HIGH SCHOOLS THAT WORK

Preparing All Teachers to Use Proven, Effective Instructional Methods Across the Curriculum

Research has shown that certain ways of teaching can make a difference in whether students learn standards-based content. Many strategies have proven to be effective in teaching literacy, mathematics, science and social studies. These strategies have facilitated blending academic and career/technical subjects to make learning more meaningful for students who learn best by doing.

Instructional techniques generally focus on engaging students in learning by reading and writing in English/language arts courses, strengthening understanding and reasoning skills in math, delving into textbooks and materials, doing lab projects in science, and using literacy and hands-on projects and problems in social studies. Authentic, integrated projects planned by academic and career/technical teachers working together and aligned to college- and career-readiness standards will motivate students to work harder and achieve at a higher level.

Many schools are organizing teachers within and across disciplines and grade levels into professional learning communities (PLCs) to provide regularly scheduled opportunities to look at assignments and assessments to determine how to ensure these instructional activities meet standards.

Implement Reading, Writing and Literacy Strategies Into All Classes

Rethinking Reading in High School — Keep Students' Interests in Mind

APRIL 2012

"By making substantive changes to what students read, we can bring immediacy and spontaneity to their learning. We can make their schooling a living experience, as if it is truly relevant to life. …The world is brimming with marvelous writing. It's time to bring it to our students."

Steven Wolk
"What **Should** Students Read?"

Why don't today's high school students read more in school? "The answer is simple," said **Monty Wilson**, supervisor of curriculum and instruction for the **Wilson County School System** in Lebanon, Tennessee. "Schools' reading requirements have remained fairly consistent for 50 years."

Wilson offered five questions to help educators rethink what they ask students to read and why they choose to assign certain reading materials:

- Why should students read?
- What is your ultimate goal for students and reading?
- What do you teach — and why?
- Can you link state and district standards to classics and contemporary reading materials?
- How can your school or district change its approach to reading?

"If reading materials are selected on the basis of students' interests, students will want to read," Wilson said. "They will be motivated to seek copies of the materials on their own and to begin reading outside of class." The goal is to create lifelong readers and thinkers.

Wilson referenced an Arthur Applebee survey of middle grades and high school students in 500 public schools. The survey revealed that the authors of the top 10 books students said they were asked to read included one female and no minorities.

"Our school district included 103 books on the high school reading list in 2008-2009," Wilson said. "Ninety of the books were written by white males and seven by white females. The list contained few books that would interest most students, least of all males and minorities."

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Schools do not need to disregard the classics in favor of contemporary books. "We can relate the classics to contemporary works and use standards to develop lessons and assignments that show correlations between the two genres," Wilson said.

Assign novels not usually found in English classrooms. Wilson encouraged teachers to develop reading projects that students can complete after taking end-of-course exams in a subject. "Students in Wilson County take the end-of-course assessment weeks before school is out," Wilson said. "Since the assessment also serves as a student's final exam, teachers use the remaining weeks to promote student-choice reading assignments and projects that go beyond the novels historically taught in English classrooms."

Give students a choice of what to read by requiring some titles and allowing students to select others. "Local bookstores and libraries can set aside areas where high-interest books are available to students," Wilson said. High schools in Wilson County have sponsored book swaps in which students received tickets for used books. Students swapped the tickets for new books that were donated and purchased for student use.

Since adopting these changes, the Wilson County School System has received positive feedback from teachers, students, parents and the community. One veteran teacher said for the first time in her career, students not only complained about stopping class readings at the bell but also took novels home for the weekend to finish the books early. Local bookstores work with the district to make sure they stock enough copies of young adult literature.

"In the district, students' value-added scores in all tested English courses rank in the top four in Tennessee," Wilson said. "The district also ranks in the top 15 percent of the state when analyzing the value-added achievement of 11th-graders on the ACT in both reading and English."

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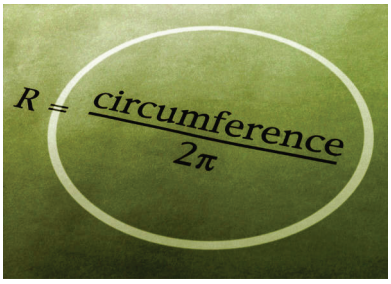
Bringing Literature Into the Mathematics Classroom: Making Connections That Enhance Student Performance

Mathematics teacher **Deborah Seldomridge** of **Keyser High School** in Keyser, West Virginia, practices her belief that literature can spark creativity and engage students in problem-solving. Seldomridge is a member of the state team that is training teachers to implement the Common Core State Standards.

"Mathematics is a language, and mathematical literacy is essential in a global economy," she said. "Storytelling is a powerful tool that brings lasting images and gives students access to abstract concepts. Reading in a mathematics classroom makes the learning experience more personal."

Seldomridge encourages the integration of reading, writing and math. Her students range from special-needs students to pre-calculus students in grades nine through 11. They begin by analyzing a Carl Sandburg poem and writing mathematics autobiographies in which they share their own journeys through mathematics. "When you read what students write, you gain insights into their struggles and triumphs in learning mathematics," she said.

Mathematics literature and video clips are readily available, Seldomridge pointed out. She has compiled a bibliography with notes on possible resources and suggestions for making mathematics more engaging for students:



"Mathematics is a language, and mathematical literacy is essential in a global economy."

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***The Phantom Tollbooth*, by Norman Juster —** Visit the National Council of Teachers of Mathematics website at http://illuminations.nctm.org/ for ways to use this children's adventure novel and modern fairy tale in a lesson on averages. Clips from the movie and other clips with a mathematics context are available at http://www.math.harvard.edu/~knill/mathmovies/. "Many passages from this book can generate interesting mathematical conversations," Seldomridge said. From dodecahedrons and estimation to big numbers and Fermi problems in Chapter 14 to modeling addition and subtraction of negative numbers and order of operations in Chapter 15, students travel with Milo and Tock to the Mathmagician's capital of Digitopolis. Students can be challenged to create estimation questions modeled on those of physicist Enrico Fermi. One example is, "What is the weight of all the students in the building?"

***A Remainder of One: A Lesson for Fifth Graders*, by Marilyn Burns —** After reading, students answer this question: "Why is it called the 25th Army Corps?" Students quickly realize that the name of the squadron is determined by the fact that 25 has a remainder of 1 when divided by 2, 3 and 4 but zero for divisor 5. Posing the question, "What is the name of the squadron with remainder 1 for divisors 2, 3, 4, 5 and 6 and zero for divisor 7?" turns out to be a rather interesting problem for high school students," Seldomridge said.

***If You Hopped Like a Frog*, by David M. Schwartz —** This children's book introduces ratios and proportions. Teachers can encourage students to react to the proportions discussed in the book and tell what mathematical concepts are needed to support the scenarios. Students can use the Internet to find the necessary information to substantiate their claims. Students' work can be compiled into a booklet to share with elementary school students.

***What's Your Angle, Pythagoras?*, by Julie Ellis —** "Although this mathematical adventure is a fictionalized look at a young Pythagoras as he discovers his famous theorem, the mathematical components of the book are accurate," Seldomridge said. The book sets the stage for students to create a quilt using right triangles.

***Flatland*, by Edward A. Abbott —** This romantic fantasy about mathematics and philosophy has been adapted into a feature film. Teacher resources are available for use with the movie.

***Fermat's Enigma*, by Simon Singh —** "Pierre de Fermat posed his famous problem, which became known as Fermat's Last Theorem, more than 350 years ago," Seldomridge said. "The book tells the story of the many mathematicians and mathematical developments that led to the solving of this problem in 1944 by Andrew Wiles, a Princeton mathematician."

Seldomridge believes all students can benefit from linking literature to mathematics instruction. "Students who struggle with mathematical concepts are drawn to the stories and retain the conceptual understandings because they can relate them to what they have read," she said. "Often students dig deeper into the understanding of concepts and apply them at a higher level as a result of exposure to literature related to the content." For example, pre-calculus students begin to write mathematical justifications in greater depth and engage in academic conversations even outside the classroom after reading *Fermat's Enigma*.

"As a result of using literature in mathematics classrooms and other school initiatives, student achievement in mathematics has increased," Seldomridge said. "School assessment data showed a 2.7 percent increase in math proficiency from 2010 to 2011."

Another thing that is evident is that **students have grown in math maturity through exposure to literature**. "As our class discussed the book Fermat's Enigma, students were able to connect the personalities and the mathematical ideas," Seldomridge said. "As we explored Godel's work on undecidability, several students noted the similarities to Heisenberg's uncertainty principle."

Rigor, Relevance, Relationships and Reading in All Content Areas Across the Curriculum

Students at **Athens Middle Schoo**l (AMS) in Athens, Alabama, are reminded constantly that rigor, relevance and relationships — plus reading — are the keys to higher achievement in every subject across the curriculum.

AMS provides professional development for teachers on how to use literacy strategies in the classroom. Teachers collaborate to conduct schoolwide "reading days," display posters of reading inspiration and techniques in hallways and staff rooms, and wear T-shirts that promote the importance of reading.

"Literacy plays a role in every content area," said Assistant Principal **Joanna May**.

Language Arts — Teachers plan how to relate reading to what is being taught. They incorporate visuals and model "talking to the text" to encourage students to develop personal relationships with written materials.

Mathematics — Teachers display posters and photos of students in the act of reading and create word walls to build students' vocabulary skills. Students read math-related articles from newspapers, magazines and the Internet and respond by summarizing, reflecting, connecting and sharing what they learn. Teachers use the **TWIRL** method: **T**alking, **W**riting, **I**nvestigating, **R**eading and **L**istening to teach literacy in math.

Science — After students complete required summer reading, they participate in a question-and-answer period and an open discussion. They also are required to pass an Accelerated Reader (AR) exam. Students' reading must correlate with the science curriculum. Math teachers use the website http://www.leadered.com/pdf/r&rframework.pdf, which describes the Rigor/Relevance Framework, a tool developed by the staff of the International Center for Leadership in Education to examine curriculum, instruction and assessment. The framework is based on the six levels of Bloom's Taxonomy (awareness, comprehension, application, analysis, synthesis and evaluation) as well as the five levels of Willard Daggett's Application Model (knowledge in one discipline, apply in one discipline, apply across disciplines, apply to real-world predictable situations and apply to real-world unpredictable situations).

Social Studies — Teachers model good reading habits and require students to read and write daily. "We don't mind borrowing from the thousands of reading resources that are available," Social Studies Teacher **Sherry McEwen** said. "It isn't necessary to reinvent the wheel."

Career Readiness — Reading current information helps students stay up-to-date in career fields. Reading nonfiction books helps them become lifelong learners. All materials are relevant to students' career interests and are chosen to enhance critical-thinking skills. Students are asked to read, summarize and reflect on articles.

Amanda Gibbs, who teaches technology classes and a career/technical class at AMS, has compiled a list of online reading resources. The list contains a Smartphone mobile link, websites containing reading strategies and graphic organizers, and information about eBooks. Contact Gibbs for more information about the list.

"Our efforts to promote reading across the curriculum have resulted in improved communication and greater student achievement," May said. "We no longer need a summer school program."

Athens Middle School received recognition in 2010 as one of the top 50 high-implementation sites in the *MMGW* network.

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Strategies and Tips for Supporting English-Language Learners

Melissa Mink is an ESOL (English for Speakers of Other Languages) reading and language arts teacher at **Bellview Middle School** in Pensacola, Florida. She teaches beginning and advanced ESOL classes to students in grades six through eight. Her responsibilities also include monitoring her students' success in other content areas and offering instructional support as needed to teachers in those areas.

"English-language learners (ELL) need listening, speaking, reading and writing embedded into their lessons on a daily basis," Mink said. "No matter the content area, all four skills can be incorporated into the instruction."

Teachers can pair ELL students with strong English-speaking students to work together in class. "Use synonyms of words daily and allow ELL students to write vocabulary words in English and in their native language, if needed," Mink said. "Ask ELL students to interview other students and teachers. Find opportunities to encourage English oral language development."

Mink recommends looking for opportunities to develop students' interpersonal skills. "Require group projects and cooperative learning in the classroom," she said. "Encourage participation, realizing that many ELL students are from countries where student participation is not encouraged. Students may be reluctant to speak, not only because they lack English skills but because they are uncomfortable in an environment where they are asked to share their ideas."

Teachers of ELL students will want to implement consistent classroom routines, Mink said. "Give students a copy of your lecture or discussion outline," she said. "This will help ELL students know where you are and where you are going in the lesson."

Mathematics Strategies:

- Differentiate math vocabulary from everyday vocabulary. Words such as product, root and function have different meanings in other contexts.
- Emphasize math vocabulary synonyms such as *addition*, *sum*, *plus* and *combine*.
- Introduce the measurement system largely used in the United States rather than the metric system.
- Provide tactile, concrete opportunities for students to experience math concepts.
- Make it possible for students to practice previously taught topics on a daily basis.
- Provide instruction in problem-solving.
- Demonstrate how to find key terms in word problems.
- Provide small-group instruction to remediate or teach additional skills.

Science Strategies:

- Emphasize visual literacy by using graphic organizers, conceptual grids, Venn diagrams, flow charts, mind maps and concept maps.
- Use charts, graphs and figures to communicate concepts with minimal use of spoken or written language.
- Activate the closed-captioning feature in science videos so that students can see what the narrators and actors are saying. This strategy will help ELL students correlate written and spoken English and see spelling and sentence construction.
- Require ELL students to keep science journals of lecture notes, new terms and responses to prompts.

- Use flash cards with pictures of science concepts on one side and the term in English on the other side.
- Post new vocabulary words on the wall. List biology terms in columns according to the level of organization (cell, tissue, organ, etc.).

Science Lab Strategies:

- Use clear, procedural steps. Science labs can be confusing and potentially dangerous for ELL students. Use flow charts, pictures and outlines to present the lab procedures.
- Demonstrate lab activities in front of the class to ensure ELL students can see the procedures before engaging in an activity.
- Provide pictures of glassware and other materials used in experiments and activities.

Mink noted that effective classrooms engage ELL students in word study, vocabulary development, research, group work and project completion. Students speak in English, engage in cultural debates, practice new words, peer tutor and give oral presentations.

"Whenever possible, make use of students' background knowledge of concepts," Mink said. "Discover what your students already know about a given topic and build on this knowledge."

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Use Proven Strategies to Increase Students' Mathematics Knowledge and Skills

Creating Mathematics Momentum Through Career/Technical Instruction

Leaders and teachers at sites across the *Technology Centers That Work* (*TCTW*) network are developing ways to increase career/technical (CT) students' mathematics achievement.

"CT instructors have excellent opportunities to engage students in applying mathematics concepts and to help students see the connections between career studies and abstract mathematics," said **Ted Archer**, mathematics instructor and professional development facilitator at **Cumberland County Technical Education Center** in Bridgeton, New Jersey. The center was named an Outstanding *TCTW* School by SREB in 2011.

SREB School Improvement Consultant **Kathleen McNally** collaborated with Archer to define and illustrate three areas of impact in addressing college- and career-readiness standards while allowing students to practice needed mathematics skills and explore confusing mathematics concepts.

- **Provide opportunities for students to think, explore, talk and justify mathematics approaches** in different forms and representations, such as decimals and fractions, as opposed to pictures and words. For example, culinary arts students can be asked to verbalize measurements — teaspoons, ounces, pints — as they work through changing a recipe. Allowing students to think through the conversions will strengthen students' conceptual understanding of numbers and operations. In using proportional relationships in their work, it is helpful for students to practice verbal and written verification of the relationship being used and the appropriate units. Here are three examples of authentic proportional relationships:

  Graphics — If a printing company runs a printing press at 8,000 impressions per 60 minutes, how long would it take the press to run 5,000 impressions?

  Dental — A chemical used for surface disinfecting is Pathex. The directions for mixing are 15 ml to 16 ounces of water. You have a gallon of water. How much Pathex do you need to add to the gallon?

  Machine Tool — A machining contract is for 150 parts from 1/16-inch-square mild steel. Each part sawed from a bar of material uses 23 inches. How much material will be needed?

- **Identify and address differences in vocabulary and terminology** from technical fields compared with the language of mathematics as a discipline. "It is important for schools to provide time for CT and mathematics teachers to work together to share the language of their fields when instructing students," Archer said. "An instructor can reference and support the other teacher's descriptions and terminology to help students increase their understanding." For example, a contractor may talk about a floor space index or a floor area ratio to meet local zoning regulations. Mathematics teachers will talk about the area and perimeter of regular polygons — the same concept described in different terms. Students in a construction career cluster need to know that the descriptions mean the same thing.
- **Use context to help students investigate mathematics concepts**. Archer and McNally pointed to the abundance of authentic scenarios that exist in CT programs. CT

instructors can encourage students to practice strategies such as drawing a picture, making a chart or a list, working backward, and looking for patterns as they become involved in scenarios. One example of how to incorporate problem-solving strategies into projects and assignments is called "Cutting Your Cake." Students use mathematics to plan how to package, cut and serve a two-tiered circular cake. They show their work and explain clearly how they arrived at the answers. Grades are based on correctness of methods and accuracy of answers. In another example, electricity students are challenged to think backwards when analyzing materials needed for rewiring an outdated home. Graphic arts students can be asked to record data and make lists when reworking advertisements to determine the best ratio of white space to print space.

TCTW sites are using an assortment of practices to create momentum for higher mathematics achievement:

- CT instructors collaborate with mathematics teachers from sending schools to plan authentic problems that can be used throughout the year.
- Students write about problems and concepts in mathematics journals.
- Mathematics and CT teachers swap classrooms for the purpose of developing joint problems and projects.
- Mathematics-enhanced lessons are being developed and expected across all programs. The number of lessons is increased each semester.
- Vocabulary exercises include mathematics and technical terminology, jargon and formulas.

Seven elements for teaching mathematics through authentic integrated project units were developed from a research project of the National Research Center for Career and Technical Education. The definitive research article on the Math-in-Career/Technical Education model was published in the *American Educational Research Journal* in 2008. The elements are:

1. CT teacher introduces a CT lesson.
2. CT teacher assesses students' mathematics awareness.
3. CT teacher works through embedded examples.
4. Mathematics teacher works through traditional mathematics examples.
5. Both CT and mathematics teachers work through related contextual examples.
6. Students demonstrate understanding in CT and mathematics classes.
7. CT and mathematics teachers formally assess students.

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Algebra I … Every Day … for 90 Minutes … All Year?

"Meeting for 90 minutes every day reinforces student success and provides extra time for new perspectives and advanced topics."

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Lower-achieving students in the **Mehlville School District** in St. Louis County, Missouri, were struggling with mathematics in the every-other-day format of the district's block schedule. As a result, a team of teachers and administrators from two high schools and four middle grades schools designed Principles of Algebra IA/IB, a capstone course for eighth-graders and a catch-up course for ninth-graders.

This redesigned course was based on *HSTW* recommendations from the state-sponsored Building Bridges conference. Educators participated in initial professional development sessions at the conference and two follow-up workshops. They also received coaching and demonstration teaching from an SREB consultant between the workshops.

The goal was to provide extra help and extended learning time during regular school hours to enable students to complete a redesigned Algebra I course taught every day at the same level of rigor as the traditional course taught in the every-other-day format. "Meeting for 90 minutes every day reinforces student success and provides extra time for new perspectives and advanced topics," said **Jane Ebert**, co-chair of the mathematics department at **Mehlville High School** (MHS). "The consistent contact builds student-teacher relationships and helps eliminate the 'I can't do it' attitude that prevents some students from learning mathematics."

Schedule Adjustments

The schools made schedule adjustments so that students could take Principles of Algebra IA/IB concurrently. This means that students meet daily with their mathematics teachers. Students receive one math credit for successful completion of IA and an elective credit for IB. They receive the same grade for both parts of the course. Eighth-graders must pass the first semester of Algebra II in the ninth grade to receive credit for Algebra I taken in the middle grades.

The target population for the course is students who say they do not like mathematics and are not interested in learning it. Teachers develop classroom assignments and assessments jointly and use engaging instructional strategies such as "foldables," a technique with step-by-step instructions for students who resist taking notes.

Teachers conduct frequent formative assessments by having students use individual dry-erase white boards (both plain and with grids). Most teachers use clickers or responders to gather real-time data.

Alone or in Groups

Students work alone or in cooperative groups to complete projects that require the use of mathematics. "The teacher is no longer the sole source of mathematics information," Ebert said.

Changes in instructional design and delivery have prompted attitudinal changes — from seeing low-level students as unable to learn to providing extra help and support for students who can learn if they make the effort. **"This change in attitude and pedagogy was achieved through strong administrative support that includes common planning time, assignment of 'seasoned' teachers willing to teach in teams, smaller class size and keeping successful teams intact over time,"** Ebert said.

The everyday algebra course has been in place at MHS for four years. During that time, performance on the Missouri End-of-Course assessment in Algebra I has shown improvement for all student groups. The percentage of students passing the EOC exam climbed 23.6 percentage points from 38.3 percent in 2006-2007 to 61.9 percent in 2010-2011 (after students had access to Principles of Algebra IA/IB). The increases included 16 points for minority students, 23 points for majority students, 24 points for students eligible for free or reduced-price lunches and 31 points for students with Individual Education Plans (IEPs).

Explore How Authentic Questions, Writing Prompts and Lab Experiments Can Help Students Learn More Science Content

Rigor, Relevance and Raising Student Achievement: The Three R's of Science Education

Studying science has real meaning for students at **Providence Grove High School** (PGHS) in rural Climax, North Carolina. Teachers are dedicated to involving students in the world around them as they solve the "mysteries" of science and learn to achieve at a higher level.

PGHS enrolls 844 students, including 41 percent eligible for free or reduced-price lunches. The parents of many students never graduated from high school.

The percentage of students scoring Proficient in biology on the North Carolina End-of-Course exam rose from 70.5 percent in 2008-2009 to 91.3 percent in 2009-2010. The percentage dipped slightly in 2010-2011 but remained high at 88.5 percent. The physical science scores in 2008-2009 showed that 53.6 percent of students were Proficient on the state end-of-course exam. When best practices were implemented in 2009-2010, the scores rose to 77.2 percent Proficient in physical science.

"The keys to our success are rigor, relevance and raising test scores," said **Donna Brown**, lead teacher. "Our students *do* science."

Rigor — Teachers teach bell-to-bell but limit their lectures to allow time for challenging hands-on activities. Classrooms focus on students and groups of students.

Relevance — Students learn concepts first and science jargon next.

Raising Scores — Teachers give frequent formative assessments and fewer summative assessments.

Teachers work together in professional learning communities (PLCs) where they tear apart the curriculum to analyze the verbs (compare, distinguish, graph and analyze) and link topics logically. "For each unit, we figure out what our students need to know and be able to do to master the unit," Brown said. Each class period focuses on "I can" statements, such as these statements from biology:

***Cell reproduction* —** I can explain that the purpose of mitosis is the reproduction of identical cells. I can determine the sex of an individual using the process of karyotyping.

***Enzymes* —** I can explain why enzyme shape is important to enzyme function. I can list at least three cellular processes that are controlled by enzymes.

***Metabolism* —** I can distinguish when fermentation will occur in a cell. I can trace an atom of carbon through its cycle.

The science faculty at PGHS teaches in a way that "makes sense." Teachers link lipids to membranes to cell classifications. They connect the Miller-Urey Experiment on the origin of life to organic testing. "We pay attention to the order of the curriculum in earth science," Brown said. "For example, we teach weather first in the fall and again in the spring."

Teachers use sorting activities (concept cards) to help students understand mitosis versus meiosis, eukaryotic versus prokaryotic, cellular respiration versus photosynthesis and active transport versus passive transport.

Students are assigned to read books and complete projects associated with the books. For example, biology students read Rodney Barker's *And the Waters Turned to Blood*, a book about a deadly organism. Students spend several weeks on a book-related project that includes a portfolio that counts as an exam grade. The project is linked to specific North Carolina biology standards. The teacher provides a rubric that tells what students will do to earn grades of A, B, C or D. Portfolios must contain complete sentences and correct grammar.

Earth science students read about the deadliest hurricane in history in *Isaac's Storm*, by Erik Larson. While reading, each student keeps a journal that includes information from each section of the book as well as his or her overall reaction to the book. Students receive points based on the number of pages and the questions for each section. Probing questions include, "Why don't hurricane clouds run out of moisture?" and "What three errors did the weather bureau make concerning notification of an impending storm?" Students are expected to write in complete sentences and use correct grammar and spelling.

PGHS science students spend time in the world outside the classroom. They perform chemical tests of water in the Deep River and at the North Carolina Zoo. Biology students study various ecosystems by collecting biotic and abiotic data on ecosystems near the school and in different ecosystems at the North Carolina Zoo.

Physics and physical science teachers at PGHS recommend two websites: http://modeling.asu.edu/modeling-HS.html about the modeling method of science instruction and http://phet.colorado.edu/en/simulations/category/new about interactive simulations in science.

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Plan Authentic Integrated Projects for Academic and Career/Technical Courses to Align With Standards and Motivate Students to Achieve

Mathematics by Design: It All Adds Up

Connie DeMillo, design and interactive media instructor, and **Erick Lehet**, mathematics coach, are integrating math into career/technical (CT) courses to help visual learners at **Northeast Metro 916 Career and Technical Center** in White Bear Lake, Minnesota, remember the math curriculum.

Every project in DeMillo's classes contains some math content:

How to Read a Ruler — Accurate measurement is an integral skill for a graphic designer. Students complete daily drawing exercises and soon become acclimated to using a ruler. They discuss fractions, decimals and the greatest common factor by dividing spaces into even increments.

Point, Line and Plane — Students take photos of point, line and plane in nature and use iPhoto to create a slideshow and GarageBand to add music to the show. Students are intrigued when they learn music is math-based.

Scaled Self-Portrait — Students shoot and print 8-by-10 self-photos. They draw value scales in their sketchbooks and use pencils to color in values in 10 percent increments. They also mark the decimal equivalents.

Cognitively Guided Instruction (CGI) Questions — Students determine larger and smaller percentages and decimal numbers. Then they draw a one-inch grid on a photo by using a t-square to draw the horizontal lines and a triangle to draw the vertical lines. Students decide on the scale, which can be larger or smaller than the original.

Orthographic Gadget Drafting — Students do isometric and orthographic projection exercises in their sketchbooks and design the "next new thing" — a gadget that would make life much easier if it was invented. They use orthographic or isometric perspective to draw the gadget.

Student Drawings of Dream Rooms — Students draw blueprint views on graph paper in their sketchbooks. The ratio of "one square equals one foot" is easiest to understand. Students decide on a dream room, figure the dimensions of the room and the furniture, and use the blueprint and dimensions as a guide in producing a one- or two-point perspective drawing of the room. They calculate at least one area measure, such as flooring or the amount of paint needed, and keep a total of the costs of the furnishings for the room.

Students at Northeast Metro have benefitted from integrating math and career content. Students at the center take a math assessment in the fall and again in the spring. The assessment consists of 40 multiple-choice questions based on the Minnesota graduation assessment and ACCUPLACER exams.

- **The scores of DeMillo's students on the math assessment improved by 29 percentage points in 2009-2010 and 24 percentage points in 2010-2011**.
- **Schoolwide gains for students taking the math assessment totaled 7 percentage points for 747 students in 2009-2010 and 5 percentage points for 752 students in 2010-2011**.
- **DeMillo's students had a graduation rate of 98 percent in 2010-2011**. **DeMillo received the 2010-2011 Teacher of the Year Award from the Minnesota Association for Career and Technical Education/Special Needs Population**.

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Construction Geometry: Real Relevance in the Classroom

Carpentry, welding, machine tool and agriculture students taking Construction Geometry at **Henderson County High School** (HCHS) in Henderson, Kentucky, put their integrated math skills to work each year in building a house they market in the community. Mathematics teacher **Beth Roberts** helps students prepare for this hands-on building experience by teaching practical applications of math concepts such as the Pythagorean theorem, triangle measurement, right angles, diagonals and rise-over-run calculations. Students learn to use construction vocabulary and math vocabulary interchangeably and to apply math properties in construction.

The class brings real job-site traditions and vocabulary into the classroom as students explain the construction process. "The class increases student learning by being relevant and fun and by promoting teamwork between staff and students," Roberts said.

In one project, students draw a plan for a three-bedroom house that will satisfy a building inspector's requirements for mathematical accuracy, architectural neatness and livability. Students earn extra points for designing a home that is wheelchair accessible.

HCHS uses the Measures of Academic Progress (MAP) assessment from the Northwest Evaluation Association to measure student achievement. **A comparison of Construction Geometry students' scores from spring 2007 when they were sophomores to spring 2008 when they were juniors showed that 48 percent advanced five points or more and 33 percent improved 10 points or more on the MAP math exam**. Eight students increased 15 points or more from 2007 to 2008. "Data from 2008-2009 showed relatively the same increases," Roberts said.

Victor Doty, director of career/technical education at HCHS, said the key to developing and implementing a successful Construction Geometry program is to "find a motivated teacher, obtain administrative attention and support, and allow teachers to step out of their comfort zones to help students learn in a new way."

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Building a Culture of Creativity to Prepare Students for the Future

Eric Longwell, physics, mathematics and electronics instructor at **Lenape Technical School** in Ford City, Pennsylvania, helped create a school culture of creativity by using project-based instruction, inquiry-based learning and incorporation of 21st-century skills. "We can't predict the future, but we know creativity will be one of the skills students will need in meeting a multitude of challenges," Longwell said.

Lenape Technical School serves 450 juniors and seniors of diverse academic and socioeconomic backgrounds from four school districts and seven sending high schools. Students are enrolled in 16 career areas. The school is in an area known for coal and natural gas production.

Two projects illustrate the culture of creativity at the school:

- Students built a wind turbine on the school grounds. This grant-funded project involved many instructors and disciplines, including construction technology, natural resource technology, environmental controls technology, welding, machining and mechanical technology. Instructors supervised students as they installed the wind-generating apparatus and determined ways to maintain and evaluate its performance. Students used scientific inquiry, math and physics applications, and synthesis of ideas in problem-solving.

  The project focused on energy conservation by raising students' awareness of current energy consumption patterns and trends. The project enabled students to be partners in the generation of electrical power and to analyze the practical benefits and liabilities of using alternative renewable sources of energy. When the wind turbine system is operating, a real-time monitor shows the power being produced. The monitor readings are displayed in a prominent location at the school for observation by students, parents and community members.

  Students were asked to do a number of things to demonstrate their knowledge and skills after completing the project:

  - Discuss local energy conservation.
  - Explain the benefits and limitations of alternative energy sources.
  - Measure power production and consumption.
  - Analyze data to support conclusions related to energy use.
  - Compare and contrast energy sources, including fossil fuels and renewable resources.
- Another project-based instructional opportunity to support creativity is in the early developmental stage at Lenape Tech. Students will build a mechanical grinder for a local company. Once again, the project will integrate technical programs at the school.

"One book has been particularly helpful in the development of these projects," Longwell said. "It is *The Act of Creation*, by Arthur Koestler." While data are currently unavailable, students have responded enthusiastically to being actively engaged in project-based learning, he added.

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Organize Teachers Into Professional Learning Communities in and Across Disciplines and Grade Levels to Ensure Assignments and Assessments Meet Standards

Promoting the Success of Professional Learning Communities

Highland High School (HHS) in Albuquerque, New Mexico, was in the third year of implementing the *HSTW* school improvement design when it hosted a Technical Assistance Visit (TAV) in the 2010-2011 school year. The TAV report revealed interesting things about how professional learning communities (PLCs) were functioning at the school.

HHS serves 1,650 students in grades nine through 12. The student population is 61 percent Hispanic, 14 percent white, 10 percent American Indian, 7 percent black, 4 percent Asian/Pacific Islander and 4 percent other ethnicities.

All teachers at HHS had been grouped into PLCs, but the approach was not working. The meetings lacked direction and purpose, and many teachers failed to attend. Based on the TAV report, school leaders realized the need to give structure and protocol to the PLCs. They also expressed the need for help in evaluating student work.

Training for All Teachers

"To improve the PLCs and to help teachers examine students' assignments, the school provided training for all 120 teachers in how to use a tuning protocol," said **Ivy Alford**, SREB's director of state services for school improvement. The *HSTW* training and follow-up sessions changed how PLC meetings are conducted and how teachers communicate with each other about students' work.

A tuning protocol consists of an introduction and six steps: presentation, clarifying questions, examination of student work samples, warm and cool feedback, reflection, and debriefing. Teachers meeting with their peers are able to obtain non-threatening feedback on their assignments and assessments with the goal of improving students' classroom experiences and achievement.

"After the schoolwide training, SREB school improvement consultants followed up with the PLCs to ensure that the strategies were being used," Alford said. "The consultants attended meetings of every PLC and completed the tuning protocol process. The school also appointed a PLC coordinator to follow up with PLCs when SREB consultants are not on campus."

Teacher Buy-In

To promote teacher buy-in, each PLC asked teachers to volunteer to present their students' work. Teachers saw that the tuning protocol process was neither an attack nor a confrontation. "From a teacher's point of view, it's critical to recognize that not all teachers feel safe talking about their instruction," said **Debi Cline**, a career/technical teacher-leader at HHS. "It's important for teachers to know that their effort and risk in taking part in the tuning protocol will be respected."

School administrators worked with the PLCs to support the process and to encourage teacher buy-in. The principal dropped in at meetings to ensure that the process was going smoothly. These unannounced visits also helped the PLCs to address teacher attendance issues.

"Meetings have become more purposeful and effective," said English department leader and PLC coordinator **Robert Frausto**. "Teachers have learned to work together to enhance professional learning."

Teachers ask focus questions to elicit input from their peers:

- How can I increase literacy or numeracy in this assignment or unit?
- How can I add relevance and engagement to this assignment or unit?
- Does this rubric measure mastery of the targeted standard? Is it easy to understand?
- How can I add technology to this assignment?
- What cross-curricular elements can I apply to this assignment or unit?
- Based on the work samples I provided, did my students understand the assignment? How can I improve the question?
- How can I address different learning styles in this assignment? How can I differentiate within the assignment?
- Have I differentiated the assignment enough to allow all students to be successful? What is missing?
- Is this assignment challenging? How can I increase the level of rigor?

The PLCs are expanding to other areas, including literacy and writing initiatives, academic interventions, and peer observations. All are designed to bring teachers out of their classrooms and to build shared responsibility for student learning.

In the future, PLCs will use a calibration protocol to align grading practices across content and evaluate instructional expectations. "We want to continue to provide tools to the PLCs," Alford said.

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Enhancing Learning Opportunities Through Professional Learning Communities

Thirty-seven high-need schools, including 20 high schools, middle grades schools and K-8 centers in **Miami-Dade County Public Schools** in Miami, Florida, are soaring through Project RISE, a U.S. Department of Education Teacher Incentive Fund grant. Project RISE (Rewards and Incentives for School Educators) combines incentives and support to increase teacher and administrator effectiveness in high-need schools. Miami-Dade County Public Schools is the fourth largest school district in the nation.

PLCs at the participating schools are impacting teacher leadership, decision making and adult learning linked to student performance.

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Entering the last year of a five-year implementation period in 2011-2012, Project RISE is demonstrating that teachers working together effectively in professional learning communities (PLCs) can produce positive outcomes. By engaging in professional study, analysis of student work, collaborative problem solving and lesson study, PLCs at the participating schools are having an impact on teacher leadership, decision-making and adult learning linked to student performance.

Teachers at the participating schools have been involved in collaborative goal-setting, constructive dialogue and questioning strategies, self-assessment, and student achievement monitoring. Schools where collaboration is the strongest have produced gains in student achievement.

- Following lesson study by mathematics teachers at **Miami Edison Middle School** in 2009-2010, the percentage of students meeting high standards on the Florida Comprehensive Achievement Test (FCAT) increased 17 percent in math. Seventy-six percent of all students and 84 percent of students in the lowest quartile made learning gains in math.
- After implementing PLCs in language arts in 2010-2011, **Westland Hialeah High School, Felix Varela High School** and **Miami Northwestern High School** all made significant progress in the percentages of students from the lowest reading quartile making gains in reading. Westland Hialeah High School showed the greatest increase by raising from 49 to 62 the percentage of lowest-quartile students showing gains in reading.

In 2009-2010, six of the 37 participating schools received a grade of A while four schools were rated a B. (The Florida Department of Education has not released high school grades for 2010-2011.) Every Project RISE school is working to reach the goal of raising its school grade and sustaining improvement.

Two National Board Certified Teachers are assigned to each Project RISE school to serve as teacher-leaders to provide professional development, facilitate PLCs and participate as members of the school's leadership team. Project RISE emphasizes collaborative professional development based on two models: Richard DuFour's Professional Learning Communities (PLCs) and a Japanese lesson study design involving a small team of instructors working together to design, teach, study and refine a single class lesson. The learning mode is "constructive dialogue."

Project RISE schools operate from a framework based on three beliefs:

- Successful school improvement efforts require capacity building and leadership sharing.
- The expertise of highly accomplished teachers is a resource that should be used strategically.
- Schools that want to enhance organizational capacity to boost student learning should work on building a professional community characterized by shared purpose and vision, collaborative problem-solving and collective responsibility.

"Our approach has been effective because we have used the same vision and goals to develop one campus leader," said **Carolyn Guthrie**, executive director of professional development for Miami-Dade County Public Schools. "The vision and goals have spread to many leaders at all of the schools."

The operational framework draws from principles in a step-by-step guidebook, *Facilitating with Ease!,* by Ingrid Bens.

- Teachers are intelligent and capable and want to do the right thing for their students.
- Individuals become committed to ideas and plans they have helped create.

- Everyone's opinion is of equal value, regardless of rank or position.
- Groups can manage their own conflicts, behaviors and relationships if they receive tools and training.
- Groups make better decisions than any one person alone.
- If the process is well designed and applied with fidelity, it can be trusted to achieve results.

Recommendations for organizing a PLC are described in *Creating Successful Collaborative Teams*, by Pat Dukewits and Lewis Gowin.

- Trust must be established and protected.
- Team members should develop common beliefs and attitudes.
- Team members need to be empowered.
- Structures and processes must be utilized to manage meetings effectively.
- Team members need to take time to reflect on their work and give honest feedback to each other.

Many ingredients are necessary for PLC success. They include trust; documentation of work with agendas and minutes; a shared mission, vision, values and language; a common focus to improve student learning; clearly defined goals; a repertoire of protocols, including a tuning protocol; feedback and reflection; data on the effectiveness of lessons; and transfer of learning to future lessons and unit designs.

"Begin with a trained facilitator who understands his or her duties, knows how to keep a group of teachers on track and will ensure that protocols and norms are carefully and thoughtfully followed," said **Amanda Heinemann**, instructional supervisor of professional development for Miami-Dade County Public Schools. "When the PLC begins to function at a high level, the facilitator role can be rotated easily."

This newsletter of "best practices" in implementing the *High Schools That Work* (*HSTW*), *Making Middle Grades Work* (*MMGW*) and *Technology Centers That Work* (*TCTW*) school improvement models is based on presentations at the 25th Annual *HSTW* Staff Development Conference in Nashville, Tennessee, in summer 2011.

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