FRONTIERS

BYU COMPUTATIONAL, MATHEMATICAL, & PHYSICAL SCIENCES SPRING 2024

50 YEARS
BYU COLLEGE OF COMPUTATIONAL, MATHEMATICAL, & PHYSICAL SCIENCES

FRONTIERS

BYU COMPUTATIONAL, MATHEMATICAL, & PHYSICAL SCIENCES

SPRING 2024

To celebrate the remarkable journey of the college over the past five decades and commemorate its growth and achievements, the college shared a fifty-foot cake with students, faculty, and staff on campus.

Dear alumni and friends,

As we celebrate the college's fiftieth anniversary and consider all that our alumni, faculty, and students have accomplished over the past year, we are incredibly proud. Just a few of these recent accomplishments include the applied and computational mathematics emphasis (ACME) program's 2024 Award for an Exemplary Program or Achievement from the American Mathematical Society and the BYU actuarial science program's receipt of the highest university recognitions from both the Casualty Actuarial Society and the Society of Actuaries.

We hope you will take a moment to visit science.byu.edu/50 and enjoy the videos that celebrate the past fifty years of the college and show how far we've come. We are excited for what the next fifty years will bring as we strive to become the "educational Everest" President Kimball challenged us to be, and we rely on you to help us reach this lofty goal.

To commemorate the college's fiftieth anniversary, we have set two major goals that will require alumni support. The first is to perpetually fund fifty student research positions every year going forward. The donations toward this goal will fund mentorships, scholarships, and experiential learning opportunities for fifty undergraduates every year. A second goal is for five hundred additional alumni to sign up as mentors on BYU Connect. The number one request we receive from our graduating seniors is for more mentoring from alumni, and signing up for BYU Connect lets us know you are open to mentoring in the future. To learn more about these goals, please visit science.byu.edu/50/give-back.

At Brigham Young University, we believe in the power that mentorship has to unlock our students' potential. Our commitment to mentoring extends beyond traditional classroom settings, fostering a faith-based culture of guidance and support. Our alumni often credit their mentors with providing valuable guidance, offering unwavering support, strengthening testimonies, and instilling in students a passion for their field. The connections students make at BYU have proven to be lasting relationships that continue to shape professional and personal journeys long after students graduate and go forth to serve.

As I follow in the footsteps of the former deans of the College of Computational, Mathematical, and Physical Sciences—including Jae R. Ballif, our college's first dean, who is spotlighted in this issue—I feel a tremendous responsibility to help the next generation of BYU students.

Thank you for staying connected with your BYU family. Your support for the mission and students of BYU inspires the university to take its place among the exceptional universities in the world.

Sincerely,

Grant Jensen

Grant Jensen, *Dean*
BYU College of Computational, Mathematical, & Physical Sciences

COVER CLOUD PHOTO BY DEMBEE TSOGOO/UNSPLASH; RIGHT PAGE, BOTTOM PHOTO BY KYLAND OCHSENBEIN

FRONTIERS

SPRING 2024

CONTACT INFORMATION

All communication should be sent to:
frontiers@byu.edu

FRONT COVER *Geremy Mustard, BYU alumnus and one of the creators of* Fortnite *(see page 8).*
BELOW *Mustard testing out a game created by BYU animation and computer science students during a student mentoring visit to campus.*

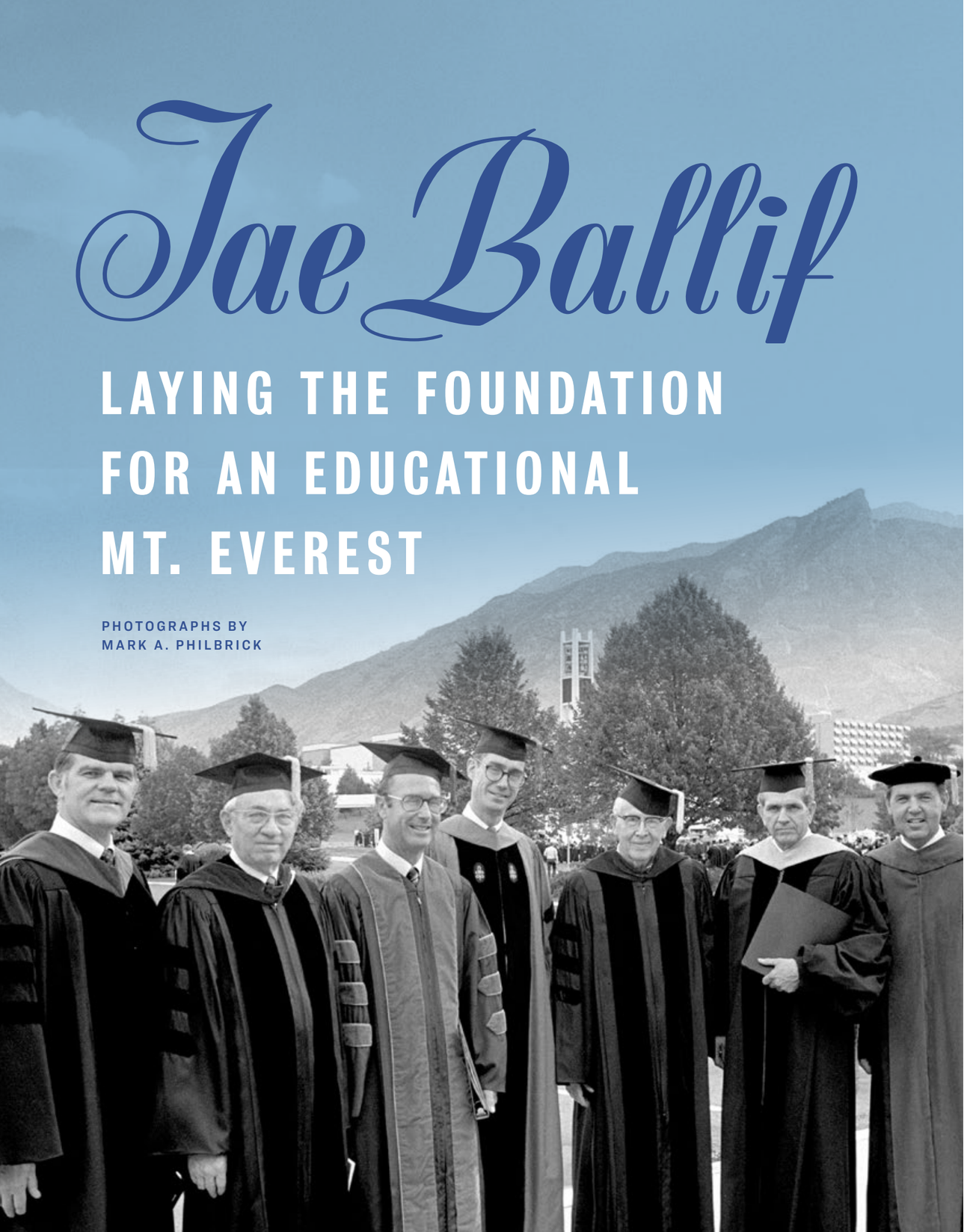
NOTE *Effective May 2024, the College of Physical and Mathematical Sciences is now the College of Computational, Mathematical, & Physical Sciences.*

CONTENTS

Jae Ballif

LAYING THE FOUNDATION FOR AN EDUCATIONAL MT. EVEREST

PHOTOGRAPHS BY
MARK A. PHILBRICK



The college's founding dean, Jae Ballif, looks back on his role in crafting BYU's *enduring mission statement.*

It's hard to imagine a time when Brigham Young University didn't have its resolute declaration "to assist individuals in their quest for perfection and eternal life." This and other iconic phrases from the BYU mission statement were carefully crafted in part by the college's founding dean, Jae Ballif. While serving as BYU's provost, Ballif worked alongside then BYU president Jeffrey R. Holland to create BYU's mission statement. Ballif's prior assignment as the inaugural dean of the College of Physical and Mathematical Sciences helped prepare him for this momentous task. As we celebrate the college's fiftieth anniversary, we look to our first dean and his formidable assignment to help form BYU's mission statement and honor the impact both the college and the mission statement have had on BYU.

BYU'S UNIQUE FOCUS ON UNDERGRADUATE TEACHING AND RESEARCH

When Jae Ballif joined the BYU faculty in 1962, physics and mathematics were in one department, and there was one large College of Physical and Engineering Sciences. Ballif's department wanted to expand research efforts but not at the expense of quality teaching, so Ballif began to experiment with new kinds of teaching, creating larger classes and developing new teaching methods to maintain quality instruction. He developed experiments to demonstrate physics principles during class. Ballif even filmed the experiments, added explanations, and put copies in the library so students could rewatch the experiments as many times as they wanted. This was cutting-edge technology in the 1960s.

Ballif helped build the legacy of focusing on undergraduate teaching, which continues today. In an address to BYU faculty, Jeffrey R. Holland recently commented:

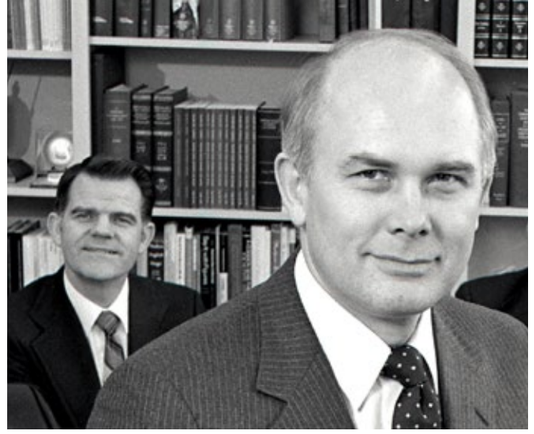
It seems clear to me in my seventy-three years of loving it that BYU will become an "educational Mt. Everest" only to the degree it embraces its uniqueness, its singularity. . . . We must have the will to be different and to stand alone, if necessary, being a university second to none in its role primarily as an undergraduate teaching institution that is unequivocally true to the gospel of the Lord Jesus Christ.[1]

Clark G. Gilbert, commissioner of the Church Educational System (CES), also observed, "This is the only place [in the CES] where we are really going to do concerted scholarship as part of our mission. . . . BYU is the flagship. You are the hope of Israel."[2] While many universities focus either on research or teaching, BYU seeks to thrive in both areas.

While quality teaching has always been of utmost importance to Ballif, he also recognized the need for research at BYU, especially in the sciences. "If you're going to be an Everest in education, you have to be a contributor to the ideas of the discipline," Ballif says. "You can't just follow along 10 years later and get part of the story. The creative mind must be at work, and that's why students do research in our disciplines." To this end, Ballif built a research lab and began mentoring several students. He soon saw how transformative mentored research was for both students and faculty. "Mentoring research students takes a lot of time, energy, emotion, and money," says Ballif. "I'm not saying BYU can do it at the level they do it at Caltech or Harvard, where they have resources way beyond what we have any idea of obtaining. But I think we'll have some divine help that gets us to where we are to go if we're working hard enough."

The emphasis on student research at BYU has grown tremendously in the past several decades, especially in our college. Last year, there were nearly five times as many student researchers as there were a decade ago. Ballif has great hope in our students and the scientific discoveries they will make. "Who's going to tell us what dark matter and dark energy really are and how they cause the acceleration of galaxies?" he asks. "I'd like to think some of our people [at BYU] will contribute to the best thing that happens in understanding this beautiful creation of ours, especially in the sciences."

◀ (left to right) Jae Ballif, Gordon B. Hinckley, David P. Gardner, Henry B. Eyring, Ezra Taft Benson, Boyd K. Packer, and Jeffery R. Holland



A NEW DEAN FOR A NEW COLLEGE

Half a century ago, then BYU president Dallin H. Oaks announced the division of the College of Physical and Engineering Sciences. The Departments of Chemistry, Physics and Astronomy, Geological Sciences, Mathematics, and Statistics moved to the newly created College of Physical and Mathematical Sciences. The Computer Science Department joined the college within a few years, and the Department of Mathematics Education was added several decades later. Although Ballif was a young professor focused on research and teaching, he was asked to be the founding dean.

As the first dean of the college, Ballif addressed two major needs. First, he hired someone to oversee the financial and physical needs of the college so that Ballif could focus on the faculty and the curriculum. Second, Ballif created the Student Advisement Center and hired an advisor, who began tracking students' progress in their majors. With those positions elevating the work of the college, Ballif began working with the department chairs to strengthen the vision and goals of each department. He wanted the department leaders to know two things: "They had to understand the mission the college was engaged in and the principles that were guiding the work," Ballif says. "We all had to understand the principles that were going to be applied in making decisions. Then I thought the chairs could operate under those conditions with as much freedom as possible."

As science and technology began impacting more fields across the university, some departments considered hiring their own physics, math, statistics, and computing faculty to teach classes for their majors. Ballif believed in the importance of having faculty members who were deeply rooted in the discipline and could understand the discipline's applications in various fields enough to create courses that would be useful for students in other majors as well. Then when the technology changed, as it inevitably would, the faculty would have enough background in the discipline to adapt.

A CALL WITHIN A CALL

Ballif and his wife were called to preside over the Massachusetts Boston Mission for The Church of Jesus Christ of Latter-day Saints in 1977. The mission covered the New England states from Maine down to Rhode Island and Connecticut. But President Oaks felt he needed Ballif back at BYU, so he asked Church leadership if Ballif's mission could be shortened. The Church asked if the Ballifs would object to serving only two years instead of the typical three. Ballif responded, "Look, we have the same boss in both jobs. So you tell us what you want us to do, and we'll be happy to do that."

Then President Oaks flew to Massachusetts and personally asked Ballif to come back to BYU, this time as a vice president. "I couldn't give him an answer immediately," Ballif says. "It wasn't what I had in mind. I still wanted to do research and teach physics, but I said I'd think about it for a month and call him back." After many prayers and conversations, the Ballifs had an answer for President Oaks. "If you only keep me a little while, I'll be a vice president," Ballif responded. Then he clarified, "I still want to do some of the other things I came to the university to do." Ballif served as the administrative vice president, responsible for intercollegiate athletics and media services. At the end of the year, President Oaks left BYU and became a judge on the Utah Supreme Court, but Ballif's time in BYU administration had only begun. BYU's new president, Jeffrey R. Holland, asked Ballif to become the provost and oversee all academics at the university. Once again, Ballif struggled with his decision but ultimately accepted the office. He served throughout President Holland's tenure.

▲ Top Left: Ballif with President Dallin H. Oaks, former BYU president; Top Right: Ballif with Elder Jeffrey R. Holland, former BYU president

"We were to become an intellectual Mt. Everest. . . . That was no small charge, but we took it very much as a prophecy for us."

—Jae Ballif

A PROPHETIC CALL TO ACTION

The university needed to unite faculty, staff, students, and administrators in alignment to a common mission, and President Holland asked Ballif to write the mission statement. It was a heavy task for Ballif because he wanted to get it right, knowing it would aid future decision-making. He also knew it needed to be different from other university mission statements because BYU's mission statement needed to reflect the unique nature of BYU as a religious university.

At the time, Spencer W. Kimball was serving as president of the Church and had recently dedicated BYU's centennial bell tower in commemoration of the University's 100th anniversary. During the dedication, President Kimball gave a pivotal talk titled "The Second Century of Brigham Young University."[3]

President Kimball's address was integral to Ballif's work on the new BYU mission statement. "President Kimball came and gave a remarkable talk that I thought was scripture as far as I and other BYU leaders were concerned," Ballif says. "I think he gave us our BYU mission. We were to become an intellectual Mt. Everest, among other major items. That was no small charge, but we took it very much as a prophecy for us."

Under the direction of President Holland, Ballif and others worked to create a mission statement for the university using President Kimball's talk as a framework. "We, of course, reworked the wording and tried to frame it," Ballif explains. "Working with President Holland, we had a mission statement that was very reflective of the things President Kimball said." The mission statement was approved by the BYU Board of Trustees on November 4, 1981, and is still used at the university today.

SETTING OUR SIGHTS ON THE SECOND CENTURY ADDRESS

In the decades since the College of Physical and Mathematical Sciences was founded, BYU has continued to embrace its singular role in higher education. As the university approaches its 150th anniversary and the midterm of the Second Century Address, we are prompted to ask, "How are we doing at becoming the 'educational Mt. Everest' President Kimball challenged BYU to become?"

As BYU and our college look toward the future, the challenge remains to uphold the principles embedded in BYU's mission statement, fostering an environment that is distinct, exceptional, and true to our foundational values. This challenge was reiterated in President C. Shane Reese's inaugural address: "President Kimball implored us to employ gospel methodology, which will not only distinguish us from other universities but also shape how we learn and improve as a community," he said. "As we embrace our unique institutional identity, we will foster at BYU a unique learning environment that will empower us to be peacemakers in an ever more divisive society."[4]

In celebrating the fiftieth anniversary of the BYU College of Physical and Mathematical Sciences, we are grateful for alumni like Jae Ballif who helped make BYU what it is today. Our college is the result of countless alumni, students, faculty, and staff who make the world a better place through discovery, innovation, and faithful commitment. As we look forward to the next fifty years, we can't wait to see what future students and alumni will accomplish.

NOTES

1. Jeffrey R. Holland, "The Second Half of the Second Century of Brigham Young University," BYU university conference address, 23 August 2021; emphasis in original; quoting Spencer W. Kimball, "Installation of and Charge to the President," *Inaugural Addresses*, 14 November 1980, Brigham Young University, 9.
2. Clark G. Gilbert, remarks, BYU leadership meeting, 15 April 2022.
3. See Spencer W. Kimball, "The Second Century of Brigham Young University," BYU devotional address, 10 October 1975.
4. C. Shane Reese, "Becoming BYU: An Inaugural Response," address given at his inauguration as BYU president, 19 September 2023.

CREATING FORTNITE AND THE FUTURE

BY KIMBERLY JENKINS

```
IF numberRow = INT((sammy(a).row + 1) / 2) AND NumberCol =
    PLAY "MB00L16>CCCE"
    IF sammy(a).length < (MAXSNAKELENGTH - 30) THEN
        sammy(a).length = sammy(a).length + number * 4
    END IF
    sammy(a).score = sammy(a).score + number
```

BEFORE CREATING *FORTNITE*, GEREMY MUSTARD WAS A BYU STUDENT WHO WANTED TO USE VIDEO GAMES TO TELL INTERESTING STORIES.

GEREMY MUSTARD was thirteen years old when he started borrowing his dad's massive fifty-pound work "laptop" to play the game *Nibbles*, in which the player moves a snake around the screen and collects numbers. The snake gets longer each time it "eats" a number, and if the snake ever runs into its tail, the game ends.

But this simple serpentine game became a game-changer for Mustard—and his future. After playing *Nibbles* for a while, he realized that instead of pushing start on the opening screen of the game, he could scroll down and see the game's code in BASIC programming language. "This is it," he realized. "This is what makes the game."

Mustard read through the code, trying to understand how it worked and wondering if there was a way to make the snake longer. Once he found what seemed to determine the snake's length, he changed the number in the code. Then he ran the program and played the game again. This time, his snake grew and grew and grew and grew.

When Mustard realized he had molded the game to do something original, he was amazed—and hooked. "Something in my brain just shifted, and I realized I have the power to make whatever I want," Mustard recalls. "From that point forward, I just became super passionate about learning everything about computers." With only a few example programs, Mustard taught himself BASIC and made his first game by the end of that year.

NEVER STOP LEARNING

Mustard had no internet access at home, and tools like AOL didn't exist yet, so he borrowed books on programming from the local library. At night, he would read in the closet to avoid disrupting his brother's sleep in their shared room. Local ward members and his parents' friends supported Mustard's growing interest, giving him books and their old computer disks with programming languages.

Mustard's hometown of Houston was also home to Compaq Computers, one of the two largest computer companies at the time, and his high school was one of the few that had a computer science program in the 1990s. The computers they used were ancient 286 computers with only 640 KB of RAM and five-inch floppy disks. Mustard tested the limits of programming and the language Pascal, taking simple assignments and making them as big as possible.

One assignment was to create a simple, text-based adventure with prompts like "There is a room in front of you with a door to the east, a door to the west, and a potion in the center of the room. What do you want to do?" Since the story was text-based, the player had to visualize the story in their head. That wasn't enough for Mustard. He wanted to stretch his skills and make a visually animated game, and this *technically* fit within the parameters of the assignment, which said the player needed to navigate through a grid. Mustard decided his grid would be visual, with animated walls and floors that would appear on the screen. While coding his game, he developed his own ASCII art animation tool that allowed him to create a character who could run, jump, climb things, and pull out a sword. He drew and animated characters, saved them into his proprietary file system, loaded them into his game, and created one level to play through with an actual boss fight at the end. "If I'd had one more day, I would've made another level," he says.

LEFT Geremy Mustard (left) on stage at a Tencent Games event in Beijing to open up *Fortnite* in China. **TOP** *Nibbles* (*Snake*) code, where Mustard first discovered the power of computer programming. A Compaq SL286 with 640 KB of RAM.

"GEREMY, WHAT ARE YOU DOING? THAT'S NOT THE ASSIGNMENT."

—MUSTARD'S H.S. TEACHER

When Mustard turned in his assignment, his teacher was baffled. He asked, "Geremy, what are you doing? That's not the assignment." Mustard explained how he met all the requirements of the assignment, just not in the way the teacher expected. Mustard continued to see his assignments as a way to build the things that were in his mind. By the time he graduated, he had mastered Pascal and Assembly, won national programming tournaments, and made full-fledged software 3D renders.

A NEW WAY TO TELL STORIES

During his first year at Brigham Young University, Mustard and his brother, Donald, had an experience that would change them forever. It all started at the local Blockbuster Video store when they rented the first-generation PlayStation console and a new video game, *Final Fantasy VII*. They only had enough money to rent both for three days, so they had to beat the game by the end of the third day. When they reached the first save point in the game, a message popped up telling them to insert a memory card. But they didn't have a memory card, and they had spent their extra cash on the game and the system rental. Not only did they have to beat the game in three days, but they couldn't turn off the console. Rising to the challenge, the brothers took turns playing so the game could keep going all day and all night.

They kept it up for two days straight. As they played, they realized this was a monumental leap forward in how stories could be told. The brothers began to envision how games could eventually surpass Hollywood as a storytelling medium. This was the future. After a frenzied forty-eight hours, they beat the game. But they couldn't stop thinking about the experience.

The brothers made a pact: Geremy would become the best programmer, Donald would become the best creative director, and one day they would build their own video game company. Then they sat down, outlined the skills they would need, and got to work. "We became great video game makers because we just wanted to tell awesome stories. We knew the way forward was games, and we committed to that path," Mustard says.

WHAT TEXTBOOKS CAN'T TEACH

Geremy Mustard was called to serve a mission in Japan for The Church of Jesus Christ of Latter-day Saints. On his mission, Mustard learned how to work with people and to listen to them with the "intent to understand them, not to get caught up on words," Mustard says. "Japanese is a complex language, and I quickly learned that you can't get caught up in the nuances of words—you simply don't know the words or culture well enough." Instead, he focused on the underlying intent of what the other person was trying to convey.

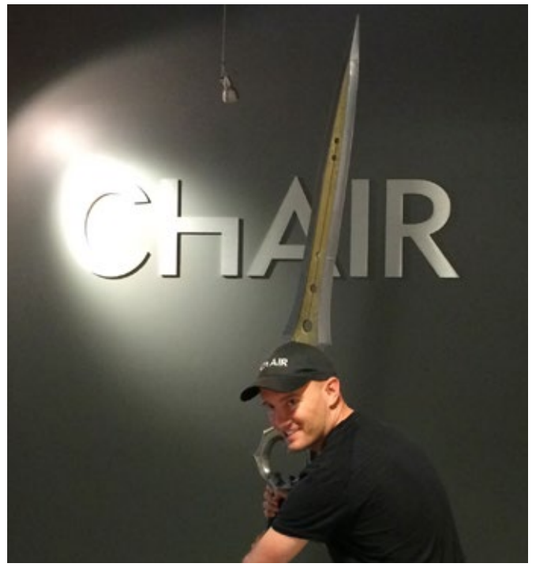
"To be successful in life, in a career, in a family, you have to be able to communicate," Mustard says. "I developed the idea of what I call 'listening with charity' to help me listen with the intent to understand rather than the intent to pick apart." The idea of listening with charity goes beyond assumptions about another person and the specific words exchanged to consider the question "What is the person in front of me trying to communicate to me?" Mustard continues, "If you can focus on that question, you'll be able to truly understand people, and they will then be more willing to understand you. If you ever want to work with a team—which you must do to maximize your own abilities—this is a critical skill. And I learned it on my mission."

When Mustard finished his mission, his brother, Donald, was graduating from what is now the BYU Center for Animation. Donald got a job with a computer animation company and recommended that the company also hire his brother, Geremy. This job, which Mustard started after his mission and before he returned to BYU, helped him build on his existing art skills and learn how to animate professionally. He also started creating custom software for the company to make animation tasks easier. Using this software, he created a prototype game that he and Donald directed, and the game eventually became the award-winning *Advent Rising*. Mustard did all this while still taking night classes at BYU. Shortly after, the brothers cofounded Chair Entertainment to continue their game making journey.

PAGE 8: SWIRL TUNNEL BY KIRYL PRO MOTION/GETTY IMAGES; PLAYSTATION CONTROLLER PHOTO BY NIKITA KOSTRYKIN/UNSPLASH; OTHER PHOTOS COURTESY OF GEREMY MUSTARD (5)

CREATIVITY LOVES CONSTRAINTS

"Whenever we see new technology, we ask ourselves 'How will this change the industry?'" says Mustard. At the end of 2004, Microsoft launched Xbox Live Arcade, where people could download games off the internet and play them right on their consoles. "We saw direct downloads and digital sales as a slow but inevitable death knell for brick-and-mortar game stores and wanted to be on the leading edge," says Mustard. He and his team were in the midst of pitching a game to publishers but weren't getting offers because they were an "unpublished team." Mustard and his team decided to quickly publish something small on Live Arcade to prove to publishers that they could build something great. The team decided to come up with one hundred unique game concepts in three days. The parameters: the game had to be cool, had to show that the team was technologically proficient, and had to be under twenty-five megabytes (the download limit at the time). The team also had to be able to build the entire game in three months. The next day, everyone brought their first five game ideas. Then they began narrowing down the options.



"The ideas kind of dwindled. But after all the initial ideas were out, some really interesting and unique ideas started popping up," Mustard says. "You'll find this in general with creativity. When your well of creativity starts to dry up, you have to dig deep and figure out 'What else is there?' That's when you start to put together ideas you may not have considered before and come up with some really amazing concepts."

Finally, the team decided on the top three games. Two of those games would become *Undertow* and *Shadow Complex*. The third game was never made, but it did influence other games Mustard eventually created. The team had a working prototype of *Undertow* within two weeks and a complete game within three months. Microsoft loved the project and wanted to publish it but insisted it could run smoothly on old dial-up networking hardware, so Mustard optimized the entire networking layer of the Unreal Engine. Since Mustard was the only programmer at Chair, it took a few months longer than expected to complete the final version.

During this time, Mustard and his team were still pitching their big game idea to large publishers. Before long, they were in London with a ten million dollar offer from a major publisher in hand. That's when the Mustard brothers realized they were at a crossroads. They could stick with their original big-game goal, take the ten million, grow their team to about one hundred people, and build the game for this publisher. Or they could keep their team small and keep building fun games to self-publish on Xbox Live Arcade. "We were having so much fun making *Undertow*, and we wanted to control our destiny," Mustard says. "We wanted the freedom to create whatever we wanted and not be restricted by what a publisher might tell us to do."

They decided to continue making smaller downloadable games. *Undertow* was downloaded and played by over 700,000 people and won numerous Editor's Choice awards. The brothers also created *Shadow Complex*, an immensely popular game that sold 200,000 units in the first week alone. Then, staying on the bleeding edge of innovation, they created the *Infinity Blade* games, which redefined the capabilities of games on iOS and were played by over

LEFT TOP Geremy Mustard wielding a fifty-pound forged Infinity Blade at his South Jordan, Utah, office. **LEFT BOTTOM** (left to right) Cofounders Geremy Mustard, Ryan Holmes, and Donald Mustard at the first Chair Entertainment office in Provo, Utah.

one hundred million people. In 2008, Chair Entertainment joined Epic Games. "I think we made a good decision turning down the big publishers," says Mustard.

FAST-TRACK TO *FORTNITE*

"At Epic, we recognized a trend where the games that completely change the industry almost always come from mods and usually come once a decade," says Mustard. The latest trend was battle royale games, where the last person standing wins. Epic felt this was the once in a decade game trend, so they decided to strike while it was hot. Rather than starting a game from scratch, which would take at least nine months to complete, they decided to use a game already in development. They had been prototyping a game called *Fortnite*, which had an original world layout and interesting building mechanics that would be unique in this genre of games. The president of the company gave the Mustard brothers the green light to move forward.

Mustard had to notify the *Fortnite* developers that the game was suddenly changing. One of the biggest challenges was the human aspect—letting team members know the goals were changing and re-forming the teams who then had to make drastic changes to the game and launch it as fast as possible. Three months later, *Fortnite Battle Royale* was launched, with the original game rebranded as *Fortnite: Save the World*. Many of the decisions they made in those three months shaped not only the game but the entire gaming industry.

A FOUNDATION FOR *FORTNITE*

Looking back, *Fortnite* seems like an obvious success. It is hard to imagine the game being designed any other way. However, many of the design ideas were unique. As a leader, Mustard had to make decisions that would drastically impact the game experience and the ultimate success of the game. "It's hard when the impact of your decision isn't exactly clear," he says. "You have to trust your gut and gather as much data as you can. You try to think about people as much as you can and not just make a decision in a vacuum."

> "THE POWER ONE PERSON HAS TO INFLUENCE AN ENTIRE COMPANY OR AN ENTIRE INDUSTRY HAS JUST ASTOUNDED ME OVER AND OVER AGAIN." —GEREMY MUSTARD

Mustard and his team started by defining the guiding principles and philosophies they wanted behind *Fortnite*. A key philosophy was generosity. They decided *Fortnite* would be released for free so anyone could play, which meant the company would monetize smaller items in the game to make it profitable. Some video games sell items that give players an advantage over others in the game, but Mustard felt this would hurt the morale and fun of the game. "We knew if we sold items in the game that gave you power over the other players, the game would be less successful," he says. "We wanted to make it so everyone could play the game for free and play *everything* in the game. We decided to sell only cosmetic items, things that have no value other than changing your appearance."

The *Fortnite* team also came up with the idea to have a "Battle Pass" that could be bought outright or earned through gameplay. Once again, pricing became a major discussion point. An economist at Epic wanted to set the price at one hundred dollars, but Mustard and the team wanted it priced so a kid could pay for it. They settled on ten dollars, about the price of a meal at a fast-food restaurant. At the time, most games only had about a 2 percent conversion rate of players who purchased optional items like this. Based on how much time and money Epic had spent developing the game, the team members knew the game would be unprofitable if they only converted 2 percent of current players. However, they kept the price at ten dollars. "The day it came out, we ended up converting over 50 percent of our audience to paying, which is unheard of," Mustard says.

The pass was so successful that it started being mimicked across the industry. "The power one person has to influence an entire company or an entire industry has just astounded me over and over again," Mustard says. "It's not even intentional. You just keep sticking up for what you think is right, fun, and innovative and keep pushing forward for something that feels better than another road. By doing that, you can change industries."

One way the philosophy of positivity made *Fortnite* unique was through the multiplayer nature of the game. These types of games typically have "taunts"—little phrases or animations that are meant to be pejorative and to incense the other players. Mustard and his team wanted *Fortnite* to have a very friendly environment, so they decided to replace the traditional taunts with funny little dances. These dances had unexpected results. "We started seeing kids do the dances popularized by *Fortnite* in real life, everywhere. To this day, I see them pop up in movies and shows I'm watching. It's surreal to see something I made have that level of influence on culture," Mustard says. The guiding principles and philosophies ultimately led the team to create an astonishingly successful game. The launch exceeded expectations, and the number of players kept climbing. Six years later, *Fortnite* has hundreds of millions of registered players. At any given time, two to four million people are playing the game somewhere in the world. In fact, "over a billion people in the world have had some touchpoint with *Fortnite*. That's over 10 percent of the entire world," Mustard says.

A FEARLESS FUTURE

Mustard retired from Epic in 2022 and is now working on a new venture called FF20, which invests in new technologies with the hope of "fast forwarding" technology twenty years in fields like material science, health technologies, and energy.

Mustard's career, including this new venture, has focused on creating the future—pushing the bounds of technology and finding the next big thing. New technologies like ChatGPT are already changing society, and that can be intimidating for many, including BYU students who are trying to plan careers in an evolving, unpredictable world. Mustard, however, has hope for the future. While artificial intelligence (AI) and other advancements will fundamentally change society and many jobs, Mustard sees the opportunity for BYU students and alumni to thrive. "The best thing is just to be excited. Be optimistic, not fearful. And always be curious," Mustard shares. "See what the possibilities are with modern technology. The people who sample it, explore it, try it out, and are excited about it are the people who are going to be super successful in the next ten years."

For Mustard, "Enter to learn; go forth to serve" is more than just BYU's motto. It's a guiding principle for work and for life. "The future is determined by those who create it," says Mustard. "So what will you create? How will you intentionally influence the direction of the future to lead to the future you want?" Mustard continues, "If you can direct the path of your future, then you can go forth not only to serve but to build the technologies that we'll need to build Zion."

When we focus on exploring beyond what we perceive as our limitations, Mustard counsels, we can make a future that is abundant and happy. "Why not ask yourself, 'How can I build a better world, the world that I want to live in?'" Mustard asks. "Everyone at BYU can do that. Go forth and do that." FR

ABOVE *Fortnite*'s Tomato Head with Mustard and his son Max in front of the *Fortnite* Battle Bus.

FORTNITE TOPOGRAPHIC MAP PHOTO BY OBERON COPELAND ©VERYINFORMED.COM/UNSPLASH

BOTTOM (left to right) Donald and Geremy Mustard with Mike Capps and Tim Sweeney from Epic Games.

HISTORY HIGHLIGHTS

(PRE COLLEGE CREATION)

1950 Eyring Science Center is dedicated

1958 The Summerhays Planetarium opens in the Eyring Science Center and becomes the first planetarium in the state of Utah

1960 Department of Statistics is formed

1968 Computer Science Department is formed

1972 Department of Mathematics begins using computer-generated exams for calculus classes

BYU acquires STRETCH computers

(COLLEGE CREATION)

1973 The College of Physical and Mathematical Sciences is created and Jae Ballif becomes the first dean

1974 James E. Talmage Mathematical Sciences/ Computer Building is dedicated

1976 Math lab is created

1977 First International Symposium on Macrocyclic Chemistry is held at BYU

BYU Cancer Research Center is organized through a partnership between the College of Physical and Mathematical Sciences and the College of Biology and Agriculture

1980 Computer Science Department introduces PASCAL into programming courses

1988 IBC Advanced Technologies is founded by BYU professors

1990 Talmage Building is rededicated after building expansion

1993 First BYU mathematics PhD graduates

1995 Chemistry Department is renamed Department of Chemistry and Biochemistry

Ezra Taft Benson Building is dedicated

1999 BYU receives the first of five supercomputers donated by Ira A. Fulton, and animation students begin using it

2001 Department of Mathematics Education is formed

2005 The Summerhays Planetarium is rebuilt and renamed the Royden G. Derrick Planetarium

2010 BYU Center for Animation is created

2011 Applied Computational Mathematics Emphasis (ACME) program is added to the Department of Mathematics

2014 BYU Cancer Research Center becomes the Simmons Center for Cancer Research to honor Daniel L. Simmons, a former director of the center

2017 C. Shane Reese is named dean of The College of Physical and Mathematical Sciences and later becomes 14th president of BYU

2020 Grant Jensen is named dean of the College of Physical and Mathematical Sciences

2021 The West View building is dedicated and becomes the new home for the Department of Statistics

2023 The college celebrates its fiftieth year by sharing a fifty-foot long cake with students and hosting an alumni gala

2024 The college is renamed The College of Computational, Mathematical, & Physical Sciences

1950 1960 1970 1980 1990 2000 2010 2020 2030

Eyring Science Center dedication, Summerhays Planetarium: photos courtesy University Archives, L. Tom Perry Special Collections, Harold B. Lee Library, BYU (2); Cancer Research Center, Benson Building dedication: photos by Mark A. Philbrick/BYU Photo (2); Simmons Center For Cancer Research photo by Jaren Wilkey/BYU Photo; Planetarium photo by Nate Edwards/BYU Photo; West View Building photo by Claire Moore/BYU Photo

Hearts Knit Together

BY LAUREN BAILEY

The Rheumatic Relief Program Blesses BYU Students and Volunteers Serving Families in American Samoa

Saving a life can be a simple thing—as long as one knows how. And that's where the Rheumatic Relief program comes in. BYU's Rheumatic Relief program unites undergraduate students, professors, cardiologists, sonographers, and the American Samoan Department of Health in its cause to educate, screen, diagnose, and set treatment plans for children in American Samoa.

"The most exciting part of the program is that we truly are saving lives," says David Cragun, a BYU alumnus and cardiologist who volunteers for the Rheumatic Relief program. "We're learning to serve together, and it impacts all of us."

Since the program's inception, volunteers have screened more than 50,000 children in Samoa and American Samoa, and about 2.5 percent of them have been diagnosed with this serious heart condition and then referred for lifesaving treatments.

HIGHEST IMPACT IN LOW-INCOME COUNTRIES

Rheumatic heart disease (RHD) causes more than 300,000 deaths annually across the world but is fully preventable. It is caused by an abnormal immune response to pharyngeal group A streptococcus infection, also known as strep throat. This disease primarily impacts children between the ages of five and fifteen who live in low- and middle-income countries. American Samoa, a small island between Hawaii and Australia, has especially high rates of RHD.

"Seeing that even kids as young as five years old can have severe cases of rheumatic heart disease was really shocking to me and really saddening. But it's also awesome to know we're here for them. We can catch this early and save their lives," says Meg Takara, a BYU cell biology and physiology major and participant in the May 2023 program.

Left untreated, RHD can lead to heart failure and even death. If caught early, this condition can be treated with antibiotics to prevent further progression. RHD is especially troubling for young women who are pregnant.

BYU alumnus and cardiologist Marv Allen shared an example of a case the program diagnosed and treated. "We saw a young woman about nineteen years old who had mitral stenosis and mitral regurgitation, which basically means she had a fairly advanced stage of rheumatic heart disease," he says. "In the very near future, especially if she were to become pregnant, the rheumatic heart disease could cause heart failure and even death. Identifying her condition was very rewarding. It feels good to know we possibly saved her life."

LEFT The Rheumatic Relief program works closely with the American Samoan Department of Health to educate, screen, diagnose, and treat children in American Samoa.

VOLUNTEERS HAVE

SCREENED 50,000+

CHILDREN IN SAMOA AND AMERICAN SAMOA

≈1,250 (2.5%)

HAVE BEEN DIAGNOSED WITH THIS SERIOUS HEART CONDITION AND THEN REFERRED FOR

LIFESAVING TREATMENTS.

ABOVE BYU students teach the children by putting on a puppet show and by singing songs with familiar tunes to which they have added "rheumatic" lyrics, all in the Samoan language.

The Rheumatic Relief program hopes to find RHD in early stages to prevent damage and limit suffering. "The goal overall is prevention," says Owen Demitz, neuroscience major at BYU and participant in the May 2023 program. "As students involved in this program, we focus on teaching the children how to help prevent this problem so that it doesn't happen to more children in the future."

Demitz talked about the impact spanning generations. "When the children we are educating now have their own children in the future, we hope they can recognize the symptoms in their children and get treatment before it's too late," he says.

PROGRAM DESIGN LEADS TO LONG-TERM RELIEF

In the Rheumatic Relief program, students have the opportunity to shadow and serve alongside board-certified cardiologists and sonographers. Visiting primary schools in American Samoa, the volunteer sonographers and cardiologists use echocardiography (ultrasound of the heart) to identify rheumatic heart disease in children and refer them for treatment.

"During the echocardiogram, we're looking at the heart valves to see how well they're opening and closing in addition to how well the heart is squeezing," explains Patty Slack, echocardiography director of the Rheumatic Relief program. "If we see any leaks, then we know that there's a possibility they have rheumatic heart disease or some other heart condition."

A unique aspect of this program is BYU's strong partnership with the Department of Health (DOH), which organizes and coordinates the Rheumatic Relief program visits with the schools. "The Department of Health in American Samoa has been fantastic in large part because they understand the danger these children are in from rheumatic heart disease. Because of this, the DOH is very anxious for us to be here and to work with them," says Paul Savage, professor of chemistry and biochemistry at BYU and faculty director of the Rheumatic Relief program.

Many of the children that the Rheumatic Relief program screens do not have the resources to travel outside of their country for diagnosis or care. The DOH provides diagnostic access, publicizes it to local families, and manages the treatment plans for children diagnosed with heart problems that need outside attention. "The DOH leaders show that they're grateful we are here by supporting us extremely well. They set up the screening schedule for where we go every day and have been very proactive in advertising the program. They help make our diagnostic events a great success with a huge turnout," Savage says.

"This partnership has been such a great initiative for American Samoa because we don't have specialty sonographers or cardiologists on the island," explains DOH representative Ipuniuesea Eliapo-Unutoa. "Rheumatic Relief doesn't just come in and screen. Rheumatic Relief trains our local people and sets the children who are diagnosed up for future success. What this program does helps us provide for our children in need."

Sharon Sanyo also works for the DOH in American Samoa. Thanks to Rheumatic Relief, she's training to be a cardiac sonographer. "We don't have any cardiac sonographers on our island, so this training is critical," she says. "It's been awesome to learn and gain the skills needed to look after the children on our island who have rheumatic heart disease. I'm so grateful to the professionals and the BYU students and anyone who helped donate to make it possible for us to save these lives."

"I'm so grateful to the professionals and the BYU students and anyone who helped donate to make it possible for us to save these lives."

—SHARON SANYO, AMERICAN SAMOA DEPT. OF HEALTH

PROVIDING EDUCATION TO AMERICAN SAMOAN FAMILIES

While the medical professionals are carrying out medical exams, the BYU students are primarily in charge of public health education for the primary school children. This is an equally important element of the work.

Tasi Pauga, a graduate of the BYU exercise science program, was in charge of the health promotion during his visit in May 2023. "We did a puppet show in their native language, sang songs, and did dances—all focused on their culture," he says. "It's really awesome to see how excited these children are to learn and to engage with us. We are teaching them lifesaving information, but we share it in a fun way that aligns with their culture, which is really important."

ABOVE Patty Slack, echocardiography director of the Rheumatic Relief program, is part of the team that offers free echo screenings and follow-up exams for the children.

PAGE 16 PHOTO BY KIMBERLY JENKINS; PAGE 17 SAMOA, PALM TREES PAGE 18, 20, 21: PHOTOS BY NATE EDWARDS/BYU PHOTO (2); CHILDREN PHOTOS BY KIMBERLY JENKINS (2)

RHEUMATIC HEART DISEASE (RHD) CAUSES MORE THAN

300,000+ DEATHS

ANNUALLY ACROSS THE WORLD BUT IS

FULLY PREVENTABLE.

CHILDREN PHOTOS BY KIMBERLY JENKINS (2)

ABOVE The Rheumatic Relief team is comprised of BYU students, cardiologists, cardiac sonographers, BYU faculty and staff, and dedicated volunteers. It takes approximately 12 months to fund and prepare for each annual trip.

Pauga's father is from Samoa, which brings a special element to this work. "Being able to be here so close to where my dad is from is really special," he says. "The love I feel from the people has been huge for me. It's the best part of this program. It's amazing to know we can help this community by serving and teaching them."

The BYU students prepared for this trip months in advance by learning the educational materials and the language. Spencer Shin, a recent BYU graduate in nutritional science, loved teaching and interacting with the children through the program. "It's funny how we prepare so much to teach these people something they're not familiar with, but I ended up learning something much bigger from them," he says. "I learned a lot about myself, and the people taught me through their humility, love, and acceptance. This experience has taught me to be more Christlike back home and wherever I go."

In addition to teaching the children, students can try their hand at imaging while being supervised by professionals. "If they are interested, we'll even let students do some imaging and try and get their hands on a little bit of what patient care is like," says Marv Allen. "It gets them excited about going into the medical field in their careers, and it's something that's rare for undergraduates to experience."

> "The love I feel from the people has been huge for me. It's the best part of this program."
>
> —TASI PAUGA

STUDENTS SET PATHS FOR THE FUTURE

Lori and Marv Allen have been traveling to Samoa to provide rheumatic relief since 2009, and the couple has loved being able to serve together in this program. "This has been a lifelong dream of ours," Marv Allen says about founding Rheumatic Relief with his wife.

The Rheumatic Relief program has blessed the lives of hundreds of thousands of children and families in American Samoa, but it has also blessed the lives of the 112 BYU students who were able to participate in these trips over the years. "We've had opportunities to talk about our careers and about family," Marv Allen says. "We get to share how to balance things like church, family life, and advancing our careers. We feel very blessed to have been at BYU, and now we have the opportunity to go out and serve—specifically serving students at BYU."

Student volunteers get a rare, invaluable opportunity to learn from professionals with decades of experience in cardiology and sonography. Marv explains, "A lot of these students are preparing to apply for medical school, PA school, or nursing school. They leave this program being able to articulate very well what rheumatic heart disease is and what they've learned about diagnosis and treatment. This is a great addition to their résumé." Lori Allen agrees, saying, "This program gives both the children of American Samoa and the BYU students a future."

The students feel the same way. "This experience has benefited me far more than I think I've benefited American Samoa," Takara says. "I've been able to learn what it means to be a true physician and to care about people and to serve and to love them. This is really going to impact my future as a physician."

Rheumatic Relief gives BYU students real-world experience they can take with them in their future careers in medicine.

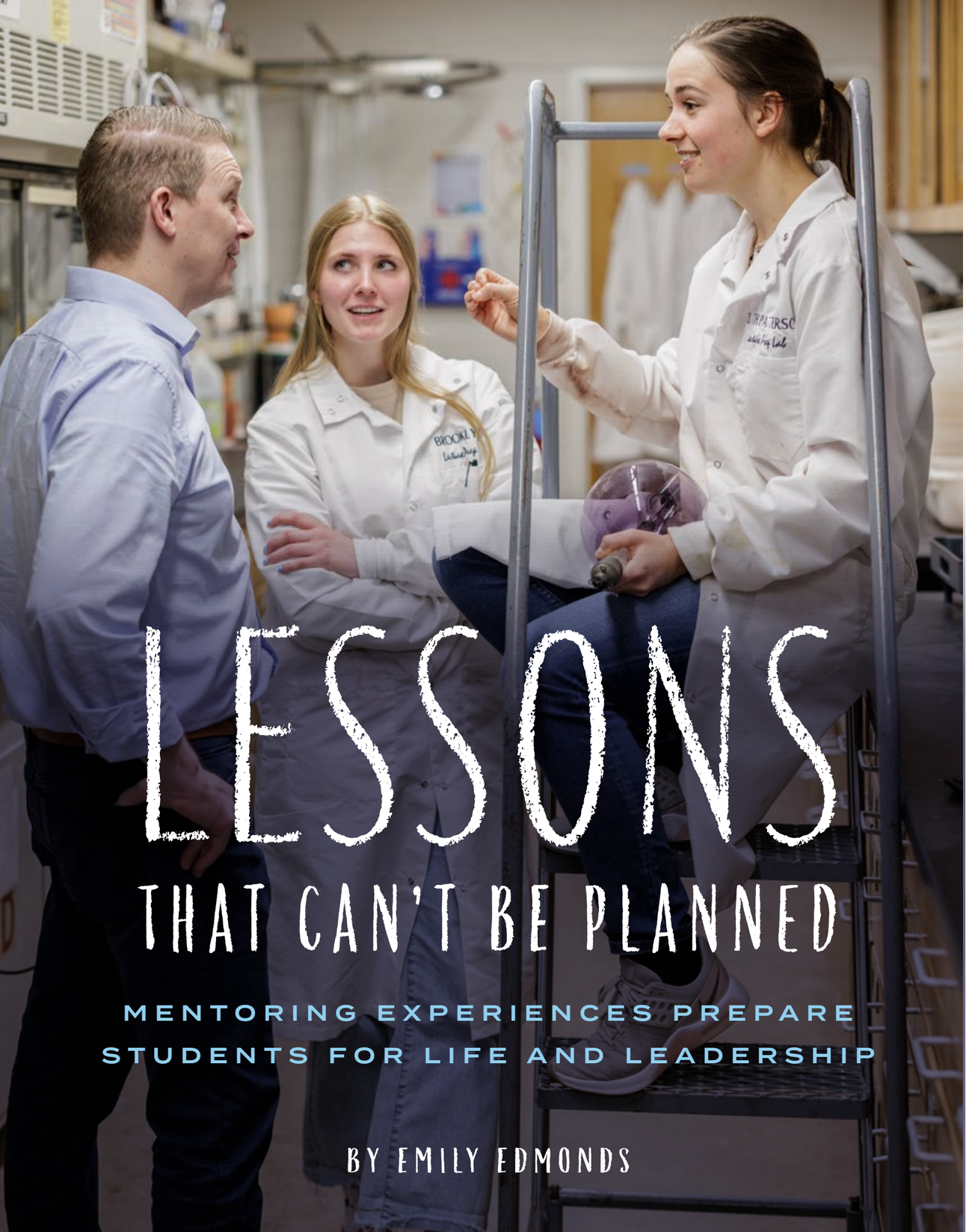
"We're not just here to go to university and to learn and do our best in the classroom," Pauga says. "It's really about what we can do outside of the classroom. Seeing the professionals here serving and taking time out of their busy lives has given me a lot of faith in the future of our healthcare. It is something that I definitely want to do in my own life as a future doctor. The fellow students I've met and served alongside come from all different cultures, know all different languages, and are ready to serve."

The experiential learning opportunities in this program are funded by BYU and donors who make it possible to continue this lifesaving work.

"None of this would be possible without the donors," Shin says. "I share that to say that I know the American Samoan children and the families here are so thankful. But also I, as a BYU student, am so thankful for this opportunity. It's changed the way that I plan to practice medicine in the future. It's even changed the way I want to treat people around me."

The Rheumatic Relief Program will continue, with the next group of students preparing for a trip in May 2024. For more information about how to get involved, visit **rheumaticrelief.byu.edu.**

BELOW Since its inception in 2009, the BYU-sponsored Rheumatic Relief humanitarian program has educated thousands of children about the dangers of rheumatic heart disease and has identified kids suffering from the potentially fatal illness.



LESSONS THAT CAN'T BE PLANNED

MENTORING EXPERIENCES PREPARE STUDENTS FOR LIFE AND LEADERSHIP

BY EMILY EDMONDS

PHOTOGRAPHS BY BRADLEY H. SLADE

Jennifer Brooks has lesson plans. Thousands of them. After all, she's been teaching math collegiately for the better part of the last twenty years. Her office is lined with binders full of handwritten outlines from earlier in her career; now she preps for classes on her tablet. "I go into every day with a very well-developed plan," she says.

But some of the most important exchanges that happen with her students—the mentoring moments when they take something to heart—don't happen during lectures. Sometimes it's an email or a conversation outside of class, and other times it's an offhand comment during lab.

And not all those lessons have to do with math.

"I don't think that I teach classes," says Brooks, an associate professor at BYU. "I teach students."

Connecting with and encouraging students is what drives Jeff Macedone, a professor of chemistry who recently received the college mentoring award. "Part of my job at BYU is to lift students," he says. "When I share things that are going on in my life—with my family, calling, or work—with them, they sometimes ask, 'How are you juggling all this?'" He continues, "They feel overwhelmed themselves, and when I share strategies that help me, it can be eye-opening for them to see that I'm happy and not crushed by the load I'm carrying."

In addition to teaching, Macedone supervises a small group of students who prepare demonstrations for chemistry lectures. "There's a lot of interaction with my crew in this lab," he says. "They ask many meaningful questions."

These spontaneous and often spiritual conversations typify the BYU faculty's commitment to its students. As the university aims to offer a world-class education in a faith-filled community, it relies on mentoring experiences—the lessons that can't be planned—to prepare students for life and leadership in a uniquely personal way.

CULTIVATING CONFIDENCE

Many people think math is understanding how to solve problems, but for Brooks it's more about ideas and communication. "I like helping students get a larger view of what math really is," she says. "I want to be there when they're feeling insecure and let them know that's how everyone feels."

> "Students need to know that someone believes in them."
> —JEFF MACEDONE

Math is a difficult subject for students, and Brooks enjoys taking students from frightened to confident. She says, "I'm willing to spend a lot of time with them so when they get to the end, they realize, 'Hey, this wasn't as bad as I thought it was going to be. I actually enjoyed it.'" And her commitment is recognized across campus. Brooks recently received the College of Physical and Mathematical Sciences Outstanding Teaching Award and the BYU Faculty Women's Association Excellence in Teaching Award.

However, it's not just the coursework students struggle with. Macedone recognizes the loneliness many students experience in addition to the typical stresses of college life. He has even found himself walking suicidal students to BYU's counseling center. "Whenever I give students a little encouragement, a compliment, or validation, they just light up because they don't have enough of that in their lives," he says. "Students need to know that someone believes in them."

A small vote of confidence can go a long way. During Brooks's first year at BYU, she recruited four students from her complex variables class to create a research group early in fall semester 2019. The following January, a student approached her and asked if she needed a grader for the new semester. "I know I wasn't your best student," he told Brooks, "but I really liked the class and would love to help grade."

Brooks's response surprised him. "I already have a grader," she explained, "but why don't you join my research group?" The student hesitated. "I want you to have this experience," Brooks added. "I think it would be good for you."

And it was. "He became more confident and assertive. I saw him open up and blossom," Brooks says. "It was one

LEFT Professor of chemistry Jeff Macedone shares lessons in life and chemistry with students Brooklynn Thuernagle and Ruth Patterson.

little semester at the end of his BYU career, but it changed how he saw himself and what he was capable of doing."

Brooks has learned to identify the students who will benefit the most from joining her research group—and it's not necessarily the most confident students or those with the highest grades. "Students often think that research or grad school are for really smart people," she says. "I want them to see it's just as much for them as it is for the straight-A students, maybe even more so."

LIFELONG EFFECTS

Mentoring experiences have long-lasting effects, and Macedone uses one lecture in his CHEM 106 class to specifically discuss preparation for the professional world. To mimic this environment, his CHEM 227 lab course is structured like a company. Students receive an email from a fictional boss at the beginning of the semester and are given "Trainee" name badges, which are replaced by "Lab Tech" badges once the students complete their training.

"I tell students, 'You're going out into the workforce. You need to be professional; if you show up late or turn in something late, I'm going to dock you on the professionalism score,'" Macedone explains.

CHEM 227 also focuses on experiential learning. Several lab periods at the end of the semester are set aside for an independent project in which students plan and execute experiments of their choice and then write reports on the experiments. "That's the environment where they're learning about critical thinking. Success in chemistry comes from being able to implement principles," Macedone says. "We need to solve real-world problems. We're not useful if we're not being inventive, innovative, and novel in our work."

One day, a student—who was generally argumentative—began complaining about a CHEM 227 assignment. Macedone heard him out and then responded, "If this was a company, I would have fired you a long time ago."

> "But when it isn't about math, when it's about the gospel, we're all students. And I learn a lot from my students."
>
> —JENNIFER BROOKS

The student was absolutely shocked. Then Macedone continued, "But I am here, right alongside you, because I want you to learn so you don't make these mistakes in your future job, and you don't get fired."

By the end of the conversation, the student could see the underlying care in that exchange. "What I said might have sounded insulting, but he got it, and it was what he needed to hear in the moment. He recently wrote to me and shared that he's thriving in a really great internship at a prestigious university," Macedone says. "One of the most significant things about mentoring is that it's not just about how you do chemistry, but it's how you treat people with respect."

MUTUAL MENTORING

Brooks, who joined The Church of Jesus Christ of Latter-day Saints in 2014, enjoys sharing her conversion story and other spiritual thoughts with her students. "But the moments that are really special to me are when the students do something that strengthens my testimony," she says.

At one point, Brooks was struggling to understand an unfulfilled promise that had been given to her in a blessing. "Three years later it hadn't happened, and I was wondering if this was something the Lord actually intended to fulfill or if it was somehow no longer expedient," she recalls.

One morning Brooks woke up to an email from a student. The message included a "pretty mundane, course-related thing," Brooks recalls. But then the student wrote that she wanted to share a scripture she thought explained strong induction—a mathematical principle.

"It was exactly what I needed at the moment: a scripture about God fulfilling His promises. And it was also an example of strong induction," Brooks says. "One of the things I love about BYU is that when it comes to math, I'm the teacher and the students are the students. But when it isn't about math, when it's about the gospel, we're all students. And I learn a lot from my students."

Macedone had a similar experience as he observed a student taking care of her best friend whose sister was killed in a skiing accident. "While she was out for two weeks mourning, her best friend attended my office hours every day, asking lots of questions. At the end of the semester, they both got really good grades," he says. "The one worked extra hard to make sure she understood the material so she could teach her friend. What she did was so selfless, loving, and Christlike."

ABOVE Math professor Jennifer Brooks meets with her undergraduate research assistants once a week, to discuss research progress, talk about how the semester is going, chat about what they are doing outside of school, and share what it's like to be a mathematician.

FAITH FIRST

BYU is a special place for Brooks. "At BYU, we don't think we have to give up our commitment to Jesus Christ to do our scholarly work," she says. "I came here because I felt the Lord wanted me to serve this group of people. That service includes being able to live the gospel that I want to live and help students who also want to live the gospel."

At the beginning of each semester, Macedone shares a faith-promoting experience from when he was earning his PhD. A laser wasn't opening properly, and he had asked for help from advisors, other grad students, and even the company that made the laser. After puzzling over the problem for a week, Macedone had the thought to pray. "I asked for help, and the inspiration came. I was able to see the parts of equipment in my mind and how the laser was passing through, and the answer all came together," he says. "I share this with students to illustrate that mistakes and challenges are part of the plan and that revelation should be part of the experience, even in analytical chemistry."

Despite all the preparation and planning she does for each class, Brooks hopes her students ultimately remember that she cared about them as she strove to help them grow personally. "The most important things they could take away from a course would be whatever they learned about themselves in the process," she says. "I hope they measure their success in terms of personal growth, not in grades."

Students are at a crossroads in their lives, Macedone notes. "The more support and charity we show them, the more likely they are to make the right choices and go down the right paths," he says. "I love to be there for the students. I tell them, 'I'm here to teach you, and I know you can do this.' They're on a journey, and I'm trying to meet them where they are."

STUDENT CENTERED

The commitment to being student-centered is at the core of BYU's educational philosophy. "We believe in creating an environment where students receive an exceptional total education, including providing career-launching experiential learning and building faith and character," says Grant Jensen, dean of the College of Computational, Mathematical, & Physical Sciences. "When expanding our faculty, one important consideration is to bring on board professors who are not only experts in their fields but who also exemplify a selfless dedication to the success and complete well-being of our students." Macedone and Brooks embody the idea that fostering a student-centered approach is not just a priority but a fundamental principle that guides the educational experience at BYU.

DEPARTMENT SNAPSHOT

CHEMISTRY & BIOCHEMISTRY

CHAIR
Jaron C. Hansen

RECENTLY RETIRED
Bruce Jackson

NUMBER OF STUDENTS

Undergraduates with a chemistry or biochemistry major	334
Undergraduates with a chemistry or biochemistry minor	131
Graduate students seeking master's	6
Graduate students seeking doctorate	104

RESEARCH AREAS
Analytical Chemistry
Biochemistry
Inorganic Chemistry
Organic Chemistry
Physical Chemistry

DEGREES OFFERED
Biochemistry (PhD, MS, BS)
Chemistry (PhD, MS, BA, BS, minor)
Chemistry Education (BS, minor)

RECENT ACCOMPLISHMENTS/NOTABLE ITEMS

- Dean Grant Jensen's research group solved the structure of the Dot/Icm bacterial type IV secretion system, one of the largest macromolecular complexes characterized to date.
- Barry Willardson's research group discovered visualizations for how a protein is folded by a folding chaperone.
- James Moody is leading a novel project to develop and test new protein crystallization technology.
- Rebecca Sansom received a four-year grant of three million dollars from the National Science Foundation to fund her research and to support science teachers in rural areas.

DEPARTMENT SNAPSHOT

COMPUTER SCIENCE

CHAIR
Kevin Seppi

RECENTLY RETIRED
Paul Roper

NUMBER OF STUDENTS

Undergraduates with a computer science major	1485
Undergraduates with a computer science minor	444
Graduate students seeking master's	42
Graduate students seeking doctorate	38

RESEARCH AREAS
Artificial Intelligence and Machine Learning
Computational Creativity and Control
Computer Networks, Systems, and Security
Data and Text Analytics
Family History Technology Laboratory
Graphics, Animation, and Computer Vision
Human-Computer Interaction and Software Development

DEGREES OFFERED
Computer Science (PhD, MS, BS, minor)
Computer Science: Animation and Games (BS)
Computer Science: Bioinformatics (BS)
Computer Science: Machine Learning (BS)
Computer Science: Software Engineering (BS)
Computer Science Teaching (minor)

RECENT ACCOMPLISHMENTS/NOTABLE ITEMS

- BYU's competitive programming team won first and second in the regional ICPC programming contest in 2023.
- BYU animation students received the Highly Commended Game of the Year award from the 2022 Rookie Awards, an international board that ranks top video game design schools around the world, for their interactive game *Liminus*.
- The Center for Animation and the Computer Science Department won Best Animation for their film *Cenote* at the 2023 College Television Awards, also known as Student Emmys.
- The department offers a new emphasis in machine learning.

DEPARTMENT SNAPSHOT

GEOLOGICAL SCIENCES

CHAIR
Brooks B. Britt

RECENTLY RETIRED
Kris Mortenson

NUMBER OF STUDENTS

Undergraduates with a geological sciences major **53**

Undergraduates with a geological sciences minor **7**

Graduate students seeking master's **27**

DEGREES OFFERED
Earth and Space Science Education (BS)
Environmental Geology (BS)
Geology (MS, BS, minor)
Geology Education (minor)

RESEARCH AREAS
Economic Geology
Geochemistry
Geological Hazards Risk Reduction
Geomorphology and Planetary Geology
Geophysics
Hydrogeology and Environmental Geology
Mineralogy and Petrology
Paleontology
Petroleum Geology
Sedimentology and Stratigraphy
Structural Geology and Tectonics
Volcanology

RECENT ACCOMPLISHMENTS/NOTABLE ITEMS

- Geological sciences launched the podcast Y Rocks.
- The department installed a new museum vending machine that vends fossil casts, shark teeth, and other cool paleontological items.
- The BYU geology mentored field trip went to Great Britain in spring 2023.
- Geological sciences master's student Sydney Richards conducted research in The Bahamas on island expansion versus sea level rise in the Bahama Islands.
- Geological science students collected water samples in the High Uintas to understand Utah's growing dust and drought problems.

DEPARTMENT SNAPSHOT

MATHEMATICS

CHAIR
Paul Jenkins

RECENTLY RETIRED
Rodney Forcade, Shue-Sum Chow

NUMBER OF STUDENTS

Undergraduates with a mathematics major **335**

Undergraduates with a mathematics minor **494**

Graduate students seeking master's **38**

Graduate students seeking doctorate **7**

DEGREES OFFERED
Mathematics (PhD, MS, BS, minor)
Mathematics: Applied and Computational Mathematics (BS)

RESEARCH AREAS
Algebra and Algebraic Geometry
Analysis
Combinatorics and Matrix Theory
Differential Equations and Dynamical Systems
Minimal Surfaces
Number Theory
Numerical Analysis and Applied Mathematics
Topology and Geometric Group Theory

RECENT ACCOMPLISHMENTS/NOTABLE ITEMS

- BYU placed thirteenth out of 456 institutions in the 2022 Putnam Competition, an advanced problem-solving competition for undergraduate students in the United States and Canada.
- The department participated in the Cougs vs Cancer Run in honor of Professor Todd Fisher who passed away in 2022.
- The department approved a new five-year integrated BS/MS program in mathematics.
- The mathematics department hosts Math Circles every Saturday for elementary, middle, and high school students.
- The mathematics department holds five-day math camps for middle and high school students during the summer.

DEPARTMENT SNAPSHOT

MATHEMATICS EDUCATION

CHAIR
Keith R. Leatham

NUMBER OF STUDENTS

Undergraduates with a mathematics education major	125
Undergraduates with a mathematics education minor	5
Graduate students seeking master's	11

DEGREES OFFERED
Mathematics Education (MS, BS, minor)

RESEARCH AREAS
Mathematics Education:
Real-world Applications of Mathematics
Teaching Mathematics for Social Justice
Classroom Mathematics Discourse
Mathematical Literacy
Student Understanding of Calculus
Curricular Reasoning
Mathematics in Society

RECENT ACCOMPLISHMENTS/NOTABLE ITEMS

- Master's student Jennifer Canizales was featured in a university article for her research that combines math education with principles of design.
- The department launched its new website, yteachmath.byu.edu, to help students understand the benefits of becoming a math teacher.
- The department hosted its annual Discover STEM event, which helps children get excited about STEM subjects through fun try-it-yourself experiments.
- The department launched a new YouTube page, Math the World: youtube.com/@maththeworld.

DEPARTMENT SNAPSHOT

PHYSICS & ASTRONOMY

CHAIR
Kent Gee

RECENTLY RETIRED
Tim Leishman

NUMBER OF STUDENTS

Undergraduates with a physics or astronomy major	305
Undergraduates with a physics or astronomy minor	62
Graduate students seeking master's	28
Graduate students seeking doctorate	32

DEGREES OFFERED
Applied Physics (BS)
Applied Physics: Acoustics (BS)
Astronomy (minor)
Physics (PhD, MS, BS, minor)
Physics and Astronomy (PhD, BS)
Physics Education (BS, minor)
Physical Science Education (BS)

RECENT ACCOMPLISHMENTS/NOTABLE ITEMS

- The BYU acoustics research team attended the NASA Artemis 1 launch.
- The BYU chapter of the Society of Physics Students was selected as a national "Outstanding Chapter" and received a Marsh W. White Outreach Award grant for 2023.
- Professor Duane Merrell was elected as president of the American Association of Physics Teachers.
- BYU was one of sixteen participating schools in the 2023 REU program, an undergraduate research initiative funded by the National Science Foundation. Also, the Fletcher Research Internship (FRI) at BYU, a similar program for students contemplating graduate school, had four outside schools participate in its 2023 inaugural year.

DEPARTMENT SNAPSHOT

STATISTICS

CHAIR
David Dahl

RECENTLY RETIRED
Dennis Eggett, Lynne Nielsen

NUMBER OF STUDENTS

Undergraduates with a statistics major	424
Undergraduates with a statistics minor	105
Graduate students seeking master's	25

DEGREES OFFERED
Actuarial Science (BS)
Statistics (MS, minor)
Statistics: Applied Statistics and Analytics (BS)
Statistics: Biostatistics (BS)
Statistics: Data Science (BS)
Statistics: Statistical Science (BS)

RECENT ACCOMPLISHMENTS/NOTABLE ITEMS

- Shane Reese was appointed fourteenth president of BYU. President Reese received his bachelor's and master's degrees in statistics from BYU and served as the dean of the College of Physical and Mathematical Sciences from 2017–2019.
- BYU is one of only five schools, and the only one in the western United States, to have the highest recognition from both US actuarial organizations.
- David Dahl was appointed the new department chair in the summer of 2022.
- BYU will host the Summer Institute of Applied Statistics 2024.
- Matt Heaton and a team of students created R Shiny, an app that guides students through data analysis processes and helps them understand difficult concepts. The app is used in Principles of Statistics (STAT 121), a required course for statistics majors and many business and communications degrees.

INSIDE BACK COVER CONFETTI: BY ART-DIGITAL-ILLUSTRATION/GETTY IMAGES

BYU Computational, Mathematical, & Physical Sciences

N-181 EYRING SCIENCE CENTER, PROVO, UT 84602