THE CENTER FOR THE FUTURE OF Teaching & Learning at WestEd

CENTERVIEW

Insight and analysis on California education policy

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Lost Opportunities: The Status of Science Education in California Middle Schools

California's middle schools have a critical role to play in furthering their students' pursuit of science learning, in high school and beyond. The rapidly changing economy, advances in technology, and the press of global challenges only increase the importance of this responsibility.

The potential is there for California's middle schools to provide each student with a strong science education. For the most part, their students have access to science facilities and basic equipment; the schools themselves have carved out dedicated time for science instruction in the weekly calendar; and many middle school science teachers have a background in science and have received additional preparation for teaching the subject.

But a closer look reveals that this potential remains largely untapped. Many students do not receive science instruction in the earlier grades, arriving at middle school underprepared for and uninterested in learning science. Some middle school teachers may not have an adequate background for teaching science, and even those who come with a science background need opportunities to deepen their knowledge and improve their teaching skills, while keeping up with ever changing developments in the field. Overcrowded classrooms, insufficient time for instruction, and inadequate resources further limit access to high-quality learning opportunities that engage students in the exploration and practice of science. Systemic support for science education has eroded, and few schools have relationships with external organizations that could otherwise help to provide quality science learning opportunities.

This CenterView highlights these issues, which are examined in greater depth in the survey-based study *Untapped Potential: The Status of Middle School Science Education in California*,[i] available on the web at www.cftl.org. This study was undertaken with the aim of better

About the Report

Untapped Potential: The Status of Middle School Science Education in California is a project of Strengthening Science Education in California, an initiative funded by the S.D. Bechtel, Jr. Foundation. Research for the report was conducted by the Lawrence Hall of Science at the University of California, Berkeley, with SRI International and the Center for the Future of Teaching and Learning at WestEd.

understanding the degree to which California middle schools are providing science learning opportunities that are aligned with the National Research Council's recommendations for science instruction. The Council's recommendations have led to development of the national Next Generation Science Standards, which emphasize providing comprehensive, high-quality science instruction that includes opportunities for students to learn by engaging in the scientific process. We also offer our view on what steps can be taken to help California middle schools more fully tap their potential to provide students with high-quality learning opportunities in science.

Potential to Build On

Access, equipment, and teachers

Most students have access to science class in middle school. Ninety-five percent of California school districts reported that more than three quarters of students in grades 6-8 are enrolled in science courses.

The basic equipment needed for science instruction is also available in most middle schools. More than two thirds of responding teachers reported having access to the Internet and to important science-related equipment, such as a sink and measuring tools.

Many responding middle school science teachers also appear to be fairly well prepared for teaching science, with about three quarters either having majored in a science-related field or having obtained a single-subject credential for teaching science. Two thirds of teachers also reported having received more than 36 hours of professional development in science over the last three years. Eighty-one percent of local school district personnel responding to the survey reported that their middle school science teachers are well prepared for teaching science.

That said, 25 percent of middle school science teachers have neither a background nor a single-subject credential in science. And some schools have more difficulty than others hiring qualified science teachers. Nearly one third (31%) of responding principals at schools serving the largest numbers of low-income students reported that finding qualified science teachers was a major challenge. By comparison, not a single principal from schools serving the fewest low-income students reported this difficulty.

Little Access to Quality Learning Opportunities

Despite existing strengths that give middle schools the potential to provide a solid science education, these schools stop short of delivering high-quality science learning experiences to their students. There is an emerging national consensus that quality science education entails giving students opportunities to engage in the *practices* of science and scientific reasoning while exploring the big ideas of science. California middle schools rarely provide such opportunities. Just 14 percent of middle school teachers provide a pattern of classroom practices that supports regular engagement in the practices of science.

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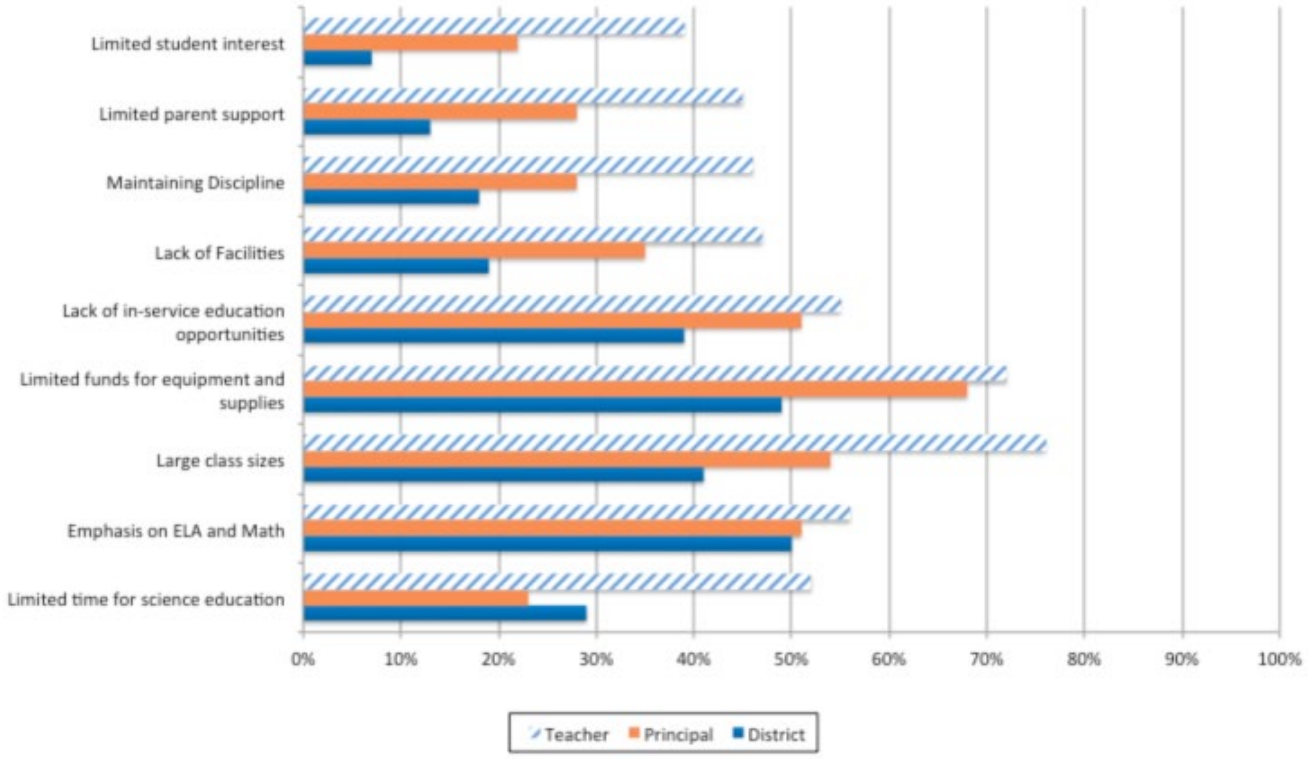
The Challenges of Middle School Science Education

In their quest to provide high-quality learning opportunities in science, California's middle schools face significant challenges. Among the most troubling findings in this study is middle school students' lack of preparation for and interest in science. Nearly 40 percent of responding teachers reported students' lack of interest as a major or moderate challenge to science instruction, and nearly half (47%) of principals reported students' lack of preparation as a major or moderate challenge. In their survey comments, middle school science teachers reported their belief that the emphasis on mathematics and English in elementary school has been squeezing science out of the curriculum. The problem of students' inadequate preparation appears worse in middle schools serving low-income students: 30 percent of principals from schools serving the largest numbers of low-income students said lack of student preparation was a major problem, whereas just 6 percent of principals from schools serving the fewest low-income students reported student preparation being a major problem.

> *"Students are not getting science in elementary and it is hurting students in middle school because they are coming in with the attitude that they do not like science since they've never done it."*
>
> – A teacher

Exhibit 1
"Major" or "Moderate" Challenges to Science Instruction



Class size is perceived by teachers as another challenge to science instruction. More than three quarters of surveyed teachers identified large class size as a major or moderate challenge. They reported that large classes are more difficult to organize for hands-on lessons and that they limit opportunities for students to conduct experiments. Teachers also cited the need for better funding, and they reported lacking access to quality materials, saying that they often pay for such things themselves. This not only puts a strain on the teacher, it also limits the types of activities that can be offered to students. While most schools have basic science equipment, access to more-specialized equipment varies in unpredictable ways. For example, schools serving either the greatest or lowest numbers of low-income students reported higher levels of access to such equipment as Bunson burners and computers compared to schools with mid-range numbers of low-income students.

Time is also an issue. Preparing for, engaging students in, and breaking down and cleaning up after a hands-on learning activity pushes the bounds of a standard 50- or 55-minute instructional period. Thus, while middle schools dedicate some time for science instruction, it may not be enough time or the time may not be scheduled in a way that accommodates experiential learning opportunities.

> *"With only 55 minutes to a class, it is difficult to do labs or go into depth to make sure they have processed the content."*
>
> – A teacher

Teacher Preparation Matters

Giving students high-quality learning opportunities in science requires that teachers possess a level of subject knowledge and instructional skill sufficient to deliver a high-quality curriculum to all students. Many middle school science teachers have a background in science: 61 percent of responding teachers majored in a science in college and have a single-subject teaching credential in science; 14 percent did not major in a science but earned a single-subject teaching credential in science. However, the remaining 25 percent of responding science teachers have neither a science major nor a single-subject credential in science; they are able to teach science because they hold a multiple-subject credential, which, in California, authorizes them to teach science (as well as other subjects) in the middle grades.

High-quality science instruction also requires that teachers stay up to date with developments in their field and learn new content and teaching strategies. Greater access to professional development will only become increasingly important as the Next Generation Science Standards* are put into place.

While two thirds of responding teachers reported having some access to professional development, they want more. Almost 60 percent of the surveyed teachers identified insufficient professional development as a barrier to high-quality science instruction.

Support for Science has Eroded

California's infrastructure for supporting science education has eroded over the past 10 years. Fewer than a third (31%) of school districts have a full-time person dedicated to overseeing science instruction in middle schools. Less assistance is coming from the state, as well. For example, funding for the California Science Project has been reduced from more than $9 million in 2002-03 to $1.2 million in 2010-11. In the face of such cutbacks, many districts and schools are looking to partner with external organizations, such as science museums, in order to bolster science instruction. However, such partnerships are in short supply. Just over half (55%) of responding middle school principals reported receiving services from external organizations, and just over a third (34%) reported receiving funds from such organizations.

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* California is one of 20 states collaborating to develop the Next Generation Science Standards.

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California does not have a coherent system for enabling teachers and schools to consistently provide students with high-quality learning experiences in science. Middle schools bring some strengths to the effort of teaching science, such as dedicated time for science education in the course schedule. But significant challenges limit teachers' ability to engage students in the exploration and practice of science. The result is missed opportunities for students.

In part, these troubling conditions are rooted in state and federal accountability policies and systems that, at the elementary school level, continue to place the greatest emphasis on English language arts and mathematics and, in the process, devalue science and other subjects. With science slipping from the elementary curriculum, students appear to lose interest in it, and teachers say that students enter middle school unprepared for learning science.

Strengthening science education must be a priority. The state should act immediately to place greater emphasis on science education in elementary schools so that students will be prepared for and interested in the pursuit of science in middle and high school. It is also imperative that policymakers and educators address the challenges highlighted in this report so as to encourage and support middle school instructional practices that promote high-quality learning opportunities in science. Our recommendations follow.

For State and Local Policymakers:

Prepare for the Next Generation Science Standards now under development. California is one of 20 states collaborating to develop the Next Generation Science Standards. District leaders should begin following the development of these standards so as to determine what science-related changes will be needed in their schools with respect to materials, equipment, facilities, scheduling, and professional development. By planning now, districts will be poised to implement the new standards upon their completion.

Focus on elementary science. It is critical that science education in California's elementary schools become a priority. With strong elementary school science education in place, middle school teachers, in turn, can build on and expand students' learning in science, preparing them for the rigors of high school science programs, which, in turn, prepare students for college science and/or careers using science.

Ensure that teachers have the professional development and other support needed in order to provide students with a comprehensive, high-quality science program. Middle school teachers need greater support if they are to provide their students the types of science learning experiences that will best prepare them for their future. Professional development should enable teachers to stay current with a rapidly changing field, should be relevant to the courses they are teaching, and should support implementation of the Next Generation Science Standards. In addition to professional development, teachers need adequate facilities and supplies of lab materials to allow students to engage in hands-on learning.

For State Policymakers:

Examine the state requirements for middle school science teacher preparation to ensure that the path leading to the credential adequately prepares the credential holder to teach rigorous middle school science. It is imperative to ensure that this credential pathway offer adequate teacher preparation for the middle school science curriculum and, also, that science teachers have the opportunity to *further* their knowledge and skills.

For Local Policymakers:

Provide opportunities for vertical professional learning communities. Science teachers at the middle and elementary levels can benefit from opportunities to collaborate with one another. Elementary teachers will be able to better tailor science instruction to their students' needs if there is a common understanding of the science-related expectations for middle school students.

Examine the master schedule of middle schools to ensure that sufficient time is devoted to science classes and is scheduled to support high-quality learning experiences in science. In order for students to engage in the practices of science, teachers need adequate and flexible time to prepare for and implement such activities.

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i. The report draws on the following data sources:

- **A survey of district administrators.** Researchers selected a stratified random sample of 451 public school districts across the state from the full list of California unified, elementary, and high school districts. In each district, they asked the individual primarily responsible for science education to respond to a series of questions about district policies and practices. Questions were asked specifically about science in middle school grades (usually grades 6-8), and this report draws on responses related to those questions. Response rate: 62%.
- **A survey of middle school principals.** Researchers selected a random sample of 300 middle schools in the state and surveyed the school principal about science education policies and practices. Response rate: 56%.
- **A survey of middle school science teachers.** In each of the middle schools in the principal survey, researchers either selected five science teachers at random or, if the school had five or fewer science teachers, selected all of them, for a total of 781 teachers who were asked to complete a survey on their science teaching, their preparation, and the support they receive. Response rate: 85%.

