

# Strategic Investment in TK-12 Science



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## EXECUTIVE SUMMARY

Elevating science is not merely a matter of content equity, it is a strategic imperative for strengthening the educational system at large.

There has never been a better time for California to embrace high-quality science instruction for all students, especially at the elementary-school level. Despite the fact that the infrastructure is in place, and many resources are available for schools—including supportive professional organizations—consistent, high-quality, hands-on science education remains a luxury for far too many students.

While the research, data, and anecdotal evidence all show that increased science instruction benefits each and every student across curricula and increases student attendance and engagement, many districts in California have yet to realize the goal of prioritizing and achieving a strong statewide science education program that is on par with that of English/Language Arts and math. A rigorous science experience for every student is imperative for strengthening the State’s educational system, not only for the future of all students in the workforce but also for the future economic viability of the State of California.

## INTRODUCTION

Every student in California, starting in Transitional Kindergarten (TK), should receive a comprehensive and high-quality science education. Twelve years after adopting the California Next Generation Science Standards (CA-NGSS, [CDE, 2013](#)), science has finally been incorporated into the state's accountability system as a full-color indicator on the [California School Dashboard](#). Although this marks a significant advancement toward ensuring all students have access to high-quality science instruction, decisions regarding how science fits into the broader accountability system have yet to be made.

### **Increasing the profile of science will support overall student learning.**

Numerous schools and districts across California and other states have successfully implemented high-quality science instruction into their curricula. This increased focus on science has not only supported students' understanding of scientific concepts and skills but has also positively impacted achievement in English/Language Arts (ELA), math, English Language Development (ELD), and overall school attendance. Instruction grounded in phenomena-based, three-dimensional learning, as outlined in the California Science Framework ([2016](#)), provides an engaging context for students to apply literacy and math skills to investigate authentic questions and solve real-world problems. Additionally, this approach promotes meaningful student collaboration, fostering sense-making through student

## High-quality science instruction doesn't just deepen students' scientific understanding — it strengthens achievement in ELA, math, and ELD, boosts engagement, and supports attendance across TK–12.

discourse and aligning with one of the key elements of the [California ELD Standards](#) (Part I: Interacting in Meaningful and Intellectually Challenging Ways). These practices echo the intent of the [Common Core State Standards](#). Both research findings and field-based evidence highlight the effectiveness of this integrated, student-centered approach to science education with specific examples and supporting data presented later in this paper.

California has the capacity to support high-quality NGSS instruction.

### **California has built a coherent and robust community of organizations that partner with the state and county offices to assist schools and teachers in transitioning to high-quality science instruction**

A wide range of resources have been thoughtfully developed, thoroughly vetted, and are readily available to support teachers and schools in delivering effective science instruction.

To fully realize the transformative potential of science education, California's science education must be positioned as a central component of systemic educational improvement, both in alignment with and—more importantly—in parity with ELA and math. Historically, science has been marginalized in instructional

priorities, particularly at the elementary level, where limited time, resources, and professional learning opportunities have hindered consistent implementation. This continued devaluation not only undermines equitable access to a robust education but also forfeits the broader benefits science brings to the educational system as a whole, including improved interdisciplinary learning and student engagement.

This inequity is not new. As noted in CASE's 2019 paper, [Equitable Access to Science in California](#), both in California and across the United States, there is unequal access to high-quality science education. Ongoing gaps exist in access and achievement in schools and districts serving large populations of low-income students, students of color, and Multilingual Learners (MLs), and these groups have historically been underrepresented in science education and careers.

Advancing science education TK-12 requires intentional investment in the following: sustained local professional development; dedicated instructional time; access to high-quality instructional materials; and procedures for accountability. Elevating science is not merely a matter of content equity: it is a strategic imperative for strengthening the educational system at large.

## California has a community of strong educators poised to support increased science instruction.

School and district administrators, teachers, county offices of education specialists, and other statewide science educators have expressed enthusiasm for the inclusion of science on the California Schools Dashboard. Many districts that have already integrated high-quality science instruction into their curricula report that it not only enhances students' understanding of scientific concepts but also supports students' development and progress in ELA, mathematics, and ELD, while also contributing to improved student attendance. The existing system of statewide science education resources and inter-organizational partnerships has been instrumental in facilitating these implementation efforts. The increased visibility afforded by the Dashboard presents a significant opportunity to build upon these successes and to expand equitable access to high-quality science education for all students in California.

There has never been a better time to ensure high-quality science education in TK-12 classrooms throughout California and, in so doing, further ensure that student achievement is more fully supported—and that all students are well-prepared to emerge as the much-needed Science, Technology, Engineering, and Mathematics (STEM) leaders of the future.

## BACKGROUND

Science is key to California's continued economic success. California must prioritize the cultivation of a STEM-educated workforce. STEM serves as a critical pathway to a wide range of stable, high-paying careers and is essential to the state's long-term economic vitality. Beyond its economic implications, STEM literacy is a foundational competency for all students, fostering curiosity, critical thinking, and problem-solving skills essential for active and informed participation in a society increasingly shaped by science and technology. Science enables students to address challenges within their communities and navigate complex issues, such as interpreting health information; evaluating the environmental impacts of policy decisions; making informed choices about investments in renewable energy; and enhancing opportunities for both personal agency and civic engagement.

California has long been recognized as a global leader in scientific innovation and discovery. However, this leadership is increasingly at risk due to reductions in federal research funding and challenges to the autonomy of our higher education institutions. These pressures threaten to accelerate the loss of scientific talent—both emerging and established—and risk undermining the State's capacity for continued innovation. In response, California must affirm its commitment to science as a cornerstone of its educational, economic, and civic future. This requires that the state must take proactive steps to strengthen and safeguard its scientific infrastructure.

Such scientific infrastructure will no doubt be difficult to maintain while access to high-quality STEM education in California remains profoundly inequitable. Students in schools that are predominantly middle and upper-income communities often benefit from hands-on science instruction at the elementary level; robust after-school science enrichment programs; and a variety of advanced science courses in high school. In contrast, students in high-poverty and rural schools often receive limited or no science instruction in elementary school and encounter limited access to advanced science coursework in later grades. As a result, many students in California are excluded from the STEM pipeline long before graduation. This limited access contributes to a loss of talent and opportunity for the State. Continuing to treat science

**Continuing to treat science education as an optional enrichment rather than a core educational right undermines both equity and access for California's students now and imperils their future ability to remain competitors in scientific fields**

education as an optional enrichment rather than a core educational right undermines both equity and access for California's students now and imperils their future ability to remain competitors in scientific fields in the future. Ensuring universal access to rigorous science and education is a necessity for equitable education and for the sustainable economic future of California as a whole.

Acknowledging the critical role of science education, the California State Board of Education adopted the California Next Generation Science Standards (CA-NGSS) in September 2013. The science framework was revised and adopted in 2016. Both steps moved California toward phenomena-driven, three-dimensional science teaching and learning. This approach transcended the mere passive transmission of facts and allowed students to engage in scientific practices and the development of scientific reasoning and mindsets. By fostering deeper conceptual understanding and inquiry-based learning, this model cultivates scientifically literate citizens who possess robust critical-thinking skills and encourages greater interest in pursuing careers in science and technology-related fields.

In order to build full capacity for CA-NGSS in select school districts and charter management organizations, the [K-12 Alliance](#), [WestEd](#) led an early implementation initiative that included collaborative input on its design and objectives from the State Board of Education, the California Department of Education, and Achieve. This was privately funded by the S.D. Bechtel, Jr. Foundation and the Hastings-Quilin Fund.

The [NGSS Collaborative](#), a joint effort of various educational organizations, developed and delivered statewide rollouts and professional learning experiences in eight of California's fifty-eight County Offices of Education. These were typically two-day workshops focused on specific grade levels and topics related to the NGSS.

Since then, the Collaborative has developed resources like the California NGSS Toolkit for Instructional Materials Evaluation ([CA-NGSS TIME](#)). The Collaborative is now offering professional learning experiences focused on coherent and student-centered science assessment systems.

However, unlike the coordinated state investment in professional learning for ELA and math during the adoption of those frameworks, the state did not provide comparable funding to support widespread professional development for science educators. Because the State has not yet invested comparable professional development funding to support the continued needs of a fully-implemented science education in all TK-12 schools, ensuring that all students have access to teachers who are prepared to teach the NGSS at the requisite level of rigor and depth remains a challenge.

Furthermore, without such professional development funding, schools were not able to maximize the benefits of all of the resources that had been put into place. While a strong foundation had been created, building upon this foundation and bringing necessary improvements to fruition remained a significant challenge. This lack of sustained public investment remains a critical gap in the successful implementation of NGSS in grades

K-12 throughout California.

Despite these funding limitations and implementation challenges, California's science education community has demonstrated remarkable resilience and leadership in advancing NGSS-aligned instruction. The NGSS rollouts and professional learning modules created by the CA-NGSS Collaborative are foundational tools, accessible to educators statewide. County offices of education have contributed by creating and disseminating high-quality resources, while informal science institutions such as the Exploratorium and the Lawrence Hall of Science at UC Berkeley continue to provide valuable support to districts and educators. Additionally, professional networks like CASE and the California Math, Science, and Computer Science Partnership (CAL-MSCS) are bringing science leaders together to foster collaboration and sustain momentum throughout the State.

Because there is strong evidence that such resources, resilience, enthusiasm, and leadership exist, California clearly has both the expertise and the capacity to meet these challenges—and rise above them—in a more excellent way.

Stories from schools and districts who have invested in high-quality science programs and reaped the benefits illustrate the powerful impact of increased science education.

Furthermore, the research behind equity in STEM underscores the remarkable effect of science learning on English-language development. Fortunately, California is already equipped with a strong capacity to support schools in moving toward high-quality science education for all students.

## REAL-WORLD IMPACT OF TK-12 SCIENCE EDUCATION

The following “Stories of Impact” highlight the many ways robust TK–12 science instruction directly supports student success across disciplines. Drawing from diverse school communities, these stories from the

field illustrate the tangible ways in which high-quality science instruction enhances student achievement in ELA, mathematics, and science, while also contributing to improved ELD outcomes and overall attendance rates. The stories featured here underscore science education’s vital role in engaging multilingual learners; fostering academic language; and

building cross-disciplinary competencies. Grounded in state assessment and attendance data, these narratives offer compelling evidence that science is not only foundational for STEM pathways but also an essential driver of equity and student growth across the curriculum.

### STORY OF IMPACT #1: Wonder in Their World, Riverside Unified School District

*Investing in science professional development boosts teacher confidence, which leads to devoting more instructional time to science, thereby increasing student engagement and attendance.*

#### PREPARED BY:

Shannon Dadlez, Ph.D.  
Riverside USD Staff Development  
Specialist, Science

“Teacher! Look at THIS!” Tiny hands shot up, pointing excitedly at a curious creature inching along an orange tree branch.

“It’s poop!” shouted one kindergartener.

“No—it’s a caterpillar,” another countered, eyes wide with wonder.

After a flurry of photo-taking and investigative excitement, the class returned inside. Through discussion, photos, and comparison, the students concluded that the mystery creature wasn’t a bird dropping—it was the larvae of a Giant Swallowtail Butterfly.

This real-life moment from a Riverside Unified School District classroom captures the goal and spirit of Next

Generation Science Standards (NGSS): giving students the tools and time to explore, question, and make sense of the world around them.

Before 2015, science instruction in Riverside elementary classrooms averaged a mere eighteen minutes per week, usually consisting of textbook reading and question-answering. But, that year, Riverside Unified became one of California’s early adopters of the Next Generation Science Standards through a grant-funded initiative called the Science Renaissance Project. The district selected two teachers from each of its thirty elementary schools—over seventy in total—to undergo intensive, multi-year professional development in NGSS content, student-centered instruction, and science discourse strategies. Teachers learned science content from the University of California, Riverside (UCR), Riverside City College (RCC), and Chaffey College professors, and teachers learned about their grade level NGSS standards from Dr. Maria Simani.

In 2025, Riverside Unified teachers adopted an NGSS-designed curriculum, Full Option Science System (FOSS) Pathways, for all TK-5 classes. While some adoption

committee members had been in the Science Renaissance Grant, most were new to NGSS. The adoption committee attended intensive training at the San Francisco Exploratorium to learn about student sense-making. During additional meetings, participants focused on improving student-centered instruction; delivering NGSS content; and increasing student discourse.

After the curriculum adoption, all TK-5th grade teachers attended three non-consecutive training sessions. The fall professional development examined NGSS shifts and the importance of student sense-making through hands-on investigations. Teachers experienced adult-level investigations for the first half of the day and then broke out by grade level rooms to meet with the curriculum publishers and experience their first science module. Riverside Union School District (RUSD) provided materials, copies, booklets, investigation guides, and pacing support to the teachers.

The winter professional development day highlighted the critical role of student discussions in the learning process. Teachers engaged with phenomena at an adult level, utilizing

the Science Talk Moves protocols to facilitate meaningful sense-making. Following this, they gathered in grade-level groups to collaborate with curriculum publishers and explore their second science module. Given the new performance standards and curriculum changes, educators were encouraged to implement two out of the three science modules during that initial year of rollout.

In the spring, professional development sessions combined science with English Language Arts (ELA) and writing, introducing educators to the living organisms pertinent to their grade levels. The outcomes have been remarkable.

Classrooms have shifted from passive textbook-based activities to dynamic investigations. Teachers transitioned from approximately eighteen minutes a week dedicated to investigations to nearly 100 minutes. Some Dual Language Immersion (DLI) sites even

began incorporating science into their Designated English Language Development (ELD) time. Educators reported high levels of student engagement, with discussions integrating scientific and academic vocabulary, which especially benefited their Multilingual Learners. A Special Education teacher expressed, "Science is the only time in the entire day that ALL my kids feel successful." Meanwhile, a kindergarten teacher noted that nature walks around the school campus led students to discuss tree parts and observe insects during recess.

Teachers also observed that science instruction was positively influencing other subject areas. Students demonstrated enhanced non-fiction reading skills; produced more detailed evidence-based writing; exhibited stronger data analysis in math; and showed improved collaboration during discussions. One educator

remarked, "Making observations and drawing conclusions has greatly improved my students' problem-solving skills."

Teachers have reported noticeable improvements in engagement, discussion, and writing within science classes. Interestingly, 40% of teachers reported that attendance improved on days when science was taught first thing in the morning, revealing students' eagerness to engage.

In Riverside Unified School District, students are actively immersing themselves in the world of science, embracing their curiosity and evolving into budding scientists, taking note of all the magic that surrounds them.

Without a doubt, this case study underscores the many benefits of increased science education in elementary classrooms.



## STORY OF IMPACT #2: Science as a Core Pathway to Student Success at Chrysalis Charter School in Shasta County

*Investing in science instructional time improves student attendance, academic achievement, and equitable access to meaningful learning.*

### PREPARED BY:

Tim Drury  
Administrator / Superintendent  
Chrysalis Charter School

### Overview

Chrysalis Charter School, a small TK–8 independent charter authorized by the Shasta County Office of Education, continues to demonstrate how much more is possible when science is treated not as an auxiliary add-on, but as a core component of the academic program. With a deep commitment to NGSS-aligned instruction, weekly field studies, and inclusive practices, Chrysalis is showing measurable success across multiple indicators of student attendance and achievement, family engagement, and equity.

### Academic Achievement: Science as a Catalyst

Chrysalis students consistently outperform state averages in science. On the 2024 California Science Test (CAST), **41.9%** of students met or exceeded standards, compared to just 30.7% statewide. Even more striking, **18.6%** of Chrysalis students exceeded the standards—nearly twice the statewide rate of **9.9%**. Earth and Space Science emerged as a particular strength, with nearly **24%** of students scoring above standard in this domain. Science instruction at Chrysalis not only boosts performance in science—it

also strengthens core literacy and numeracy skills. On the 2024 California Assessment of Student Performance and Progress (CAASPP):

- **56%** of students met or exceeded standards in English Language Arts (ELA)
- **39%** met or exceeded standards in Mathematics

This growth is supported by cross-curricular science practices such as data analysis, written scientific explanation, and collaborative reasoning, all of which help students build the academic language and critical thinking skills that transfer to other subjects.

### Attendance and Engagement: When Science Drives Motivation

Chrysalis has also made significant progress in reducing chronic absenteeism, achieving rates well below the state average as seen in Table 1. In 2024, the school’s chronic absenteeism rate was just **4.2%**, compared to **18.6%** statewide. This is a remarkable decline from **11.9%** in 2022 and reflects the school’s success in building a culture of curiosity and belonging.

Students are deeply engaged through:

- Weekly science field studies in natural environments (four out of nine classes per week)
- Biannual school-wide camping trips
- Hands-on, NGSS-aligned labs and outdoor learning experiences

This increased student engagement is a direct result of positive changes in science instruction. As one teacher put it: “When science is central, students show up.”

Table 1. Chronic Absenteeism (Chrysalis vs. State)

YEAR	CHRYSALIS	STATE AVG
2019	5.8%	10.1%
2022	11.9%	30.0%
2023	11.4%	24.3%
2024	4.2%	18.6%

### Equity & Inclusion in Science: Access to Science for All Learners

Chrysalis exceeds state recommendations for science instructional minutes at every grade level, combining structured class time with experiential learning in the field. For example:

- **Kindergarten** receives 225 minutes of science weekly, plus 60–240 minutes of field study
- Grades 1–4 receive 225 minutes weekly, also with added field study
- Grades 5–8 meet or exceed the upper end of the state’s guidance, with field study integrated regularly

The school implements a full inclusion model, ensuring that students with IEPs and 504 plans fully participate in science instruction, fieldwork, and community-based projects with appropriate support. Classrooms are structured around collaborative investigations, real-world problem solving, engineering design, and data modeling, making science accessible to all learners, thereby proving that, “Science is where students who struggle elsewhere come alive. It’s

where we see their curiosity—and their confidence—grow.”

## Community, Citizenship, and the Culture of Science

At Chrysalis, science is not limited to test prep or classroom work: Science is a lived experience. The school has cultivated a science-rich culture that blends academic rigor with real-world application and community connection.

Students participate in:

- Weekly outdoor field studies using local creeks, forests, and mountains
- STEM Nights and hands-on science events for families
- School-wide camping and rafting trips that foster community and shared learning
- Service-learning projects such as habitat restoration and environmental advocacy

Chrysalis school states that in its science program: “We study science as a core subject, use the outdoors as our classroom on Fridays, go camping twice a year as a community, and much, much more.” And Chrysalis parents concur. As one parent noted: “Where else are kids out in the creeks, fields, mountains, skiing, rafting, and learning?”

## Why Chrysalis Matters for California

Chrysalis offers a compelling example of the possibilities

for increased student achievement when science is treated as essential rather than as enrichment. The school’s results speak for themselves:

- Higher science achievement than the state average
- Strong ELA and math outcomes supported by integrated science practices
- Dramatically lower absenteeism
- Inclusive learning environments that support all students
- Strong family engagement and a deep culture of belonging

This case study points to several important policy recommendations for California’s future:

- **Add science to the California School Dashboard** with equal weight as ELA and math
- **Encourage districts to prioritize science** in their Local Control and Accountability Plans (LCAPs)
- **Fund science-specific professional development** and field-based instructional models statewide

In short, increased prioritization of science instruction is essential. Chrysalis school demonstrates that a deep commitment produces stronger outcomes for all students.

## STORY OF IMPACT #3: Elevating Science Education: A Collaborative Journey in Alisal Union School District: Investing in Science as a Lever for Language and Literacy

### PREPARED BY:

William Franzell, Principal  
*Creekside Elementary School, Alisal Union School District*

### Introduction

This article highlights a collaborative effort among educators in the Alisal Union School District, focusing on the transformative power of science education. It chronicles the journey of Monica Anzo, Edi Porter, and Will Franzell, from classroom teachers to district and site leadership roles, and how their shared passion for science has driven significant positive change. This paper also details the implementation of these ideas at Creekside Elementary School, under the leadership of Will Franzell and Christina Mendoza.

### Background

The story begins with Monica Anzo, Edi Porter, and Will Franzell, who were all teachers in the Alisal Union School District. Their paths crossed at district leadership meetings and Summer School, where they discovered a shared passion for the teaching and learning of science. This common interest sparked a collaboration that would span many years and impact numerous educators and students.

From 2018 to 2022, Edi Porter and Will Franzell served as Science and ELA/ELD Coordinators at the Monterey County Office of Education. During this time, Monica Anzo held the position of Curriculum and Instruction Director in Alisal Union School District. The trio’s collaborative professional learning sessions became highly sought-after, attracting teachers and Teachers on Special Assignment (TOSAs) from across the region, even continuing online during the pandemic.

Edi Porter and Will Franzell expanded their “Science as a Lever” professional development model, working with multiple districts throughout Monterey County.

## Returning to Alisal and Transforming Creekside

Several years later, Edi Porter and Will Franzell returned to the Alisal Union School District. Monica Anzo assumed the role of Deputy Superintendent, and Edi Porter became the Curriculum and Instruction Director. Will Franzell became the principal of Creekside Elementary School, the same school where he had previously taught for ten years and served as an instructional coach for two years. Christina Mendoza joined Creekside as Assistant Principal, and Guadalupe Zavala became the Instructional Coach.

At Creekside, Will Franzell and Christina Mendoza have implemented a series of strategic steps to foster a thriving learning environment, with science education as a central focus. These steps include:

- **Building Relationships and Trust:** Establishing strong connections with staff, students, and families as the foundation for collaboration and shared purpose.
- **Investing in the Leadership Team:** Developing the capacity of the leadership team to drive instructional improvement and support teacher growth.
- **Co-Creating a 30-60-90 Day Plan:** Developing a focused plan to set goals and establish priorities.
- **Improving School Climate and Culture:** Cultivating a positive and supportive environment that promotes student learning and well-being.
- **Redesigning Staff Meetings and Site Professional Development:**

Creating engaging and relevant professional learning experiences that empower teachers.

- **Science as a Driving Force:** Prioritizing science education as a key component of the school’s instructional program.
- **Collaboration with EdTech and VAPA TOSAs:** Partnering with technology and visual and performing arts specialists to integrate these areas into science instruction.
- **Co-Creating Vision, Mission, and Values:** Establishing a shared understanding of the school’s purpose and guiding principles.
- **Co-designing an Innovation Lab and Providing Professional Development:** Creating a dedicated space for innovative teaching and learning, and providing teachers with the necessary training and support.
- **Partnering with STEM 4 Real:** Collaborating with external organizations to enhance STEM education opportunities for students.
- **Including Science/STEM in the School Plan for Student Achievement (SPSA):** Integrating science and STEM goals into the school’s overall improvement plan.

## Science as a Lever: A Model for Transformation

The work of Anzo, Porter, and Franzell demonstrates the power of science education as a lever for broader school improvement. Their approach, honed through years of collaboration and refined through practical application, emphasizes the following key principles:

- **Inquiry-Based Learning:** Science provides a natural context for inquiry-based learning, where

students develop critical thinking, problem-solving, and collaboration skills.

- **Cross-Curricular Connections:** Science can be effectively integrated with other subject areas, such as ELA, mathematics, and the arts, to create meaningful and engaging learning experiences.
- **Teacher Collaboration:** Collaborative professional learning and ongoing support are essential for teachers to effectively implement inquiry-based science instruction.
- **Leadership Support:** School leaders play a crucial role in creating a culture that values science education and provides teachers with the resources and support they need.
- **Community Partnerships:** Collaborating with external organizations and community partners can enrich science education and provide students with real-world learning opportunities. Local examples include the Monterey Bay Aquarium, CSUMB, Hartnell College, etc.

The collaborative journey of Monica Anzo, Edi Porter, and Will Franzell exemplifies the transformative potential of a shared vision and a commitment to science education. Their work, both at the county and district level, and at Creekside, demonstrates that by prioritizing science, fostering collaboration, and empowering teachers, schools can create vibrant learning communities that prepare students for success in the 21st century. The Alisal Union School District, and Creekside in particular, serve as a model for how a focus on science can drive positive change and improve outcomes for all students.

## STORY OF IMPACT #4: From Collaboration to Transformation: How Collective Efficacy Propelled Science Achievement in One Southern California School

*Investing in collaborative science communities improves student assessment data.*

### PREPARED BY:

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Science Instructional Specialist,  
Adjunct Faculty, CSU Channel Islands  
A large district in Southern California

### Introduction

In December 2022, I received a call that would catalyze a transformative journey. I was working as the science instructional specialist for a large school district in Southern California and fifth-grade teachers Laura P. and Sandy S. reached out and expressed concern that they were not as familiar with the science standards as they were in ELA and math: “We want to improve our CAST scores. Only 11% of our students were proficient last year. What should we focus on?”

Rather than focusing on specific disciplinary core ideas, I urged them to emphasize the science and engineering practices (SEPs) and crosscutting concepts (CCCs) that form the backbone of the NGSS. This initially surprised them, but they were open—and eager—to learn. Over winter break, we spent two intensive days diving into the three dimensions of the NGSS and analyzing the CAST practice test. The importance of SEPs, particularly in data analysis and modeling, quickly came into focus.

My colleagues were worried that if we focused so much attention on the SEPs, they were not going to get

through enough of the standards before CAST testing in May. I assured them that, when getting started, it is more important to focus on learning how to take an inquiry approach to instruction and teaching the SEPs really well than to “get through” all the standards.

I arranged substitute coverage in January so I could facilitate a two-day training with Mrs. P and Mrs. S on the 5E instructional model, storylines, and driving question boards (DQBs). What followed were countless working lunches and after-school sessions, culminating in the development of two targeted science units built around four SEPs:

- Asking Questions
- Developing and Using Models
- Analyzing and Interpreting Data
- Using Mathematics and Computational Thinking

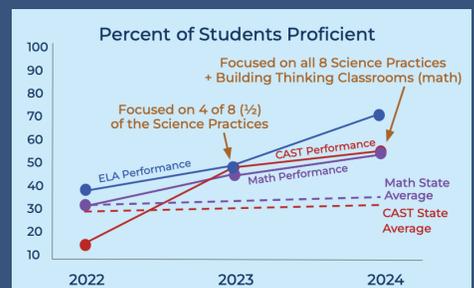
Mrs. P and Mrs. S had already been working to implement an inquiry approach to their instruction in other disciplines. They seized the opportunity to align their inquiry-based math instruction with science, creating a cross-disciplinary approach that led to powerful results.

### Early Wins: The Data Speaks

By June 2023, we eagerly awaited the CAST results. The outcomes exceeded expectations: science proficiency jumped from 11% to 44% — quadrupling in one year. Even more impressively, this success came in a district where nearly 90% of students are socioeconomically disadvantaged and half are English learners. Math and ELA scores also saw double-digit gains (see Figure 1).

Over the next two years, Mrs. P and Mrs. S expanded their work, developing additional units that covered the remaining SEPs. By spring of 2024, 50% of their students met or exceeded standards in science, and nearly every other student achieved “approaching standard.” Preliminary 2025 data shows continued growth across all subject areas.

Figure 1. CAASPP Results Indicate Improved Pedagogy



2022	2023	2024
<b>Prior to Science Collaboration</b>	<b>Year 1 of Science Collaboration</b>	<b>Year 2 of Science Collaboration</b>
CAST: 11% at or above standard	CAST: 44% at or above standard	CAST: *50% at or above standard
ELA: 37% at or above standard	ELA: 44% at or above standard	ELA: *71% at or above standard (a 19 pt growth from 4th grade)
Math: 12% at or above standard	Math: 42% at or above standard	Math: *49% at or above standard (a 6 pt growth from 4th grade)
		* when looking at data from the 2 classrooms that collaborated

Note. The table and graph above display achievement data from the California Science Test (CAST) and the English language arts (ELA) and math CAASPP assessments for 2022-2024 for one fifth grade team that worked intensively to implement NGSS. During this time, the teachers transitioned to an inquiry-based approach to teaching science and math, which they eventually also adopted for ELA and social studies. They also shifted to a focus on the science and engineering practices (SEPs) and similar disciplinary practices respective to the math, ELA, and social studies standards. The data shows that these pedagogical shifts are positively correlated with significantly higher student outcomes.

\* Note. The data in 2021-22 and 2022-23 is averaged from three participating 5th grade classrooms. However, in 2023-24 one of the 5th grade classes was replaced with a 4th/5th combo and a new teacher that did not participate in the collaboration. So the data for 2023-24 represents only the 5th grade students in Mrs. P's class and Mrs. S's class.

## How We Did It: Our KWEST to Build Great Units

During Year One, I modeled unit design and led instruction. In our first unit, students explored Earth's water distribution (5-ESS2-2) and constructed bar graphs and models. Using a kind of driving question board called a KWEST chart (Know, Wonder, Evidence, Science Vocab, Thinking), students tracked their understanding across lessons (See Figure 2). Co-constructing strategy charts helped students learn and apply protocols for practices like graphing, modeling, and making claims based on evidence (see Figure 3).

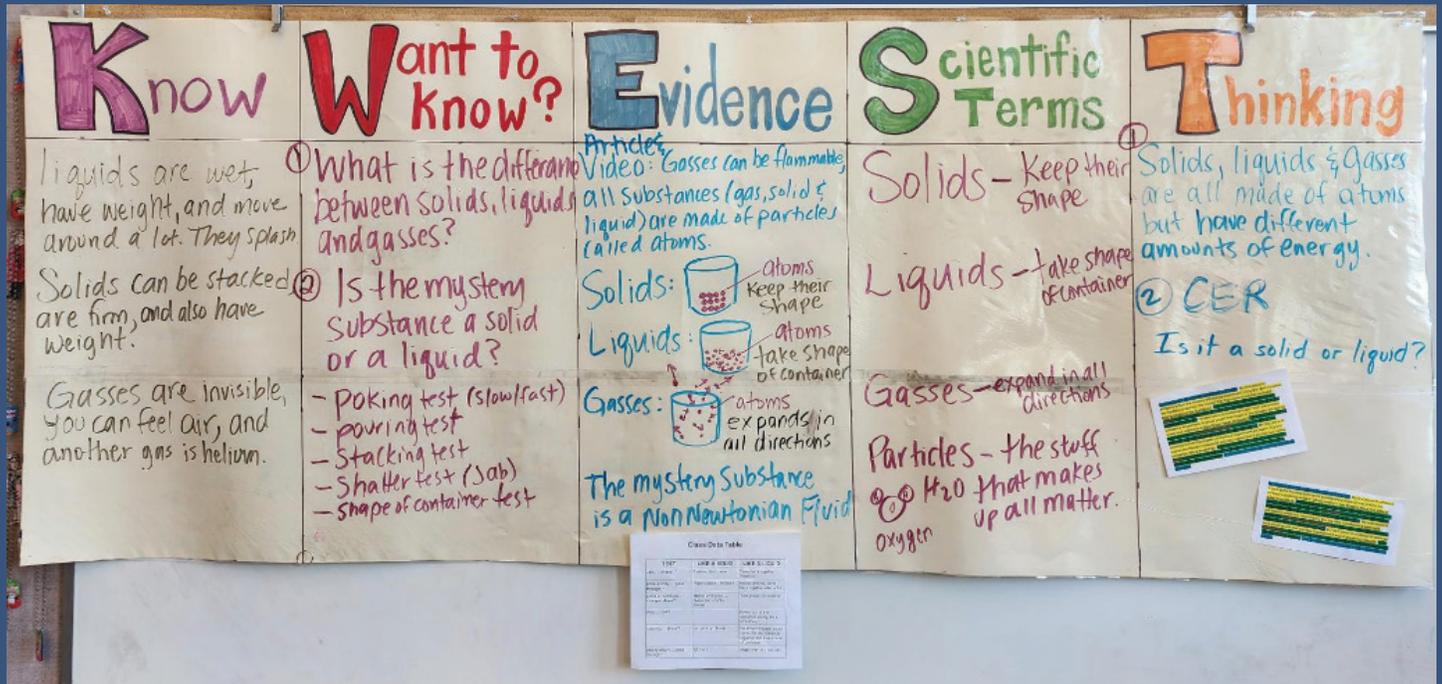
In Unit Two, students investigated why most of Earth's water is salty, diving into particle theory (5-PS1-1) and Earth systems interactions (5-ESS2-1). This time, Mrs. P and Mrs. S took the lead, with me offering consultation and feedback.

Year Two introduced units centered on planning investigations (SEP 3), constructing explanations (SEP 6), and arguing from evidence (SEP 7). Teaching fair tests was a particular challenge, but our strategy charts scaffolded student learning. By the end of the year, Mrs. P and Mrs. S had transformed their entire curriculum—including ELA and social studies—into cross disciplinary, inquiry-based storylines.

Figure 2. KWEST Chart (Driving Question Board)

Note. Driving question boards help students keep track of and connect their learning across multiple lessons. We used the KWEST format in our classroom, which the author had developed over previous years with prior teachers. In the KWEST format, the teacher records student-generated driving questions in the "W" column. Then the teacher guides students to share what they already know related to these questions and records their prior knowledge in the "K" column. As

Figure 2. KWEST Chart (Driving Question Board)



students work through the unit, the teacher adds evidence related to figuring out the answers to the driving questions in the “E” column and adds new vocabulary terms to the “S” column as the terms are introduced in context during the lessons. Once students have collected enough evidence to address one of the driving questions, the class co-constructs a concise explanation, which the teacher writes in the “T” column.

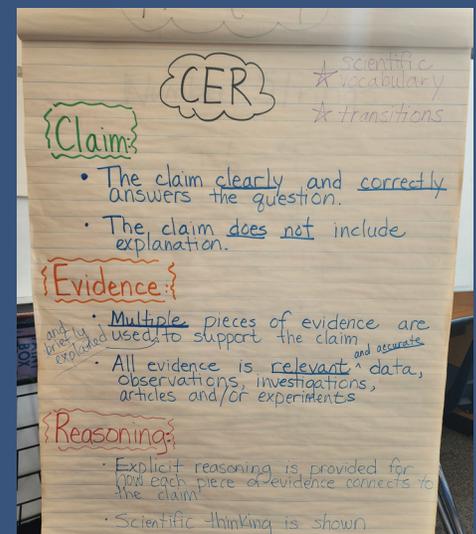
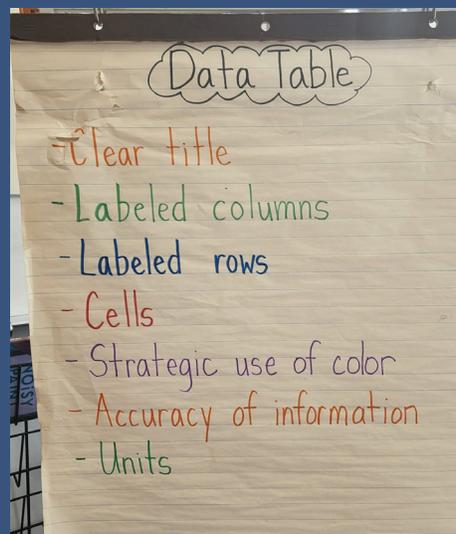
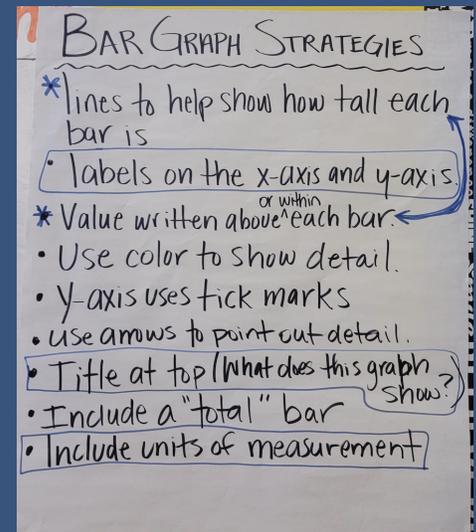
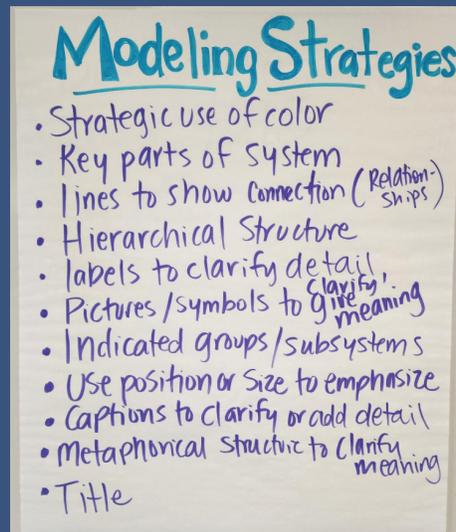
Figure 3. SEP Strategy Charts

Note. The science and engineering practices (SEPs) require students to use multiple skills to carry out various different processes. Strategy charts, also known as protocol charts, help students remember how to accomplish important skills and processes. These charts should be co-constructed with students as the class collectively thinks through a skill or process to identify the key components. Teachers should begin by eliciting strategies students already know and then, as part of the instructional sequence, add on additional strategies through analysis of mentor examples (e.g. by analyzing graphs, models, arguments, data tables, etc in “real-world” text and media). The figure above shows examples of five different strategy charts. The two CER charts in the bottom row support students in making claims based on evidence and reasoning. This supports two SEPs: arguing based on evidence and constructing explanations.

## Engineering Integration and Real-World Connections

In Year Three, we refined existing units and addressed engineering standards. I shared a protocol for teaching the engineering design process, and we embedded design challenges throughout the year. These projects linked to ELA and social studies units, as well as real-world

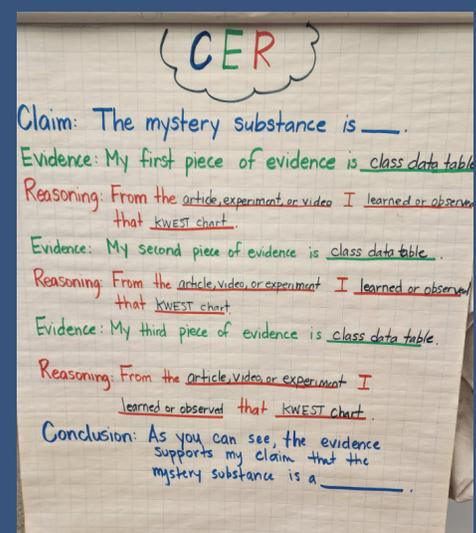
Figure 3.



math applications. For example, while reading Sign of the Beaver, students designed log cabins using budget constraints, material properties, and measurement skills. They had to calculate costs using decimals and measure materials precisely—an authentic blend of math, science, and social studies.

## The Catalyst: Collective Efficacy

There was no magic formula. The results came from hours of collaboration, mutual trust, and a shared commitment to student growth. With administrative support,



including substitute release time and stipends for extra work, Mrs. P and Mrs. S leaned into a growth mindset. They were not afraid to fail forward, try new strategies, and refine their practice through trial and error.

It is important to point out that this was not a straightforward and easy process. Learning how to implement the NGSS well is confusing and messy and full of productive struggle. “This process was super frustrating,” reported Mrs. S, “at first I had no idea what it was Kristin was trying to have us do. I was really lost. But then she modeled the lessons and it really made more sense watching her go through the process with students.” Mrs. P added, “It’s just messy. It just is. And you have to get comfortable with being uncomfortable.”

Collective efficacy was our superpower: the belief that through shared effort, we could overcome obstacles and make meaningful change. Lack of planning time was our biggest challenge. We had to be creative about finding time to collaborate wherever we could: after school, during breaks, and even on weekends. We focused not on perfection, but on progress. Our first goal was to design and implement one rigorous, high-impact science unit—and do it exceptionally well.

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## WHY INVESTMENT IN SCIENCE EDUCATION MATTERS

Our journey affirms that sustained investment in science education—especially when it centers teacher collaboration and skill development—has a transformative effect on student learning. CAST scores rose, but more importantly, so did student agency, teacher capacity, and our collective belief in what is possible. Science education is not an add-on. It’s a driver of academic equity and excellence. When districts invest in high quality instructional leadership and create ample opportunities for collaboration, great things can and do happen.

While each of these real-world stories of impact provides compelling evidence of the positive impact of increased instructional quality in science, academic research also underscores the many benefits of making greater investments in science education.

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## Our Instructional Framework

Our instructional redesign focused on these pillars:

- Phenomena-Based Storylines to anchor student inquiry.
- Question Formulation Technique (QFT) to cultivate high-leverage questions from students.
- KWEST Charts (Know, Wonder, Evidence, Science Vocab, Thinking) to scaffold inquiry and connect learning across lessons.
- The 5E Instructional Model (Engage, Explore, Explain, Elaborate, Evaluate) to deepen engagement and promote sensemaking.
- Co-Constructed Strategy Charts to build skill mastery in the SEPs.

Together, these tools created a classroom where students weren’t just learning science—they were doing science.

## A Model Worth Replicating

- Our success wasn’t a fluke. This model is scalable and sustainable:
- Invest in instructional leadership with NGSS expertise.
- Start small: Focus on one high-quality unit.
- Build with phenomena and storylines.
- Use driving question boards to anchor learning.
- Prioritize skill-building (SEPs) over content coverage.
- Create more time for collaboration.

## WHERE SCIENCE MEETS LITERACY: WHAT THE RESEARCH SHOWS

Overall, research corroborates the observations in these stories of impact: high-quality science instruction improves student performance in all content areas—without detracting from these other content areas—and supports all learners, including English-language learners. In fact, studies consistently show that integrating science with English Language Arts (ELA) and English Language Development (ELD) not only deepens content understanding but also strengthens students’ language and literacy skills. This section highlights key research findings that reinforce the value of well-designed, standards-aligned science instruction as a driver of academic growth across disciplines and as a powerful equity strategy for multilingual learners.

### [Unlocking Learning: Science as a Lever for English Learner Equity](#)

This research is based on in-depth site visits and featuring real-world examples of high-performing schools, and it shows that integrating science and language development can simultaneously enhance students’ academic performance in reading, writing, and science. Promising practices lead to achievement levels double or even triple the state average for English learners who have met or exceeded proficiency.

### [Integrating Literacy and Science: A Powerful Partnership for Student Success](#)

This research demonstrates that when elementary schools integrate literacy



Research corroborates that high-quality science instruction improves student performance in all content areas — and supports all learners, including English-language learners.

and science instruction, they create rich learning environments that allow students to develop an understanding of science ideas while improving their reading, writing, and speaking skills at the same time. Neither subject takes a back seat. Literacy instruction supports science, and science instruction supports literacy, thereby creating a positive outcome for everyone.

### [Inquiry Science: The Gateway to English Language Proficiency](#)

Results from this study suggest that restricting instructional minutes for science to provide additional time for ELD and English language arts may be

unnecessary. Rather, allowing consistent time for science instruction that incorporates ELD instruction along with inquiry science experiences may provide the authentic and purposeful context students need to develop new language without restricting access to science content.

### [Impact of a Large-Scale Science Intervention Focused on English Language Learners](#)

Promoting Science Among English-Language Learners (P-SELL) is a science curricular and professional development intervention for fifth-grade students focused on English language learners (ELL), found

significant and meaningfully sized intervention effects on a researcher-developed science assessment and the state science assessment. Subgroup analyses revealed that the P-SELL intervention had a positive and significant effect for each language proficiency group.

#### [English Learners in STEM Subjects: Transforming Classrooms, Schools, and Lives](#)

English learners (EL) comprise a diverse and talented pool of learners who bring valuable perspectives and resources to science, technology, engineering, and mathematics (STEM) born out of their experiences in their home languages, home and communities, and STEM schooling in other countries. Yet, these students lack access to rigorous STEM learning opportunities, in part due to incorrect assumptions that English proficiency is a prerequisite for students to meaningfully engage with STEM content learning.

#### [Equity in STEM Education: Framing Decisions for the Future](#)

Science, technology, engineering, and mathematics (STEM) live in the American imagination as promising tools for solving pressing global challenges and enhancing quality of life. Despite the importance of the STEM disciplines in the landscape of U.S. political, economic, and social priorities, STEM learning opportunities are unevenly distributed, and the experiences an individual has in STEM education are likely to vary tremendously based on their race, ethnicity, socio-economic class, gender, and a myriad of other factors.

#### [Synergistic Effects of Students' Mathematics and Science Motivational Beliefs on Achievement, and Their Determinants](#)

Research published in the International Journal of STEM Education explored the relationship between students' motivational beliefs in math and science. The study found that students' beliefs in these subjects are closely related and significantly influence their academic achievement, suggesting that positive experiences in science can bolster confidence and performance in mathematics.

#### [The Effect of Using STEM Education on Students' Mathematics Achievement](#)

This study examined how STEM education affects 8th-grade students' math achievement using a quasi-experimental design. Students exposed to hands-on, interdisciplinary STEM instruction showed significantly higher gains in math skills compared to those who did not receive the intervention. The findings suggest that integrating STEM into the curriculum can meaningfully enhance middle school students' understanding and engagement in mathematics.

#### [Key Takeaways from the Early Years of Transforming Science Education for the Next Generation](#)

This research emphasizes that transforming science education requires equitable access to high-quality instructional materials, professional learning, and aligned

assessments, all supported by sustained investment. Key takeaways include the importance of strong science leadership, the selection and use of standards-aligned materials, ongoing teacher development focused on diverse learners, and assessment systems that go beyond memorization to measure deep understanding. Long-term systemic support is essential to ensure lasting improvements in science teaching and student outcomes.

While case studies and research both provide compelling evidence of the benefits of investing in and implementing increased science instruction, California has the additional advantage of several organizations that support educators and their students. These organizations further enhance the State's ability to realize the goal of robust, hands-on science experiences for all students.

# BEYOND STORIES OF IMPACT AND RESEARCH: STRONG ADVOCATES OF SCIENCE FOR ALL IN CALIFORNIA

The following organizations further enhance California's ability to provide high-quality science education for all students by providing necessary components for successful implementation, including:

- Support for continued leadership
- Professional collaboration, learning opportunities, and experiences
- Assessment tools
- Resources for students
- Strategies and content support for teachers

By aligning their efforts with state priorities and the vision of the CA-NGSS, these organizations play a critical role in building sustainable systems of support. Their contributions help ensure that educators are well-equipped, students are meaningfully engaged, and schools are positioned to deliver equitable, standards-aligned science instruction across all grade levels.

## [California NGSS Collaborative](#)

Developed to support the implementation of the California Next Generation Science Standards (CA-NGSS), the CA-NGSS Collaborative was formed in 2015. It is a joint effort involving the California Department of Education, California Science Project, California Association of Science Educators, California County Superintendents, and the K-12 Alliance, WestEd. Together, the Collaborative develops and delivers

the statewide NGSS rollouts and professional learning experiences. In 2018, the Collaborative developed and released the California NGSS Toolkit for Instructional Material Evaluation (CA-NGSS TIME).

## [California Department of Education \(CDE\)- Science Teaching and Learning](#)

CDE is a crucial member of the California NGSS Collaborative, supporting science through innovations in classroom assessment, which include the Tools for Teachers resources, the development of classroom-embedded interim assessments, and contributions to the California Science Test Concept Paper.

## [California Association of Science Educators \(CASE\)](#)

CASE promotes high-quality, equitable science education through advocacy, collaboration, and communication. Recognizing that science profoundly influences our lives, local environments, and the world, CASE fosters a community dedicated to enhancing scientific and environmental literacy and agency for all. CASE hosts the annual California Science Education Conference, publishes California Classroom Science, and supports webinars and live events throughout the state to improve science teaching.

## [K-12 Alliance](#), WestEd

The K-12 Alliance, WestEd is a professional learning organization dedicated to transforming teaching, learning, and leadership in science and mathematics. Focused on all students, the K-12 Alliance, WestEd supports every level of the school system and their impact on the

classroom as a unit of change. It is committed to collaborating with all sectors of the educational system and its supporting communities. Grounded in a research-based theory of change, the K-12 Alliance, WestEd has provided high-quality professional learning in science and mathematics since 1987.

## [California Science Project \(CSP\)](#)

The mission of the California Science Project is to develop and enhance teachers' science content knowledge and pedagogical practices in order to support high-quality science education for all students. Each CSP program is guided by the following key goals: deepening teachers' understanding of science content in alignment with CA-NGSS, Common Core State Standards, and ELD standards, thereby strengthening instructional and differentiation strategies to improve outcomes for all learners and fostering professional learning communities grounded in teacher action, evidence-based practice, and reflective inquiry. CSP also prioritizes the development of teacher leaders who can mentor and support their peers, and it offers research-based technical assistance, evaluation, and assessment services to schools and districts to help advance science education programs statewide.

## [Curricular Improvement Support Committee Science Subcommittee](#)

The Science Subcommittee provides collaborative leadership among county offices of education, the California Department of Education, and science partners to improve achievement in science for all students and to close the achievement gap. The committee

aims to provide a wide range of services, including professional development, curriculum resources and publications, activities that enrich science education, initiatives that support the field on science-related issues, and the facilitation of effective communication with timely information updates. Furthermore, the subcommittee strives to utilize and leverage the county offices of education as an efficient and effective delivery system.

### [California Math, Science and Computer Science Partnership](#)

CAL-MSCS is a statewide Community of Practice that unites science educators and leaders from all California counties to share best practices. The CAL-MSCS Science Leadership Team operates on the theory of action that if science educators have access to professional learning systems and experiences promoting equity, the students they serve will excel in science. It recognizes the roles that families, educators, communities, and systems play in building students' scientific literacy and strives to enhance the capacity of educators and their partners to provide hands-on, asset-based, and culturally responsive science learning that empowers students to ask questions, observe, and discover, paving the way for innovative solutions to complex challenges.

### [The Exploratorium](#)

The Exploratorium is a professional home and collaborative hub for science educators, providing phenomena-based, inquiry-centered professional learning to pre-K–12

teachers, teacher leaders, professional development providers, and leaders in science education. The Exploratorium offers a constellation of programs, workshops, activities, and resources to educators, with a longstanding commitment to supporting educators in the California public education system. The Exploratorium's signature offerings include the [preK-12 CA Science Education Leadership Network](#), the [Summer Institutes for Teachers](#), and [Science Snacks](#).

### [The Lawrence Hall of Science](#)

The Lawrence Hall of Science partners with school districts to support science learning by offering district-wide programs for elementary, middle, and high school students, either virtually or in person. Provides a variety of exceptional inquiry-based professional development options in science and mathematics that exemplify effective teaching strategies and are designed to meet the needs of all learners. Reaches more than 20,000 teachers annually—regionally, nationally, and even internationally—through collaborations with partner sites, publishers, and school districts from New York City to Los Angeles, as well as partners as far away as Japan and Jordan.

### [Ten Strands](#)

Ten Strands' mission is to strengthen the partnerships and strategies that will bring environmental literacy to all of California's TK–12

students. They foster efforts to infuse environmental themes into core subjects, and empower teachers to use the environment as a context for learning in core subject areas—science, social studies, English/Language Arts, and more. Ten Strands works collaboratively to bring California schools, environmental education providers, teachers, parents, and students together to ensure a thriving planet for future generations.

California is indeed fortunate to have such a plethora of professional organizations so well-equipped to serve teachers and students and to provide the support necessary for implementing such critical increased science instruction at the elementary level. As noted earlier, proper investment is the precursor to successful implementation. And, with such compelling evidence demonstrating the benefits of advancing science education, California has both the critical need and the capacity for making system-wide shifts and to realize its goals for the future of Science education throughout the State.



# RECOMMENDATIONS FOR SUCCESSFUL IMPLEMENTATION: SYSTEM-LEVEL SHIFTS TO ADVANCE SCIENCE EDUCATION IN CALIFORNIA

While implementing greater high-quality science instruction throughout the State is no small undertaking, California is fortunate to have the capacity to do so, even though this will require essential shifts at the system level, including: investment in professional learning; additional dedicated instructional time; access to high-quality instructional materials; active collaboration with both local and statewide partnerships; and incorporation of science into accountability and local planning systems.

Fortunately, California has all of the necessary components for investment in professional learning. As noted earlier, a wide variety of resources—including human resources—are available to support professional learning. With the support and advocacy of many organizations and leaders, it will be imperative for California to invest in professional learning, as this will create a solid foundation and help ensure that increased dedicated instructional time will be used to full effect for the benefit of all students. Naturally, with well-trained teachers who have instructional time to spend with students, access to high-quality materials is essential to promote engagement and provide real-world experiences for students. When all of these components are combined with and enhanced by state and local partnerships, teachers and students alike will have the resources they need to create exceptional science

programming—and the infrastructure exists to ensure assessment and accountability for instructional quality at both the state and local levels. A high degree of commitment to and investment in each of these components is essential and, thankfully, California has the capacity to make such investments and to give all students an exceptional science-learning experience that will serve them—and California as a whole—now and well into the future.

To fully realize this vision, we must act with urgency and intention. Science matters—not only as a core academic subject, but as a critical driver of student engagement, academic achievement, workforce readiness, and informed citizenship. As California continues to lead in innovation, climate action, and technological advancement, it is imperative that our education system reflects and supports these priorities through sustained commitment to science education.

**To fully realize this vision, we must act with urgency and intention. Science matters—not only as a core academic subject, but as a critical driver of student engagement, academic achievement, workforce readiness, and informed citizenship**



**We offer three key recommendations, in accordance with the [National Science Academy \(NAS\)](#), to help move this work forward:**

- 1. Elevate equitable, high-quality science instruction** by making it a visible priority in schools and districts across the state. This includes ensuring dedicated instructional time for science, especially in the elementary grades, and integrating science meaningfully with ELA/ELD and other content areas.
- 2. Strengthen accountability systems**—such as California’s School Dashboard and Local Control and Accountability Plans (LCAPs)—to reflect the importance of science education. Making science instruction and outcomes more visible in these tools reinforces its value and supports continuous improvement.
- 3. Support and sustain California’s strong science education community**, especially now. Our State is home to an unparalleled network of educators, organizations, and partners with deep expertise and commitment to equitable science education. Strategic investment and recognition of this community’s work will be key to maintaining momentum and ensuring every student has access to high-quality, standards-aligned science learning.

Now is the time to capitalize on California’s readiness, resources, and leadership. By taking bold steps today, we can ensure that all students—regardless of background or ZIP code—experience the wonder, relevance, and transformative power of science education. California is a national leader in STEM innovation, yet we risk falling behind.

For example, from 2011 to 2021, the [STEM workforce grew](#) by 20%, but degrees in STEM fields continue to lag. We cannot prepare a STEM-minded, STEM-skilled workforce if science is not prioritized systemically. For over a decade, the lack of full accountability has hampered progress in closing these opportunity gaps. Students in under-resourced schools—often students of color, English learners, and those in rural areas—are the most likely to attend schools where science is minimal or missing altogether. This is an equity issue. When science is optional, equity is optional, and California’s students deserve more.

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## CALL TO ACTION

Now more than ever, California must recognize the need to prioritize science education. Just as the state has done with math and ELA, California must recognize science education as an equity issue. Just as “a rising tide lifts all ships,” providing students with high-quality science instruction improves outcomes for all students in all content areas. A strong science foundation in the elementary grades ensures that students are well-prepared for essential complex college-preparatory coursework in high schools. Furthermore, increased accountability measures help ensure that the students of today will emerge as the important STEM leaders of tomorrow: bold, confident, actively-engaged critical thinkers who are well-equipped to enter the workforce, and who will improve the quality of life and economic viability for all Californians. Let’s work together to make science matter.



## ACKNOWLEDGMENTS

### Author and Contributors

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