MAST

MASTHEAD

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State Chapter of the National Science Teachers Association

LETTER FROM THE PRESIDENT

Betsey Clifford

Summer is knocking at our door. The last few weeks of a school year can be hectic, bittersweet, and fulfilling. There is so much going on that it is hard to keep up with planning, grading, paperwork, and end of the year activities. The end of the year brings mixed feelings as students graduate or move on to the next grade. So many memories throughout the year and it is hard to believe it's over. Hopefully the end of the year is fulfilling. Students grow so much throughout the year and teachers look forward to seeing them make connections in the curriculum and develop socially.

Summer also provides a transition. Some teachers will begin summer jobs or courses, take workshops, travel, or spend time with family and friends. Regardless of your plans, I would like to wish you a happy, healthy, and relaxing summer. This is the time to recharge for many but also to start thinking about next year. I encourage you to reach out to colleagues and do some networking. Summer is also a time for reflection. For teachers, reflection is an essential practice. We must reflect day to day on activities and lessons but also do some broader reflection that encompasses our general methodology, classroom management system, and philosophy. I urge you to reflect and discuss your thoughts with others to make the necessary changes in order to have an even more successful year next year.

Members of the MAST Board of Directors will be busy this summer. Representatives are working on the new Massachusetts standards, attending the National Congress on Science Education, preparing for fall events, organizing and planning the NSTA 2014 conference in Boston, and much more. We hope to also be improving our website over the next several months. Save the dates! The MAST Fall Event will be on Saturday, November 16th from 9-12 at the Holiday Inn Boxborough. This will focus on the new standards. MAST is partnering with the DESE, MassTEC, and MSELA. The NSTA Conference will be in Boston April 3-6, 2014.

Please consider getting more involved with MAST. We have some vacancies listed and described later in this newsletter. Working with MAST is a great way to develop your leadership skills.

Please be in touch with interest, questions, or comments at betsey.clifford@gmail.com.

Best wishes this summer season,
Betsey Clifford, MAST President

In this issue ~

THE MASTHEAD

The MASTHEAD is published by the Massachusetts Association of Science Teachers. Members receive four issues per year in September, December, March, and June. The MASTHEAD is published for those interested in the advancement of science education. This publication provides information about science activities, and opportunities around the state and the nation, as well as sources for materials for science teachers. It also serves as a forum for ideas and classroom strategies.

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The Final Push for Revised Massachusetts Science and Technology/Engineering Standards

By Jacob Foster

Now that the Next Generation Science Standards (NGSS) are done and available for states to consider we need to consider what will work for us here in Massachusetts. This article takes a moment to reflect on the Massachusetts Science and Technology/Engineering (STE) standards revision process to date and what steps are likely remaining before we can adopt revised standards.

Many of you recall that the revision of STE standards started in 2009. At that time we asked for input from the field about the current (2001/2006) standards – what could be improved and what should be protected. We also put together a 35+ Review Panel that is representative of the many roles and positions that contribute to science and technology/engineering education across the state. The Review Panel spent about a year and a half determining what broad changes should be made to the STE standards (www.doe.mass.edu/boe/docs/0111/item2.html) and began to revise the standards. Before the actual revisions got too far, however, the National Research Council (NRC) and the 26 Lead States for the NGSS began the multi-state science standards development process. Massachusetts participated in the NGSS process over the past two years, using input from Massachusetts' educators, Review Panel members and an expanded advisory group to advocate for standards we believe include the features needed in high quality, effective standards.

> *Working together on the implementation of revised STE standards will provide a more systemic, cohesive and effective experience for all students.*

The final version of the NGSS represents several important changes that we value here in Massachusetts; these values have emerged and been reinforced through the work of our Review Panel and input from numerous educators across Massachusetts over the past three years. These changes include: 1. Integration of disciplinary core ideas (content) with science and engineering practices (the 8 skill areas presented in the NRC's Framework for K-12 Science Education); 2. Attention to progressions of learning across years to effectively sequence learning over time; 3. Connections to math and literacy standards, particularly as represented in the science and engineering practices; and 4. Integration of engineering design with the traditional sciences. I've written about a few of these changes in prior MASThead articles. We will all need to work together to develop resources, adjust our curriculum and instructional practice, and help students to make the transitions reflected in these changes. Many of you have already begun this work – most frequently by attending to the practices and connections to math and literacy standards. Thank you for being proactive and moving your work forward even as the standards continue to be developed.

While the NGSS reflects significant progress toward high quality STE standards and key goals for Massachusetts' students there are several significant differences between NGSS and our current standards that still need to be considered. Through input from educators across the state during the past three years we have heard that these aspects of NGSS may be difficult to adopt and implement in Massachusetts: 1. Standards that reflect four dimensions of expected student outcomes (content, practices, crosscutting concepts, and nature of science); 2. Lack of a definition of college and career readiness for science and engineering; 3. Lack of high school courses or pathways that allow for multiple options for schools and students; and 4. Lack of a full technology/engineering discipline.

Our current standards are functionally 1-dimensional; they focus on the content of each discipline to be learned. While they are written as performance expectations, with a verb that describes the expected student performance relative to the content, those verbs are general cognitive verbs (Bloom's taxonomy verbs) and not scientific skills. In 2006 when the high school standards underwent a "minor" revision to clarify expectations for the high stakes test (addition of science to the state's Competency Determination), several standards focused on skills were added but left very general and still separate from content. Most who have provided input over the past 3 years agree that integration of content and practices (2 dimensions) is a worthy goal and if achieved would represent a significant accomplishment. Trying to include additional dimensions above that is likely to lead to confusing and dense standards that would not effectively convey clear and coherent science goals.

A definition of college and career readiness (CCR) and high school courses and pathways are linked

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items. The NGSS does not define CCR but does advocate for all students to learn all the NGSS high school standards, effectively defining three years of science that all students would take. This is a very different model from our current approach to high school where 5 different "introductory" (gr. 9 or 10) courses are articulated, from which schools can choose from and build upon at upper grades to provide students many options for pathways through science. Additionally, Massachusetts continues to value and strongly support STEM education and a STEM economy; as such we will continue to include and advance technology/engineering with the traditional sciences. These are significant differences between NGSS and our current standards that reflect different conceptions of what it means to be ready for college and career opportunities after high school.

It is important to note that Massachusetts is committed to using the NGSS as a basis for any additional work in revising our state's STE standards. We have to keep in mind the value of common standards for us all – particularly as a small state for which little published curricula, textbooks or instructional resources are developed in direct alignment to Massachusetts' standards. Having standards that are common to other states will allow each of us to find such resources developed around the country without having to adapt them to fit our unique standards. So there are clear benefits to common standards. However, we will not adopt standards that we do not feel reflect clear, coherent, and rigorous expectations that we can all implement effectively. So some adjustments of the NGSS are necessary before Massachusetts can adopt revised STE standards. The particular nature and scope of the adjustments are is what the next several months will help us determine.

Work on these remaining issues will move along relatively quickly. We already have input from many educators about these issues and received or developed a number of suggested strategies to address each. Over the next several months our STE Review Panel and expanded advisory group will be providing recommendations about particular actions. They will also assist in the refinement or revision of standards to reflect those actions. The goal is to have a draft set of revised STE standards for public consideration and comment by this coming fall. Once that draft is available significant time will be provided for all Massachusetts educators to review and provide additional input. This input will be used to make final adjustments and edits before the standards are adopted by the state Board of Education, ideally in the winter (about mid-school year).

There are a couple of things that are helpful to keep in mind as you consider what it will take to implement revised STE standards. First, the science and engineering practices are about student outcomes—the skills students are to learn and be able to do; they are not about instruction per se. The practices are skills students are to have learned as a result of instruction. Instruction of particular concepts does not have to be limited to or constrained by the practices included in the standard. Second, an emphasis on progressions of learning highlights the importance of student experience and learning of standards at all grades. We cannot assume that students can arrive in 5th grade, or middle school, with little science instruction through elementary grades and expect to succeed without significant remediation. And third, there are several statewide initiatives underway that provide opportunities to advance the implementation of new STE standards and their key features. Both the goal setting and personal professional development components of the new educator evaluation system provide a systemic way to highlight and get support for the changes that will be called for. Through this process districts and schools will also be creating (ideally in collaboration with other districts and schools) district-determined measures that should emphasize demonstrations of science and engineering skills and knowledge all students should achieve. Please help each other advance this work and make effective use of these opportunities. The Department will also be looking to provide examples and support for this work over the next several years. Working together on the implementation of revised STE standards will provide a more systemic, cohesive and effective experience for all students.

We are in the final phases of the STE standards revision process. Please check the revision page for periodic updates on next steps (www.doe.mass.edu/omste/review.html). We will soon have a comprehensive set of revised Massachusetts STE standards that we can all comment on, that we can rally around, and that we can engage our students in.

Opinionator
Exclusive Online Community From The Times
THE GREAT DIVIDE April 27, 2013, 6:15 pm

No Rich Child Left Behind

By Sean F. Reardon

THE GREAT DIVIDE is a series about inequality.

Here's a fact that may not surprise you: the children of the rich perform better in school, on average, than children from middle-class or poor families. Students growing up in richer families have better grades and higher standardized test scores, on average, than poorer students; they also have higher rates of participation in extracurricular activities and school leadership positions, higher graduation rates and higher rates of college enrollment and completion.

Whether you think it deeply unjust, lamentable but inevitable, or obvious and unproblematic, this is hardly news. It is true in most societies and has been true in the United States for at least as long as we have thought to ask the question and had sufficient data to verify the answer.

What is news is that in the United States over the last few decades these differences in educational success between high- and lower-income students have grown substantially.

One way to see this is to look at the scores of rich and poor students on standardized math and reading tests over the last 50 years. When I did this using information from a dozen large national studies conducted between 1960 and 2010, I found that the rich-poor gap in test scores is about 40 percent larger now than it was 30 years ago.

To make this trend concrete, consider two children, one from a family with income of $165,000 and one from a family with income of $15,000. These incomes are at the 90th and 10th percentiles of the income distribution nationally, meaning that 10 percent of children today grow up in families with incomes below $15,000 and 10 percent grow up in families with incomes above $165,000.

In the 1980s, on an 800-point SAT-type test scale, the average difference in test scores between two such children would have been about 90 points; today it is 125 points. This is almost twice as large as the 70-point test score gap between white and black children. Family income is now a better predictor of children's success in school than race.

The same pattern is evident in other, more tangible, measures of educational success, like college completion. In a study similar to mine, Martha J. Bailey and Susan M. Dynarski, economists at the University of Michigan, found that the proportion of students from upper-income families who earn a bachelor's degree has increased by 18 percentage points over a 20-year period, while the completion rate of poor students has grown by only 4 points.

In a more recent study, my graduate students and I found that 15 percent of high-income students from the high school class of 2004 enrolled in a highly selective college or university, while fewer than 5 percent

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of middle-income and 2 percent of low-income students did.

These widening disparities are not confined to academic outcomes: new research by the Harvard political scientist Robert D. Putnam and his colleagues shows that the rich-poor gaps in student participation in sports, extracurricular activities, volunteer work and church attendance have grown sharply as well.

In San Francisco this week, more than 14,000 educators and education scholars have gathered for the annual meeting of the American Educational Research Association. The theme this year is familiar: Can schools provide children a way out of poverty?

We are still talking about this despite decades of clucking about the crisis in American education and wave after wave of school reform. Whatever we've been doing in our schools, it hasn't reduced educational inequality between children from upper- and lower-income families.

Part of knowing what we should do about this is understanding how and why these educational disparities are growing. For the past few years, alongside other scholars, I have been digging into historical data to understand just that. The results of this research don't always match received wisdom or playground folklore.

The most potent development over the past three decades is that the test scores of children from high-income families have increased very rapidly. Before 1980, affluent students had little advantage over middle-class students in academic performance; most of the socioeconomic disparity in academics was between the middle class and the poor. But the rich now outperform the middle class by as much as the middle class outperform the poor. Just as the incomes of the affluent have grown much more rapidly than those of the middle class over the last few decades, so, too, have most of the gains in educational success accrued to the children of the rich.

Before we can figure out what's happening here, let's dispel a few myths.

The income gap in academic achievement is not growing because the test scores of poor students are dropping or because our schools are in decline. In fact, average test scores on the National Assessment of Educational Progress, the so-called Nation's Report Card, have been rising — substantially in math and very slowly in reading — since the 1970s. The average 9-year-old today has math skills equal to those her parents had at age 11, a two-year improvement in a single generation. The gains are not as large in reading and they are not as large for older students, but there is no evidence that average test scores have declined over the last three decades for any age or economic group.

The widening income disparity in academic achievement is not a result of widening racial gaps in achievement, either. The achievement gaps between blacks and whites, and Hispanic and non-Hispanic whites have been narrowing slowly over the last two decades, trends that actually keep the yawning gap between higher- and lower-income students from getting even wider. If we look at the test scores of white students only, we find the same growing gap between high- and low-income children as we see in the population as a whole.

It may seem counterintuitive, but schools don't seem to produce much of the disparity in test scores between high- and low-income students. We know this because children from rich and poor families score very differently on school readiness tests when they enter kindergarten, and this gap grows by less than 10 percent between kindergarten and high school. There is some evidence that achievement gaps between high- and low-income students actually narrow during the nine-month school year, but they widen again in the summer months.

That isn't to say that there aren't important differences in quality between schools serving low- and high-income students — there certainly are — but they appear to do less to reinforce the trends than conventional wisdom would have us believe.

If not the usual suspects, what's going on? It boils down to this: The academic gap is widening because rich students are increasingly entering kindergarten much better prepared to succeed in school than middle-class students. This difference in preparation persists through elementary and high school.

My research suggests that one part of the explanation for this is rising income inequality. As you may

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have heard, the incomes of the rich have grown faster over the last 30 years than the incomes of the middle class and the poor. Money helps families provide cognitively stimulating experiences for their young children because it provides more stable home environments, more time for parents to read to their children, access to higher-quality child care and preschool and — in places like New York City, where 4-year-old children take tests to determine entry into gifted and talented programs — access to preschool test preparation tutors or the time to serve as tutors themselves.

But rising income inequality explains, at best, half of the increase in the rich-poor academic achievement gap. It's not just that the rich have more money than they used to, it's that they are using it differently. This is where things get really interesting.

High-income families are increasingly focusing their resources — their money, time and knowledge of what it takes to be successful in school — on their children's cognitive development and educational success. They are doing this because educational success is much more important than it used to be, even for the rich.

With a college degree insufficient to ensure a high-income job, or even a job as a barista, parents are now investing more time and money in their children's cognitive development from the earliest ages. It may seem self-evident that parents with more resources are able to invest more — more of both money and of what Mr. Putnam calls "'Goodnight Moon' time" — in their children's development. But even though middle-class and poor families are also increasing the time and money they invest in their children, they are not doing so as quickly or as deeply as the rich.

The more we do to ensure that all children have similar cognitively stimulating early childhood experiences, the less we will have to worry about failing schools.

The economists Richard J. Murnane and Greg J. Duncan report that from 1972 to 2006 high-income families increased the amount they spent on enrichment activities for their children by 150 percent, while the spending of low-income families grew by 57 percent over the same time period. Likewise, the amount of time parents spend with their children has grown twice as fast since 1975 among college-educated parents as it has among less-educated parents. The economists Garey Ramey and Valerie A. Ramey of the University of California, San Diego, call this escalation of early childhood investment "the rug rat race," a phrase that nicely captures the growing perception that early childhood experiences are central to winning a lifelong educational and economic competition.

It's not clear what we should do about all this. Partly that's because much of our public conversation about education is focused on the wrong culprits: we blame failing schools and the behavior of the poor for trends that are really the result of deepening income inequality and the behavior of the rich.

We're also slow to understand what's happening, I think, because the nature of the problem — a growing educational gap between the rich and the middle class — is unfamiliar. After all, for much of the last 50 years our national conversation about educational inequality has focused almost exclusively on strategies for reducing inequalities between the educational successes of the poor and the middle class, and it has relied on programs aimed at the poor, like Head Start and Title I.

We've barely given a thought to what the rich were doing. With the exception of our continuing discussion about whether the rising costs of higher education are pricing the middle class out of college, we don't have much practice talking about what economists call "upper-tail inequality" in education, much less success at reducing it.

Meanwhile, not only are the children of the rich doing better in school than even the children of the middle class, but the changing economy means that school success is increasingly necessary to future economic success, a worrisome mutual reinforcement of trends that is making our society more socially and economically immobile.

We need to start talking about this. Strangely, the rapid growth in the rich-poor educational gap provides a ray of hope: if the relationship between family income and educational success can change this rapidly, then it is not an immutable, inevitable pattern. What changed once can change again. Policy choices matter more than we have recently been taught to think.

So how can we move toward a society in which educational success is not so strongly linked to family background? Maybe we should take a lesson from the rich and invest much more heavily as a society in our children's educational opportunities from the day they are born. Investments in early-childhood education pay very high societal dividends. That means investing in developing high-quality child care and preschool that is available to poor and middle-class children. It also means recruiting and training a cadre of skilled preschool teachers and child care providers. These are not new ideas, but we have to stop talking about how expensive and difficult they are to implement and just get on with it.

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But we need to do much more than expand and improve preschool and child care. There is a lot of discussion these days about investing in teachers and "improving teacher quality," but improving the quality of our parenting and of our children's earliest environments may be even more important. Let's invest in parents so they can better invest in their children.

This means finding ways of helping parents become better teachers themselves. This might include strategies to support working families so that they can read to their children more often.. It also means expanding programs like the Nurse-Family Partnership that have proved to be effective at helping single parents educate their children; but we also need to pay for research to develop new resources for single parents.

It might also mean greater business and government support for maternity and paternity leave and day care so that the middle class and the poor can get some of the educational benefits that the early academic intervention of the rich provides their children. Fundamentally, it means rethinking our still-persistent notion that educational problems should be solved by schools alone.

The more we do to ensure that all children have similar cognitively stimulating early childhood experiences, the less we will have to worry about failing schools. This in turn will enable us to let our schools focus on teaching the skills — how to solve complex problems, how to think critically and how to collaborate — essential to a growing economy and a lively democracy.

Sean F. Reardon *is a professor of education and sociology at Stanford.*

Understanding Student Weaknesses

May 2, 2013 — As part of an unusual study, Philip Sadler, the Frances W. Wright Senior Lecturer in the Department of Astronomy, and colleagues tested 181 middle school physical science teachers and nearly 10,000 of their students, and showed that while most of the teachers were well-versed in their subject, those better able to predict their students' wrong answers on standardized tests helped students learn the most.

If you had to explain what causes the change in seasons, could you? Surprisingly, studies have shown that as many as 95 percent of people -- including most college graduates -- hold the incorrect belief that the seasons are the result of the Earth moving closer to or further from the sun.

The real answer, scientists say, is that as Earth's axis is tilted with respect to its orbit, when on its journey it is angled inward, the sun rises higher in the sky, and that results in more direct sunlight, longer days, and warmer temperatures. Distance plays no role; we are actually closest to the sun in the dead of winter, during the first week of January.

Why do so many people continue to hold the wrong idea? The answer, said Philip Sadler, the Frances W. Wright Senior Lecturer in the Department of Astronomy and director of the science education department at the Harvard-Smithsonian Center for Astrophysics (CfA), may be found in what science teachers know.

As part of an unusual study, Sadler and colleagues tested 181 middle school physical science teachers and nearly 10,000 of their students, and showed that while most of the teachers were well-versed in their subject, those better able to predict their students' wrong answers on standardized tests helped students learn the most. The findings are described in a paper published last month in the American Educational Research Journal titled "The Influence of Teachers' Knowledge on Student Learning in Middle-School Physical Science Classrooms."

"What our research group found was that for the science that people considered factual, teacher knowledge was very important. If the teachers didn't know the facts, they couldn't convey them to the students," Sadler said. "But for the kinds of questions that measure conceptual understanding, even if the teacher

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knew the scientific explanation, that wasn't enough to guarantee that their students would actually learn the science."

Sadler pointed to the question of what happens to a lamp when the power cord is squeezed.

"Middle school students say if you squeeze hard you will see the light gets dimmer, even though they've stepped on that cord before, or they've put the corner of their chair on that cord before, and nothing has happened," he said. "Their theoretical understanding of the way the world works includes the idea that electricity is like water flowing through a garden hose. If you put some pressure on the cord, you will get less electricity out the other end. It turns out that for most major scientific concepts, kids come into the classroom -- even in middle school -- with a whole set of beliefs that are commonly at odds with what scientists, and their science teachers, know to be true."

If teachers are to help students change their incorrect beliefs, they first need to know what those are. That's where the standardized tests developed by Sadler and his colleagues come in. Multiple-choice answers were gleaned from hundreds of research studies examining students' ideas, particularly those that are common -- such as electricity behaving like water.

For the study described in their paper, Sadler and his colleagues asked teachers to answer each question twice, once to give the scientifically correct answer, and the second time to predict which wrong answer their students were likeliest to choose. Students were then given the tests three times throughout the year to determine whether their knowledge improved.

The results showed that students' scores showed the most improvement when teachers were able to predict their students' wrong answers.

"Nobody has quite used test questions before in this way," Sadler said. "What I had noticed, even before we did this study, was that the most amazing science teachers actually know what their students' wrong ideas are. It occurred to us that there might be a way to measure this kind of teacher knowledge easily without needing to spend long periods of time observing teachers in their classrooms."

To help teachers hone this knowledge, Sadler and his colleagues have made the kind of tests used in their study publicly available. More than a dozen tests covering kindergarten through grade 12 are downloadable here, after completing a tutorial on their development and interpretation.

Going forward, Sadler said he hopes to conduct similar studies in the life sciences, particularly around concepts such as evolution and heredity. He also plans to study what types of professional development and new teacher preparation programs help improve instructors' facility in knowing what their students know.

Ultimately, Sadler said, he hopes teachers will be able to use the tests to help design lessons that change students' incorrect ideas and help them learn science more quickly and easily. This is particularly important as states adopt the recently released Next Generation Science Standards.

"State certification for teaching science might well include making sure that new teachers are aware of the common student misconceptions that they will encounter, as well as being proficient in the underlying science," said Sadler. "Prior to this, there has never been an easy way to measure teachers' knowledge of student thinking, while we have probably been placing too much emphasis on testing for advanced scientific knowledge.

"Everyone has had a teacher or professor who is incredibly knowledgeable about their field, yet some of them are less-than-stellar teachers," he continued. "One of the reasons for this is that teachers can be unaware of what is going on in their students' heads, even though they may have had exactly the same ideas when they were students themselves. Knowledge of student misconceptions is a critical tool for science teachers. It can help teachers to decide which demonstration to do in class, and to start the lesson by asking students to predict what's going to happen. If a teacher doesn't have this special kind of knowledge, though, it's nearly impossible to change students' ideas.

"The best teachers base their lessons on what the American humorist-philosopher Will Rogers observed: It ain't what they don't know that gives them trouble, it's what they know that ain't so."

Story Source:

The above story is reprinted from materials provided by Harvard University.

Journal Reference:

1. P. M. Sadler, G. Sonnert, H. P. Coyle, N. Cook-Smith, J. L. Miller. **The Influence of Teachers' Knowledge on Student Learning in Middle School Physical Science Classrooms.** *American Educational Research Journal*, 2013; DOI: 10.3102/0002831213477680

CAKE PLATE TECTONICS *Using a Model to Understand*

MOUNTAIN BUILDING & EARTHQUAKES

By Susan Plati
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PRELIMINARY PREPARATIONS

(for the teacher)

This is a lab that I developed for my ninth grade earth science students. There were 6 groups of 4 students in each group. Prior to the class I baked the cakes so that each lab group would have 1 cake. One cake mix would fill 3 of the aluminum cake pans described in the lab directions below. Thus for the class of 24 students you would need 2 cake mixes. Additionally you need sugar cubes and frosting. I used two different kinds of cake mix and tested the steps at home before having the students do the lab.

STUDENT DIRECTIONS

INTRODUCTION: Scientists often use models to help them to understand complicated processes. Today you will use such a model to make observations when a particular medium is put under the stresses that model the stresses of the plates that make up the earth. You will then compare these stresses and the resulting condition of the experimental medium to changes that occur in the earth that result in mountain building and earthquakes.

IMPORTANT NOTE: You may <u>NOT EAT</u> the cake until the lab is complete and you are directed to do so. You should wash your hands and wash off the surface of the lab table before you begin the lab so that you will be able to eat the cake when you have completed the lab

PROCEDURE: Each lab group will be given a small sheet cake that is contained in a flexible aluminum pan (18cm x 24cm). Using the flexible pan to hold the cake, you will then subject your cake to a variety of gentle stresses as you make preliminary observations as listed below.

PRELIMINARY OBSERVATIONS: (draw sketches of what happens in each case—be quantitative and measure all changes—record where you push and where changes in the cake's surface occur)

1. Push gently (but firmly) on the walls of the cake (using the pan) in the short dimension.
2. Repeat this in the long direction.
3. Cut a 4cm. strip parallel to the short dimension of the cake. You now have one section (18 x 4 cm). Then cut the strip in half giving you 2 sections (plates) each 9 x 4 cm. Leave this cut portion in the pan as you perform the following operations:
   A. Push on one of the plates forcing it against the other plate. Draw what happens
   B. Push on both plates simultaneously - from the outside - forcing them together in the middle. Draw the results.

4. Twist the cake across the diagonal
   - observe carefully what happens
   - where are the "mountains"? What happens to each of the plates?

THE EXPERIMENT: Twist and push the pan - slowly and gently until the cake cracks. Use a knife to extend this "fault line". Sketch your resulting "continent model." Make sure you show where each of the pressures is originating and the extent of the fault line.

THE CHALLENGE: Your lab group is an engineering firm in the city of Pillsbury. Your task is to build a building that can withstand earthquakes. You will use sugar cube "bricks" and frosting "mortar" to construct your building. Design a building that will rest on the fault line. Sketch your final building and its placement - Place it on the fault line.

THE TEST: Model an earthquake - first a gentle one, then increasing gradually in intensity. Describe what happens to your building. Compare your results to those of other groups.

QUESTIONS FOR DISCUSSION

1. Describe specifically what parts of mountain building and earthquakes are represented in this model.
2. Are there differences in the chocolate or white cake in the faulting and folding that occurs when you

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subject the cake to various stresses? (Compare your results to other groups)

3. What building design seemed to be most "earthquake resistant" Why do you think this result occurred? (Compare results of each group)

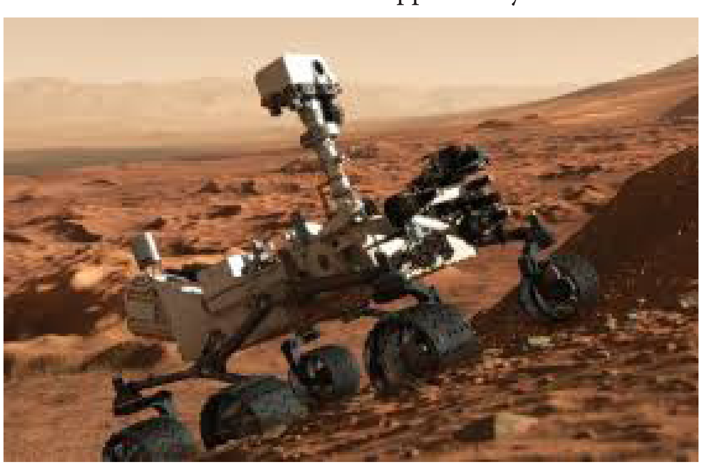
CLEANING UP YOUR WORK SPACE:

After you have recorded all your data and answered all questions and completed any additional experiments—divide your cake "continent" among the members of your lab group and dispose of the cake by eating it or wrapping it up and taking it home—ENJOY!

ROVERS *Revisited*

Rick Varner
Education Specialist,
NASA's Aerospace Education Services Project (AESP)

Just one year ago we were looking forward with great anticipation to the discoveries to be made by NASA's newest Martian rover, Curiosity. So far, Curiosity and its team of scientists and engineers have not disappointed and the search for evidence of a prior life-supporting environment continues. In addition to Curiosity's ongoing mission, this summer will mark ten years since NASA first launched the Martian rovers Spirit and Opportunity toward the red planet.



The Mars Exploration Rovers (MER) was basically designed to be a summer research project. The mission was designed for 90 days of exploration to characterize Martian rocks and soils to "follow the water", a search for evidence that Mars was once a wet planet, not unlike the Earth. Each rover was designed to travel roughly a kilometer during the mission and after a decade, well past the warranty period, Spirit traveled 7.73 kilometers and is retired at Troy, while Opportunity has traversed more than 35.65 kilometers and is poised to continue its extended mission on the rim of Endeavour Crater.

Keeping the rover theme for summer interests is not terribly difficult as there are many choices for inexpensive to elaborate activities in engineering design. NASA's Beginning Engineering, Science, and Technology (BEST) offer a variety of engineering design activities through a series of guides developed for grades K-2, 3-5 and 6-8. Many of these activities have been adapted from pre-existing NASA activities and renovated to align with the Engineering Design process that is a cornerstone for study in the Next Generation Science Standards (NGSS). The materials used in the BEST activities are intended to be inexpensive and the directions easily comprehended to incorporate these activities into after-school/out-of-school time programs, which is a cornerstone in Massachusetts K-12 STEM educational design.

The activity "Design a Lunar Buggy" appears in each of the three guides

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and will require appropriate scaffolding for the grades K-2. While all of the activities in the BEST guides are designed for teams of students which reinforces the engineering design concept as well, the younger grades will require more instructor lead direction and materials preparation in order to gain the outcomes of carrying their penny payloads and plastic astronaut crews safely down the ramp. For the youngest learners, guided inquiry is entirely appropriate as an introduction to this activity. The suggestion of "Goldilocks" experiments makes for nice connections to grade appropriate reading and introduces the idea of potential "failure parameters" for engineering design. Following the brainstorming of rover design ideas, as a group, the K-2 class might design three comparable rovers to carry the different penny loads to discover which load is "just right" for their rover design. The addition of plastic astronauts to the design introduces new testing and discovery.

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For the intermediate and middle grade student teams the scaffolding would be significantly less and the design parameters and outcomes more pronounced to allow the student teams to explore new and innovative designs for testing. Essentially, the activity is an adaptation of a pinewood derby competition with an outcome difference being the 100cm distance and intact transport of passengers and payload as the measure of success in design. Extended distances create an element of competition between design teams and provokes discussion on design efficiency.

Most engineering design activities could easily take an interdisciplinary approach through the introduction of a materials budget, bookkeeping, drafting proposals and reporting. For spaceflight considerations, comparing the mass of the entire design upon completion to the relative outcomes and minimal standards may be a secondary outcome that is not readily apparent.

www.nasa.gov/audience/foreducators/best/

Another wonderful resource for engineering design activities was developed through collaboration between NASA and the PBS Design Squad teams. The "On The Moon" Design Squad activity guide contains activities that are designed for elementary and secondary age groups. In this guide the "Roving the Moon" activity is better suited for middle to high school students and adds the additional design parameter of being self-propelled by a rubber band powered system.

"Roving The Moon", like the BEST activities, is designed to use simple and inexpensive materials readily available to most programs and students. The initial rover design introduced to the teams is purposefully intended to suggest common sense improvements. The Test, Evaluate and Redesign aspects of the engineering design process are essential and the focus of this activity. Instructional leaders will quickly recognize extensions and curriculum connections to make this single activity one, which could last an entire week during the summer.

http://pbskids.org/designsquad/parentseducators/guides/activity_guide_moon.html

Leaving the rover theme for a moment, there is also a host of engineering design activities available at the middle grade level through the Summer of Innovation thematic units posted online. NASA's Summer of Innovation (SoI) is a project designed in response to President Obama's Educate to Innovate initiative. Realizing that many underrepresented student groups experience a broadening learning gap each summer, education specialists have selected a series of NASA activities appropriate for camp and out-of-school programs to introduce during the summer months.

To download the NASA Summer of Innovation "Engineering" thematic unit activities go to: www.nasa.gov/offices/education/programs/national/summer/education_resources/engineering_grades7-9/index.html

Since professional development continues across the summer, NASA's Aerospace Education Services Project (AESP) offers many online webinars and webshops on a variety of NASA STEM topics. There is an updated posting of these events located at: http://aesp.pspm.outreach.psu.edu/programs/webinars/

Additionally, AESP and Penn State University are introducing a unique learning community entitled Teacher Learning Journeys, which offers asynchronous and synchronous online learning opportunities that result in PSU CEU's and recognitions for STEM

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"Rovers"...continued

professional development. At http://aesp.psu.edu/programs/teacher-learning-journey/ teachers can register to begin their personally designed Learning Journey, as well as request professional development programs onsite and online for your school district. I have been involved with the Solar System and Engineering journey development teams and look forward to working with teachers from the northeast who choose these adventures in learning.

Teachers who piloted the Teacher Learning Journey project last summer indicated five reasons why they found the experience to be valuable:

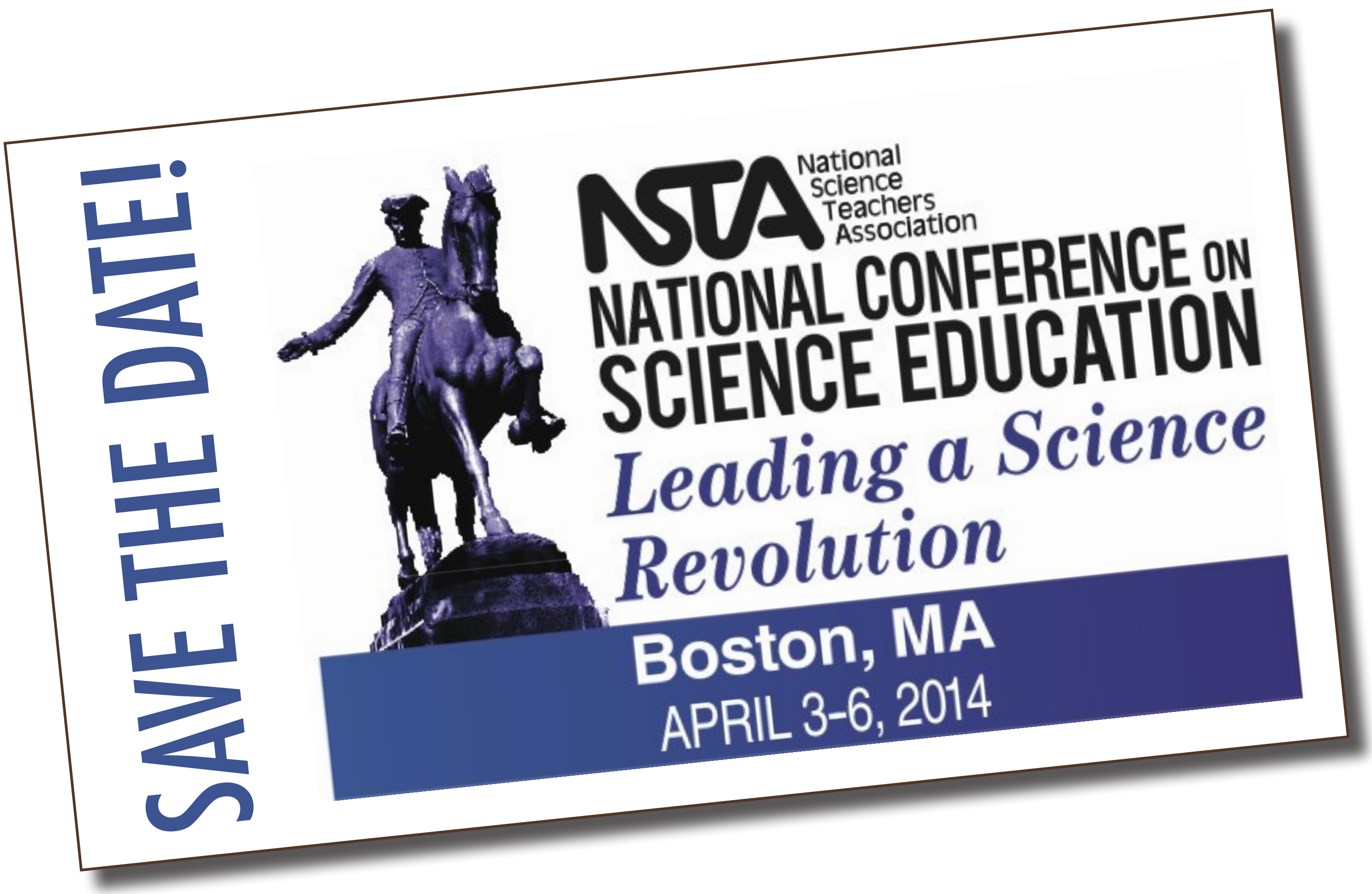
1. Find PD that meets your needs
2. Learn when and where you want
3. Work at your own pace
4. Maintain an archive of your professional learning
5. Create a digital portfolio to showcase your PD

Participating administrators also suggested:

1. Itinerary provides an opportunity to discuss PD goals
2. Accountability through digital badges and reports that document progress
3. Personal relevance over one-size-fits all approach to PD
4. NASA/NSTA STEM content and educator expertise
5. No cost

The Teacher Learning Journey web site opened on May 1st

Have a wonderful summer of STEM experiences as we look forward to even better opportunities in the 2013-14 school year ahead.



Save the Date

Massachusetts Revised Science and Technology/Engineering Standards

Join science and technology/engineering colleagues in considering shifts in revised standards and their implications for our work!

Jake Foster of the Massachusetts Department of Elementary and Secondary Education will be the featured speaker to provide an overview and context.

Breakout groups facilitated by MAST, MSELA and MassTEC leaders will focus on:

- Changes in the standards across the grades
- Model-based teaching and learning
- Talking like a scientist and an engineer; what do we have in common?
- Sharing lessons and activities to support implementation of the new revised standards
- Networking with others involved in Science, Technology and Engineering professional associations in Massachusetts

Saturday, November 16, 2013
9:00 am to Noon
Holiday Inn, Boxboro, MA

Cost: $15 per person

This event is brought to you in collaboration with the Massachusetts Association of Science Teachers, Massachusetts Science Education Leadership Association, the Massachusetts Technology Education/Engineering Collaborative, and the Massachusetts Department of Elementary and Secondary Education.

Watch your email for registration information.

MAST

Massachusetts Association of Science Teachers

"To enhance science teaching and empower teachers of science"

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