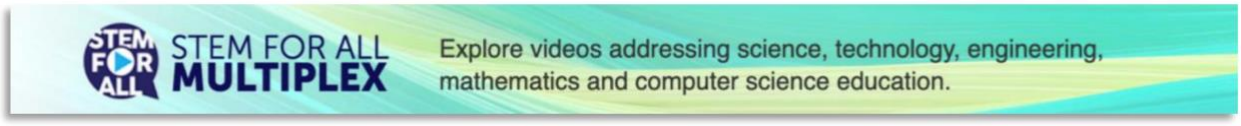

Synthesis: Multiplex Theme March/April 2020
Science in the elementary grades: An issue of equity

> High-quality elementary science education is essential for establishing a sound foundation of learning in later grades, instilling a wonder of and enthusiasm for science that lasts a lifetime, and in addressing the critical need for a well-informed citizenry and society,
>
> NSTA "Position Statement on Elementary School Science."

Active science seems like a natural fit for early learners, who are full of questions and take an active interest in the world. Moreover, research shows that when students have an early engagement with high-quality science — age-appropriate, hands-on, minds-on science — they are far more likely than otherwise to be science-involved through their later schooling, and to consider STEM careers. STEM professionals and STEM Majors say that their interest began in the elementary grades.

Moreover, the beneficial effects of good early science learning is more marked for students from underserved populations. In schools where good elementary science is not available, students whose parents have the resources (time and money) can give their children access to science in other settings, while other families have limited ability to do this. This disparity is one reason why diverse populations are so badly under-represented in STEM fields. So the availability of elementary science education is an equity issue: the path to "STEM for all" must include engaging, high-quality elementary science.

So why do so many schools lack good elementary science education? The research suggests that there are a range of barriers, including inadequate curricular resources, limited space and time, and insufficient teacher preparation. On top of these factors, there is the impact of high-stakes focus on literacy and mathematics performance.

Unfortunately, when schools see unsatisfactory test scores in these subjects, the commonest response is to "double down" and allocate even more time and effort to math or literacy — "more of the same." This diminishes the time available for other subjects — including science. The evidence accumulating since the beginning of the current era of high-stakes testing is that strategy does not produce significant improvements, and it tends to discourage engagement and motivation — for both students and teachers. Because literacy, for example, is widely construed as a set of "skills", the result is that many schools have abandoned science for content-free reading. The reading is thus also context free — unconnected to the world the students inhabit outside of school. This strategy has not improved reading scores.

Yet the inherently interdisciplinary nature of science can provide strategies to address several of these issues, including literacy and math learning, by not segregating the subjects artificially. After all, one advantage that elementary schools have is that, typically, the teacher is responsible for teaching all the subjects. In real life, the world is a whole, and math, science, and language are all ways to relate to our world. So the elementary teacher is in a good position to take advantage of this natural integration of subjects and ideas. Science is a verb! That is, it is an active way to engage with the world. Seen through this lens, the strategies and practices the kids practice in the classrooms are applicable to all subjects and to everything they do. Moreover, the

interests, abilities, and habits of mind which are particularly useful in one subject focus can support students who are weaker in other areas, and thus help them make progress across the board. In this way, the student who may not read strongly may be motivated in the doing, thinking, and communicating of science — and so their literacy improves.

Teacher PD. To make this approach to integrated learning of science with literacy, math, and other topics, we need to overcome the barrier of inadequate teacher preparation — or teachers' lack of self-confidence about teaching science. Research makes it very clear that teacher PD is essential — substantial and carefully designed. Poor science education in the early grades can discourage young students from further interest, so the quality of the teachers' PD is crucial. They need to build on what they know, learn how to read science material effectively (looking for example at how claims are made and supported, the underlying cause-and-effect models in the narrative, the use of evidence). They need to have the experience of hands-on learning, including the excitement and confusion of generating questions about phenomena, and doing projects to answer their own questions. Teachers are much more likely to teach active science when they have experienced it for themselves.

This then provides the basis on which to step back and examine their own learning process — and work out how to organize and consolidate learning in a way that builds on discoveries as well as prior knowledge and reading, and uses it to drive further inquiry. PD like this takes time — solid, focused time both outside of school (such as during a summer institute), and continued time during the year, in collaboration with colleagues. Instructional change is not a one-and-done matter. It takes time and attention, and teachers are important resources for each other in this work, as are teacher-coaches and science specialists. Teachers should have opportunities to see others teaching, and to reflect upon their own practice and that of others.

Finally, the re-visioning of science as integrated with (and enriching) the other subjects in the elementary curriculum requires informed, sustained support by administrators at the building and district level. Of course, materials and space are important, but just as important is time for teacher experimentation, for collegial reflection and collaboration about the innovations being tried, and for trouble-shooting. As one contributor to the Theme of the Month discussion wrote, " the support of the elementary principals is critical to this discussion. Without their support , the change will be minimal as it might change in one teacher's classroom, but what about the other classrooms?" So reform of elementary science is part of school-wide reform.

<u>Recommendations for teachers</u>

Be proactive: go search for programs, take your PD into your own hands. Get motivated, and grab knowledge from wherever you can. Say Yes to opportunities to deepen your knowledge and learn how to see how science is integrated into the other curricular subjects (and *vice versa*) — intermingled just as in real life.

<u>Recommendations for district and building administrators</u>

• Remember, teacher teams can work collaboratively to introduce effective integration.
• Every elementary school needs a well-furnished lab, ideally with a technician to maintain materials and tools, and help support teachers.
• Teachers' learning and practice of food-quality integrated science is best supported by well-designed, coherent materials that help teachers and students build knowledge cumulatively. Catch-as-catch-can curriculum does not help! So administrators need to help their teachers find and implement effective materials for integrated learning

• Help teachers find the time every day to bring high quality science into their instruction.
• School districts need to change rules and statutes that mandate set amount of time for science -- if not, it won't increase.

Recommendations for teacher leaders

• Help teachers find and make use of good PD experiences
• Support teachers' reflection — singly and collaboratively — on their own practice, and learn from each others'
• Work to create a clear message about the goals and strategies being implemented, so that the ideas and experiments in practice can be implemented effectively, evaluated constructively, and shared throughout the system — within the school, the district, and perhaps beyond.
• Encourage learning at every level of the system — principals need PD about good-quality science for elementary grades, and what it takes to advocate for and support it; teacher leaders need continuing PD (including collegial conversations) about teacher learning, pedagogical change, and how to support and evaluate the implementation of new materials and practices.

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