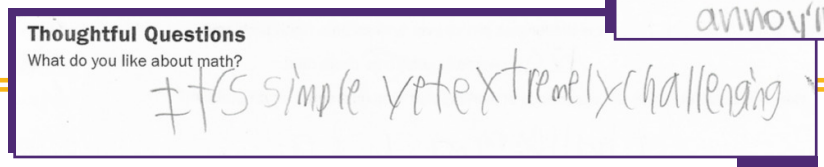
At this point in your life, what is the longest you've ever worked on a math problem?

a few (minutes/hours/days, circle one)

How would you describe the experience of working that long on a single math problem?

Exciting, and annoying but not in a bad way

-Maxine



Thoughtful Questions

What do you like about math?

It's simple yet extremely challenging

- Eric

...that when investigated or explained may prove to be well founded or **true.**

The paradox the students felt was that their joy was not despite the challenge of the math they did, but because of it. Math that makes you grow is hard and frustrating but deeply rewarding, and instead of being scared, the students were inspired.

Sharon, Rihighna, and Valerie work on problem sets for their fractions class during OMT.

We loved these student comments, as they show students coming to terms with the nature of doing mathematics. This is the truth of doing math: sometimes a seemingly contradictory idea ends up being true.

"It is very fun that you really are getting challenged but it is fun."
— Sofia

What was it like to work on a single math problem for a whole week?
"It was very challenging, but worth it to complete it." — David

"I learned new things, and had an amazing time."
— Janey

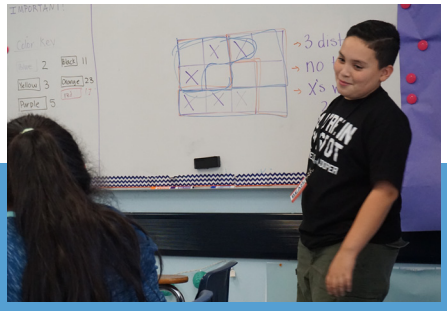
Read more about BEAM 6 LA: **beammath.org/losangeles**

Melane and Julianna work with lanyards during their arts and crafts activity.

At BEAM 6 LA, students took classes in logical reasoning, in applied math, in math fundamentals, and in math team strategies. They learned to work on their own and to be comfortable seeking help; they learned to spend hours thinking deeply about one question; they developed the self-reliance to set their own mathematical priorities. "Focusing," said Samantha, "was harder than finding a unicorn." But she learned, and she grew. It was frustrating, challenging, but also hopeful, very fun, and worth it.

How does it feel to work on a single math problem for 2 days? **"Focusing was harder than finding a unicorn."** **— Samantha**

Also Samantha: What would you tell someone about BEAM? **"It really makes math fun!"**

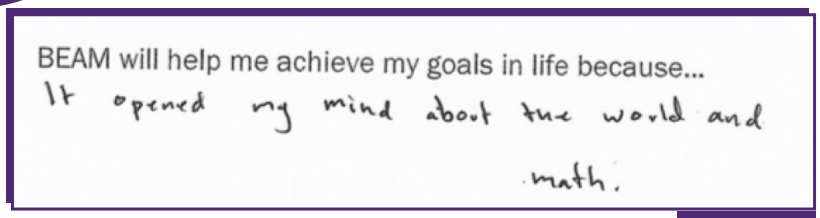


Abel talks to Lesly during voting theory class about why his map is compact.

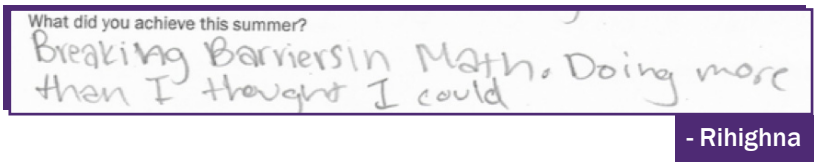
What do you like about math? **"It's amazing."** — Emily

"[BEAM] is fun and it is not what you expect." — Abigail

How does it feel to work on a single math problem for 2 days? **"Frustrating, wondering, hopeful"** **— Brian**



- Kimberly



- Rihighna

Samantha (top center) giggles while talking about her solution to a KenKen puzzle with Sarah (left), Vivian (bottom center), and Juliet (right).

Germán (right) is excited to take pictures with Julian (left)

100 PROBLEM

This year, BEAM 6 launched the 100 Problem Challenge. During daily Open Math Time, students were able to choose what math to do, and these problems were a popular choice! Students could work solo or in groups; some of them went right for the new problems while others tried out some that their friends had enjoyed and solved already. Crucially, each problem was carefully selected to challenge students mathematically and bring them just to the edge of mathematical proof.

PROBLEM #13

Dan, our Executive Director and author of the 100 Problem Challenge, was in charge of checking solutions for the BEAM 6 students at our Uptown NYC site. During the fourth week, Dan was out of the office for two days, but he made sure to video-conference in during Open Math Time to review student work. In this photo, Adil is discussing Problem 13 with Dan. In Dan's words, **"This was a very difficult problem, and Adil did eventually solve it, although it wasn't solved during this chat. He had to come back and discuss it with me a number of times, but when he got it, he really got it."**

An eccentric queen is once again testing if you can be her advisor.

"Here is your new challenge," she says. She takes out twelve identical coins, all with her smiling face on them. "One of these is counterfeit and weighs a different amount than the others. You need to figure out which it is."

"Does it weigh more or less?"

"I'm not going to tell you!" she says, smiling.

With that, she brings out a balance scale. A balance scale lets you compare the weight of whatever is in its two pans—the heavier pan tips lower. However, it doesn't tell you what the items in the pans actually weigh, just which one is heavier (or if they're equal, it stays equal).

"Now be careful," she says, "you only get to use it three times, and then you have to tell me which is counterfeit and if it weighs more or less."

How can you figure out which coin is counterfeit, and if it's lighter or heavier, in just three weighings of the balance scale?

Note: This problem is similar to #2. Maybe the person who solved it can help you!

PROBLEM #67

Daisy, a student at BEAM 6 Los Angeles, was enrolled in a programming course over the summer. Her instructor, Lee-kai, encouraged students to design programs in Python that would solve some of the 100 problems. Here she is with the solution to problem 67!

How many ways are there to make change for $3 using only pennies, nickels, and dimes?

Hint: The information from problem #51 might be helpful here!

PROBLEM #51

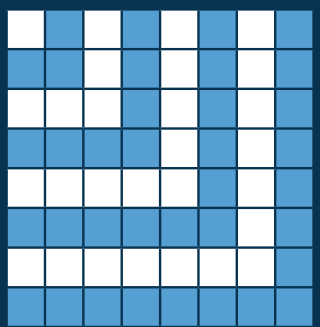
Add the first few odd numbers:

Numbers	Sum
1	
1+3	
1+3+5	
1+3+5+7	
1+3+5+7+9	
1+3+5+7+9+11	
1+3+5+7+9+11+13	

You should see a pattern. First, use that pattern to find the value of

1+3+5+7 ... +197+199

Now, give an explanation of why this pattern is true. How does the diagram below prove your pattern always works?



CHALLENGE

A large board in the hallway kept track of student progress. Unfortunately, the BEAM 6 Los Angeles students only solved 99 of the problems (the final problem was a real stumper!) but both sites of BEAM 6 New York City solved all 100 problems, leading to a reward for the entire program: a visit from an ice cream truck after the talent show. So what were the 100 problems? **Try four of them yourself!**

PROBLEM #63

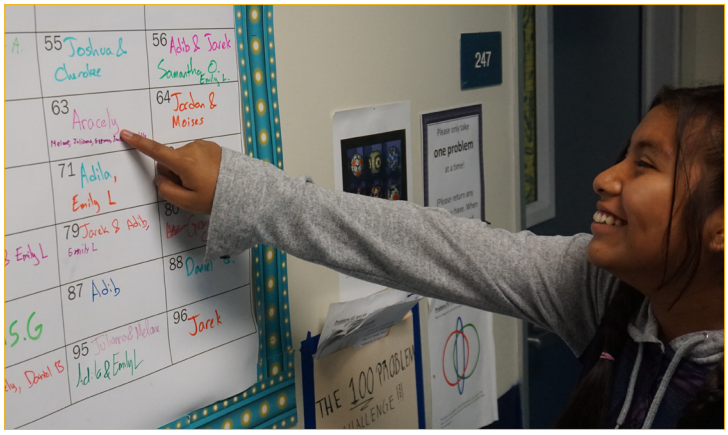
Meghan, a BEAM instructor, wrote this:

"Aracely is the kind of student who spends a lot of time on her work until it is perfect. One day during Open Math Time, I convinced her to take a break from her required work and try a 100 problem. She was a little reluctant because she wanted to get her required work done (it wasn't due for several days... but she's an anti-procrastinator!), so I went and grabbed one of the sheets for her and told her to just try it for a few minutes. She tried it and basically just worked on that problem until she solved it. There were actually lots of people working on problem 63 at the same time, but they would work on it for a little while, then take a break and do something else, then come back to it. But Aracely just had a single track mind until she got it finished. She actually brought it to lunch with her and spent most of the lunch period working on it and that's when she cracked it open. I'm pretty sure that that was the first 100 problem that she attempted, and you can see in her face how happy and proud she is!"

At the end of the summer, Aracely wrote that BEAM was the best summer of her life.

You and your friends have built motarized boats that you're going to race. The problem is that you forgot to bring a timer, so you have no way to figure out how long each boat takes to finish.

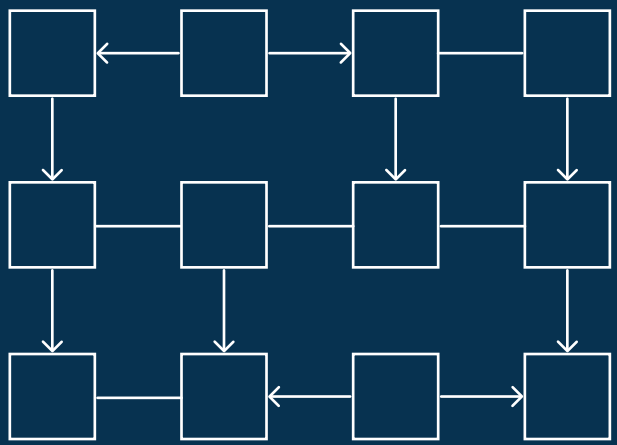
You have space in the tank to race five boats at a time, and you can still record which boat finishes first, second, third, fourth, or fifth. If you have 25 boats all together, what's the fewest number of races you need to figure out the top three fastest, and how do you do it?



PROBLEM #68

At BEAM 6 Los Angeles, one of the classrooms was shaped like a trapezoid and it became the default hang-out spot during Open Math Time for a group of students who liked to work together. Here they are presenting the solution to problem 68, the last problem solved by the BEAM 6 LA students this summer. The folks whose faces you can see are Jacob Castaneda along with students Adib, Matthew, Jarek, and Emily.

Place the numbers 1–6 in the following boxes (using each number multiple times) so that every possible pair of different numbers is connected by a line, and when there's an arrow, it always points from a smaller number to a bigger number.



If it helps, here's a list of all possible pairs of numbers:

1&2	1&3	1&4	1&5	1&6	2&3	2&4
2&5	2&6	3&4	3&5	3&6	4&5	4&6
5&6						

Source: USA Mathematical Talent Search

Read more about the 100 Problem Challenge: **beammath.org/100problem**

COLLEGE SUPPORT

Students from high-income families are over six times more likely to earn a STEM degree than those from low-income families. Students from low-income or underrepresented backgrounds face obstacles that others simply don't. These obstacles include not just academic preparation, but also student and family knowledge of the system and important deadlines, comfort navigating bureaucracy, difficulty fitting in once on campus, and subtle messaging that can come from faculty and advisors who make assumptions about students' capacities. Since our founding, BEAM's long-term goal for students has always been college success, and that means we need to provide our students with the tools and support to complete a STEM major.

Ayinde advises Aisha, a freshman at Northwestern, on which classes to take during her first term at college.

BEAM's oldest alumni, nearly 100 of them, are now enrolled in college. Zavier, who worked to open BEAM 6 in Los Angeles this summer, is majoring in computer science with a minor in studio art. Ilearys is majoring in physics. Fatima is majoring in biology and on a pre-med track. Mirai is completing a combined major in computer science and mathematics.

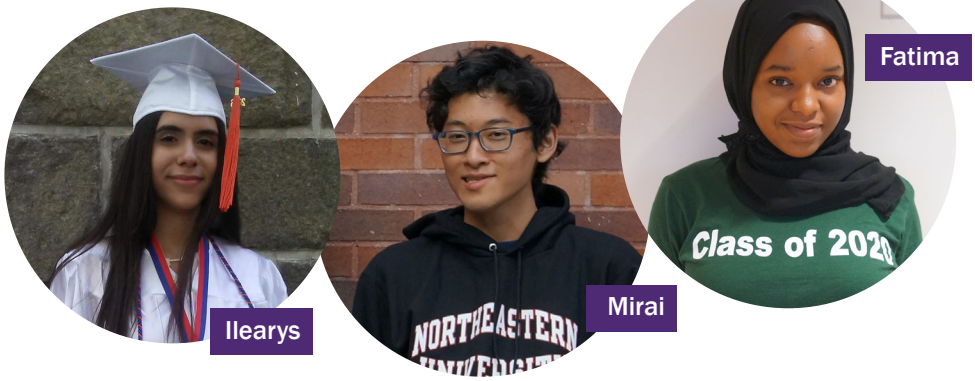
BEAM's preparation has gotten them this far, from challenging high schools into strong fit colleges. Yet, in this final stretch, even minor support can make a disproportionate difference in student lives. For some students, there's no coming back from a missed financial aid deadline.

So, this year, BEAM launched a new initiative, BEAM Through College, to ensure students have access to just-in-time college advice from the people they already know and trust at BEAM. Ayinde Alleyne, BEAM's College Support Coordinator and an engineering graduate from UPenn, said this about the program goals:

BEAM alumni now in college are entering a new phase of their lives, in an environment where they are unlikely to have prior contacts. The best thing we can do as an organization for them is to advise them on both how to use the resources their college provides and also how to use their BEAM network. Our advice might address how to pick classes for a first semester in college, why to go to office hours, which Dean or center on campus to contact for any given question, or how to use both the campus and BEAM networks to search for summer jobs and internships. Each challenge they face, whether academic or social-emotional, is something that other BEAM students (or students from comparable backgrounds) have dealt with and solved. By providing students resources where they can find these answers, we allow them to worry less and have academic success.

Zavier works with students on a Problem of the Week during BEAM 6 Los Angeles 2018.

BEAM college students now get monthly reminder emails, two "stay-on-track" meetings a year with Ayinde, and dedicated support in answering questions. We're proud to be providing this essential support to our students.



Read more about Aisha: **beammath.org/aisha**

WHAT DOES NEXT YEAR HOLD FOR BEAM?

BEAM continues to grow! As we look forward to 2019, we're excited about the following new programs and initiatives at BEAM.

The first summer of BEAM 7 in California. Last summer, 86 students completed BEAM 6 in Los Angeles. During 7th grade, they have access to continued math enrichment, including monthly challenge sets mailed home as well as free online prealgebra courses provided in partnership with Art of Problem Solving. At the same time, our LA staff is hard at work, signing contracts and making plans to open BEAM 7 in southern California.

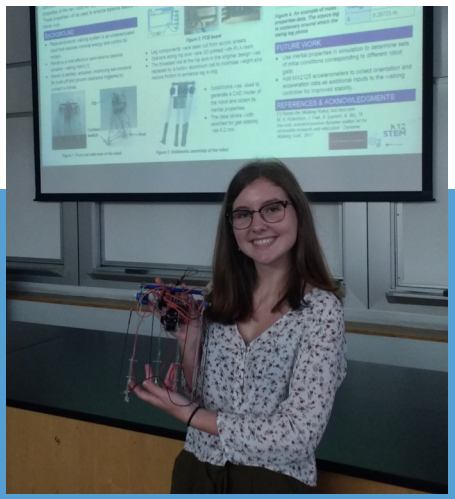
Published curriculum for BEAM 6. Now that BEAM 6 has finished its third summer, we are excited to share curriculum and resources with the wider community. This winter, we will be releasing the first set of course materials, based on the class "Truth, Lies, and Logic" from our logical reasoning track. A second course will follow in the early spring. The courses will be posted free online for use by school clubs and other enrichment programs nationwide. They will also be used by faculty new to BEAM to get a clear sense of what a great BEAM course entails.

BEAM 12th graders announce their college plans at College Decision Day, Apollo Theater, May 2018.

Data dashboard and Salesforce integration. Over 700 students have now completed a summer with BEAM. That's a lot of people to track! With three cohorts now in college, but no college graduation data yet, we are actively thinking about both the educational achievements of our students and also which of those achievements matter most to our ultimate goal: earning a college degree in a STEM field. This year, we are rolling out a data dashboard and integrating that into our student database in Salesforce so we can better track and drive key student outcomes.

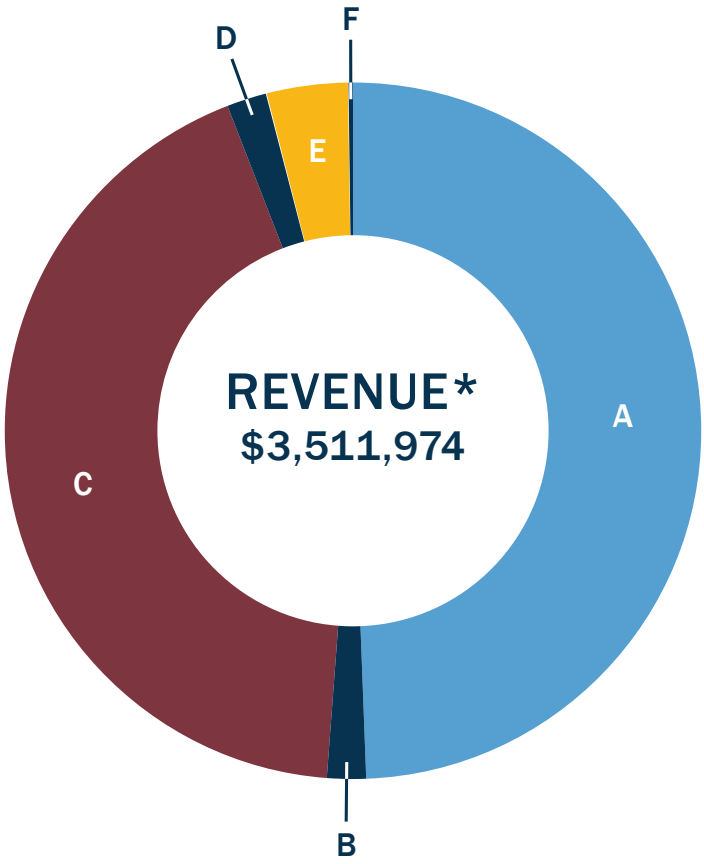
There will be much more information on all of these initiatives over the course of the next year on our blog, in our online newsletter, and in the 2019 Summer Report!

Thanks to all of our supporters whose continued investment in BEAM allows us to continue innovating.

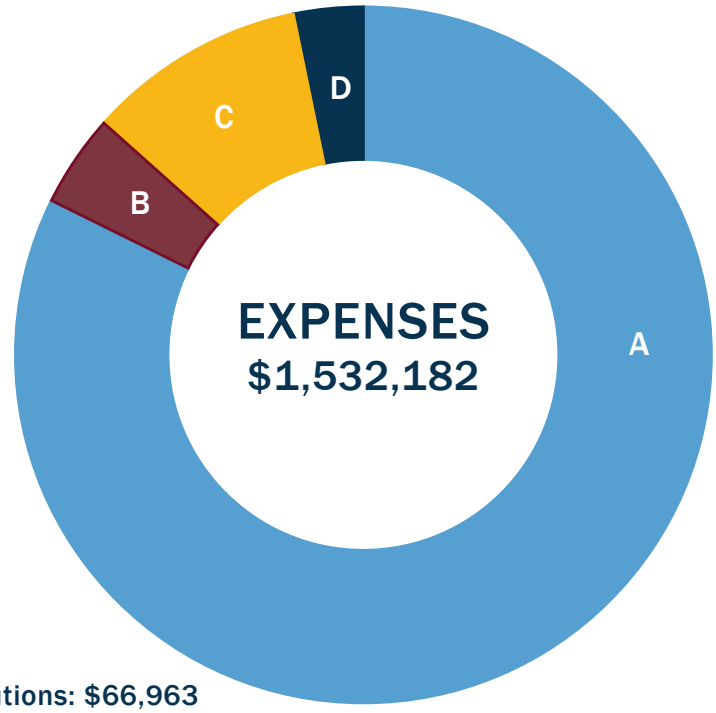

Isabella displays her self-attenuating robot and her academic poster at NYU ARISE, August 2018.

Rashik is in his senior year of Bard High School Early College, one of the top high schools in the city where he will graduate with both a high school diploma and an associates' degree. As a junior counselor at BEAM 6 this summer, he worked with future high achievers like Joel, now in 7th grade.

FISCAL YEAR 2017 FINANCIALS



A. Individual Donations: $1,737,521
B. Government Grants: $64,318
C. Foundation Grants: $1,500,600
D. Corporate Contributions: $66,963
E. In-Kind Contributions: $133,994
F. Special Events and Other Income: $8,578



A. BEAM Programs - $1,261,643
B. Fundraising - $67,052
C. Management and General - $155,583
D. USA Mathematical Talent Search Program Service - $47,904

The Art of Problem Solving Initiative, Inc. has changed our fiscal year to better match our program calendar. Fiscal year 2017 was 1/1/17-12/31/17. Fiscal year 2019 is 6/1/18-5/31/19. This left a stub fiscal year 2018 which spanned 1/1/18-5/31/18. Expenses for this FY18 were $508,000 and revenue was $457,334.

* Revenue includes a $1,000,000 three-year grant from the Jack Kent Cooke Foundation to launch BEAM Los Angeles. BEAM's budget policy is to use revenue from each fiscal year to fund the following year. Hence, 2017 revenue will be used to fuel growth in the next full fiscal year, which has a budget of $2,713,320.

BEAM
Bridge to Enter Advanced Mathematics

SUPPORTERS

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!

CORE SUPPORTER

JACK KENT COOKE FOUNDATION

MAJOR SUPPORTER

SCIENCE Simons Foundation SANDBOX

2017 & 2018 HONOR ROLL

$250,000+
Anonymous
*The Jack Kent Cooke Foundation**
*The Lehoczky Escobar Family**
*Paul Sherman and Lynn Hsu**
*Alex Schwendner and Aakanksha Sarda**

$100,000-$249,000
Anonymous (x3)
*Science Sandbox, an Initiative of the Simons Foundation**
Edwin Gould Foundation†*

$25,000-$99,999
*Akamai Foundation Inc.**
Arbor Brothers
*Ann and John Doerr**
Horwitz Redlich Donor-Advised Fund
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Pinkerton Foundation
*Richard and Vanessa Rusczyk**

$10,000-$24,999
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*American Mathematical Society Epsilon Fund**
Ken Baron
Evan Goldberg
*Loewenberg Foundation Incorporated**
*National Security Agency STEM Education Partnership Program (MEPP)**
Laurie and Andy Okun
*Overdeck Family Foundation**
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In honor of Anna Weltman and Joel Weber
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9 Dots
*The Art of Problem Solving, Inc.**
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*Edwin Gould Foundation**
*The Math League**
*NYU Courant Institute of Mathematical Sciences and the Center for Mathematical Talent**
*Wolfram Research**

**Consecutive Year Donor*
†Support included both financial and in-kind contributions

THIS YEAR AT BEAM

1. The staff and students of BEAM 7 at Union College.

2. Rising 12th graders Rashik, Teo, Michael, Maria, and Elisa pose at the spring party photobooth.

3. 8th grader David on a career field trip to Hudson River Training.

4. On the first day ever of BEAM 6 Los Angeles, students play tag.

5. Staff Darien (left) and Will (back) along with students Tony, Joshua, Ous, Marvellous, and Gabi enjoying their treats after BEAM hired an ice cream truck to celebrate the conclusion of the 100 Problem Challenge!

6. From students to coworkers! In 2012, Joel, John, and Quentin were students at BEAM 7 Bard College. In 2018, they came back to Bard as BEAM 7 Counselors and TAs.

Front page. Rising college first years Vielka, Will, Mona, Ariel, Tanasia, Aisha, and Elijah celebrate their college pride.

Bridge to Enter Advanced Mathematics (BEAM) is a project of the Art of Problem Solving Initiative, Inc.

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Bridge to Enter Advanced Mathematics

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