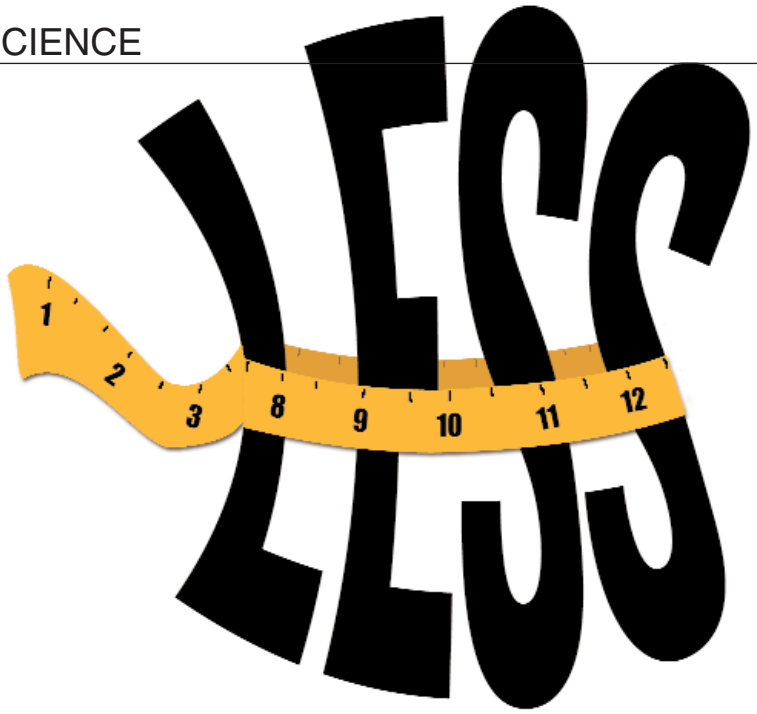


IS More

Trimming the Overstuffed Curriculum

Through a science curriculum "diet," districts discover that less topics could fatten students' understanding

BY LISA FRATT

The scenario in a typical district goes something like this: Dinosaurs, plants and other popular topics are taught year after year in the elementary science curriculum. Teachers who branch out to introduce other topics are usually responsible for gathering materials for experiments and demonstrations themselves. By fourth or fifth grade, science becomes an exercise in memorizing technical terms and getting through the textbook, which may cover dozens of topics. Heavy on vocabulary and light on actual science, this approach continues through high school.

Not surprisingly, these methods have failed to produce science literacy. The Nation's Report Card: Science 2000 shows that the average scores of fourth and eighth graders failed to improve between 1996 and 2000, and scores for 12th graders fell significantly. The report also reveals that male students outperform females and whites outperform blacks and Hispanics.

Overstuffed and undernourishing is the way many experts describe the science curriculum. The Third International Math and Science Study characterizes U.S. math and science curricula as "a mile wide and an inch deep." Instead of forcing students to digest more and more content and vocabulary as science continues to advance, experts recommend a science curriculum "diet" to help take a bite out of the nation's current science achievement woes.

Yes, that's right. Less is more. This unburdening of the science curriculum is already occurring as individual teachers eliminate topics in their overloaded textbooks. But there is a better, less haphazard, approach.

Although there's no simple formula for boosting scientific understanding and achievement, *Designs for Science Literacy*, a report from Project 2061 of the American Association for the Advancement of Science, recommends that schools create more time for in-depth study. Reducing the number of major topics taught, pruning unnecessary details or subtopics, de-emphasizing technical vocabulary and eliminating repetition are the goals.

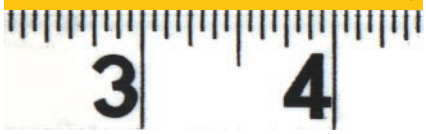
Science Diet Essentials

While implementing a "science diet" can seem daunting, a handful of districts and several states are meeting the challenge. The first step, says Arthur Camins, elementary math and science director for Hudson (Mass.) Public Schools, is to take a look at how students learn science. Recommended reading? *The National Science Education Standards and Benchmarks for Science Literacy*, published by AAAS, which contains statements of what all students should know and be able to do in science, mathematics and technology at the end of grades two, five, eight and 12.

When Hudson revamped its science curriculum, teachers and administrators reviewed the national and Massachusetts standards and compared them to what teachers actually taught in the classroom. "We found there was no consistency.

"Anytime you take anything out of the curriculum, you're opening yourself up to charges that you're dumbing things down."

—George Nelson, director of science, math and technology education, Western Washington University



Some topics were taught twice; others not at all," says Camins. Repeating topics without developing a broader understanding is a hallmark of the overstuffed curriculum. Instead, districts should aim to revisit and expand on topics introduced at earlier grade levels.

Christina Hilton, curriculum program coordinator for the Indiana Department of Education, suggests that districts "go through the state standards, find where they meet the standards, fill in the gaps and trim away the extras." This may mean losing favorite topics for some teachers.

Still, compromise is possible. One Indiana seventh grade teacher had developed a popular unit on forces and motions that included rockets and roller coasters. Unfortunately, it wasn't aligned with the state's new, lean K-8 standards, which could serve as a less-is-more model. Hilton recommended the teacher scale back to one activity rather than spend months on each topic. Of course, relying on state standards works best when the state has already adopted the less-is-more thinking.

Based on input from teacher-administrator teams in six districts, *Benchmarks* gives a true taste of what this means. If a topic was not deemed essential for science literacy or if its importance was out of proportion to the amount of time needed for students to understand the concept, it was eliminated.

The result? Dozens of traditional topics—including acids and bases, simple machines, stellar evolution and branches of biology—don't make the final list of must-do topics. *Designs for Science Literacy* includes a CD-ROM with a sample table of contents that lets administrators and teachers simulate the process of paring the curriculum.

When a district is ready to review the nuts-and-bolts of its curriculum, *Designs* outlines a process to trim topics, sub-topics and vocabulary. Because it's a gradual approach and teachers are involved in the decision-making, the change process is manageable. Here's a summary of the steps:

1. List topics in the current curriculum or textbook.
2. Compare the list with learning goals in *Benchmarks*.
3. Create a second list of possible topics for elimination—those that aren't linked to a specific learning goal.
4. Ask science teachers to drop one topic at a time and invest additional time in a core topic.
5. Evaluate the effects of the change. Then repeat the five steps, involving more topics.

Using this process, the report concludes, might mean eliminating main topics, such as gas laws, simple machines and optics. For topics that districts decide to keep, *Designs* recommends that subtopics be considered, as well. For example, you might want to eliminate sea and land breezes or trade winds from a unit on climate.

Camins recommends that districts review National Science Foundation-supported programs based on the less-is-more philosophy. Kit-based programs include Science and Technology for

One District's Push for Science Reform

The El Centro (Calif.) Elementary School District is in year seven of a long-term project focusing on the inquiry approach to student learning in science. The project has boosted achievement in science and across the curriculum, despite that El Centro is geographically isolated and predominantly poor. Sixty-seven percent of students qualify for free lunch, and half of the students start school speaking Spanish.

Like other districts on the cutting-edge of science reform, El Centro Superintendent Michael Klentschy describes systemic change as an ongoing process. The district is focusing on five critical elements simultaneously: high quality curriculum, sustained professional development, materials support, community and administrative support, and assessment and evaluation.

At the curricular level, teachers introduce a mere four science modules (all aligned to national standards) each year. For example, teachers might be able to devote an entire nine-week quarter to water, which offers students an opportunity to understand a few big ideas, instead of gain exposure to dozens of disparate science factoids.

The district provides at least 100 hours of professional development designed to deepen content understanding and address pedagogical and assessment issues, as well as in-class support. And teachers no longer need to run around before school buying food coloring needed for that day's science experiment. All materials needed for a module are delivered to the teacher's door every 10 weeks.

Cover less, absorb more: In El Centro students get engaged in science through in-depth study. Each year, third graders study just four main topics: earth materials, weather, sound and the life cycle of brine shrimp.

Curricular modules aren't sequential within each grade. This saves the district money, as all materials aren't used in every classroom at the same time. The district also recruits science professionals to work with teachers, presents family science nights and maintains a close relationship with local newspapers. Administrators aren't left out of the loop either. The program provides training and professional development for principals, too.

The final strand of the El Centro program is assessment. So far, science, reading, math and writing test scores correlate with the length of time students are exposed to the science program: the longer students are involved, the better their scores are. Moreover, the gap between males and females is eliminated, the gap between free-lunch students and others closes over time, and limited English proficiency students actually demonstrate a higher rate of growth than English speakers.

Klentschy credits the cross-curricular gains to the programs providing real world focus, which helps build comprehension. The benefits continue after students leave the elementary level. Middle school teachers report that students are entering with a better understanding of science, which allows them to focus on content. At the high school level, enrollment levels in biology, chemistry and physics have risen.

Children, Full Option Science System and InSights. With the option system, for example, the fifth grade curriculum can be scaled back to four modules: food and nutrition, levers and pulleys, solar energy and models and designs.

Most state standards incorporate the national standards and *Benchmarks,* says George Nelson, director of science, math and technology education at Western Washington University and former Project 2061 director. States tend to fall short, however, in covering historical perspectives on science, common themes that pervade science, math and technology, and scientific habits of mind. While individual districts can still include these subjects, the need to add makes the need to cut ever more important.

A Balanced Diet for Reform

Organizing a K-12 educators' dialogue is often helpful in jumpstarting the curriculum trimming process and other science reform. When Ashland (Wis.) School District was aligning its K-12 science curriculum to state standards, science teachers from every grade level were brought together. Anni Schneider, physical science teacher at Ashland High School, says, "That's when we said, 'We can't all do dinosaurs.'"

Trimming the science curriculum and aligning it to national and state standards is part of the reform process. Another critical piece is selecting the right type of curricular materials. After all, it is possible to cut the science curriculum in half and be left with a poor program. Nelson says, "Science educators and cognitive scientists have found

Tips for Science Diet Success

When you're ready to prescribe a science diet in your own district, here are a few healthy hints:

- **Make sure administrators, teachers and the community understand the "less-is-more" goal.** Conversations about trimming the curriculum often turn to questions about adding to the curriculum, says George Nelson, former director of the American Association for the Advancement of Science's Project 2061. Administrators, teachers and parents need to be educated about current research on science and learning. Hosting community nights to share research about science education can help.
- **Dig for dollars.** Unfortunately, reform can be costly. New curriculum and sustained professional development have a high price tag. Many districts that have successfully implemented reform received grants.
- **Develop partnerships.** More often than not, the community is willing to get involved in local education. In Indiana, retired scientists from the global pharmaceutical company Eli Lilly serve as substitutes while teachers attend professional development devoted to science. Look to companies based near your district and universities to find similar programs, and consider partnering with other area districts.

that telling kids lots of stuff doesn't result in a lot of learning."

A quality science curriculum pares down the content. But it also engages students in science and the real world and provides time for students to communicate their thoughts and understanding.

Here's an example of new vs. old ways of thinking about science: In a typical high school biology class, students might mistakenly believe plants get their food from the soil. The teacher assigns a paper chromatography experiment and has students memorize a definition for photosynthesis. A more effective method would be for students to discuss their understanding of photosynthesis, complete relevant lab investigations and compare their thoughts to what they learned in the lab. Students could then explain photosynthesis in their own words, demonstrating their understanding of the concept, not just the technical terminology.

The new process takes time, but it has a much better chance of resulting in mastery of the subject. Indeed, de-emphasizing technical vocabulary is key to a successful science diet.

Districts working on trimming the science curriculum should also determine the most appropriate grade level for topics. Elementary teachers can spend a fair amount of time teaching about the solar system, for example, but research shows that at this age level children can't easily comprehend the science of the solar system. So a science unit on the solar system is watered down to memorizing planet names. On the other hand, if the unit is introduced at the middle school level, students can begin to develop an understanding of how the solar system functions.

Hudson considered grade levels when overhauling its science curriculum. "If you take topics accessible to students' level of cognitive development, the curriculum becomes much more efficient," Camins says.

Nelson cautions that science reform can't be purchased as a particular curriculum. For example, teachers in Rockford (Ill.) Public Schools have a textbook for each course, but they are encouraged to use a variety of resources. The district provides teachers with binders filled with objectives, activities and assessments. The point is not to 'do' or 'cover' the entire textbook or binder, but to give teachers an array of tools to help students learn.

Even with the right curriculum and resource materials for teachers, some districts have difficulty completing the task of trimming the science curriculum. Meaningful and continued professional development for teachers that reinforces science concepts and the underlying pedagogy is critical.

Sticking to the Diet

It may take two or three years just to think through what to leave in the curriculum and what to throw out, Nelson says. "Any time you take anything out of the curriculum, you're opening yourself up to charges that you're dumbing things down," he says. The process should include a substantial professional development program, and it may also involve partnerships with outside organizations and a community education effort. Bringing the community along gives administrators and teachers the chance share research with them.

It's also important to remember that the national standards and *Benchmarks* are intended to describe the bare core of what students should know about science. Certainly some high school students are ready to digest more sophisticated science topics. Those topics, Nelson explains, can be addressed in advanced science courses.

Like any diet, trimming the curriculum can be painful. Nelson warns that teachers will have to leave out some of their favorite topics and activities as they cut the curriculum. But the results are well worth the effort. Since Hudson initiated its new science program, Camins has heard from almost every teacher how much kids are enjoying science. He says, "If you want to do anything meaningful and worthwhile, it takes time." **D**

Lisa Fratt, lfratt@cheqnet.net.com, is a freelance writer based in Ashland, Wis.