

COMPUTING FOR ALL

AT ROWLAND HALL

Computer science impacts our daily lives, but its workforce falls woefully short when it comes to reflecting national racial, ethnic, and gender demographics. Solving that problem starts with K–12 education. The subject’s proponents at Rowland Hall are ensuring equity is programmed into the curriculum—and the curriculum gets the attention it deserves—building toward a computing-literate society where everyone has a seat at the table.

P
R
O
G
R
A
M

During hybrid learning one February afternoon, about 40 Rowland Hall faculty, staff, and upper schoolers—some working from home, others from the Lincoln Street Campus—gradually populated a Zoom room. It started off as a standard pandemic-era Upper School class, but 20 minutes later, it looked more like an avant-garde digital dress rehearsal. Students unearthed accessories from family members’ closets and Halloween costumes past: a cowboy hat, a pair of aviation goggles, a leopard-print scarf. They cloaked themselves in masks, feather boas, heavy makeup, and oversized sunglasses.

Director of Arts Sofia Gorder and her dance students comprised half of these creative camouflagers, but despite appearances, it wasn’t prep for one of their performances. It was an open workshop held by teacher Ben Smith ’89 and his Advanced Placement Computer Science (CS) Principles class to show the Upper School community how facial-recognition technologies work and how they can be harmful, particularly for underrepresented groups.

One dance student, Mena Zendejas-Portugal ’21, wore a pink wig with bangs that covered her eyes. She used makeup to draw decoy eyes on her cheeks, below the magenta fringe. Mena and her peers smirked at their laptop cameras as a web-based program used artificial intelligence (AI) to guess their ages and genders.

Before Mena wore her disguise, the program vacillated between misidentifying her as a 13-year-old boy and a 12-year-old girl. After Mena changed her appearance, ironically, the program’s guess came closer to the reality: it classified her as a 16-year-old female.

“It wasn’t a surprise how the AI read me since I have a rounder face along with short hair,” said Mena, one of the leaders of the student Justice, Equity, Diversity, and Inclusion (JEDI) Committee. “It’s just a confirmation for the thought of AI being built around stereotypes and constructed beauty standards that aren’t applicable to everyone.”

Algorithms permeate our daily lives, and the type of flawed coding that Mena experienced can have devastating real-world consequences, from wrongful arrests to housing discrimination. Ben educates the Rowland Hall community on these problems, and ensures his CS students are equipped to solve them. “If these students are going to become leaders in technology, they need to have this perspective,” Ben said. “You can’t ask people to have an interest in a career and not prepare them for the future ramifications of that.”

Ben has long given students space to discuss JEDI issues but formally added it to his CS curriculum during the 2020–2021 school year. And at Rowland Hall, the marriage of CS and social justice is a natural development: the school prioritized science, technology, engineering, and math (STEM) in the 2014 Strategic Plan, and during the past school year, longtime JEDI work escalated as a priority.

February’s facial-recognition workshop—Drag Vs. AI by the Algorithmic Justice League, which “combines art and research to illuminate the social implications and harms” of AI—helped a cross section of upper schoolers see firsthand why this work matters: “By just learning CS and not looking behind the scenes, the future could be less inclusive than we envision,” Mena reflected. Indeed, AI researcher Joy Buolamwini, a Black woman, launched the league after personally experiencing algorithmic discrimination in her work. In one project utilizing generic facial-recognition software, the program

failed to detect Joy’s face until she wore a white mask. In another, she had to ask a lighter-skinned friend to stand in for her. We can solve these problems, Joy posited in a 2016 TED Talk with over 1.4 million views, by creating more inclusive code. Teams must be diverse and driven to create “a world where technology works for all of us, not just some of us, a world where we value inclusion and center social change.”

This ethos fuels Ben’s work. The Rowland Hall alumnus, now celebrating 20 years as a faculty member at his alma mater, started teaching CS in 2015 and shifted to teaching that subject exclusively two years later. From day one, he’s made it his mission to diversify CS, a field “plagued by stark underrepresentation by gender, race, ethnicity, geography, and family income,” according to CS advocacy nonprofit Code.org. The US needs more—and more diverse—computer scientists, and efforts to broaden that workforce need to start in K–12 schools. Computing jobs are the top source of all new wages in the US and they make up two-thirds



of all projected new jobs in STEM fields, Code.org touts, making CS one of the most in-demand college degrees. And exposure before college makes a difference: students who learn CS in high school are six times more likely to major in it. Among traditionally underrepresented groups, the likelihood is even higher: seven times for Black and Latinx students, and 10 times for women.

Ben currently relies on one-to-one recruitment to grow CS enrollment among those underrepresented populations. He read a book around 2014, during graduate school in instructional design and educational technology at the University of Utah, that sparked his professional goals: *Stuck in the Shallow End: Education, Race, and Computing* by Jane Margolis. The book chronicles the lack of access to CS courses for Black and Latinx students—and addresses how to change the system. “It was just one of those eye-opening moments,” he said. “There’s no logical reason—except institutional bias—for why computer science education looks the way it does today ... It’s incredibly unjust.” Since then, Ben has prioritized combating what he calls the most glaring equity issue in education today. He collaborates with other schools and organizations that are trying desperately to expand CS opportunities, and works diligently to build an equitable CS program for Rowland Hall. “With Rowland Hall’s support, I’m committed to a future where all computer science courses have a student population that mirrors the demographics of the school as a whole.”

BUILDING CURRICULUM FROM THE GROUND UP

Fortunately, Ben isn’t starting from scratch when sixth graders meet him in Foundations of Computer Science, a required class since 2016. Since Christian Waters stepped into the role of director of technology integration in 2013, he has crafted an arsenal of computing lessons to captivate the full spectrum of beginning and lower schoolers. Christian teaches at least one unit of digital citizenship, coding, and robotics to every lower schooler. Kids engage in hands-on activities like programming colorful toy robots and building wearable tech comprised of LED lights affixed to felt. They also get the space to think big and consider computing’s real-world applications, like furthering one of the United Nations Sustainable Development Goals. How might they use computing, for example, to remedy a problem like overcrowding or a lack of affordable and clean energy?

Christian draws curriculum from dozens of expert educational resources, including the Robotics Institute at Carnegie Mellon University, Children’s Innovation Project, and Code.org. “We’ve built something that is really relevant, and the best combination of the best materials and resources,” Christian said. “It’s not a curriculum that is sold in a big box that you wheel into a classroom, and everyone has to do it the exact same way.

It’s tailored to the needs of Rowland Hall and relevant to our goals and our objectives.”

Thanks to ongoing collaboration between Christian and Ben, Rowland Hall’s CS curriculum is also vertically aligned: “We’re preparing students for Advanced Placement Computer Science A Java in a way they never were before. Students in the Middle School are learning about objects, classes, functions, and variables,” Christian explained. “It’s thanks in part to how we’re building up from the Beginning School.”

One example of vertical alignment and mission-centric curriculum: Christian uses a Code.org activity where lower schoolers train a computer to recognize facial expressions—broaching some of the same issues upper schoolers examined in their February workshop. The crux of the Lower School lesson, according to the educator: “How do we distinguish between facial features and whether someone is happy or sad or excited, and is that even ethical to do that?” Students exercise their critical-thinking skills and confront questions involving how these programs work, and how to ensure they’re as ethical and unbiased as possible. “Ultimately what students get is that there is a lot of subjectivity in how we humans train computers,” Christian said.

A GROUP EFFORT

Part of attracting younger and more diverse students to CS—and, down the road, reducing bias in code—entails continual, widespread exposure. Christian has not only integrated CS into classrooms, he’s also created community-wide opportunities to rally around computing and engineering. He organizes three annual events that are now synonymous with STEM culture on the McCarthey Campus: the beginning and lower school Family Maker Night in the fall, the school-wide Hour of Code in the winter, and Lower School Maker Day in the spring. “These events are designed to demystify technology and making,” Christian said. “All students can see themselves as computer scientists, coders, makers, roboticists, engineers.”

These events and the school’s CS curriculum as a whole are dominated by collaborative group work that occasionally reaches across subjects and divisions. Before the COVID-19 pandemic, Ben Smith’s Advanced Placement Computer Science Principles students collaborated annually with Tyler Stack’s fourth graders to make an app that helps young students learn math. Upper schoolers worked in groups to devise and test app concepts on the lower schoolers and use their feedback to improve app design. For Katy Dark ’21, it was a highlight of Rowland Hall’s CS program: “The thing that will stick with me the most is using new interfaces to help people.” It’s a fitting favorite memory for Katy, who in 2020 became the first Rowland Hall student to win the top national award from the Aspirations in Computing program, sponsored by the National Center for Women & Information Technology (NCWIT). She won, in part, for her efforts in tutoring students and developing a coding club at Salt Lake City’s Dual Immersion Academy, a bilingual Spanish-English charter school she attended during her elementary years.

The app project is a prime example of group work that can encourage underrepresented populations to pursue CS, according to Dr. Helen Hu, a Westminster College computer science professor whose work examines how educators can improve diversity in CS. “In industry, there’s something called agile co-programming, which is people working in groups,” said Dr. Hu, also the parent of

a Rowland Hall ninth grader and seventh grader. “This is actually an important skill in computing—being able to work with others.” While some students love computing for computing’s sake, she added, a lot of others love it because of what it can do, “because of the problems you can solve, because of the impact you can have,” she said. “By doing both, by emphasizing these other parts of computing, you’re helping both types of students. The students who love to code still get to code. The students who love coding to solve problems are getting to do that. We know that students aren’t going to learn it as well when you just teach it at the level of, ‘Where does the semicolon go, and where do parentheses go?’”

Alex Armknecht ’20, a 2019 Aspirations in Computing regional award winner who’s now a CS major at Loyola Marymount University (LMU), appreciated learning CS at a more holistic level. “I loved the CS classes at Rowland Hall, and they were consistently my favorite classes throughout high school,” she said. “I loved the way Mr. Smith taught and allowed us creative freedom ... his class is the main reason I am majoring in CS. I learned the importance of asking for help, creativity, and collaboration, which all have been helpful to me in my college CS classes.”

During her senior year, Alex also participated in another shining example of collaborative group

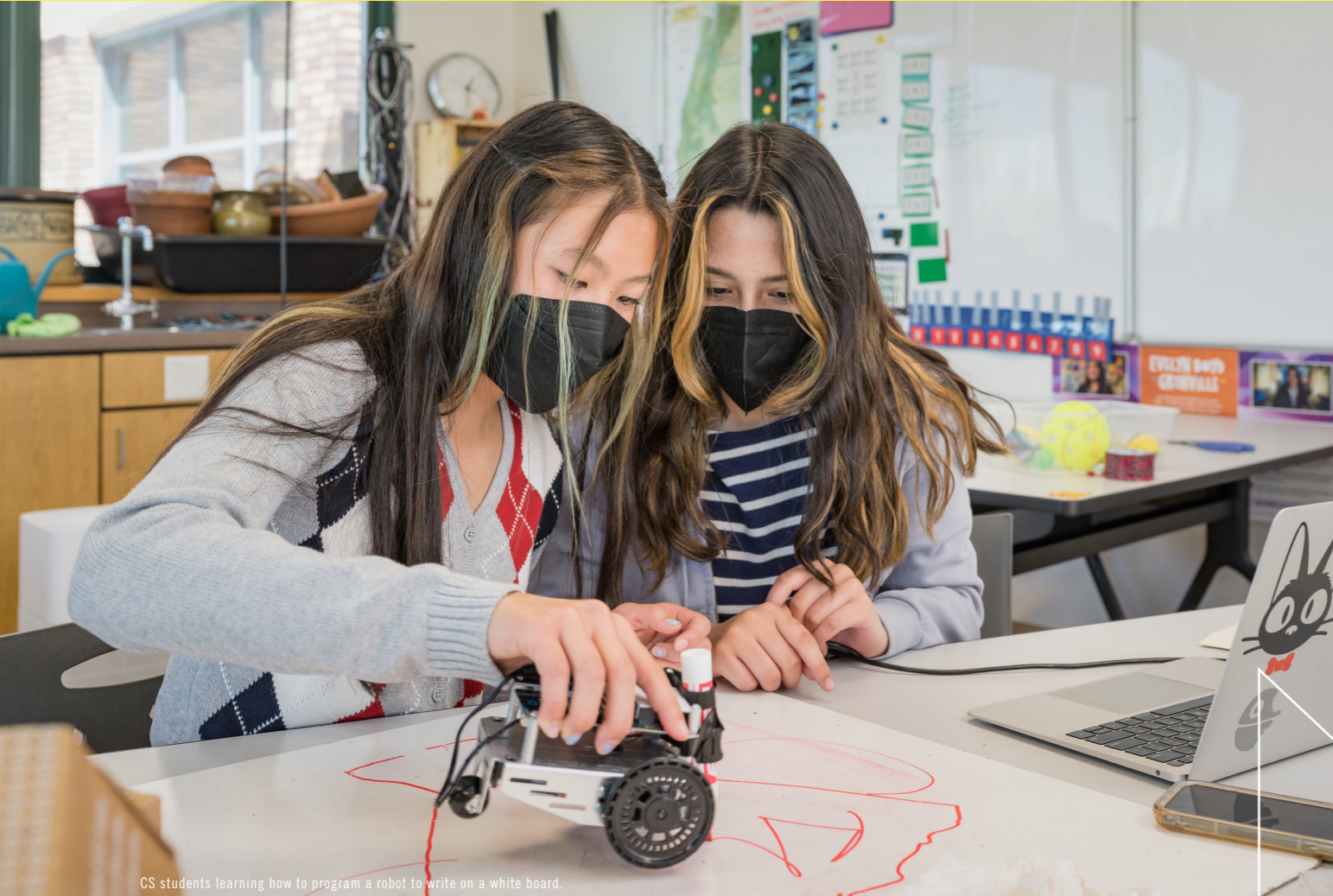
COURSES

Upper School

Robotics
Exploring Computer Science
Java Fundamentals
AP Computer Science Principles
AP Computer Science A (Java)
Robotics Team (club)

Middle School

Foundations of Computer Science (sixth grade)
Art with Code
Digital Sculptures
Make Club
Robotics and Inventing Arts & Ensembles semester course



CS students learning how to program a robot to write on a white board.

work in CS: the Upper School's For Inspiration and Recognition of Science and Technology (FIRST) Tech Challenge Robotics team. The team started off strong in its inaugural 2019–2020 year and has continued to evolve, Ben said: "It's expanded the opportunities for young women to become leaders, compete, and see how other girls across the state are involved with technology and engineering."

During the 2020–2021 school year, juniors Irenka Saffarian and Tina Su stepped into unofficial leadership roles that bode well for the near future. Both have taken Advanced Placement CS A and are great coders, Ben said, and they pushed hard for the team to make it to the national semifinals in the FIRST Global Innovation Awards. Rowland Hall was the only team from Utah and one of only 60 teams

internationally to make it that far. "Our theme right now is take it to the next level," Ben said. "We realize we are right on the verge of getting to that level where we're really competitive—where we actually compete with the best teams in the state." And Irenka and Tina, Ben said, are committed to getting the team there. They embody the enthusiasm that Ben and Christian hope to cultivate across the school. "I hope that the future of taking computer science courses at Rowland Hall is increasingly coming from a place of excitement and interest and, 'I cannot wait to use this skill in anything that interests me,'" Ben said. "It's not about a kid sitting in a basement all alone typing on their computer. This is about groups of people making exciting and interesting and really impactful decisions, and everyone needs to be at the table."

PROGRESS MADE AND THE WORK AHEAD

"We are talking more about it, not just because it's zeitgeisty, but because technology has a lot of ground to make up here."

—*Christian Waters, director of technology integration*

While Katy, Alex, Irenka, and Tina are recent success stories, Christian and Ben readily acknowledge that Rowland Hall isn't exempt from racial and gender disparities in CS. But the school is perpetually working "to change that from the ground up," Christian said. Thanks in part to schoolwide training, JEDI values are ingrained in how Rowland Hall instructors design and teach tech-related classes. "We are talking more about it, not just because it's zeitgeisty, but because technology has a lot of ground to make up here. We see ourselves as trying to help kids recognize that."

Ané Hernandez, a junior who took AP computer science and robotics as a sophomore during the 2020–2021 year, appreciated the heightened JEDI focus. Ané's parents are both engineers, and she's been interested in CS for as long as she can remember—the winner of a 2021 Aspirations in Computing regional honorable mention loves the art of programming. Ané, who is Mexican American, has also long been interested in JEDI issues and advocating for more equity and representation, including through Rowland Hall's student JEDI Committee. She found it compelling to see how two of her passions, JEDI and CS, are related. "As technology is rising, racial, gender, and socioeconomic problems still exist," Ané said, "so they're just becoming interwoven."

While she's grateful for how the JEDI units have furthered her passion for CS, she hopes her

school also uses this momentum to self-reflect on, for instance, how to make CS more accessible to lower-income schools and communities. And that sort of community outreach isn't unprecedented at Rowland Hall. In summer 2015, and in the two summers that followed, Rowland Hall hosted a nonprofit Hackathon centered around teacher training. "That was a way that we contributed to a culture of learning and growth in our community," Christian said. Educators from local public and independent schools convened on the Lincoln Street Campus to learn coding skills and how to use certain tools, like 3D printers and Arduino robots. The technology team helped cover some of the costs, Christian said, and teachers could earn state licensing credit for attending. Ben's resume is also flooded with conferences and workshops where he's trained his peers. "It's great for me to show a group of 15 or 20 educators how to teach a curriculum," he said, "and then I can show them that I have a classroom with a majority of female students, and that I've been able to recruit and build, and that this is possible."



Lower School Maker Night 2018

Ben, Christian, and the faculty and staff who support them remain focused on graduating good citizens armed with the tools to make tech work for all of us, not just some of us.



These sorts of efforts could expand in the future. Rowland Hall is seriously considering ways to increase CS opportunities and spaces, and plans could solidify as early as the 2021–2022 school year. Christian and Ben are drafting a long-term CS plan that involves integrating CS with other subjects, training teachers, and expanding current classes. And Christian, Ben, and Director of Curriculum and Instruction Wendell Thomas are starting a CS task force and have asked others to join: one or two teachers from each division, Dr. Hu, and Sunny Washington, a startup COO and CEO who also serves on the board of Equality Utah. One of the task force’s first actions will be to provide feedback on the draft plan.

For now, Christian and Ben’s work to recruit more—and more diverse—CS students is paying off. Since 2014, 19 Winged Lions have earned a collective 25 awards from the Aspirations in Computing program, including one win (Katy’s) and two honorable mentions at the national level (see page 36 for this year’s winners). Rowland Hall also won The College Board’s 2019 and 2020 Advanced Placement Computer Science Female Diversity Award for achieving high female representation in our AP CS Principles class. Dr. Hu lauded the achievement. “That’s pretty impressive,” she said—especially for Utah. “There are some states where they have tens of teachers who received this. We have three. I think that speaks to how difficult this is in the state.”

Ben, Christian, and the faculty and staff who support them remain focused on graduating good citizens armed with the tools to make tech work for all of us, not just some of us, as Joy Buolamwini so wisely said. Recent grad Katy is now attending Trinity College in Dublin, Ireland, and majoring in law—possibly cyber law. Anna Shott ’16 emailed Ben in December 2020 to share that she’d be joining Microsoft as a program manager the following year. “Your class

truly influenced the path I chose, and I cannot thank you enough for sparking my interest in computer science,” wrote Anna, a University of Southern California grad who also worked as a K–12 CS camp counselor on her college campus. And current student Ané said what she learned in AP Computer Science Principles—that an algorithm can decide whether someone is granted a loan, for example—was a game-changer for her. “This experience has made me want to not only major in computer science, but a specific realm of computer science that maybe deals with AI and diversifying participants and coders so that there isn’t such a large bias.”

Alex also plans on working in CS, another testament to Ben’s teaching: “I decided I wanted to go to my college when I met LMU’s chair and professor of computer science and he reminded me of Mr. Smith,” she said. “I would not be a computer science major if it weren’t for him. He pushed me to work my hardest, to try new things, and provided me with lots of opportunities.”

This sort of feedback keeps Ben laser-focused on boosting equity in CS at Rowland Hall and beyond. “I won’t pretend that it didn’t bring a tear to my eye,” he said. “It’s certainly fuel for the work that I do, and it reminds me that it’s worth doing. I could sit back on a curriculum and just deliver, and do fairly well at it. But this is beyond that. The work is more than what I teach—it’s who I’m teaching to.”

TIMELINE: MODERN COMPUTER SCIENCE AT ROWLAND HALL

Rowland Hall offered computer science (CS) or adjacent courses/clubs as early as the 1980s, but the curriculum began expanding in the mid-2010s. This timeline covers that recent history.

2011

Middle School competes in For Inspiration and Recognition of Science and Technology (FIRST) LEGO League robotics regional competitions (through 2013).

2013

Christian Waters becomes director of technology integration and starts bringing coding into all Rowland Hall classrooms.

Middle School begins offering robotics for all students, and adds after-school robotics clubs.

2014

Tianxing Jin ’15 is the first Rowland Hall student to win an award in the National Center for Women & Information Technology’s (NCWIT) Aspirations in Computing Northern Utah competition.

Rowland Hall launches a new tradition of participating in the global annual Hour of Code to spark student interest in CS.

The school’s Strategic Plan sets a goal of providing the Intermountain West’s most outstanding math and science program.

Christian begins teaching at least one unit of digital citizenship, robotics, and coding to all K–5 students.

2015

Ben Smith ’89 begins teaching CS, starting with web design and AP Computer Science Principles in the Upper School, and Exploring Computer Science in the Middle School.

Hour of Code expands to Week of Code in the Lower School.

Two students earn Aspirations in Computing accolades, including a national honorable mention for Tianxing Jin.

2016

Foundations of Computer Science is added as a required course for sixth grade.

Four students win regional Aspirations in Computing accolades.

2017

Three Middle School electives are added: Art with Code, Digital Sculptures, and Make Club.

Ben wins Utah Coalition for Education Technology’s (UCET) Outstanding Teacher of the Year award.

Rowland Hall holds inaugural Maker Day to further Lower School interest in science, technology, engineering, art, and math.

Two students win Aspirations in Computing accolades, including a national honorable mention for Marguerite Tate ’17.

Ben starts teaching CS exclusively in the fall.

2018

Upper School adds Advanced Placement Computer Science A.

Three students win regional Aspirations in Computing accolades.

2019

Upper School FIRST Tech Challenge Robotics team starts. Family Maker Night launched for beginning and lower school families.

Two students win regional Aspirations in Computing accolades.

Ben is named a Northern Utah Affiliate Honorable Mention recipient of the NCWIT Educator Award.

Rowland Hall wins The College Board’s 2019 Advanced Placement Computer Science Female Diversity Award for achieving high female representation in our AP CS Principles class. Of 818 schools that won the award, we’re one of only two in Utah.

Christian works with Lower School Principal Jij de Jesus and science teacher Carly Biedul to launch once-a-month Tinker Days where students create maker projects.

2020

Middle School adds Arts & Ensembles Robotics elective. Rookie robotics team wins the design award at a West High School competition and the control award Utah Championship at Weber State University.

Five students win Aspirations in Computing accolades, including a national win for Katy Dark ’21 and a national certificate of distinction for Violette Truong. Ben is named NCWIT Northern Utah Affiliate Educator Award Winner.

Rowland Hall wins The College Board’s 2020 Advanced Placement Computer Science Female Diversity Award for achieving high female representation in our AP CS A class. Out of 1,119 schools that won the award, we’re one of only three in Utah.

2021

Robotics team wins the connect award at a qualifying tournament and earns a bid to the state competition (they didn’t attend state due to COVID-19 restrictions). Robotics team also named national semifinalists for the FIRST Global Innovation Awards—the only team from Utah and one of only 60 teams internationally to make it that far.

Six students win regional Aspirations in Computing accolades.