Implementing Three-Dimensional Learning for Today’s 6–12 Science Classroom

Your Guide to Navigating the Standards. With Answers to Your Most Commonly Asked Questions.
When disciplinary core ideas, science and engineering practices, and crosscutting concepts converge, classrooms transform to a three-dimensional learning environment where the next generation of scientists and everyday problem solvers is born.

Educators understand the goals the science standards are designed to achieve. Yet, as we talk to teachers, curriculum directors, and administrators across the country, many common questions arise on how best to meet the standards.

1. How do teachers transition classrooms to a three-dimensional learning model?

2. How do teachers ensure learning is student-led?

3. How are science and engineering practices best integrated into classroom instruction?

4. What should educators look for when seeking a new 6–12 science program?

This eBook is designed to help answer educators’ questions and provide them with useful tips to help their 6–12 science students meet the standards.
How Do Teachers Transition Classrooms to a Three-dimensional Learning Model?

There are numerous ways to make the transition. Utilize these helpful strategies:

- Choose curriculum that ensures each lesson aligns to the standards for more effective lesson planning
- Reconfigure classrooms for small group collaboration
- Adapt teaching style to include inquiry-first instruction, where students are asking the questions to help find answers, rather than teachers asking them

Prepare for Longer Lessons

- Recognize that lessons will take longer to implement. For example, the entire first day may be needed to provide background and safety procedures and introduce students to the equipment they will be using. Allow at least two to three days per lesson.
- Provide students ample time to both plan and carry out their investigation, collaborate, and connect with the science, as well as make the connections to math.
- Incorporate disciplinary core ideas and crosscutting concepts into one lesson. For example, Tricia Shelton, a ninth-grade science teacher in Boone County, Kentucky, uses the study of conservation and the flow of matter and energy within a life science system. She then has students use a Rube Goldberg to provide the opportunity to transfer to a physical science system. The umbrella, crosscutting concept is energy and matter.

According to Shelton, allowing students to explore the concepts before teacher explanations helps make the crosscutting concept explicit and provides the tools that allow students to become independent thinkers.¹

Revive Model Making and Visual Representations

For example, in a lab on endothermic and exothermic reactions, have students draw pictures to represent reactions at each stage of experimentation so they see misconceptions and visualize results for deeper understanding. Also, use the pictures for a quick-read, teacher evaluation.

More recently considered a tool for elementary students only, visual representations are making a comeback at middle and high school grade levels. Research shows that visuals help the brain process information.²

Access Professional Development Resources

- Find readily available resources, including lesson plans, articles, videos, and more on the National Science Teacher’s Association (NSTA) www.nsta.org and the Next Generation Science Standards (NGSS) nextgenscience.org websites.
- Collaborate with other science teachers within schools and across districts to share successful strategies and lessons.

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2 How Do Teachers Ensure Learning Is Student-led?

Once teachers make the transition to three-dimensional classrooms, changing their instructional routines by following these strategies will help ensure student-led learning.

Embrace the Transformed Teacher Role

Realize that student-led learning does not diminish teachers’ purpose; rather, it provides new avenues to motivate students. Recognize that teachers are still at the heart of classroom instruction:

- Using an inquiry-based learning model that allows them to pose questions, problems, or scenarios that spark student curiosity to learn
- Creating an atmosphere of exploration with hands-on activities and labs that inspire students to make their own discoveries and take ownership of their learning
- Actively facilitating learning, providing students the background and tools they need to help them get started on their own learning paths
- Coaching and cheerleading when students hit obstacles, supporting them in finding answers, while not directly giving the answers away

According to Carol K. Baker, Ed.D., NGSS Writing Team Member and Director of Curriculum for Science and Music for CHSD#218 in Oak Lawn, Illinois, the teacher and student roles are changing. “What teachers are used to doing is walking into a class...with) this rapid fire questioning... Now, what we’re telling kids is ‘we want you to look at a situation...a scenario...a movie clip...a process, and what questions do you have?’ ...So we try doing things like providing them with question stems to help them articulate, find the language and find some comfort as they are trying to develop the questions.”

Student-led learning doesn’t just happen. Teachers are there every step of the way—leading and coaching.
Engage Students with Hands-on and Interactive Learning tools

Look for science programs to provide:

- Suggested labs that allow students to actively engage in scientific practices on their own or in small groups for self-directed learning
- Adaptive learning technology that delivers individualized instruction, providing the precise content an individual student has demonstrated readiness to learn
- Virtual labs that simulate real equipment and experiments and allow students to practice science on their own inside or outside the classroom

Provide Collaboration Opportunities

Efficiently and effectively incorporate student-led, collaborative projects into daily lessons. Use science programs that:

- Make it easy for teachers to integrate their own curated, custom, or open educational resources (OER) into curriculum
- Provide student access to resources for effective collaboration whether they are physically in the classroom, or participating virtually with their team members from home or elsewhere online
How Are Science and Engineering Practices Best Integrated into Classroom Instruction?

One of the best ways teachers can integrate science and engineering design practices into classroom instruction is to make science relevant to students’ everyday lives.

Teachers can accomplish this by creating a classroom learning environment where students engage in the same practices scientists and engineers use to help students understand what they are doing and why.

Bring Science and Engineering Practices to Life

Utilize these instructional techniques to make the science meaningful:

- Use videos, movies, real-world situations, and/or scenarios to nurture student curiosity
- Have students act as scientists, to ask relevant questions for the problem they are trying to solve, and, as design engineers, to define what specifically needs to be improved
- Support students with question stems that allow them to come up with questions on their own
- Invite actual scientists and engineers to the classroom to share their personal experiences, or expose students to the scientific process via Skype or video showing scientists performing an actual experiment or making a discovery
Allow Active Student Participation in the Scientific Process

Support students in acquiring the critical thinking and analytical skills they need to become everyday problem solvers; using hands-on learning activities, small group projects, and labs designed for student application of authentic science and engineering processes. Afford students continuing opportunities to:

- Generate and refine questions
- Develop models
- Plan and carry out investigations
- Analyze and interpret data
- Use data and classroom models to support claims
- Use math and computational thinking to build deeper understanding
- Construct explanations and design solutions
- Engage in arguments from evidence
- Effectively evaluate and communicate information

Change the Experiential Focus

Recognize that to make the science meaningful, the student experience must change from what Dr. Carol Baker calls “cookbook labs”—where students follow the procedures outline in a lab but obtain little learning or application—to active engagement in scientific practices, spending equal time on each phase of the scientific process.

Change lesson focus so that students:

- Generate and refine their own questions, not rely on teacher-generated ones
- Plan investigations, not just carry them out
- Analyze the data, not just collect it
- Explain answers from deep understanding of the process, versus quoting meaningless statistics
What Should Educators Look for When Seeking a New 6–12 Science Program?

Look for a science program that provides already time-stressed teachers the flexibility and comprehensive support they need to successfully transition classrooms.

Find a Science Program with Solid Teacher Support

Consider a science curriculum specifically designed to empower teachers to:

- Easily access reliable professional development via point-of-use resources, on-demand webinars, and workshops, with ongoing support
- Easily integrate their own curated, custom, or open educational resources (OER) with already vetted content to make lesson planning more efficient and learning more effective
- Access a complete curriculum with abundant, available resources that are easy to find and integrate into lessons for teachers still uncomfortable using OER
- Incorporate inquiry-based learning techniques, clearly labeled, for teachers to achieve classroom rigor
- Cultivate literacy with relevant vocabulary and integrated reading and writing support, including multiple-language vocabulary for ELL
Identify a Program that Enables Students to Practice Science

Discover the many classroom rewards when a science program is designed to:

- Develop and enhance communication skills with project-based learning (PBL) activities that allow students to collaborate, construct explanations, engage in arguments, and confidently present findings
- Inspire students to think scientifically to achieve positive outcomes in the classroom and the world around them
- Help students make sense of concepts, sparking discussions first, then allowing student access to content to make it relevant
- Engage students in science and engineering practices to develop the critical thinking and analytical skills they need to become everyday problem solvers
- Include easily accessible educational resources for heightened content knowledge and more successful student-led collaboration

Seek Out a Science Program that Provides Purposeful Technology

Consider a program that:

- Supports the needs of administrators, teachers, and students in one, easy-to-access digital platform
- Incorporates adaptive learning technology to individualize instruction
- Provides real-time student data, monitoring, and feedback
- Provides robust reporting on classroom, school, and district levels

As educators navigate the standards to implement three-dimensional learning, McGraw-Hill Education is here to support them every step of the way.

To learn more, contact your McGraw-Hill Education sales representative.
References

