The Lawrence Hall of Science
UNIVERSITY OF CALIFORNIA, BERKELEY

PROGRAM BRIEF

How High School Science Teachers Respond in a Crisis

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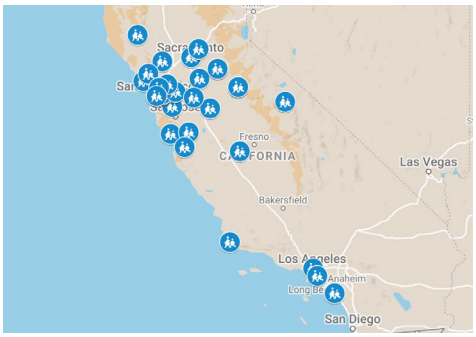
In spring 2020, the pandemic changed our world suddenly and drastically, and educators were called upon to respond to the most acute challenges that coronavirus brought to our education system, and more generally, to society. States, districts, and schools were forced to: reinvent how we teach; how we support students socially and emotionally; how we interact with and support one another; how we conceive classrooms, schools and districts; and, how we set policy and make decisions. The status quo was called into question, for the short term, and as we move into another school year, for the long term.

The health and educational crisis has strengthened our conviction for science, providing students with the essential tools and abilities to solve problems, improve their lives and communities, and make the world a better place. In March 2020, as districts ramped up their online and distance learning programs, our Learning & Teaching Group staff committed to working closely with high school teachers to create a community of learners to discuss, share, and collaborate on strategies for improving distance learning. The goal of bringing together the high school community was simple: convene high school science educators from a diverse set of school districts to think about engaging learners with science phenomena in the virtual space. Educators eager to participate in conversations where they could learn 'what are others doing?' Science learning, defined as not just reading about science, but instead providing students with an important opportunity to take charge of their own learning, and to explore the real world around them more independently, no matter where they live. In response, our series created a space for high school science educators to talk and spark ideas about what they were doing, what they were learning, and how they were looking ahead to the start of a new school year with a high likelihood of beginning with distance learning. **The purpose of this report is to point out key ideas and considerations, informing secondary leaders and teachers to reflect on improving learning and teaching environments, going forward.**

Our high school science educator community was made up of over one hundred educators and administrators representing over 35 school districts, county offices of education, and independent schools, mostly within the state of California, and two teachers from Hawaii and Texas. This community came together to think and share about: ***emerging best practices; evaluating student thinking and learning;*** and, ***looking ahead and reimagining what is possible for the next school year*** in a three-part interactive webinar series, during May 2020.



High school science educators shared their experiences and insights about distance learning for science, considering and discussing the affordances and limitations of different teaching and learning approaches. They looked critically at how assessment of student learning required educators to shift their practices, perhaps ever more so, during a time of crisis. High school educators also spent time reflecting on both teacher and learner experiences, and began to identify concerns that would resurface when planning for the start of the next school year. Though varied and vast in nature, only the concerns that related to what happened in the virtual classroom were the focus of our collective strategizing.

Remote Teaching

At the time of the shutdown, high school science educators described using a "vast, rainforest of survival strategies." Teachers were planning and delivering instruction, simultaneously shifting to technology-based teaching from home, while being firehosed with online teaching resources and rapidly adapted activities from various sources.

"The beginning is always messy." How and when teachers interacted with their students was mostly determined by district-wide policies, teacher capacity, and preference. Some districts sanctioned flexible remote teaching schedules, accommodating teachers' comfort level with online technologies, and the unprecedented circumstances. Others were more prescriptive, with a fixed online platform and set regulations about the number of minutes teachers and students were expected to interact virtually. Students inevitably showed their opinions for these new learning contexts through inattendance, not completing assignments, and not turning their cameras on. High school science leaders soon learned what was working and were able to make adjustments. Some teachers relied on lecture-style instruction and student worksheets, while others created or found new online science lessons. A few teachers explained that one adjustment was through employing the "flipped" model of instruction, and it worked well.

"All that we have learned about what students need during the shutdown MUST inform how we support students for the future."

Students were introduced to content on their own via teacher video, etc. (*asynchronous learning*) and used valuable online time for teachers and students to grapple with conceptually challenging ideas through collaborative interactions (*synchronous learning*). A few other teachers considered this model as least effective because many of their students did not engage with the offline tasks independently and were then unable to participate in the follow-up, whole-class, sense-making tasks online.

"Classroom culture matters when assessing the learning process." An essential element of the virtual learning environment is student participation in class discussions and the ability to collaborate with other students. In a remote learning environment, it is extremely important to cultivate and support students with building this skill as they learn in a nontraditional learning space with unique limitations and distractions. Recognizing "student thinking made visible" is a critical component to high-quality learning environments, high school science educators were remiss to see the classroom cultures they worked so hard to create go away in the virtual spaces. Teachers self-reported attempts to support students by asking students to put their ideas in writing and sharing them with their peers, using group discussions and online collaborative documents. Yet, strategies to support making student thinking visible proved difficult in this new context. For example, asking students to construct and develop models (an instructional practice for helping students to explain their thought processes) was often constrained by technology. In other cases, teachers struggled to ensure student anonymity (a strategy known to positively impact the learning experience) with mechanisms like online collaborative documents.

"What about science learning?" Not surprisingly, high school science educators reported a dramatic decrease in NGSS-aligned, 3-dimensional instruction during the initial foray into distance learning. All teachers were able to provide some science content, but by the end of the school year, units of course curriculum remained untaught and assessed. Teachers were concerned about this lack of exposure to content (specifically, the NGSS Disciplinary Core Ideas), and the effects on students' future science learning and trajectory through high school. Teachers speculated that students could be better supported if science teachers were able to collaborate across courses and disciplines to focus on the content interconnections and that such an articulation would be helpful to districts, teachers, but first and foremost, students.

"Students who were struggling to connect at school are still struggling to connect."

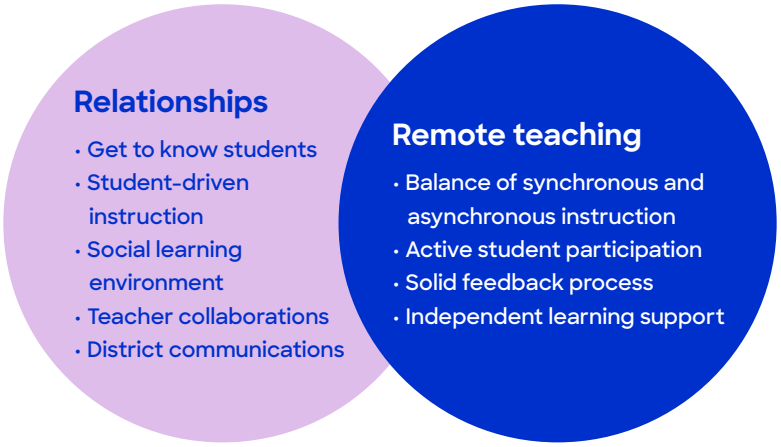
"Feedback at a distance is challenging but possible." Most teachers reported experiencing difficulty providing actionable feedback to students during distance learning. Certain teachers had online systems of feedback in place before the shutdown and could continue to employ those methods of communication. Previously relying on personal interactions to give students "just in time" feedback in the classroom, teachers shifted to 'office hours', one-to-one check-ins, and emails, describing these methods as effective for reaching students, but prohibitive for ongoing communication with 128 students or more. One effective strategy described students keeping track of their learning on a shared document, where students expected feedback and were expected to offer feedback to peers.

"Now is the time to increase independent learning." Students learning from home need to be able to work independently. This has always been the case with homework, but distance learning challenges learners to complete assignments and learning tasks alone. For example, teachers reported that students who typically needed more support and scaffolding in the classroom were frequently unable to complete assignments without regular, one-to-one teacher-student interactions. The majority of teachers simply asked their students to reflect on their own learning, but students were largely unskilled at this. Still, some teachers provided assignments with self checklists or asked students to complete self-assessment rubrics, and noticed that this was a helpful strategy. Students become more independent learners as they internalize the thinking and reflection routines put in place by their teachers. It remains clear, teachers must continue to make these instructional routines explicit and is an effective practice in both in-person and remote learning environments.

Looking ahead to the future, we recommend increased district-wide coherence with specified technological platforms at grade spans; a common strategy for using synchronous and asynchronous teaching and learning; collaboration and clear expectations for both students and teachers; and, instructional design that creates a community of young learners who feel safe to make mistakes, ask questions, and respond to feedback.

Building Relationships

How people learn did not change when we shifted to distance learning. Learning is an active process, requiring motivation and cognitive engagement. It occurs in complex social environments as learners build on prior knowledge, situated in authentic contexts. What has changed is the mode of engagement. If our assumption is that relationships and identities (related to subject matter, with other students, with educators, and with learning, itself) have influence on learning, how can high school educators foster community and engagement among students in distance learning settings?



"We need to know what students are dealing with outside of school." High school science educators described spending more time on nurturing relationships with their students during distance learning, than before. Teachers described using regular community circles and integrating more small group meetings for shorter periods of time as a way to deepen those teacher-student relationships. Many teachers provided "office hours" and others engaged in one-on-one check-ins. Teachers reported feeling increased benefits to their overall practice, and others described notable deeper connections with struggling students they might not have had before the shutdown. In particular, there was a general and valid concern for the social emotional health and learning of all students, influencing teacher reflection and planning for distance learning in the long-term.

"Learning is social, but interaction and discourse is rarely spontaneous or simple in remote teaching." Peer interactions can motivate students, but about 30% of our high school science educators were restricted from

allowing students to talk in any setting other than the whole class. Teachers with technological access to breakout groups reported using this setting frequently, and both mitigated "off task" learners and addressed needs for additional student support by tracking small group progress. Overall, teachers and administrators consistently shared a common belief related to the need for building relationships with students and also wondered how best to support the development and deepening of those relationships in a remote setting from their respective vantage points.

"I am having to find ways to make my class more intrinsically meaningful." It was no surprise that the health crisis and shift to distance learning decreased learner engagement and motivation. Facing less restrictions on their curriculum, some teachers were able to respond positively by offering open-ended assignments and projects, such as asking students to submit videos of phenomena they noticed, and sending students outdoors to make observations. Other teachers implemented student-driven, project-based units and noticed increased student engagement with the content, particularly with relevant real-world issues (e.g., the Covid-19 pandemic, viruses, and human health). As teachers considered the start of a new school year, many planned to deepen their understanding and facility with project-based and problem-based learning resources, and focusing more on student-driven instruction.

It is the case that high-quality, standards-based curriculum (designed using research-based, best practices for teaching and learning) will support students with virtual learning. It is our recommendation that leaders and educators prioritize getting to know their students and facilitating student-driven, social interactions as often as possible.

With the sudden shift to remote teaching, high school science educators reacted to ever-changing, novel situations and challenges with a variety of decisions and supports for students. Teachers worked with colleagues and administrators to address the needs of their students and families impacted by the health crisis. The goal of this program brief is to inform district and high school stakeholders about the considerations for instructional practices and district infrastructure to support high-quality, high school science learning. As leaders and educators consider the purpose and consequences of remote teaching, districts can better support teachers by providing:

- **Purposeful collaboration opportunities and expert input to address student learning and assessment**
- **Coherent, common methods and technologies for synchronous and asynchronous teaching and learning**
- **Prioritization of teacher-student relationship building and communication**
- **Common and consistent curriculum and instructional supports for content and independent learning**

BaySci
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BaySci is a program within the Learning & Teaching Group at the Lawrence Hall of Science. We help support district-wide capacity building for the implementation of equitable, high-quality science education and environmental literacy.