

Teaching

for high potential

The Difference is Resilience: When Trouble Hits Close to Home

Maureen Neihart, Psy.D., Laurel, Montana

When he heard about the destruction caused by the tsunami in December 2004, seven-year-old Jesse Taconelli asked his mother if somebody might have lost their teddy bear in the Tsunami. The realization that he had received so much over the holidays while other children had lost everything they owned disturbed him. He decided to use the money he'd been saving for a puppy to start a tzedakah, a Jewish tradition of charity, for tsunami survivors. On his own, he came up with the idea of a gratitude tax, to be calculated by blessings. With his mother's help, Jesse came up with 18 questions people could answer to determine the blessings in their lives and the gratitude tax they owed. His questions included items like, "How many kinds of cookies are in your cabinets?" "How many pillows are on your bed?" "How many people say I love you to you every day?" Jesse suggested that people pay one dollar for every blessing in their life. His family's total came to \$63. Jesse's efforts raised more

than \$1,000 for Save the Children and he persuaded merchants to donate \$5,000 worth of teddy bears. His mother, Stephanie, said the experience has been a life changing experience for him.

Some Children are More Resilient than Others

As educators, we naturally wish for the safety and well being of our students, and we do what we can to keep them from experiencing extreme adversity, but stuff happens. The world is not a safe place for many children and there is evidence that for many it is becoming increasingly dangerous. Fortunately, circumstances do not determine outcomes in life. If they did, people who have suffered a great deal would be less well adjusted than those who have suffered less, but we all know individuals who have been through a lot and yet do remarkably well. They're emotionally strong, physically healthy, achieving, happy and making a difference in the world. Similarly, we know individuals who appear to have had every advantage, yet they crumble at the first sign of trouble. The difference is resilience. Some people are more resilient than others and bounce back more easily. Studies tell us that children are generally much more resilient than we give them credit for, and that gifted children in particular tend to demonstrate positive adjustment overall. What

steps can we take to increase the odds for resilience in our students?

Identifying Resilient Behaviors

What do resilient children look like? Numerous studies over the last half-century have compared resilient and vulnerable children and concluded that children who do well in the face of adversity often possess similar characteristics, noted in the box on this page (Anthony & Cohler, 1987; Neihart, 2002; Seligman, 1995; Werner & Smith, 1982).

Even in the face of the most devastating losses, simple supports and structure go a long way to support children's health and hopefulness. One way you can increase your students' ability to bounce back from adversity is to strengthen these characteristics when you see them, model resilience yourself, and help students build a strong social support network. In addition, there are five things you can do to mitigate the potential emotional harm when tragedy strikes close to home.

Nurturing Resilience in the Classroom

First, establish a sense of safety and trust by returning to daily routines quickly. Upsetting events should not become a reason to overlook mis-

Characteristics of Resilient Children

- *Compassion for others*
- *Sense of humor*
- *Persistence in the face of failure*
- *Moral conviction, or a strong code of ethics*
- *Interest in spirituality or religion*
- *A respectful manner*
- *Capacity to get attention in positive ways*
- *Ability to plan ahead*
- *Skill at problem solving*
- *Feeling of autonomy*
- *Maintaining a positive outlook on life*
- *Belief that one's effort can change things*
- *Talent or hobby*
- *Flexibility in gender roles*



behavior or to disregard classroom routines. Rules and routines tell children that although their world has taken a big hit, they are still secure.

Second, limit students' exposure to adults' intense emotional reactions. Fear and distress is contagious, especially for younger children who take their cues from adults. Save your strong emotional reactions for times when you are alone with trusted friends or family, and monitor your students' media exposure.

Third, nurture and strengthen children's relationships. Helping children find the right friends is important because relationships develop healthy self-esteem, strong social skills, and positive attitudes toward school and achievement. They help children deal with the everyday stressors of life, reduce their anxiety and loneliness, and foster in them a sense of well-being. Gifted children often have different friendship patterns than other children so they may need extra assistance finding and connecting with others who share their interests and motivation. Social connections are extremely important during stressful times. Many studies have shown that children with strong social support networks are more resilient.

Fourth, support children as they learn to lean on their faith. Tragedy and loss in particu-

lar often prompt curiosity about the big questions of life. What happens to us after we die? Why do bad things happen to good people? Why are we here? If God loves us, why do bad things happen? Gifted children in particular, given their advanced cognitive maturity, their sensitivity, and their heightened awareness of spiritual or moral issues, may verbalize such questions at younger ages than other children. Most children are raised with some sort of faith tradition and the research is robust that religious practice increases resilience. You don't have to pretend to have all the answers, but it is helpful to affirm that these are valuable questions to ask, and to validate the child's wonder about such things.

Finally, tell stories, especially stories of courage and selflessness. Stories that instill a message of hope reinforce the habit of turning in that direction when times get tough. Stories of others' courage and hopefulness prompt us to ask ourselves, what would we do? For example:

The destruction of Hurricane Katrina caught the attention of many students as they headed back to school in September, 2005. Elizabeth Zorrilla, a freshman explained: "I saw the pictures of the devastation on the news, and it struck me that there is life outside the 'perfect teenage world.' Just the thought of living in a house with so much stuff, while kids down there don't even have food for the day, made me want to help."

Elizabeth and her classmates and teachers at Lampeter-Strasburg High School in Pennsylvania set a plan in motion to transport an entire homecoming weekend to the hard hit communities of Long Beach and Pass Christian in coastal Mississippi. Students collected about \$40,000 and lots of other donations, including dresses for the girls, ties for the boys, food, and transportation from local businesses. A group of 40 students were selected by lottery to travel over 1,000 miles by bus to

help organize a pep rally, cheer at a football game, decorate for a dance, and share a life-changing experience with newfound friends in need.

Preserving Hope

As a teacher, you are a constant in the lives of children. You are a source of hope too. You model discipline, perseverance, and self-control, often without even realizing it. You give children strong messages about their worth and develop in them a perspective that they are competent individuals, capable of coping and succeeding with whatever life brings them.

Reinforce traits of resilience when you see them. Demonstrate the conviction that life is good and worthwhile. Focus on children's strengths rather than on their weaknesses and help them to develop their talents. Support their hobbies and special interests.

Preserving hope is something we should work at every single day. Affirming people's connections, their strengths, and their effort, even when life is distressing or disappointing, helps people to feel more hopeful. Mastery of stress can serve as a type of inoculation against future disorienting stress. The experience of having endured what once seemed insurmountable can become a shield of confidence and self-esteem that provides a perceived invulnerability against future stressors in life and builds a child's optimism about the future.

References

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The information contained in this article aligns with the following Gifted

Program Standards: **Socio-Emotional Guidance and Counseling (1, 2, 4)**. For a complete copy of the Standards, visit www.nagc.org.

Stories of Courage & Hope

- *CinderEdna* by Ellen Jackson (Lothrop, Lee & Shephard, 1994)
- *Crow and Weasel* by Barry Lopez (North Point Press, 1990)
- *Developing Resiliency Through Children's Literature* by Nancy L. Cecil, Patricia L. Roberts (McFarland & Co., 1992).
- *A Hope in the Unseen* by Ron Suskind (Broadway Books, 1998)
- *Kids With Courage* by Barbara Lewis (Free Spirit, 1992)
- *The Librarian of Basra: A True Story from Iraq* by Jeanette Winter (Harcourt, 2005)
- *Life Doesn't Frighten Me At All* by Maya Angelou (Stewart, Tabori, & Chang, 1996)
- *Out of the Dust* by Karen Hesse (Scholastic Press, 1997)
- *Peach and Blue* by Sarah Kilborne (Alfred Knopf, 1994)
- *Weslandia* by Paul Fleischman (Candlewick Press, 1999)
- *The Wolf* by Margaret Barbalet (Macmillan Publishing, 1992)

The Seven Components of Successful Programs for Mathematically Gifted Children

by Ed Zaccaro, Dubuque Community Schools, Bellevue, Iowa

What do I do with the third grader who spends his evenings computing baseball statistics? How do I challenge the sixth grader who loves to talk about the big ideas in math and always seems to finish her work before her classmates? Many elementary and middle school teachers find themselves with one or more students in their classroom who are gifted in mathematics. It can be difficult to determine the most effective way to provide programming for these children. Although there is no one perfect program, these guidelines, based on years of experience and study, are designed to help your advanced students experience challenge and enjoyment in math.

1) Challenge and frustration are a part of learning and life. They should both be viewed as a normal part of the learning process.

While most mathematically gifted children enjoy challenging material, some children find the experience of challenge and frustration to be quite stressful because it is a foreign concept to them. Teachers of mathematically gifted children have the sometimes unpleasant task of helping these students understand that limiting their academics to an intellectual box where there is no struggle or frustration is not healthy and leads to a life that is not as fulfilling or as rewarding.

For example, I share with my students many experiences where adults have made mistakes, including many of my own such as rappelling off a cliff without checking to see if the rope was long enough to hit the bottom. (It wasn't and I was forced to jump 15 feet.) I also have students work on problems where mistakes are frequently made, like those in the box at right, so they can have the experience of making a mistake and seeing that life goes on.

2) Math is often taught as all scales and no music. Children must have the opportunity to see the exciting and interesting parts of mathematics.

The goal of many programs for mathematically gifted children is

to move students through the curriculum as quickly as possible. This approach can lead to a loss of interest in the subject because it does not nurture a child's passion for mathematics. An alternative approach is to keep gifted children with their same age peers, but give them an opportunity to experience the parts of mathematics that are not only challenging, but also very interesting.

When children first see the wonders of math and science, it is as if they stepped into a room that they didn't know existed. When they are provided with the opportunity to work with algebra, trigonometry, and physics, children are in awe of what mathematics allows them to do. Examples include:

- *Using simple geometry to see how the circumference of the earth was determined for the first time almost 2500 years ago,*

- *Using their knowledge of the speed of light to realize that looking at stars is looking back in time a hundred, a thousand, or even a million years,*

- *Finding the distance a ship is from shore through the use of trigonometry (Yes, gifted children in elementary school can work with trigonometry), and*

- *Finding the height of a tree by measuring its shadow and then using ratios.*

Gifted children typically are not given the opportunity to see the wondrous side of mathematics because it is usually taught as all scales and no music. If musicians were not given the opportunity to perform or play music that stirred their hearts, it is unlikely

that they would develop a passion for their field. The same holds true for children and mathematics. Children who are talented in mathematics must be exposed to material that lights a fire and nurtures their gift.

3) It is important for children to be shown the fascinating connections between mathematics and the real world.

Because mathematics instruction is often dominated by facts and calculation, children are rarely exposed to important concepts that connect math and science to the real world.

One of these concepts relates to an under-appreciated fact about mathematics and science----Math and science are not like referees and umpires that you can argue with if you don't like what they tell you. Math and science are coldly and cruelly indifferent to your hopes, dreams, and wishes. They give you an honest and objective look at a situation. Do not ignore their message!!

No Easy Answers: Problems that Mirror Life

1) How many square inches are in a square foot?

2) What is $8 \div 1/2$?

3) What is larger, n or $2n$?

4) If there is a giant piece of chocolate that weighs 250 pounds, how many $4/5$ pound pieces can be cut from it?

5) The unit for weight that is used in the United States is the pound. What is the metric unit for weight?

6) The unit for weight that is used in the United States is the pound. What is the unit for mass that is used in the United States?

6) It is the slug.

5) No it is not the kilogram or gram. Kilograms are units of mass. The metric unit for weight is the newton.

4) 312.5

3) It is impossible to tell -- If n is negative, then $2n$ is smaller than n .

2) 16

1) 144

Answers:

There are hundreds of stories from history that show this concept has not been followed:

- *The Challenger disaster occurred because the recommendation not to launch made by mathematicians and engineers was overruled by management.*
- *The popular singer Aaliya was killed in a plane crash because the pilot and others ignored what mathematics told them. (They knew they were dangerously overloaded, but chose to try to fly anyway.)*
- *Racial bias in jury selection was proven by a mathematician. (It was determined mathematically that the probability the jury was fairly picked was approximately 1 in 1,000,000,000,000,000.)*
- *About 2500 years ago, mathematicians changed the study of space from one of fantasy and guesswork into a real science.*

4) Children who are gifted in mathematics must learn to appreciate their gift.

Can you imagine what it feels like for an athlete or musician to have hundreds of parents and classmates cheering for him or her? Add to that the newspaper articles, trophies, medals, and other awards. This kind of reinforcement pushes athletes and musicians to excel. It is unlikely that this kind of motivating environment will ever become routine for those students who excel in math and science. Because there are precious few opportunities for gifted children to be formally recognized and honored, it is important that teachers make students feel that their gifts are something to be treasured.

I have found the use of Einstein Awards for extraordinary problem solving to be a very effective tool to motivate children. When students solve a very difficult problem (called Einstein problems), they receive an award with a picture of Einstein presented in class.

The response to these awards has been dramatic. One parent called and said that she had to limit her son to two hours of math each night because he was constantly trying to solve Einstein problems. Another parent called and said his 5th grade daughter was so excited by her first Einstein award that she told him that it was the best thing that ever happened to her!

When children see that an area in which they excel is valued by those

around them, their interest and passion for the subject can increase dramatically.

5) Parents and educators must understand that a child's interests and passions do not necessarily correspond with their areas of giftedness.

The experience I had with my oldest child led me to a clear understanding of the importance of allowing and encouraging children to follow their passions, which may or may not be their area of giftedness.

Luke was a very talented violin player and also gifted in mathematics, but Luke's two areas of passion were soccer and voice. Two very worthy areas of passion, but unfortunately they were areas where Luke not only did not possess giftedness, but also had clear weaknesses.

Luke played soccer for years and eventually because of his perseverance and passion for the game, made and played on his high school team. He also had an ambition to make the All-State choir. To that end he practiced for years without success. The noises coming from his room were not always pleasant, but he continued to rehearse several hours each day until he finally made All-State in his senior year of high school.

Today Luke is not involved in either mathematics or violin. He is the vocal director and teacher at a high school in Wisconsin and also the varsity soccer coach and, from what I can see, very happy and content with his life's direction.

6) Mathematically gifted children must be given material that truly challenges them and appropriately challenges them.

Bright math students usually pick up concepts so quickly that they are left with very little to do intellectually while the rest of the class masters the new material. In addition, the consequences of not challenging elementary children can be serious because children who are bored tend to develop thinking skills and work habits that are less than ideal.

One solution to this dilemma is to differentiate instruction. Look at the problems below. Notice how the complexity and difficulty increase as the levels increase. When children are presented with various degrees of difficulty, they are able to attempt problems that are just

within their cognitive grasp. This not only enables them to grow intellectually, but also helps nurture a passion for mathematics.

Level 1: Eight gallons were poured into a gas tank that was $\frac{1}{4}$ full. Now the tank is $\frac{3}{4}$ full. How many gallons does a full tank hold?

Level 2: Sound takes 5 seconds to go one mile. Clark is standing near a rock wall and when he shouts, it takes 20 seconds for the echo to reach his ears. How far away is the rock wall?

Level 3: A sprinkler that waters in a circular pattern shoots water to a distance of 15 feet. If the sprinkler is set in the middle of a 30 foot by 30 foot yard, how many square feet of the lawn does the sprinkler miss?

Einstein: Sara, Claudia, Karen and Kath are sisters who inherited money from an uncle. Claudia received $\frac{1}{5}$ of the money while Karen received $\frac{1}{2}$ of the money. Kath received $\frac{1}{4}$ and Sara was given the rest. If Sara received \$1750, how much money did all four sisters inherit?

7) Highly able children must have the opportunity to work with children with similar abilities.

The importance of having the opportunity to work with children of similar abilities cannot be overstated because the value of this kind of interaction is not limited to the intellectual growth that it can foster. The social and emotional development that can occur as a result of healthy disagreement, discussion, and debate can have a profound impact on mathematically gifted children. An additional benefit is a reduction in the social isolation that these children sometimes experience.

In summary, meeting the needs of mathematically gifted children can be difficult. As teachers try to develop mathematics programs that provide appropriate challenges and also teach basics skills, decisions need to be made concerning acceleration, enrichment and differentiation. As these decisions are made, it is imperative that teachers also keep in mind that they must help students take intellectual risks; learn to think deeply and with insight; see the magic and wonders of mathematics; and help students understand and appreciate mathematics and its place in the world.

Ed is a retired teacher and the author of several books that provide curriculum for mathematically gifted children. He can be reached at challengemath@aol.com

Tiered Instruction: Beginning the Process

Bertie Kingore, Ph.D., Professional Associates Publishing, Austin, Texas

State and national standards demand that all students master grade-level skills and understanding; yet some learners who already know those skills and concepts may be treading instead of learning. Tiered instruction invites educators to rethink traditional educational practices that view students as having similar backgrounds and readiness levels. There are two essential components that make this possible:

- **Tiered instruction blends assessment and instruction.** Before initiating each segment of learning, the teacher completes a pre-assessment to determine what students know and then plans content materials and learning experiences that promote continued learning for each student. As teachers consider students' assessed readiness levels, it becomes obvious that everyone is not at the same place in their learning and that different tasks are needed to optimize every student's classroom experience.

- **Tiered instruction aligns complexity to the readiness levels and learning needs of students.** The teacher plans different kinds and degrees of instructional support and structure, depending upon each student's needs. Tiered instruction allows all students to focus on essential concepts and skills yet still be challenged at the different levels on which they are individually capable of working.

Ideally, tiered learning tasks engage students slightly beyond what they find easy or comfortable in order to provide genuine challenge and to promote their continued learning (Sylwester, 2003; Vygotsky, 1986). Optimally, a tiered task is neither too simple leading to boredom nor too difficult resulting in frustration. As Tomlinson cautions, "Only when students work at appropriate challenge levels do they develop the essential habits of persistence, curiosity, and willingness to take intellectual risks" (2001, p. 5).

Tiered Instruction is a Stairwell

As you begin this process, you may find it helpful to think of tiered instruction as a stairwell providing access within the large building of learning. The bottom story represents learning tasks for students with less readiness and fewer skills. The stairwell continues through enough floors to reach the appropriate challenge level for students with advanced skills and complex understanding. There isn't always a student working on every stairwell level because students progress through tiers of learning at different paces. Also, within each tier, there can be multiple small-group activities presenting different ways to learn. Some floors in the stairwell may even have multiple stairways or elevators as students access higher learning levels differently and at different rates.

Guidelines for Tiered Instruction

Although construction of the multi-storied building of learning may seem daunting

at first, these simple guidelines will help you build stairwells to challenge all of your students, including advanced learners.

1. *Ensure that group membership is flexible.*

The word tiered is not a euphemism for stagnant low-middle-high groups that label who can learn and who is not learning. Tiered assignments denote all children as able to learn the same essential skills in different ways. The make-up of students working at each tier varies with the content, assignment, and quantity of tiers.

2. *Plan the number of levels most appropriate for instruction.*

Different quantities of tiers are needed for different curricular areas, concepts, and skills in relation to different learners' needs. Sometimes, two tiers are sufficient; at other times, three to five or more work better to match the wide range of learners. Changing the number of tiers is also a way to vitalize flexible groupings and ensure that students are not always in the same group.

3. *Recognize that complexity is relative.*

The complexity of a tiered assignment is relative because it is determined by the specific needs of the students and because learners' readiness levels vary

What Are You Thinking?

Use the quiz below to reflect on how tiered instruction translates into classroom activities. Then, analyze your problem-solving on the quiz to conclude which factors influence tiering complexity.

Tiered Reading Tasks: A Quiz

Number each task tier 1, 2, 3, or 4 as you determine the simplest (1) to most complex (4) learning tasks.

_____ A. Students work in trios to create a Venn Diagram comparing the traits of the main characters in the two novels they read. With the teacher, the trios then compare their diagrams and identify how those traits caused similar effects in the sequence of both stories.

_____ B. With the teacher, students determine the five key events in sequence in the story that affected the main character. They then discuss and record the cause of each on a chart.

	Effect	Cause
1.		
2.		

_____ C. The teacher discusses and lists five key events in the story that affected the main character. With the teacher, students determine the sequence of those events and then record the cause of each on a chart.

	Effect: What happened?	Cause: Why?
1.		
2.		

_____ D. With teacher facilitation, students use a Venn Diagram to compare traits of the main character at the beginning and end of the book. Then, they brainstorm, list together, and sequence the events that caused the character to change.

Quiz answers: Tier 1: C Tier 2: B Tier 3: D Tier 4: A

Factors Influencing the Complexity of Tiered Learning Experiences

Degree of assistance and support

- Teacher directs instruction
- Teacher facilitates
- Small group support
- Individual autonomy

Degree of structure

- Clearly defined parameters
- Open-ended criteria and parameters

Required background knowledge and skills

- Minimal, basic information
- Grade-level information
- More extensive information and understanding is required

Concrete or more abstract

- Process and product are concrete
- Process and product involve abstract thinking and interpretation

Quantity of resources

- Single resource is provided
- Multiple and varied resources are employed

Complexity of resources

- Grade-level resources
- Resources require above grade-level ability
- Resources are concept dense
- Sophisticated technology applications are required

Complexity of process

- Pacing
- Repetition and guided practice are paced at rate typical for grade level
- Minimum repetition and practice allow acceleration
- Number and complexity of steps
- Process is simple and short-term
- Multiple steps and an extended period of time are required
- Simple to high-levels of thinking
- Sophisticated research skills are required

Complexity of product

- Simple, correct answers
- Varied and complex responses
- Integration of advanced skills and concepts is required

in different curricular areas. In classes with below grade-level learners, the lowest tier would respond to those students. In classes in which all students are at or above grade level, the lowest tier would respond to grade-level or even above grade-level readiness.

4. Promote high-level thinking in each tier.

The background and readiness levels of students should not limit the range of thinking opportunities provided through tiered assignments. Avoid always allocating simple thinking tasks for students with the fewest skills. All students need opportunities to analyze, synthesize, and evaluate information.

5. Provide teacher support at every tier.

Every tier requires teacher modeling and support for students working at that tier. All learners benefit from a teacher's instruction, interaction, guidance, and feedback—even gifted children whom some educators perceive as always making it on their own.

Reflect upon your problem-solving process on the quiz. What are the similarities among the tiers? For example, notice that all of the tasks incorporate essential concepts

and skills including high-level thinking, character analysis, cause and effect relationships, and sequence.

What are some of the differences among the levels? For example, which aspects of tier one make it simpler than tier three? Differences, such as the ones you identified, are the factors that teachers can modify to influence the complexity of tiered tasks. As you read the list on the left, notice that a series of increasingly complex descriptions accompanies each factor.

Identifying complexity factors helps teachers efficiently proceed with the development of tiered tasks. When you assess that students require variations of the concepts and skills designated in a lesson, you can use these factors as a planning checklist. Select one factor or combination of factors to appropriately vary instructional complexity. Some of the factors are more easily modified by the teacher, such as the degree of assistance a teacher provides, the complexity of the resources used, and the concrete or abstract nature of the process and product. Some factors are non-negotiable and require teachers to understand and accommodate within every tier, such as the background knowledge and skills students bring to the task.

Getting Started

Tiered instruction evolves from teachers' assessments and decisions regarding how to modulate tasks around the combinations of factors they select that influence complexity. The intent is to accommodate the unique diversity of learners rather than to divide students into leveled groups.

Begin or extend your tiered instruction by varying one lesson. Then, reflect upon that success and consider tiering another learning experience for your students.

*Be not afraid of moving slowly.
Be afraid only of standing still.*

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Dr. Kingore is a national consultant and author with Professional Associates Publishing in Austin, Texas.



The information contained in this article aligns with the following Gifted Program Standards: Curriculum and Instruction (1, 2, 3, 5) and Program Design (4, 5). For a complete copy of the Standards, visit www.nagc.org.

Javits Works

The "Javits Works" column is designed to showcase success stories and research-based best practices from the only federal program that supports gifted education, the Jacob K. Javits Gifted and Talented Students Education Program. The Javits Act funds the work of the National Research Center on the Gifted and Talented (NRC/GT) and 28 additional research projects, reaching gifted and talented students and teachers in over 20 states.

Providing Kids with Challenge in Science: Scientists-In-Schools

Dorothy A. Sisk, Ph.D., Lamar University, Beaumont, Texas

Three large yellow school buses pull into Lamar University, in Beaumont, Texas, at 8:30 a.m. on Saturday morning. Sixty 8th grade kids tumble out for a quick breakfast, followed by two hands-on seminars in science hosted by professors from the geology, physics, biology, and chemistry departments. In small groups of 20, the students participate in two 90-minute labs designed to hone scientific research and inquiry skills. Their science teachers work side-by-side with the professors to extend the lessons and learning into the regular classroom. As students enter a geology professor's laboratory, they are presented with an over-arching inquiry question as a starting point: What are the Earth's plates, where are they, and what do they do?

Scientists-in-Schools (SIS) is a five-year, collaborative Javits project between Lamar University and Beaumont Independent School District (BISD). SIS integrates teacher training and accelerated/enriched science experiences for underrepresented and underserved students with a focus on inquiry. The project incorporates Saturday seminars and summer courses for the students, as well as professional development for their teachers to support connections to the classroom.

The project is designed to engage and challenge students from backgrounds frequently underrepresented and underserved in science programs. Student participants are selected for their interest and aptitude in science, but also because they are low income, minority scholars who are frequently underrepresented in the field of science. Criteria used for student selection include grades of B or better in science, teacher nomination, interest and enthusiasm for science, and will-

ingness to participate in Saturday seminars at Lamar University. Each year, new groups of sixty students in grades 8 and 10 are identified to attend a three-week summer residential program at Lamar University, in which they take two science courses and one elective. The focus is on leadership and ethical decision-making involving real-world problems. Similar groups of students are also identified as a control group each year, to allow comparison of outcomes based on participation or non-participation in the SIS program.

On the Saturday described in the opening of this article, students use a model of the earth's tectonic plates constructed with lasagna noodles and a modified Science Exemplar lesson to investigate what happens when two of the Earth's plates shift. To prepare, students read about Alfred Wegener, a scientist who hypothesized that at one time all of the continents were one land mass. Wegener's theory of Pangaea suggests that today's continents once fit together like a puzzle which slowly drifted apart to produce the

geographic features we recognize today.

Today's investigation focuses on plate tectonic theory. Students are exploring the possible outcomes when two of the Earth's plates meet. Prior to the lab, teachers pre-cooked lasagna so that the noodles would be flexible, but not completely cooked, and placed them in plastic bins with 2-3 inches of water. Using this inexpensive model, students can manipulate the "plates" and record their findings. The professor, a geologist, uses the following questions to frame student inquiry:

If the continent is on top of the plate, what would happen to it as one plate moves against another? As you work, think about how other land forms that you've seen or read about might be the result of moving plates on the Earth's surface.

During the inquiry activity, the students explore the basic problem, "What could happen along the fault line where two tectonic plates meet?" They use key terms such as hypothesis, data, obser-

Figure 1

PROJECT SIS: OVERALL RESULTS (JANUARY 2003 – MAY 2005)

• **300 high potential minority** underrepresented 8th, 9th, 10th, and 11th grade students have been identified.

• **Significant growth** in achievement (Stanford 9 & 10 in Science) has been realized, with an average increase of the experimental group of 1.5 for year one, 1.6 for year two, and 1.8 for year three. The control group's growth was 0.6 for year one, 1.3 for year two, and 1.1 for year three.

• In 2005, all 60 of the experimental group graduated from high school, enrolled in a science course each year, applied to colleges and universities, and **52% identified science as a career focus.**

• **25% of the students have been recommended for the gifted and talented program** as gifted students in a specific aptitude (science).

• **Two units** - Aquatic Science and Environmental Systems - have been developed by writing teams including both teachers and scientists.

vation, theory, and conclusions, both in conversation and in their lab report. They are given a worksheet providing the basic structure of components to include, but the inquiry is primarily guided by students' own explorations, questions, findings, conclusions about cause-effect relationships, and further questions. Although they work in small groups, each student is responsible for recording his or her own observations and writing a lab report.

As the lab activity progresses, the students identify the characteristics of geological processes, events such as earthquakes, volcanoes, mountain building, and land forms that result from plate motions. They use their skills of observing, predicting, recording using words and drawings, and communicating to expand their understanding of geology.

The comments of one of the teachers capture the teacher/student interaction of the Saturday lab:

"The students noticed that the plates might slide under each other (subduction) or scrunch up to build mountains. As they talked about their findings, I was able to identify the different levels of science concepts of the students, and that pro-

vides me clues for follow-up in the classroom, such as tracking real-life events of volcanoes and earthquakes, or constructing geologic timelines."

Project SIS outcomes include increases in science achievement and number of completed science courses for participating students; the percentage of low income, minority students identified as gifted and talented; high school graduation rates; and students applying to colleges or universities selecting science as a future career choice.

All of the first group of sixty 10th grade students attending the summer residential program in 2003 graduated from high school in 2005; took four or more courses in science; and applied to colleges and/or universities; and 52% indicated a career choice in science. On the Stanford 10 Achievement Test in Science,

80% of the experimental students scored at the 13 grade equivalent, in comparison to the control group, in which 60% scored at the 13 grade equivalent. Figure 1 summarizes additional results from the project.

Scientists-in-Schools is enabling teachers to see the "greatness" in their students, but most importantly SIS is enabling the students to see the "greatness" in themselves, while providing them with advanced content in science and the tools to find and develop confidence in their own strengths.



The information contained in this article aligns with the following Gifted

Program Standards: Curriculum and Instruction (2, 5) and Student Identification (2, 4). For a complete copy of the Standards, visit www.nagc.org.

Websites for Building Enthusiasm for Science:

- **Reeko's Mad Scientist Lab:** www.spartechsoftware.com/reeko
- **The Boston Museum of Science:** www.mos.org
- **Internet Science and Technology Fair:** <http://istf.ucf.edu/>
- **American Museum of Natural History:** www.amnh.org
- **The Franklin Institute Online:** <http://sln.fi.edu/>

Websites for Extending Content in Science:

- **The Educator's Reference Desk:** www.eduref.org/cgi-bin/lessons.cgi/Science
- **Science NetLinks:** www.sciencenetlinks.com
- **National Science Digital Library:** <http://nsdl.org/>
- **Annenberg/CPB Teacher's Lab:** www.learner.org/teacherslab/index.html



1707 L STREET, NW, SUITE 550
WASHINGTON, DC 20036
www.nagc.org