

APRIL 2019



The STEM Teacher Shortage and Arizona's Future



An Informational Brief
About the Importance of
Quality STEM Education

ABOUT ARIZONA SCIENCE CENTER

The mission of Arizona Science Center is to inspire, educate, and engage curious minds through science. The Center, located at 600 E. Washington Street in downtown Phoenix, features more than 300 hands-on exhibits, live demonstrations, the state-of-the-art Dorrance Planetarium, CREATE at Arizona Science Center® makerspace, and the five-story Irene P. Flinn Giant Screen Theater. Additionally, the Center provides high-quality professional development for science teachers in Arizona through its Science Teacher Residency (STaR) program. The STaR program, supported by Helios Education Foundation, is designed to enhance educators' understanding of science content and equip them with the skills needed to effectively teach and engage students. To learn more, please visit azscience.org.

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STEM

education is vital to

Arizona's future. It prepares our young people with the knowledge and skills that are essential for success in higher education and in our increasingly high-tech economy. As the demand for talent in STEM fields grows, and as Arizona works to attract innovative science- and technology-focused businesses, ensuring that our education system provides quality STEM teaching and learning is a significant priority.

The widespread STEM teacher shortage in our state represents a major barrier to quality education in STEM subjects and has the potential to harm not just student learning, but also Arizona's economy. This informational brief provides essential context for understanding the STEM teacher shortage in Arizona, with a specific focus on how STEM education outcomes are connected to our state's economic development.



Arizona suffers from a shortage of teachers with a strong background and teaching experience in math and science.

—**Education Commission**

of the States

The STEM Teacher Shortage is Significant

Amid the highly publicized general teacher shortage in Arizona, the severe lack of STEM teachers represents an ongoing education crisis that profoundly impacts the future of our state. Information from the U.S. Department of Education indicates numerous statewide teacher shortage areas in Arizona in key STEM subjects ranging from the elementary level through to the high school level, where schools are particularly affected.¹

In 2017, just 20 percent of eighth grade students had a math teacher who majored in the subject in college. Similarly, in 2015, only 36 percent of eighth grade students in Arizona had science teachers who were science majors in college.²

In 2016-17, teacher shortage areas included:

Elementary School Level

Mathematics Specialist

Middle School Level

General Science

Mathematics

Mathematics Specialist

High School Level

Biology

Chemistry

Earth Sciences

General Sciences

Mathematics

Physical Sciences

Physics

40% OF ADMINISTRATORS HAVE THE MOST DIFFICULTY FILLING MATH TEACHING POSITIONS

30% OF ADMINISTRATORS HAVE THE MOST DIFFICULTY FILLING SCIENCE TEACHING POSITIONS

Many schools struggle to find qualified teachers in math and science. A 2017 survey by the Morrison Institute, at Arizona State University, found that nearly 40 percent of administrators have the most difficulty filling math teaching positions, and that 30 percent of administrators have the most difficulty filling science teaching positions.³

The documented shortages of STEM teachers likely only partially reflect a larger problem related to a lack of STEM learning opportunities. Teacher shortage numbers in STEM subjects may be lower due to fewer STEM classes offered in schools; that is, "if a high school does not offer calculus...the school is not counted as lacking a calculus teacher."⁴

PERCENTAGE OF EIGHTH GRADE STUDENTS WHOSE TEACHER MAJORED IN MATH OR SCIENCE

MATH

ARIZONA

20%

NATIONAL

31%

SCIENCE

ARIZONA

36%

NATIONAL

48%

Arizona Students are Falling Behind in STEM

Arizona's public education system is not preparing students to excel in STEM fields. Too few Arizona students develop the STEM skills that will enable them to thrive in STEM-focused college courses and careers. Historically, students in Arizona have scored below average across all subjects on the National Assessment of Educational Progress (NAEP), nationally considered the leading statewide measure of student performance.⁵

STEM engages students and equips them with critical thinking, problem solving, creative, and collaborative skills.

—Arizona STEM Network

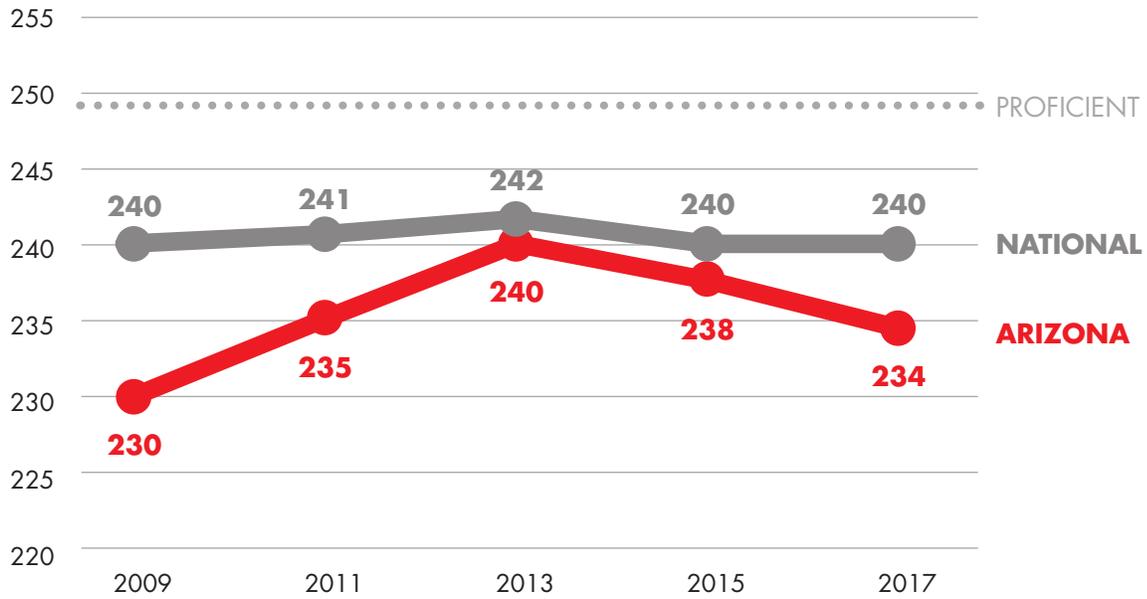


Despite noteworthy increases, fourth and eighth grade students continue to score below proficiency benchmarks on national measures of science and math achievement. Compared to other states, Arizona's eighth grade NAEP science achievement scores are among the lowest in the country. Of the 45 states ranked, 40 states had higher average scores in 2015.⁶

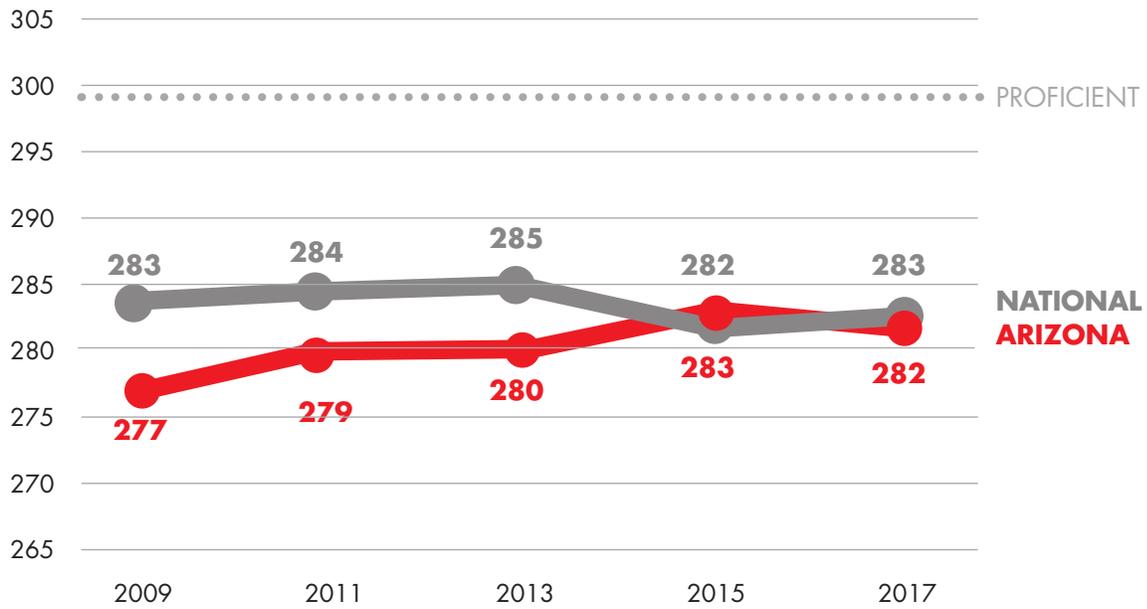
Low STEM achievement by Arizona students is also evident at the high school level. A 2016 study by ACT found that among students in Arizona who took the ACT test and had an interest in STEM, just 23 percent met ACT college readiness and STEM benchmarks.⁷

Beyond high school, Arizona STEM talent production is also limited. In 2014-15, just 23.8 percent of certificates and degrees awarded in Arizona were in STEM fields.⁸ This is below the national average and represents an important limitation on the STEM talent available in Arizona's workforce. Moreover, women and minorities in Arizona earn STEM degrees and certificates at significantly lower rates than their peers who are male and white.⁹

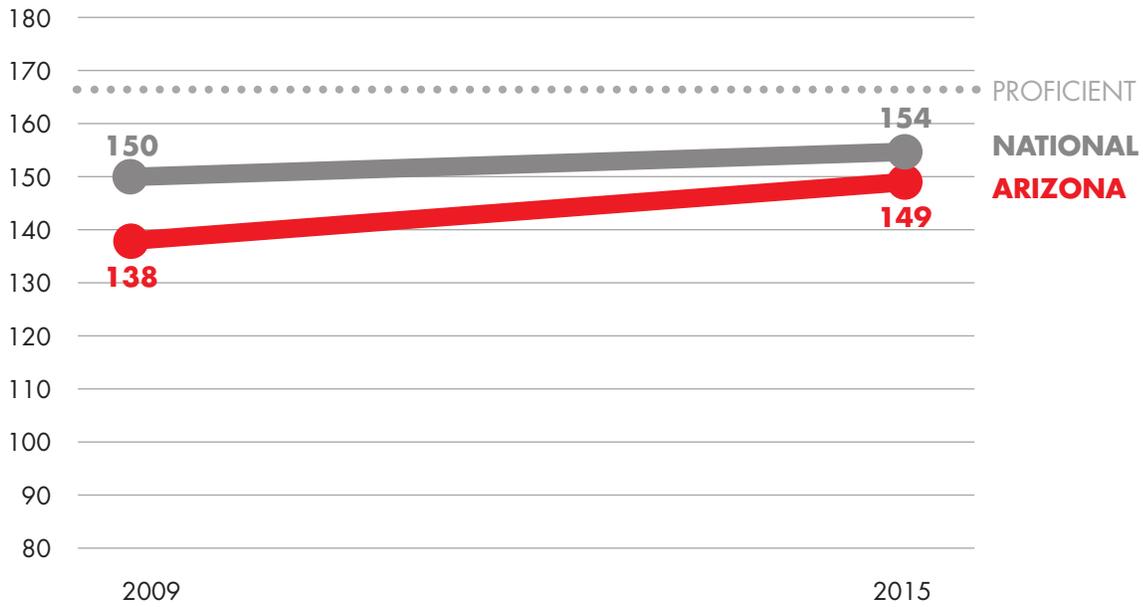
NAEP GRADE 4 MATH



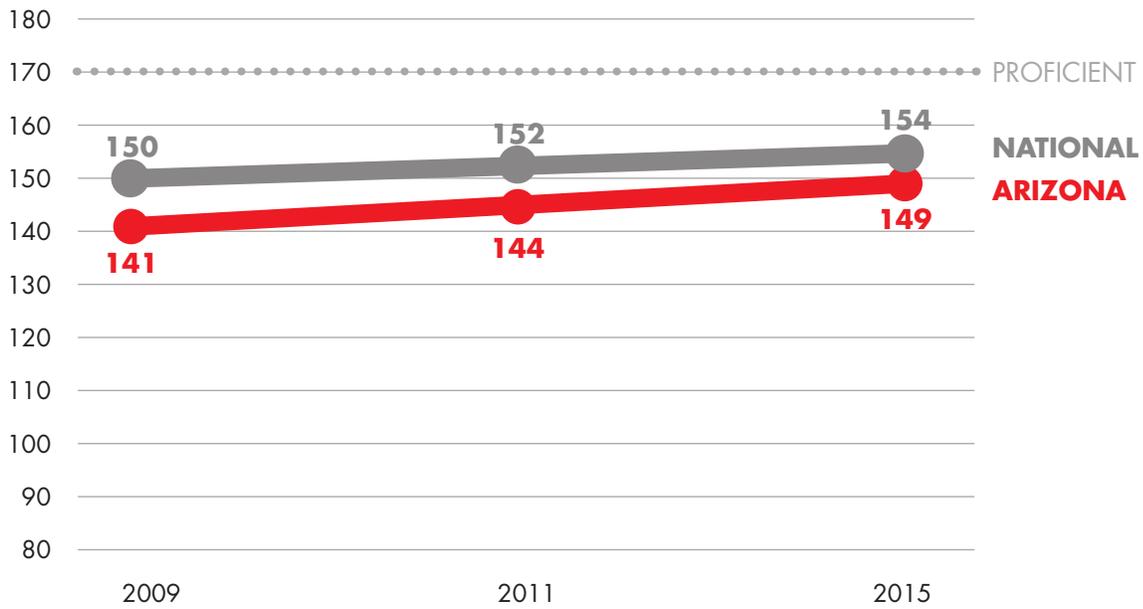
NAEP GRADE 8 MATH

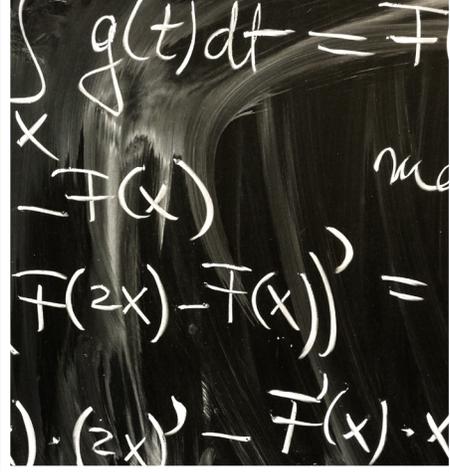


NAEP GRADE 4 SCIENCE



NAEP GRADE 8 SCIENCE



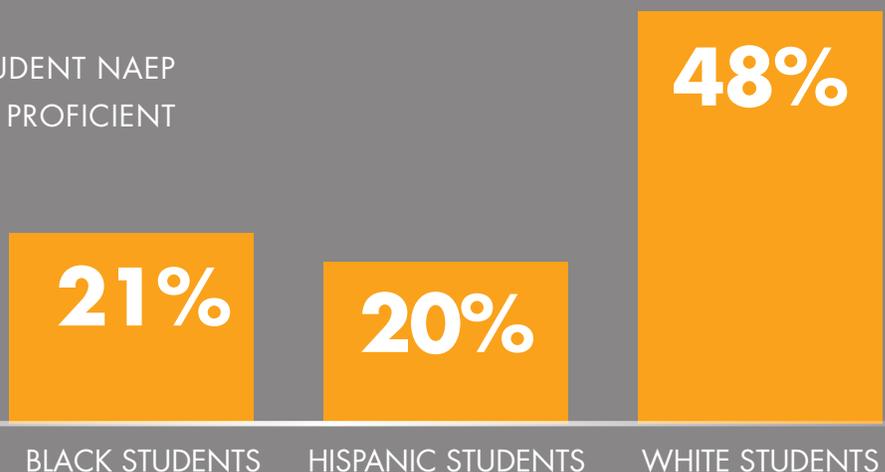


Arizona's STEM Teacher Shortage Deepens Educational Inequity

The achievement gaps that separate low-income and minority students from higher-income and white students, in an overall sense, are particularly evident in STEM subjects. In eighth grade math, for example, 21 percent of black students and 20 percent of Hispanic students in Arizona had NAEP scores at or above proficiency in 2017. By contrast, 48 percent of white students scored at or above proficient. On the same assessment, 21 percent of low-income students scored at or above proficiency, compared to 44 percent of their peers from higher-income families.¹⁰

The challenges that schools across the state grapple with in trying to meet their teacher workforce needs tend to be magnified at low-income schools and schools that serve high numbers of minority students. Research shows that low-income schools are especially likely to experience high rates of teacher turnover, which can “result in students falling behind at higher rates than students in higher-income schools with lower turnover.”¹¹

ARIZONA EIGHTH GRADE STUDENT NAEP
MATH SCORES AT OR ABOVE PROFICIENT



STEM Learning Outcomes Impact Arizona's Workforce

In addition to damaging the quality of education that students receive, Arizona's teacher shortage also jeopardizes the state's economic future. For Arizona to achieve its ambitions of becoming the go-to destination for innovative businesses and a premier regional economy, a quality education system capable of developing a skilled workforce that meets that changing needs of employers and prepares young people for the jobs of the future is vital. Simply put, "the skills derived from a STEM education are the mission-critical elements of the jobs of tomorrow, for they are directly linked to economic productivity and competitive products."¹²

Furthermore, increasing the overall college attainment rate—the number of Arizonans who hold a college certificate or degree—from 43 percent to 60 percent by 2030 is one of Arizona's most important education goals, toward which an alliance of more than 60 community, business, philanthropic, and education organizations (including Arizona Science Center) are working.¹³ Accomplishing this goal has the potential to inject \$3.5 billion, from personal income and tax revenue, into the state annually.¹⁴ As part of this effort, it will be essential to ensure that more students enter college with the skills required to succeed in STEM fields.

People who are employed in STEM occupations make up an important segment of Arizona's workforce. In 2016, scientists and engineers, as well as people working in occupations that require technical expertise in science and engineering, accounted for 6.6 percent of workers in Arizona (compared to the national rate of 6.2 percent).¹⁵ Between 2017 and 2027, the number of STEM jobs in Arizona will grow by 21 percent; all other jobs are projected to grow by 15 percent.¹⁶



IN 2014-15 ONLY
24%
OF CERTIFICATES AND
DEGREES AWARDED IN
ARIZONA WERE IN
STEM FIELDS

BETWEEN 2017
AND 2027
IN ARIZONA,
STEM JOBS WILL
GROW BY
21%

The STEM Teacher Shortage is Part of an Overall Teacher Shortage

Arizona's overall teacher shortage is severe and the state is resorting to emergency measures in an effort to help superintendents and principals staff their schools. While there are approximately 90,000 certified teachers in Arizona, 25 percent of the 6,227 teacher vacancies remained unfilled as of August 31, 2018, and nearly 3,000 positions were filled by teachers not meeting standard requirements for certification.¹⁷

This means that more than 72 percent of the unfilled teaching positions in the state—as of August 31, 2018—either remain vacant or have been filled by a teacher who is certified by a non-standard method, such as an emergency certification or subject matter expert certification.¹⁸

This is partly because Arizona has the highest teacher turnover rate in the country. Nearly one-quarter of teachers in the state leave their schools annually. This turnover rate is almost twice the national median.¹⁹ Since 2013, 42 percent of teachers in Arizona have left their schools within three years of being hired.²⁰

Also concerning is the fact that Arizona's teacher pipeline has been dwindling for nearly a decade. Between 2008 and 2016, the number of students working towards degrees in education at Arizona's public universities dropped by 18 percent.²¹

The impact of the overall teacher shortage in our state is not limited to the positions that go unfilled in schools throughout the state. It also affects the strength of the existing teacher workforce. As many as 17.3 percent of teachers in Arizona are inexperienced (in their first or second year of teaching), and 11.7 percent of teachers in the state are uncertified. By comparison, the national average for the proportion of uncertified teachers in the workforce is 2.6 percent.²²



“The skills derived from a STEM education are the mission-critical elements of the jobs of tomorrow, for they are directly linked to economic productivity and competitive products.”

—U.S. News and World Report

Given that effective teachers are, by some measures, the most important school-based factor that influences student learning,²³ the proportion of inexperienced and uncertified teachers represents a troubling extension of the problems caused by the overall teacher shortage. Simply put, too few students in Arizona learn from teachers who have the requisite experience and the skills to provide a first-class education.

Moreover, the holes in Arizona’s existing teacher workforce have not gone unnoticed by the public. According to a 2017 survey by the Prime Group, 45 percent of registered voters in Arizona surveyed believe that unqualified teachers and administrators represent one of the top two challenges facing public schools.²⁴

The systemic problems that have contributed to the statewide teacher shortage are not the fault of teachers themselves, who are doing admirable work under difficult circumstances.²⁵ For example, Arizona spends less per pupil on education overall than every other state, as well as less on instruction and teacher compensation.²⁶

17.3%
OF TEACHERS IN
ARIZONA ARE
INEXPERIENCED

11.7%
OF TEACHERS IN
ARIZONA ARE
UNCERTIFIED

PER-PUPIL EXPENDITURE ON INSTRUCTION, 2013-14*



PER-PUPIL INSTRUCTIONAL EXPENDITURE ON COMPENSATION, 2013-14*



*Adjusted for geography

Working Conditions and Low Compensation Contribute to Arizona's Teacher Shortage

Arizona is a difficult state in which to be a teacher. In 2016, the Learning Policy Institute analyzed the factors contributing to teacher shortages in all 50 states. According to this analysis—which looks at metrics related to compensation, working conditions, and teacher qualifications and turnover—Arizona ranked last among all states, in terms of the attractiveness of the teaching profession, with a rating of 1.5 (out of five).²⁷ A 2018 update to the Learning Policy Institute analysis showed even further decline in the attractiveness of the teaching profession in Arizona, rating it at 1.3 (again, out of five).²⁸ This makes it difficult for schools to attract talented teachers in STEM and other subject areas.

It takes the average Arizona teacher more than 25 years to earn a family living wage.

—Arizona Community Foundation



Teacher pay, if not the only reason for Arizona's teacher shortage, is among the primary factors contributing to the high turnover and attrition rates in the state. In fact, 80 percent of teachers surveyed indicated low pay as the main reason for leaving the profession.²⁹ The starting salary for teachers in Arizona is \$33,973, compared to the \$38,617 national average.³⁰ A 2018 analysis by Expect More Arizona ranked Arizona 49th in terms of teacher pay when adjusted for cost of living.³¹ Currently, it takes the average Arizona teacher more than 25 years just to to earn a family living wage (\$58,200, in 2017).³²

Teacher Shortages in Rural Schools

Rural schools are particularly affected by the teacher shortage in Arizona. Compared to 77 percent of school administrators in urban districts, 85 percent of rural school administrators in Arizona report that it is either somewhat or extremely difficult to hire new teachers. This challenge can be even greater when it comes to hiring math and science teachers.³³

Arizona Can Take Action

STEM education holds the key to Arizona’s future prosperity and economic competitiveness. As schools throughout the state continue to struggle to hire the teachers they need, more and more students face uncertain prospects about the quality of the education that they will receive and whether or not their STEM teachers will have the requisite knowledge and experience. In turn, this jeopardizes student learning, readiness for college, and their chances of building a career in Arizona’s increasingly skilled and competitive economy.

As the growth of STEM jobs in Arizona continues to outpace job growth in all other sectors, it is essential that the state develops a stronger pipeline of STEM talent to bolster competitiveness and ensure that employers in STEM fields can hire the workers they need to be competitive. The STEM teacher shortage remains a major impediment to this effort. Finding long-term solutions to the STEM teacher shortage, and the statewide teacher shortage more broadly, will be essential to the success of Arizona’s next generation. Businesses, industry leaders, community-based organizations, the higher education sector, and lawmakers all have a role to play in building Arizona’s teacher workforce and ensuring that all students have the opportunity to learn from qualified STEM teachers. By strengthening STEM education from all angles and reinforcing the STEM teacher workforce, Arizona has the potential to develop a pipeline of talent that helps secure our state’s future competitiveness and prosperity.



Endnotes

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// According to nearly half of Arizona voters surveyed, unqualified teachers represent one of the two biggest challenges for public education in the state. //

—Arizona Community Foundation

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Never stop wondering.
Never stop imagining.™