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The Tech
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WEATHER, p. 2
FRI: 53°F | 47°F Rain Showers
SAT: 76°F | 59°F Sunny
SUN: 83°F | 56°F Partly Cloudy

Volume 146, Number 8

Thursday, May 14, 2026

Gunman fires 60 rounds on Memorial Drive

Two drivers critically injured by shots from the gunman's semiautomatic rifle

By Samuel Yuan
NEWS EDITOR

At 1:30 p.m. on Monday, May 11, less than a mile away from campus on Memorial Drive, a gunman sprayed nearly 60 rounds into traffic with a semiautomatic rifle, Middlesex County District Attorney Marian Ryan said at a press conference.

The shooting occurred at the intersection of River Street and Memorial Drive. Two drivers were shot and were rushed to Boston hospitals with life-threatening injuries. The gunman Tyler Brown is in custody.

The gunman was previously involved in a 2020 shooting with police officers in South End and was released from prison.

Both Cambridge and Massachusetts State Police responded to the scene, and Ryan said that it was the combined effort of a civilian and a State trooper that took down the gunman.

"[The] trooper and civilian rather than going [away] went towards the suspect with their weapons to end the situation," Ryan said. "Both the civilian and the trooper fired their weapons, and the suspect was struck multiple times."

"What happened today cannot stand," he added.

In a statement, the Cambridge Police Department wrote that prior to the shooting at around 1:00 p.m., they received a call from Boston Police warning them about an erratic individual in the Cambridge area.

"Boston Police also relayed that the suspect was believed to be in possession of a rifle," the Department wrote. "[The suspect] was later identified as the person involved in today's shooting."

The gunman will be charged with two counts of armed assault with intent to murder.

In the 2020 case, Brown was sentenced by Suffolk Superior Court Judge Janet Sanders to five to six years in prison and three years of probation despite prosecutors recommending 10 to 12 years of prison and five years of probation.

Massachusetts Governor Maura Healey said in a statement that there "is no ongoing threat to the public" and that she is "grateful to first responders who worked quickly to keep people safe and secure the scene."

While the shooting took place between the MIT and Harvard campuses, neither school was directly affected. MIT Police did not respond to the scene, and no campus alert was sent.

PHOTO COURTESY OF KAI DE LEON DEJESUS

The shooting occurred near the Mobil gas station at the intersection of Memorial Drive and River Street in Cambridge on Monday, May 11, 2026.

MIT Mock Trial advances to Nationals for the first time

Yeoh: "We showed people that MIT Mock Trial is not to be underestimated"

By Grace Zhang
EDITOR-IN-CHIEF

A three-way tie. Two more spots for Nationals.

Going into the awards ceremony at the Opening Round Championship Series (ORCS) Tournament in New Rochelle, N.Y., the MIT A Mock Trial team was "full blind," with no knowledge of their win/loss ratio. Their crucial final round was against the University of Maryland (UMD) — one of the best teams in the country — and would decide if they qualified for the National Championship Tournament.

For Kaitlin Yeoh '28, time seemed to slow down as the first bid was announced.

It was MIT.

The eight-person team immediately leapt to their feet in excitement, screaming and hugging each other as they celebrated a long-awaited accomplishment.

"I was so happy. This year has truly felt like the culmination of all 11 years of hard work that members before us put into this program," Yeoh said. "It's such a storybook ending."

The MIT Mock Trial organization, composed of 25 students competing across three teams, was founded in 2015 by current head coach Brian Pilchik. This year marks MIT's first-ever qualification to the National Championship.

"MIT has had years where we've come very, very close," Pilchik recalled. "In 2021, we just missed the cutoff; we would have been the next team out. So it was only a matter of time."

This year, over 800 teams competed in mock trial; MIT was in the top 6% that advanced to Nationals. But for team member Darius Sinha '28, MIT Mock Trial's achievement is bigger than the competition itself.

"What our team has shown is that MIT students can do more than STEM, and can go on to be leaders in public speaking and advocacy," Sinha said.

PHOTO COURTESY OF KAITLIN YEOH

Members of MIT Mock Trial at the 41st American Mock Trial Association National Championship Tournament in Washington, D.C. on Sunday, April 19, 2026.

The road to Nationals

Students in Mock Trial compete in simulated court trials as attorneys and witnesses, working together as attorney-witness pairs to argue their case.

Every July, the American Mock Trial Association (AMTA) releases the official case materials for the year. After tryouts in early September, MIT Mock Trial workshops their arguments and narratives, competing in invitational tournaments in the fall. Then, the three teams — A, B, and C — face off against other schools in official regional tournaments in January and February to

Mock Trial, Page 2

5/14 IN SHORT

Final exams start on Friday, May 15 and end on Wednesday, May 20.

Students must move out by 12 p.m. on Thursday, May 21.

Pre-registration closes at 5 p.m. on Thursday, May 28.

Memorial Day is on Monday, May 25.

Commencement is from Wednesday, May 27 to Friday, May 29.

Interested in joining *The Tech*? Email *tt-join@mit.edu*

Send news and tips to *tt-tips@mit.edu*

MIT Canvas goes down after Instructure breach

MIT is among thousands of universities affected by ShinyHunters extortion hack

By Samuel Yuan and Grace Zhang
EDITORS

Shortly after 4:00 p.m. on Thursday, May 7, MIT students lost access to Canvas, the platform that hosts instructional material for nearly all courses, following a breach of the website's parent company Instructure by cybercrime group ShinyHunters.

MIT is among thousands of universities that use Canvas as their primary instructional platform and are affected by the hack.

Initially, users attempting to access the MIT Canvas page were greeted with a message from ShinyHunters that warned affected schools to "consult with a cyber advisory firm" to contact the cybercrime group and "negotiate a settlement" if they were "interested in preventing the release of their data."

"You have till the end of the day by 12 May 2026 before everything is leaked," the group wrote.

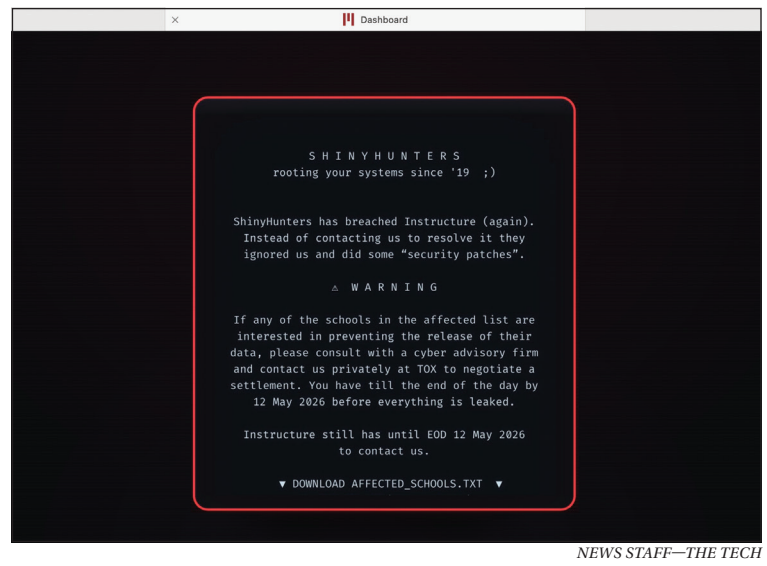
ShinyHunters claimed that this is the second time that the group has successfully breached Instructure's services. It also mocked the company for implementing "security patches" and "ignoring" the group.

The message from ShinyHunters was later replaced by a Canvas maintenance notice.

"Canvas is currently undergoing scheduled maintenance," the page reads. "Check back soon." No estimate has been provided for when service will return.

The breach comes just as students are wrapping up their final as-

Canvas, Page 2



NEWS STAFF—THE TECH

A message by the cybercrime group ShinyHunters replaces the Canvas homepage after the group had breached the site on Thursday, May 7, 2026.

THE HARDEST PROBLEM

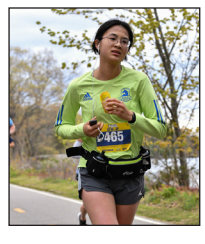
Pondering before graduation. **CAMPUS LIFE, p. 3**

HIDDEN TRUTHS, HUMAN TIES

Celeste Ng talks about diving into complex themes. **ARTS, p. 5**

SCIENCE YOUTUBER

From 21W at MIT to Veritasium. **SCIENCE, p. 6**



MARATHON JOURNEY

What it takes to run a marathon and life advice. **CAMPUS LIFE, p. 4**

HEALTHCARE AND AI

Need for establishing guidelines for AI usage in healthcare. **OPINION, p. 7**

SECTIONS

WEATHER WEATHER WEATHER WEATHER

Today
Rain.
59°F
15°C
Wind Speed: 10–15 mph.
Gusts: 25 mph.
Direction: E.

Tonight
Rain.
49°F
9°C
Wind Speed: 5–10 mph.
Gusts: 15 mph.
Direction: NE.

Friday
Rain showers.
53°F 47°
12°C | 8°C
Wind Speed: 10–15 mph.
Gusts: 30 mph.
Direction: NE.

Saturday
Sunny.
76°F 59°
24°C | 15°C
Wind Speed: 10–15 mph.
Gusts: 25 mph.
Direction: SW.

Sunday
Partly cloudy.
83°F 56°
28°C | 13°C
Wind Speed: 10–15 mph.
Gusts: 25 mph.
Direction: W.

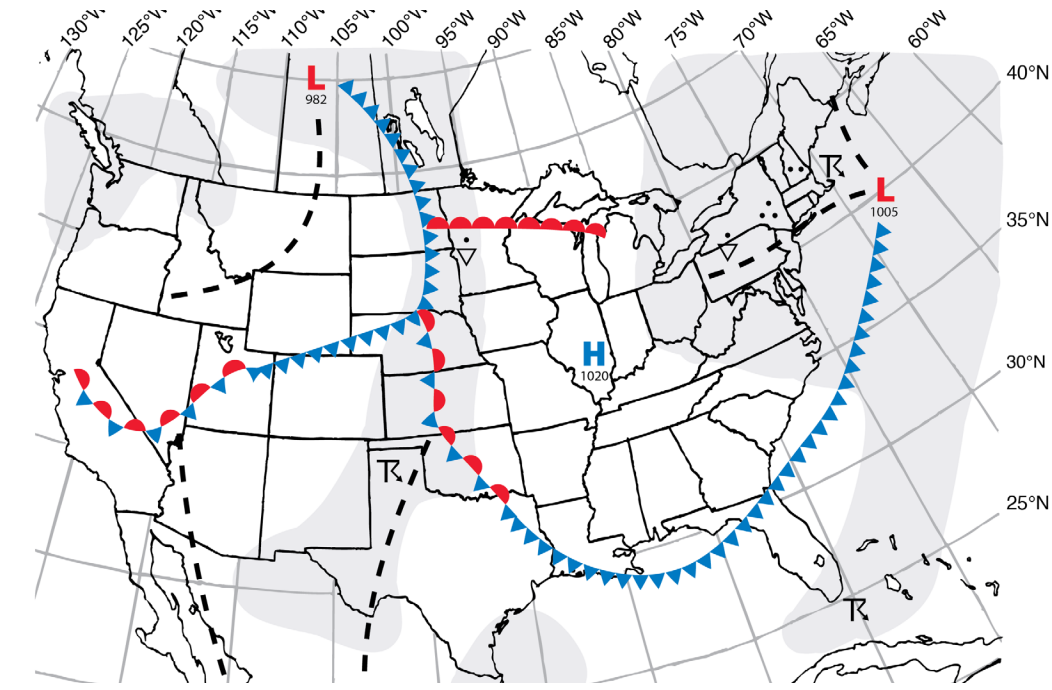
A beautiful weekend and very warm week ahead

By Conrad Straden
CHIEF METEOROLOGIST

We will finish this week with some wet and unpleasant weather. A low-pressure system will swing over Boston today, bringing steady rain. Expect the heaviest rain to be in the early evening before lightening up overnight. As the system pulls away on Friday, rain showers will continue, with a drizzle lasting most of the day. Steady northeast winds will keep temperatures in the low 50s, making it quite unpleasant. This will all change on Saturday, as a high-pressure system will move in and bring nicer weather along the way; the sun will be out and temperatures will climb into the mid 70s. Sunday will be even warmer, topping out in the 80s. There is a slight chance for some rain showers in the morning, but any clouds will clear out for a very nice afternoon.

The warm weather will continue next week. On Tuesday and Wednesday, highs in the 80s or even 90s could be possible. While this can be nice, hopefully the heat will not be too extreme for the comfort of those taking finals in Walker Memorial or the Johnson Athletic Center.

Additionally, starting on Saturday, sunsets will be after 8 p.m., marking the transition into summer with longer days and brighter evenings as we count down the days to commencement later this month.



An AWS outage repeat

Canvas, from Page 1

signments. According to the MIT Registrar, no assignment may be due after May 8 for subjects with final exams. It also comes just before MIT's final exams period, which is from May 15 to 20.

MIT's Information and Systems Technology (IS&T) is aware of the data breach and has issued an announcement on its website. The notice reads, "MIT is actively monitoring the situation and coordinating with the vendor as they work to restore service. This issue originates with the vendor environment and is not the result of an issue within MIT's local systems."

Earlier in October, an Amazon Web Services incident resulted in Canvas and Piazza outages that lasted around 12 hours.

At the time of first publication, it appears that other MIT websites and internet services, including Piazza, MITx, and Panopto, are not affected.

Update: Access to Canvas was restored less than 24 hours later on Friday, May 8. Instructure published an incident update apologizing for the disruption and informing consumers that it had reached "an agreement with the unauthorized actor involved in this incident."

PHOTO COURTESY OF KAITLIN YEOH

Iva Goel '26, Kaitlin Yeoh '28, and Benjamin Lammers '26 of the MIT A Mock Trial team compete in the 41st American Mock Trial Association National Championship Tournament in Washington, D.C. on Sunday, April 19, 2026.

Mock Trial looks ahead

Mock Trial, from Page 1

earn bids to the ORCS tournaments. From there, the top 48 teams from across the nation qualify for the National Championship in April.

Teams going to Nationals pivot to an entirely new case. With only a month to fully prepare for the tournament, it becomes a race to build the most compelling strategy. Pilchik compared the experience to "living an extra semester in the span of a month."

"Our team met up with each other almost every day for those four weeks to write content, practice, [and] scrimmage other teams," Hannah Rose '26 said.

This year, Nationals took place from April 17 to April 19 in Washington, D.C., where the MIT Mock Trial team competed in real courtrooms for the very first time. Led by co-presidents Iva Goel '26 and Benjamin Lammers '26, MIT A — which also includes Rose, Sinha, Yeoh, Ava Muffoletto '26, Dubem Echezona '27, and Vivian Dinh '29 — finished 16th out of 26 teams in the CUA Law division, posting a 5–7 record.

Yeoh highlighted the last two rounds of Nationals as particularly memorable. MIT faced UC Berkeley and Boston University, two teams that went on to place in the top five of the division. Despite the challenge, the team left with a sense of accomplishment.

"Getting to see them perform really opened my eyes to the way other teams run, and I think we put up a good fight against them," she said. "We showed people that MIT Mock Trial is not to be underestimated."

Beyond the tournament, team members shared that the most meaningful part of the experience was each other. Whether it was practicing their case around the clock or exploring the D.C. area in their downtime, the trip brought the MIT team closer together.

"What I'll remember most… is how we supported each other, learned from each other, and bonded together," Dinh said.

Future aspirations

While four seniors on the A team will graduate from the Institute in May, leaving several spots open next season, the team believes they are well-positioned for future success. Some plan to return as alumni mentors, and according to Sinha, they have all "passed down their wisdom."

With the Nationals barrier finally broken, the remaining members expressed a desire to pursue even greater accomplishments next year. They seek to improve by learning from other teams, reflecting on their experiences, and adapting to new challenges.

"We are so excited to take on next year's case and to show to the world that MIT's showing at nationals wasn't a one-off occurrence," Sinha said.

Jada Ogueh '29 contributed to reporting for this article.

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SENIOR SIDE NOTES

Is life an optimization problem?

On reflection and regret

By Kanna Pichappan
CAMPUS LIFE STAFF WRITER

"I'm not everything I want to be yet, but I'm a lot of things that I wanted to be two years ago, and what a wonderful thing it is to realize that." — Unknown

As graduation approaches, I find myself cycling through a tangle of feelings. Gratitude for the people and experiences that have shaped me these four years. Inspiration from watching peers dedicate themselves, again and again, to their work and to each other. A sadness at the thought of leaving college. And underneath all of it, surfacing more than I'd like at times: regret.

Not regret over a single choice, but a more diffuse kind — the feeling that I could have done more, been more, and made more of the time available to me. When this is overlaid with the recognition that college isn't the only thing ending — that my life, if I'm lucky enough to reach 100, is already at least 21 percent behind me — that feeling can get even heavier.

I recognize that wanting to have done better can drive us to actually do better. But there's a version of regret that curdles into something less useful: a grief for a past that can't be changed and a hypothetical present that could have been, but never will be. I've felt that version lately, at times.

So, I've been trying to figure out how to hold both things at once — the genuine value of looking back, and the real cost of letting that looking back become a kind of grief. A few things have helped.

> **The qualities I wanted to embody, the perspectives I hoped to develop, the ways of moving through the world I was reaching for two years ago — a lot of them did come to be.**

The first is turning the lesson into action as quickly as possible. When I notice something I wish I'd done differently, I try to find one concrete thing I can do about it today or this week. Moving the energy somewhere useful helps me remember that these lessons have real potential to improve my future.

The second — the one that has stayed with me most — is a sentence I came across a while back: *I'm not everything I want to be yet, but I'm a lot of things that I wanted to be two years ago, and what a wonderful thing it is to realize that.* When I actually sit with that, it's remarkable. The qualities I wanted to embody, the perspectives I hoped to develop, the ways of moving through the world I was reaching for two years ago — a lot of them did come to be. By this same logic, the things I'm reaching for now — if pursued with sincere effort — have a real shot too. Suddenly, there's a person on the other side of the coming years worth looking forward to, rather than only mourning the one I could have been over the past several years.

The third is remembering that, in the grand scheme of life, I'm — if you will — "just a kid." Some of us, or at least myself, approach life like an optimization problem, always striving for the maximum and seeking to avoid sunken resources. That drive can be a gift, until it becomes a source of pain every time I realize that there was a potentially better way to do things. Kids, it seems to me, try their best in the moment and then move on — unburdened by past failures and unafraid of future ones.

> **Kids, it seems to me, try their best in the moment and then move on — unburdened by past failures and unafraid of future ones.**

Graduation is in less than a month. While I look forward to enacting what I have learned over the past few years in the upcoming ones, I am also considering that perhaps life is not an optimization problem. Or at the very least, if I insist on trying to optimize, it's high time I think carefully about what I'm actually optimizing for and at what cost.

Why MIT should preserve the tutorial style in humanities classes

Learning history in a room without a back row

By Mariam Kazimli

In high school, I took multiple history classes but never learned about the historical complexities in Africa in depth.

This gap in my knowledge bothered me, so when I saw that a course on South Africa and Apartheid (21H.266) was listed for the spring 2026 semester at MIT, I signed up.

On the first day of class, I noticed a problem (or so I thought at the time): There were only two other students in the room.

> **It no longer becomes the anonymous silence of a lecture hall, but rather, a palpable, almost physical silence.**

The small class size made me uneasy at first, because when you do not know the answer to a question in a lecture hall, it is easy to blend in with the crowd in silence. However, the silence feels different in a room containing only three students. It no longer becomes the anonymous silence of a lecture hall, but rather, a palpable, almost physical silence. At the start of the semester, the chance of this silence occurring worried me. I thought that I had to know the answer to all the content before class. Eventually, however, I realized that this silence has allowed me to think, listen, and learn better.

Professor Kenda Mutongi used the first day to explain the *tutorial* approach of learning we were going to follow because of the small class size. A tutorial is a unique method of teaching that originated at Oxford University. Its whole goal is to create a more personal style of instruction involving a professor and only two or three students. Since then, many universities have adopted this system, but it remains rare at MIT. I didn't realize it at the time, but this experience was going to be an extraordinarily meaningful learning opportunity for me. In a larger class, I might have absorbed the material more passively, but in this tutorial class, I had no choice but to participate actively to make sense of things.

> **The small size of the class made history feel less distant and made my own thoughts more visible to me.**

The history we were examining had a lot of complex layers; apartheid in South Africa did not simply consist of a list of laws or a period of racial segregation that could be summarized easily. It was a system constructed through politics, economics, violence, ideology, and daily life. Through our readings and discussions, I began to understand South African history through the lens of oppression and resistance, and as a complex web of choices, contradictions, survival, and struggle.

The tutorial style involves analyzing a lot of content in a short period of time. In the first week of the class, we read the entirety of Clark and Worger's *South Africa: The Rise and Fall of Apartheid*. This book was necessary to provide the vocabulary and chronology we needed before we could begin asking more complex questions. Initially, the reading felt overwhelming because it was full of unfamiliar names and laws. However, the goal of the course was not to memorize everything all at once, but rather to build a foundation that would expand into a map.

Each subsequent week, we added another layer to our understanding. We moved from Afrikaner nationalism to Indian and Colored identities. The next week, we learned about rural life and how it contrasted with urban life in South Africa. We also learned about societal complexities from education to domestic and mine workers, as well as armed resistance and the Black Consciousness Movement.

With every passing week in this class, I understood better how apartheid shaped everything from where people lived, how they worked, how they were educated, how they built communities, and how they resisted.

The format of the course made the learning process so much easier. I found myself trying to come up with ways to respond as a historian would argue in group discussions. Listening to how my peers elaborated on their perspectives was also enlightening. Many times, I realized how my mind could change about a certain topic in real time. The small size of the class made history feel less distant and made my own thoughts more visible to me.

> **I had never before been in a classroom where my unfinished thoughts were laid so bare.**

Every week, one person would write the main essay for the designated topic. The remaining two people would receive the essay the day before class and come to class with prepared critiques. During class time, we read our work aloud and began discussing. I had never before been in a classroom where my unfinished thoughts were laid so bare. Yet, over time, this openness became one of the most valuable aspects of the course. I learned a great deal from my classmates' differing approaches to the same readings.

By the end of the semester, I realized that I had not only learned about South Africa and apartheid, but had gained a new and unconventional way of studying history. History became less about memorizing a fixed narrative and more about asking better questions: Who benefits from this system? Whose voices are missing? How do ordinary people survive within structures designed to constrain their lives? What counts as resistance?

> **It taught me something very important, which is that learning is not solely about receiving information, but also about building knowledge through active discussion.**

This course did not simplify history for me. On the contrary, it made history feel more layered and alive. In the end, I understood a wider breadth of history's complexities and challenges to interpret it. The class pushed me to speak before my ideas were fully formed. I had to listen when discussions with my peers complicated my thinking. It taught me something very important, which is that learning is not solely about receiving information, but also about building knowledge through active discussion. I hope that MIT continues to uphold this tutorial approach in other humanities classes. While the tutorial began as an intimidating room of three students to me, it became a reminder that some of the most expansive learning at MIT can happen in the smallest classrooms.

VIVIAN'S REFLECTIONS

From non-runner to marathon runner

My four-year journey of long distance running

By Vivian Hir
SENIOR EDITOR

When people ask me when I started running, they are often surprised to learn that I began during my freshman year at MIT.

Growing up, I hated running. The most I ran was 1.5 miles for my high school PE class. Although my mile time was above average, I found running to be an awfully boring, exhausting, and painful activity. I never understood why someone would enjoy running. I mean, what joy could come from physical exertion?

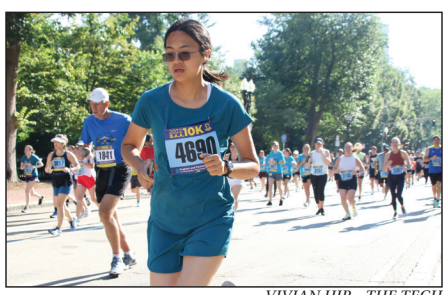
It wasn't until my first year of undergrad that I became interested in running. During winter break, I reflected upon my relatively sedentary first semester. I decided to adopt a more active and healthier lifestyle for the new year. I began the year by running a mile at the local 400-meter track. I was slow, but at least I started somewhere. I continued doing short runs that were between one and two miles throughout IAP and the spring semester, but I did not have a regular running habit. What truly sparked my interest in running was an interesting conversation I had with a volunteer at the Happy Beaver Invitational, a running meet hosted by the MIT Running Club.

The volunteer was a friendly old man who was well-versed in running marathons. I told him I was just there to volunteer and never saw myself running long distances, but he encouraged me to reconsider, sharing that his wife had gone from barely running to finishing a marathon within a year by training with a team. If someone like her could do it, then what excuse did I have? Perhaps running a marathon wasn't such a crazy and delusional idea after all. I was 18 years old, a young and healthy adult. If there was an ideal time for me to start running, it was now.

Feeling inspired after the invitational, I searched for 5k runs nearby. I was happy to find a weekly 5k event called Parkrun, a free, community event that was beginner-friendly. When I went to my first Parkrun in mid-April, I found the run difficult, but it went better than I expected. It was perhaps the first time in my life when I finally comprehended the idea of running as a fun and social activity. The excitement and infectious energy from the other runners nudged me to change my attitude towards running.

> **Although I could have registered later in the month, there was something symbolic about committing to a marathon on New Year's Day.**

I felt motivated to go to more Parkruns, so for the rest of the semester, I went to one every Saturday to build up my confidence in running a 5k. Once I was able to run a 5k without feeling the need to stop, I decided to run the B.A.A. 10k in June, then the B.A.A. Half Marathon in November. After I completed the half marathon, I was unsure what my next running goal would be. I was already very happy that my running and stamina improved significantly in less than a year, but training for another half marathon didn't excite or interest me that much. On the other hand, training for a marathon would provide me with a new challenge, even though the training plan looked daunting at first glance. I signed up for the 2023 Providence Marathon that sophomore spring. However, it wasn't until three years later that I finally ran the 2026 Providence Marathon.



VIVIAN HIR—THE TECH

Vivian Hir '25 running the B.A.A. 10K in Boston on Sunday, June 26, 2022.

Training for the marathon

In my first year of marathon training, I unfortunately injured my hamstring two weeks before the race, and did not recover by race day. I signed up again in junior year, but only three months into my training, the marathon was unexpectedly canceled.

In the end, I ran my own marathon route in early May, which consisted of the Minuteman Bikeway, Fresh Pond, and Memorial Drive. The marathon went surprisingly well: somehow, I experienced a runner's high throughout the entire run, even though my legs and feet started to feel tired around mile 20. When I reached my destination of Tang Hall, I was so proud of myself for finishing the marathon. However, I still wanted to run the Providence Marathon because the race was USATF-certified, meaning that its distance is accurately measured. Although Strava said that I ran 26.23 miles, the app had consistently overestimated my distance by a small margin in past runs, so I considered my first marathon unofficial.

In senior year, I considered running Providence, but before I registered, I got a bone bruise from a fall during IAP and couldn't run until April. Despite the long recovery period, I was able to run the Cambridge Half in the fall, which gave me the confidence to train for a marathon in the upcoming spring.

> **What I like the most about running is its meditative nature. There's something powerful about continuously moving for a long period.**

On New Year's Day, I decided to register for the Providence Marathon and pay the $110 registration fee. Although I could have registered later in the month, there was something symbolic about committing to a marathon on New Year's Day. It was a resolution that I wanted to complete, to run Providence after three years of setbacks. I wanted to begin my year with a commitment to maintaining my health and achieving ambitious goals.

For four months, I trained for the marathon. Although there were times I didn't feel like running because I was tired or busy, I overall enjoyed each of my runs, whether they were six-mile loops around the Charles River or long runs that ranged from 15-20 miles on weekends. Whenever I got bored of running along the Charles River, a route that I have run countless times, I decided to explore unfamiliar places on my long runs, from Newton to Winchester.

What I like the most about running is its meditative nature. There's something powerful about continuously moving for a long period — it allows me to clear my thoughts instead of letting them stay in one place. When I run, I try to focus on the present moment, instead of letting my thoughts distract me. By doing so, I have become comfortable embracing boredom on my runs. Besides practicing mindfulness, running encourages me to go outside and appreciate my natural surroundings. Although Cambridge and Boston are urban, the Charles River and other parks like the Emerald Necklace have many trees, which offer some semblance of nature. After spending a whole day indoors working in front of a monitor, it's always nice to get a breath of fresh air and enjoy the view on my run.

Running the Providence Marathon

After 16 weeks of training, race day finally came. The day before the marathon, I couldn't help but worry about what would happen on race day, like getting severe leg cramps or hitting a wall of exhaustion. Even though I followed the runs on my training schedule, which included a 20-mile run, 26.2 miles felt like a distance on a whole new level. When I arrived at the start line at Bold Point Park, however, my worries began to ease. The sunny, blue sky had wispy clouds, and I could feel a gentle breeze near the clear river. Although the temperature was on the colder end, I looked forward to running a marathon in this weather.

For the first half of the marathon, I had a delightful experience. After crossing the Linear Park Bridge, I ran along the Seekonk River, a scenic riverfront route. Then, I got to explore the peaceful, quiet residential neighborhoods of Providence and Pawtucket, where historic homes had neatly trimmed lawns and nice tree-lined streets. Based on my watch, my average mile time was faster than I had expected, which made me feel quite confident about finishing within four hours, even if that meant a slower mile time towards the end.

The second half of the marathon route was in East Providence and Barrington. The route was first the East Bay Bike Path, a route with impressive coastal views, followed by a large loop around the Rhode Island Country Club, and then back to the East Bay Bike Path. When I crossed the half-marathon mark, I was happy, but it felt like false optimism — I was only halfway done. Yet it felt like I had already run so much. It was too early for me to know what the end would be like. There were around 13 more miles to go, which meant about 2 more hours of running.

> **The last 6.2 miles felt like the longest part of the race, as if time got significantly stretched and all the time before that got compressed.**

Between miles 14–16, my excitement gradually dissipated because I still had a long way to go. I also started to feel bored, probably because there were fewer things to see on the route and my iPod finished playing all my Fall Out Boy songs. I also noticed that my average mile time began increasing slightly, but it was nothing out of the ordinary and did not concern me. But around mile 18, running felt much harder than before. Part of the reason was the strong wind, but my legs and feet felt much heavier. I wasn't in pain, but my body felt a lot more exhausted, causing me to drastically slow down.

When I saw the mile 20 marker, I felt a lot more hopeful, even if that meant I still had 6.2 miles to go. But my hope was fleeting because my mind returned to thinking about how heavy my feet felt, as if they were bricks. Consuming energy gels helped, but they were not enough to replace my depleting glycogen levels.

The last 6.2 miles felt like the longest part of the race, as if time got significantly stretched and all the time before that got compressed. I noticed that my mile time was higher than my mile time in the first half, and by this point, I wasn't sure if I could make a sub-four-hour marathon. I was nervous at first, but I quickly adjusted my expectations and told myself that I should be happy to finish the race without getting any injuries in the end. In other words, my baseline expectation was to keep moving: just lift one foot at a time and look ahead.

Besides feeling much more tired, what made the last 6.2 miles worse than the first 20 miles was the strong winds on the waterfront route, which made running a lot harder. I was glad it was not raining, which the weather forecast initially predicted, but the wind was just as undesirable. Despite the challenging stretch, a positive thing was that I got to see a nice view of the expansive tidal river. The upbeat rock music also helped me dissociate and distract my mind from thinking about the exhaustion. But when I saw the sub-four-hour pacer come up to me around mile 23, I started to feel stressed, because if I could not run ahead of him, then I was not going to make my goal. On the upside, having him near me forced me to speed up.

VIVIAN HIR—THE TECH

The start line of the Providence Marathon at Bold Point Park on Sunday, May 3, 2026.

Seeing the mile markers in the last 6.2 miles of the marathon felt like bigger victories than before, but the finish line still felt so far, and all I could think about was wanting this run to end. While I kept moving, it felt like time did not. It wasn't until I saw the mile 26 marker that I felt ecstatic, a feeling that lasted for the remaining 0.2 miles of the race. I knew that I could run 0.2 more miles, or about 2 more minutes of running.

The 0.2 miles felt twice as long, but when the finish line was in my sight, I couldn't believe that I was so close to reaching the end. For some reason, I didn't really notice the spectators who cheered or processed what they yelled, probably because I was so focused on crossing the finish line that my mind filtered them out. When I saw the live stopwatch near the finish line, I was delighted to learn that my marathon time was a few minutes under 4 hours.

> **Miles 20 to 26 forced me to keep going and not give up, while miles 26 to 26.2 gave me the final push to finish strong.**

When I crossed the finish line, I thought I would feel immense joy, but I was just relieved. Somehow, crossing the finish line felt somewhat anticlimactic because everything was over. My four months of training culminated in approximately four hours of running, and I was done. Perhaps the anticlimactic feeling came from the event being on a much smaller scale compared to other marathons, like Boston and New York. At the same time, I also felt disbelief. I couldn't believe that I was able to run 26.2 miles without stopping or getting injured.

I thought the rest of the day would feel joyous and celebratory, but that didn't really happen, probably because my friends weren't there to celebrate with me after the marathon. After taking a nice shower and checking out of the hotel, I ate a large breakfast burrito and overly sweet cheesecake at The Cheesecake Factory, which felt like two meals. Even though I felt bloated, I treated myself to an iced mocha at Sydney, a local café, then took the commuter rail and returned to my apartment.

Reflections

Even though the marathon was a mentally draining and physically taxing experience towards the end, I would have done it again. In hindsight, it was worthwhile and gratifying to persist and ultimately cross the finish line. Although the oddly specific distance of 26.2 miles exists for historical reasons, I also believe there's a psychological reason for 26.2 miles. While it would have been nice to end at mile 20, it wouldn't feel like a real marathon unless there was a significant physical and mental challenge; for me, most of this challenge happened in the end. Miles 20 to 26 forced me to keep going and not give up, while miles 26 to 26.2 gave me the final push to finish strong.

That's not to say that nothing happens between mile 0 and 20. For me, the first 20 miles taught me the importance of being patient and acknowledging small wins, as each mile was instrumental in completing the marathon. Having to run this long distance has also encouraged me to enjoy the present moment, instead of being fixated on the end goal because that makes the experience lose its fun and meaning.

Overall, running the marathon has taught me that I can achieve difficult goals, even if they may seem impossible at first. It has driven me to be persistent, resilient, and have the courage to take risks. Besides having better physical health, marathon training has also motivated me to build strong habits in other areas, including diet and time management. Throughout my marathon training, I have considered how the mindset I have developed for marathon training can be applied to other parts of my life.

Like running a marathon, achieving big goals requires achieving small goals one at a time. Doing this requires consistency, dedication, and patience. Even if the ultimate goal may be large and overwhelming, it is important to celebrate progress along the way to reach that goal. Likewise, achieving goals means not making excuses. While it is tempting to think that something will be done later, it may never get done if one keeps making excuses.

I don't know how long my body can run marathons for. For now, I hope that I can run one marathon a year, ideally a different marathon each time, so I can explore new places in the country and the world. One major item on my bucket list is to run all six Abbott World Marathon Majors (Boston, New York, Chicago, London, Berlin, Tokyo) before I die. I don't know if I will be able to complete all of them, since my options are either lottery or charity entry because my time isn't fast enough as of now. Even if I don't make this goal, I would be very happy to even complete one of the six.

When I reflect upon how I have changed ever since I left home for college, the biggest positive change I can think of is becoming a runner. College has been full of ups and downs, but I am proud that I am able to run a marathon, a goal that I didn't think was even conceivable four years ago.

Award-winning author Celeste Ng discusses 'Everything I Never Told You' at MIT

The bestselling debut novel explores family secrets, conflicts, and ties

Celeste Ng

Everything I Never Told You

EG&G Education Center (34-101), MIT

April 28, 2026

By Vivian Hir
SENIOR EDITOR

On April 28, award-winning author Celeste Ng discussed her debut novel, *Everything I Never Told You*, at an MIT Libraries community event titled "Hidden Truths & Human Ties." Associate Professor of Literature Sandy Alexandre moderated the discussion. MIT Reads, an MIT Libraries program that aims to foster community book discussion, selected *Everything I Never Told You* as the book for spring 2026.

Ng is the author of three bestselling novels — *Everything I Never Told You, Little Fires Everywhere,* and *Our Missing Hearts*. Her accolades include the Pushcart Prize and the Guggenheim Fellowship. Ng grew up in Pittsburgh, Pennsylvania and Shaker Heights, Ohio. She majored in English at Harvard and received an MFA from the University of Michigan.

> **From the writing process, Ng came to realize that the book's central question is whether somebody can truly understand someone else's experiences, and vice versa.**

Everything I Never Told You is about the multiracial Asian/white family of James and Marilyn Lee in 1970s small-town Ohio. When teenage daughter Lydia's body is suddenly found in the local lake, her unexpected death causes the family to unravel, as they each grieve differently and struggle to understand one another. The novel explores many complex themes that center around family conflict, including secrets and generational differences.

Ng began by reading a passage from the novel about the pressures Lydia feels from her mother's high academic expectations. Marilyn wants Lydia to become a doctor, as she herself never became one. Lydia's parents view her as a high achiever, but in reality, Lydia is struggling: she does well in college-level biology because she cheats off of her classmate, and she is close to failing high school physics.

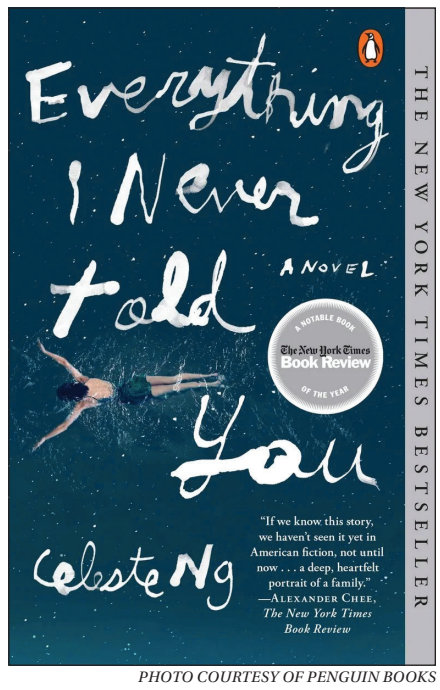


PHOTO COURTESY OF PENGUIN BOOKS

The cover of Celeste Ng's debut novel, 'Everything I Never Told You,' a 2014 *New York Times* bestseller.

The passage was filled with engaging, vivid details about Lydia's struggle to comprehend physics and biology, from the daunting unknown variables in her physics homework to memorizing random biology concepts. This narrative makes her a relatable and sympathetic character for the audience. Although it is clear from the passage that Lydia is unhappy, she chooses to keep quiet and let her secrets grow instead. The other family members also remain silent, ultimately fracturing family dynamics.

Since the book focuses on family tensions and conflict, its story has reportedly encouraged many children and parents to better understand one another through conversations, even if they may be difficult. For Ng, this is one of her favorite things to hear at a book event.

"I really feel like this is a huge honor to have that [impact] and is something that I try not to take lightly," Ng said.

When Ng wrote the book, she did not enter with the mindset of having a "thesis" or message for readers about the family. Instead, she used an investigative approach, asking many questions about their situation throughout the writing process; it wasn't until the end of the book that all the pieces came together for her.

> **"You have this idea that the closer you are to someone, the more you know everything about them," Ng said. "I don't know if that's always true."**

From the writing process, Ng came to realize that the book's central question is whether somebody can truly understand someone else's experiences, and vice versa. She shared that her family related to this question; her parents immigrated from Hong Kong, but she was born and raised in the U.S. These cultural and generational differences made Ng wonder how much she could explain her experiences to her parents, such as growing up in a place where very few people besides her family looked like her.

"They knew we had that [experience], but I don't think they knew exactly what it was like, because they haven't experienced it," Ng said.

Ng believes that the main piece of advice in the book is that even though it may be difficult for one to explain their past and experiences to someone, it is still "worth trying" instead of just "giving up." However, Ng recognized that the main barrier to having open conversations is that people don't want to share certain things about themselves. Although many of these unsaid experiences are secrets, Ng stated that some things simply end up not entering the conversation.

"You have this idea that the closer you are to someone, the more you know everything about them," Ng said. "I don't know if that's always true."

In regards to the family's secretive nature, Ng attributes this dynamic to cultural clashes that not only include racial and ethnic differences, but also generational differences. She acknowledged how these differences can pose parenting challenges.

"I don't actually know anyone who is growing up in the exact same culture [as someone else], right? The world changes," Ng said.

Despite this gap, Ng hopes that families can find a point in the middle where there is some mutual understanding, instead of letting differences persist and cause friction in relationships.

To foster dialogue across differences in families, Ng shared that it helps to encourage others to listen. She commented on how people tend to focus more on talking in conversations instead of listening, which she argues is also important. In addition, Ng encouraged the audience to enter a conversation with the "willingness to sit in uncertainty" and not be focused so much on making progress, since progress in conversations is "slow work" and requires time.

While progress can feel incremental, Ng underscored the importance of persisting in hard conversations. "The work of it is in staying in that conversation and keeping on having these conversations again and again," she said.

PHOTO COURTESY OF BRYCE VICKMARK

Celeste Ng (left) discusses her bestselling debut novel, 'Everything I Never Told You,' at an MIT Libraries event on Tuesday, April 28, 2026.

From MIT to Veritasium

Leah "Sulli" Yost '22 uses her MIT education to make videos for one of the world's leading science YouTube channels

By Veronika Moroz
SCIENCE EDITOR

Breaking down the science of superglue and its applications to everything from wound treatment to preventing microplastic pollution. Traveling to the Netherlands to look inside the machine responsible for some of the tiniest, most delicate parts of modern computers. Illuminating a logical paradox so divisive that experts around the world — and in the YouTube comment section — can't agree on the optimal solution.

In the two years since Leah "Sulli" Yost '22 began working as a writer and director for the science YouTube channel Veritasium, she has gone deep down many scientific rabbit holes. Her videos have been published in seven different languages, reaching Veritasium's over 20 million subscribers.

Though Yost says she's "always really loved" stories of many forms — including movies, books, and interactive infographics — her path to YouTube was not exactly linear. Originally a mathematics (Course 18) and writing (Course 21W) double major, Yost only began working on science videos after Veritasium hired her. She was able to navigate the change because of her love for writing and her MIT education.

Writing her way through college

During her undergraduate studies, Yost was one of few students who declared a humanities major before picking a technical major to go with it. She had entered MIT planning to major in mechanical engineering (Course 2); however, after spending her summer doing research in a MechE lab, she realized the subject wasn't for her.

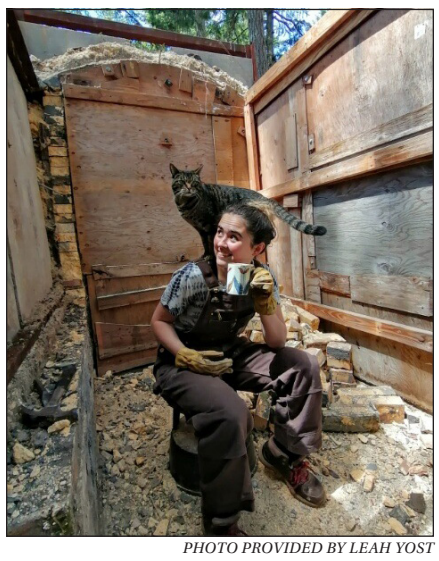


PHOTO PROVIDED BY LEAH YOST
Yost working on an art project.

> **"I honestly think the MIT learning experience is a far better preparation than the actual math major," Yost reflected.**

"It was really boring," she recalled. "If I stuck with mechanical engineering, a lot of jobs would just be looking at computers. If I'm going to be looking at computers, I want it to be more interesting."

However, Yost credits the experience with inspiring her to commit to writing. "I [realized] I can't do this for the rest of my life, so I better figure something out with writing, because I can actually do that, and I love it," she said.

Many MIT students avoid declaring Course 21W because of the thesis requirement, a long-form piece that Course 21W students develop during their senior year. Yost, on the other hand, loved writing so much that the challenge of completing a thesis for her major excited her.

"I would procrastinate on my psets by doing my writing assignments," Yost recalled.

Her writing classes turned out to be some of her favorites: namely, Science Writing and Contemporary Society (taught by USA Today Enterprise Editor and Writing Lecturer Karen Weintraub), and Apocalyptic Storytelling and Critical Worldbuilding (both taught by Pulitzer Prize-winning Professor Junot Díaz).

Yost complemented her writing major with a math major because she enjoyed exploring math, thought she could reasonably complete the double major, and wanted to develop technical skills.

"If I was going to go into science writing, a math major would give me the background I needed to explore basically any other subject," Yost explained.

Today, Yost says she's benefited less from what she learned and more from how she learned it. Since every video she makes immerses her in a new topic, her experience learning math at the Institute helps her parse intimidating research papers. But "having the confidence to [say], 'I can tackle this' is more helpful," according to her.

"I honestly think the MIT learning experience is a far better preparation than the actual math major," Yost reflected.

PHOTO PROVIDED BY LEAH YOST
Leah "Sulli" Yost '22 is a writer, director, and science communicator.

Diving into science YouTube

After being rejected from the MIT Graduate Program in Science Writing a year after graduating, Yost was looking for a job when she stumbled across a LinkedIn job posting for Script Writing and Directing at Veritasium. She applied and got the job, but she still faced a large knowledge gap: Yost had never made science videos before, and she didn't consider herself a "YouTube aficionado." Fortunately, she had the help of the large team working at Veritasium, from additional writers, editors, and animators to the video hosts and Veritasium founder Derek Muller.

"The learning curve is crazy," Yost admitted. "I mean, it's maybe not quite as steep as the MIT one, but it's pretty steep because you wear a lot of hats."

By taking on both the script-writing and directing roles, Yost also bore the responsibility of scheduling the people involved, picking everything from the storyline to the video thumbnail and studying existing literature on the topic.

One of the biggest struggles for her was figuring out what ideas would stick. Though Yost was given guidelines for what stories Veritasium usually tells, she initially struggled to get her ideas approved. Now, she's gotten so much practice that she can notice flaws in other people's potential pitches.

"The things that Veritasium looks for in videos are some sort of mystery, misconception, or curiosity," Yost revealed. For example, she recently finished making a video about a machine manufactured by the company ASML, which uses lasers to make computer parts smaller than the wavelength of visible light. Not only did Yost break down the mystery of how this process occurs, but she was also able to take viewers inside the machine, highlighting Veritasium's second signature video technique: "really big visual stunts."

Veritasium has grown since Yost made her first video, and she's been able to work with a larger team so that she can focus on fewer responsibilities. But most of what she's learned before was through trial by fire.

"You watch a lot of YouTube videos and you learn a lot, mostly by submitting bad stuff and other people telling you it's bad, then fixing it," Yost said.

An MIT student through and through

Looking back, Yost finds her path to science communication a bit surprising. "You know, when I was in college, I was like, 'there has to be some sort of path,'" Yost recalled. "And it is so *random*! I'm so sorry, but it is random," she added, laughing.

When she came to MIT, Yost didn't know she was going to be a writer. But she did know she loved writing, and she worked hard to get better. To this day, she stays in touch with some of her writing teachers from MIT, including Weintraub.

It's through this mixture of luck, talent, and determination that Yost has excelled at her work, producing one of Veritasium's longest videos yet and racking up hundreds of thousands of views. By staying true to herself and being open to new opportunities, she found a job where she can pursue her love of storytelling and learn a lot while doing it.

The Marble Center celebrates its 10th anniversary, showcases success stories behind translating experiments to clinical products

Since 2016, MIT's Marble Center for Cancer Nanomedicine has been working to bring cutting-edge nanoscience to cancer care

By Chelsy Goodwill and Jojo Placides
SCIENCE STAFF WRITERS

"The world that we can't see is so rich in detail and possibility," said Susan Hockfield, professor of Neuroscience and President Emerita of MIT. From bacteria and viruses to DNA and proteins, much of biology exists at the nanoscale. MIT's Marble Center for Cancer Nanomedicine was born to meet the need for a research center that focuses on the power of cancer technology at this scale.

Founded in 2016, the Marble Center for Cancer Nanomedicine is a collective of faculty research labs that aims to advance cancer nanomedicine, a field that seeks to detect, treat, and monitor cancer progression through biomaterials only a few water molecules in size. On April 9, 2026, the Marble Center celebrated its 10th anniversary at the Broad Institute.

Director Sangeeta Bhatia PhD '97 stated that the center's goal is "to build a community, to train the next generation of leaders, and to translate inventions that maybe were considered high risk or futuristic towards patients and into the future." Since the Marble Center's creation, these labs have published hundreds of papers, trained 491 graduate students and postdoctoral fellows, begun eight Investigational New Drug-IND enabling studies (the final pre-clinical experiments before human testing), and created 23 startups, some of which presented at the celebration's panel.

The event featured opening remarks by Bhatia, as well as Marble Center member and David H. Koch Institute Professor Robert Langer ScD '74. This was followed by a panel of biotechnology executives led by Hockfield, who shared success stories behind translating an experimental discovery into products for real patients.

Because cancers are so diverse, their treatments need to be diverse too. The panelists tackled cancer treatments from various angles, all showing success stories of translation, from ideas to clinical trials and eventually, manufacturing.

Viktor Adalsteinsson PhD '15, co-founder of biotechnology start-up Amplifyer Bio and director of the Gerstner Center for Cancer Diagnostics at the Broad Institute of MIT and Harvard, described his experience in studying cancer detection. A potential non-invasive way to diagnose cancer is to draw blood from a patient and screen it for shed tumor DNA, a test known as a liquid biopsy. However, patients' livers ingested and destroyed most of these molecules, leaving behind an undetectable amount for the liquid biopsy. While obtaining his PhD at MIT's Love Lab, Adalsteinsson founded Amplifyer Bio. This company produces a decoy nanoparticle that acts as a priming agent and distracts the liver for long enough to allow tumor DNA to accumulate to detectable levels. Then, the blood sample is taken and properly screened for this DNA, enabling doctors to monitor and detect cancer early, when it's most treatable.

> **"Do I want to use the most exciting, novel approach? It works great in the discovery setting, but it has impacts [in the manufacturing side]," Dudkin said.**

Meanwhile, precise treatment is the mission of Noor Jailkhani, the CEO, cofounder, and president of Martisome Bio, which focuses on radiopharmaceuticals. Radiation therapy is currently a standard of care treatment for solid tumors. It uses high-energy beams to induce DNA damage, leading to cell death. However, radiation also kills healthy cells in the process, causing unnecessary damage and side effects in patients. Matrisome Bio's product is a small, highly specific protein called a nanobody attached to a radioactive payload. The nanobody is engineered to bind to the extracellular matrix (ECM), a scaffold of proteins and sugars that surrounds both cancerous and normal cells. The ECM undergoes a process called ECM remodeling around sites of inflammation, such as tumors. This makes the cancerous ECM a conserved drug target across patients. Matrisome Bio's nanobody delivers targeted radiation to the remodeled ECM and thus, cancer cells. Jailkhani hopes that this tech-

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Why MIT needs to gradually and responsibly train its future doctors in the AI era

The Harvard-MIT Health Sciences & Technology Program must also ensure that technical AI literacy doesn't come at the expense of student mental health

By Archana Podury

In the field of medicine, the reach of AI has expanded from early research initiatives to direct clinical applications. AI has already been used to catch abnormalities early on through radiology and imaging, to manage patient flows in hospitals, and to simplify medical documentation through transcription systems, among other applications. However, even as AI use has expanded in medicine, we do not yet have clear guidelines on its use.

While many clinicians have voluntarily adopted AI tools for tasks such as diagnostic support and note-taking, others have stayed on the periphery. This self-driven adoption of AI, along with a sense among clinicians that they must "catch up" to better implement AI-based tools, has created a feeling of subtle pressure and uncertainty in medical circles. Pioneering medical institutions such as MIT must prepare future medical professionals for this transition in a systematic way.

It is therefore essential that these curricula are integrated into medical education while balancing the well-being of medical students and the demands placed upon them. To do so, AI literacy should be incorporated into existing medical education frameworks in a structured manner and as a core competency, alongside medical systems analysis, statistics, and medical ethics. Embedding AI into familiar curriculum structures, as opposed to open-ended self-learning, gives students clear expectations, reducing uncertainty and anxiety around AI use. Students, too, agree that AI learning is key, yet must be done while keeping both AI's benefits and risks in mind. According to a survey of 145 pre-medical students and medical school applicants, over 66% of participants believed that AI-based skills are essential for their careers, and 81% responded that physicians should be aware of AI risks, including hallucinations, bias, data quality issues, and overreliance on results.

Throughout their training, medical students and physicians must learn to assess the benefits and drawbacks of publicly available AI models, recognize structural and implicit biases in clinical datasets, understand data privacy and the Health Insurance Portability and Accountability Act (HIPAA), and guide ethics and policy discussions. These new responsibilities, however, increase an already tall burden on what clinicians must learn through medical training — exacerbated by stressors such as burnout, costly educational loans, and now, practicing medicine amidst rapid technological advancements with significant implications on the field.

> **"We need clinicians who are not only technically trained in using technology, but who also feel confident and mentally resilient while navigating it responsibly."**

A formal curriculum might cover a basic overview of the architecture of various AI models, data management, data confidentiality, outcome assessment methods (e.g. for diagnostic accuracy, finalizing treatment, or patient safety), along with the common pitfalls of using AI. Medical students can gain more exposure to AI-based tools through journal clubs that critically analyze model architecture and outcomes. Clerkships can offer hands-on didactics about integrating AI-based tools into clinical workflows. Quantitatively-oriented programs such as the Harvard-MIT Health Sciences & Technology (HST) Program can provide students with opportunities to build or modify simple open-source AI models using common coding platforms, which might involve AI coding agents such as Cursor or Microsoft Copilot.

While such structured learning can reduce ambiguity and overwhelm around AI use for medicine, we must also offer adequate mental health support to students and residents. For instance, protected wellness time in clerkships can provide scheduled rest periods for students and recent graduates. Other measures could include longitudinal faculty mentorships with frequent student check-ins and peer support groups. Schools can also offer skills-based sessions on stress management and cognitive behavioral strategies. In addition, institutions should prioritize confidential, no-cost counseling for all students.

As medical institutions like MIT begin to train their cohort of future healthcare professionals about the role of AI in medicine, they must ensure that the training is being done strategically and holistically. We need clinicians who are not only technically trained in using technology, but who also feel confident and mentally resilient while navigating it responsibly.

Dr. Archana Podury '23 earned her MD from Harvard Medical School in the Harvard-MIT Health Sciences & Technology (HST) Program and is now an admissions consultant at Inspira Advantage, a medical school admissions consulting firm.

OPINION POLICY

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Nanomedicine for cancer metastasis

MIT Marble Center, from Page 6

nology will address what she calls "the largest unmet need for oncology": metastatic tumors, or cancer cells that spread from the primary tumor.

Peter DeMuth, the chief scientific officer of Elicio Therapeutics, explained how his company develops peptide-based cancer vaccines that target the lymph nodes, where most immune cells are created. However, in developing such technologies, the company ran into a fundamental problem with vaccine delivery. On paper, peptides are perfect candidates for cancer vaccines, since they can be engineered to bind to specific biomolecules. However, the lymph nodes are a difficult destination; the body can easily ship them off to the blood or destroy them entirely. Elicio Therapeutics utilizes albumin hitchhiking to tackle this obstacle, according to DeMuth. With this strategy, components are bound to albumin, the same protein that makes up egg whites. Using albumin as a shuttle, Elicio Therapeutics's peptide-based cancer vaccines target a mutated driver of cancer growth known mKRAS that can reach the lymph nodes, and eventually the blood.

According to Dudkin, solving the problem of drug delivery will eventually allow researchers to better control cells.

While Elicio Therapeutics focuses on delivering peptides to lymph nodes, Souffle Therapeutics aims to enable the targeted delivery of siRNA-based medicines to any cell in the body. Small interfering RNA (siRNA) is a class of double-stranded RNA molecules that silence specific genes that create disease-causing proteins. Like with previous technologies, delivery of these siRNA-based medicines to the cells became a problem. The siRNA's hydrophilic nature can prevent it from passing through the hydrophobic cell membrane.

Vadim Dudkin, the founding chief technology officer at Souffle Therapeutics, talked about the company's systematic approach to this problem. When delivering molecules to cells, they often need to be attached to a ligand which interacts with cell surface receptors, akin to a key being inserted into a door lock.

"We [screen] cells and whole tissues to identify what receptors are on the surface, and then how we can identify subsets of them that can drive productive delivery," Dudkin said. Using these subsets of receptors, ligands can then be designed so that molecules are allowed entry into certain cells in the body.

Panelists agreed that scaling up novel technologies was one of the biggest challenges in translating their ideas to an actual product. Manufacturers have to decide if new and innovative ideas can withstand large-scale manufacturing.

"Do I want to use the most exciting, novel approach? It works great in the discovery setting, but it has impacts [in the manufacturing side]," Dudkin said.

The solution, Dudkin explained, is to balance between innovation and reliability. "We ended up going from the fanciest, most sophisticated... technologies to things that are in already approved drugs and have been in them for decades," he remarked.

DeMuth similarly noted that, in scaling up discoveries, simplifying a complex process is often key. For example, polyethylene glycol (PEG) is a cheap and readily-available polymer frequently used in many academic settings for the synthesis and modification of drug molecules, often binding drugs to ligands or coating the drug. However, PEG is a chain of ethylene glycol units, and they often come in different sizes determined by how many units are in the chain. If researchers use different masses of PEG, they will yield different products.

"We started to imagine this convoluted mass problem where many [products] would have very complex mass profiles," DeMuth said.

Instead of dealing with this complication, DeMuth chose to simplify the problem by using a variant of PEG called discrete PEG, in which every chain has the same number of ethylene glycol units and, therefore, the same mass. "That eliminates a lot of complexity and ultimately gives us a lot more control over the product as it goes forward," DeMuth explained.

Hockfield closed the discussion by asking the panelists what they think the next decade of nanomedicine will yield. Both Jailkhani and DeMuth answered that precision will be the key impact of nanomedicine, allowing scientists to eliminate treatments' side effects and deliver payloads more effectively and accurately.

According to Dudkin, solving the problem of drug delivery will eventually allow researchers to better control cells. "When we figure out delivery, we will figure out how to drive the molecular biology of the cell in a way that will alleviate the disease," Dudkin said.

From exploiting the extracellular matrix to using albumin to deliver molecules to the lymph nodes, the Marble Center's 10th anniversary celebration was a showcase of stories where bold, innovative ideas get transformed into solutions for the real world.