Easing the Digital Divide

How to Promote Equity, Rigor, and Continuity in Science Learning in an Uncertain School Year

What are best practices for reducing barriers; maximizing opportunities; and providing rigor, equity, and continuity in a school year that's filled with uncertainty?

For science education, look toward a blend of the inclusivity of the Universal Design for Learning (UDL) principles and the conventions of the Next Generation Science Standards* (NGSS) and other standards that encompass the three dimensions of science learning.

"Having a curriculum that supports the NGSS just naturally brings in the UDL guidelines," Haley Shust, a former science teacher who now develops science curriculum for Carolina Biological Supply Company, says. "The [three-dimensional] content drives students to be interested in something that they will have full engagement with. It's not a matter of trying to coax them into learning something. It's them wanting to drive their own learning."

Keeping a diverse class of students engaged in learning is just one of many teaching challenges exacerbated during disruptions to education caused by the COVID-19 pandemic. When schools closed in the spring of 2020, teachers first had to quickly develop ways to even connect with students who were in different locations—especially those students who had no or limited access to the internet or digital devices.

The Digital Divide

The ACT Research & Center for Equity in Learning defines *digital divide* as the gap between people who have sufficient knowledge of and access to technology and those who do not (Moore, Vitale, and Stawinoga 2018). This gap is not a newly acknowledged inequity in educational programs, but the closing of most US schools as a result of the COVID-19 pandemic revealed the urgency in the need to resolve it.

In an April 2020 survey, 94% of parents responding said their children's schools were closed due to the COVID-19 pandemic (Pew Research Center 2020). Of those:

* 1 in 5 parents overall said their children would not be able to complete schoolwork because they didn't have access to a computer at home (21%) or did not have a reliable internet connection (22%). For lower income families specifically, the percentages increased to 36% and 40%, respectively.
* 3 in 10 parents (29%) overall said it was likely that their children would need to do their schoolwork on a cell phone. For lower income families specifically, the percentage increased to 43%.

> "Universal design for learning is a framework to improve and optimize teaching and learning for all people based on scientific insights into how humans learn."
>
> *—Center for Applied Special Technology (CAST)*

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"Children without connectivity are at risk of not only being unable to complete their homework during this pandemic, but being unable to continue their overall education," 35 US senators said in a letter to Senate leadership as they advocated for a financial support package for home internet access (Hutzler 2020).

When students are physically in the classroom, there are increased opportunities to incorporate the digital tools that enrich learning. In 2019, 99% of US public schools had enough bandwidth for digital learning, and 87% of teachers enhanced their lessons with digital resources several times a week. That means while at school, 46.3 million students and 2.8 million teachers can connect to help students develop a deeper understanding of core ideas (EducationSuperHighway 2019). But the American Federation of Teachers and the American Enterprise Institute agree that in the 2020–21 school year, remote learning should continue while schools stagger schedules and administrators should be prepared for additional peaks of COVID-19 that could lead to future school shutdowns.

"School and district leaders will have their hands full next school year, not only negotiating the continued uncertainty of coronavirus, but also assessing the progress students have made, or not made, since mid-March," a study that demonstrated that only 1 in 5 schools offered a rigorous remote program in March through May 2020 concludes (Malkus 2020). "They will soon have to implement sustainable instructional programs to make up lost ground."

Indeed, as the 2020–21 school year gets underway, it's anticipated that teachers will face expanded achievement gaps among their students, with typical classroom abilities widened even further by two or more grades (NWEA 2020). One opportunity to ease differentiation and make learning accessible for all students is to develop teaching strategies and rely on curricula that incorporate UDL principles.

UDL, 3-D Science, and Student Choice

According to the Center for Applied Special Technology (CAST)—the national center on Universal Design for Learning—a UDL learning environment is one that provides genuine opportunities that minimize barriers and maximize learning for all students; builds in support and challenge; and addresses the three networks of the brain to encompass the why, what, and how of learning (CAST 2018). The guidelines offer a tool for implementing UDL in the following areas that students access, build, and internalize through multiple means of:

- Engagement to create expert learners who are purposeful and motivated
- Representation to create expert learners who are resourceful and knowledgeable
- Action and expression to create expert learners who are strategic and goal directed

In science education, the NGSS and other similar standards share UDL goals by supporting student-driven, flexible lessons to ensure meaningful access for diverse learners. With standards-based, three-dimensional science instruction, students work to figure out the world around them—to make sense of phenomena and problem-solve—by engaging in scientific and engineering practices while applying core ideas and crosscutting concepts. They do this through hands-on investigations or virtual simulations as they develop models, participate in constructive discourse, and develop artifacts that weave together the three dimensions of the standards to demonstrate learning.

In developing curriculum, Shust explains, "The content should be accessible so that phenomena that's driving students' learning can be understood and deemed important no matter where you are and no matter what your age is. . . . Then presenting the same information in different ways gives students options as they learn about something new."

Integrating UDL Principles in Three-Dimensional Science Learning

Grade	Driving Question	Options for Creating Expert Learners
K	What happens when you roll a ball?	* Compare how a ball rolls after a "big" push and a "small" push. * Measure the distance a ball rolls by lining up identical objects, like paper clips or pencils, and counting them. * Build or find an incline, such as a hill or a ramp, and observe how objects move when they are released from the top.
1	Can I observe shadows to learn about the sun's position in the sky?	* On a sunny day, plan to go outside and take a picture of your shadow at 9 am, 12 pm, and 3 pm. Make sure you stand in the same place. * In the morning, place a tall object outside. Mark the length of the object's shadow every few hours until the sun goes down.
2	What do plants need to grow?	* Plant seeds in two different cups, and observe how they grow with and without either sunlight or water. * Try growing the same seeds inside and outside. Check the plants each day and compare how they grow.
3	How does force affect the motion of an object?	* Find an object that rolls, like a ball or a toy car. Push the object using different amounts of force and measure how far it moves. * Push or pull an object across a smooth surface, like tile, and a rough surface, like carpet. Compare how the objects move.
4	How can we use maps to learn about Earth?	* Color the locations of rivers and mountains on a map of the United States, then look for patterns. * Make comparisons between topographic, political, and physical maps. * Create a map of your home or backyard using symbols.
5	How do humans impact ecosystems?	* Write a T-chart of things humans do that help the ecosystem and that harm the ecosystem. * Take a survey to determine your impact on Earth's ecosystems. * Learn about the recycling program in your area, and describe how recycling can benefit living things.

*Examples are from Building Blocks of Science™ 3D curriculum.

To answer "Why am I learning this?" encourage students to make connections by exploring their own environments.

Multiple means of engagement: In UDL practices, this is the "why" of learning, enabling students to be engaged and motivated. In three-dimensional learning, a driving question that represents a core idea and introduces phenomena that are relevant and interesting immediately motivates students to learn more.

"Videos are really helpful to get students to generate questions, to start thinking about what they're learning," Shust says. For example, a video about different types of animals in a rain forest can encourage students to consider why the frogs and birds are more colorful that those in nearby habitats.

In science learning, particularly life science, Shust notes that lessons may revolve around things students can see in nature near their homes or schools. "We encourage them to go out on nature walks and start looking around to make connections to things they might have read about or done in class," she says. "That helps to answer that question 'why am I learning this?' because now they see it in their own environments, and it becomes more meaningful."

Multiple means of representation: The "what" of UDL learning provides options for comprehension—sharing information through multiple forms of supporting media. To provide representation that can be offered in a classroom or remote location, lessons should:

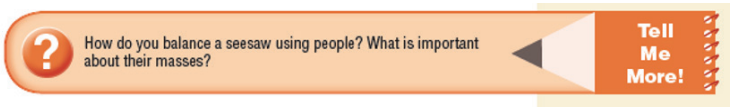
- Support hands-on investigations as part of everyday learning with materials that are provided through lab kits or are commonly found in a home
- Offer digital components that include literacy readers, interactive student investigation sheets, simulations, and assessments
- Incorporate printed text scenarios for on- and below-grade levels

"Hands-on labs, that's how every student learns science best, by manipulating materials," Shust says. "If they're having a tough time understanding something as they move materials around, they can look at a simulation that helps key them into an idea. The good thing about this [phenomena-based science learning] is the teacher can offer the information in different ways to have students make sense of it."

When it's difficult to source materials for hands-on labs in remote locations, look for a science curriculum that incorporates readers that blend English language arts with science. "This is a really quick fix [for teachers] in how to incorporate science into the students' day to day," Shust says. "It's something that they can print out and write on, supporting reading comprehension and science applications." To further incorporate options for differentiation, use resources that are offered in Spanish to support students whose families speak Spanish in their homes.

Multiple means of action and expression: The "how" of learning enables students to demonstrate learning in ways most suited to them, sharing their individual artifacts that represent understanding for assessment. Whether learning remotely or in a classroom, students can:

- Record answers on interactive digital investigation sheets or record videos of themselves
- Write on index cards that can be added to a science notebook and referenced to demonstrate learning growth
- Engage in scientific discourse either on a digital platform, through phone conversations, or in a classroom. Even while socially distancing, students should strive to clearly present their thinking, using evidence to support their conclusions, and revising as their discussions lead to further discoveries.
- Answer open-ended questions to conclude an investigation to prompt deeper thinking, relating the core idea beyond the investigation



Open-ended questions, like the "Tell Me More" questions in Building Blocks of Science™ 3D curriculum, enable students to represent learning in ways that make sense to them.

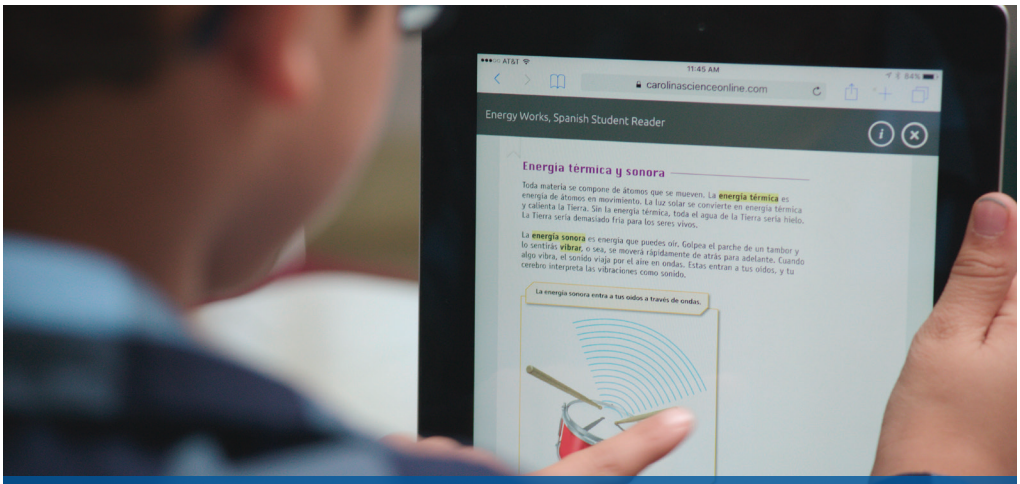
"To share what they know throughout, students can do note-booking. It can be done digitally, but I encourage that it's done with a physical composite notebook," Shust says. "That's a great science practice and also translates into creating a journal . . . and helps with organization strategies. That's an important piece that closes the digital divide—anything they do in a science classroom needs to be recorded, and there are multiple ways to record your information either at school or at home."

Finding Opportunity in the Challenges

"Adapting to the challenges of COVID-19 gives America's schools the opportunity to provide what is uniquely possible in the schoolhouse while seeking new ways to fully use technology and community partnerships," John Bailey and Frederick Hess write in "A Blueprint for Back to School."

"The good thing about it," Shust says about three-dimensional science learning, "is the teacher can offer the information in different ways to have students make sense of it. Any group activity could be turned into an individual activity with the teacher acting as a middleman to gather students' data, reorganize it, and send it back for students to analyze. For shy students . . . they may find that, by doing an investigation by themselves, they can gather a better idea of what's going on."

By continually providing choices that engage every learner in the science and engineering practices that guide them to make sense of and solve problems related to phenomena, teachers can be prepared to optimize three-dimensional science learning no matter where students learn.



To demonstrate learning, students can record answers on interactive digital investigation sheets.

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Learn how the easy-to-use Building Blocks of Science™ 3D curriculum can promote equity and rigor in your students' science education.

ABOUT CAROLINA

Carolina Biological Supply Company is a leading supplier of science teaching materials. Headquartered in Burlington, North Carolina, it serves customers worldwide, including teachers, professors, homeschool educators, and professionals in health- and science-related fields. Carolina is the exclusive developer, publisher, and distributor of the Building Blocks of Science™ 3D curriculum.

ABOUT BUILDING BLOCKS OF SCIENCE™ 3D

Building Blocks of Science™ 3D is an all-inclusive, hands-on, phenomena-based curriculum developed to establish a solid foundation in elementary science while precisely connecting daily instruction to the NGSS. It empowers students to ask questions, investigate possibilities, and build solutions through multiple opportunities to engage in three-dimensional learning anchored in phenomena whether they are learning in school or at home.

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