MSTA Newsletter

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In this Issue

From the President's Desk

By Jen Arnswald, MSTA President

Happy Fall!

This summer, Robby Cramer and I attended the National Congress on Science Education. The theme for the event was "Teachers are the Key to Unlocking Our Potential: Connect, Collaborate, Celebrate!" As many of the science teachers in Michigan begin to implement the New Michigan Science Standards, we must always remember to do these 3Cs.

Connect:
Often, I hear that teachers feel like they are alone on an island when they are in their classrooms. This is especially true in Michigan. In many districts, there is only one science teacher in the building or perhaps only one teaching each subject. Thankfully, we are very fortunate to have technology to help us expand our professional learning networks and can learn from educators other states that have dipped their toes in NGSS before Michigan.

3 Ways to Connect

1. https://twitter.com/
   Make an account or just do a search! To search Twitter, click the button. Then search for #ngsschat or # Miscichat. You will be amazed to see how many educators are connecting through Twitter!

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From The Desk of Your Executive Director

From Robby Cramer, MSTA Executive Director

In Stephen Pruitt's MSTA keynote speech, he teased, "Here is your science. The Next Generation Science Standards are finished, you can relax." Then he challenged us saying, "The development was the easy part…" It was hard to imagine that Stephen might be correct. The development and the process of adopting the Michigan Science Standards was truly challenging (and sometimes exhausting and frustrating… to say the least). However, last November the Michigan State Board of Education finally adopted the Michigan Science Standards. Now the **really hard** work of implementation begins!

Michigan science educators are now one year into the statewide implementation of the new Michigan Science Standards. MSTA's theme for the 64th State Conference March 24 & 25, 2017 is "Putting Legs on the New Science Standards." Currently, we are finalizing sessions, speakers, and strands for the 64th MSTA state science conference and the Pre-conferences Thursday, March 23rd. We hope you will join us to hear from Michigan teachers and leaders, many of whom are early adopters of the new standards. There will be many opportunities to ask your questions and discover how other teachers are wrestling with the same questions you have! Join us for support, ideas, and resources as you continue your personal journey of implementing these exciting new standards in your setting.

The mission of the MSTA is to stimulate, support and provide leadership for the improvement of science education throughout Michigan. Our organization's mission has guided our work as we move science education and the new Michigan Science Standards forward. Watch your email and the MSTA website for conference updates and information on the registration process for the 64th state science conference- ***"Putting Legs on the New Science Standards!"***

From the President's Desk

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2. Sign up for the NGSS Now Newsletter.
   http://nextgenscience.org/
   Click "Subscribe for the latest NGSS news"
3. Find resources on the NGSS PLN Blog
   http://www.ngsspln.com/

Collaborate:
We learn just as our kids do—through conversation and sense-making. As we begin to implement the new Michigan Science Standards, we must remember that we are learning just as much, if not more, than our students. There is not enough time in the day to do it all! Join other educators as you embark on your NGSS journey!

3 Ways to Collaborate

1. Attend the MSTA Annual Conference March 24-25, 2017 in Novi! Come together and share your ideas with other educators.
2. Make a twitter account and participate in Twitter chats! #NGSSCHAT is every other Thursday at 9:00pm and #MISciChat every second Monday at 8:30 pm.
3. Attend NSTA Webinars and explore the resources in the NSTA Learning Center https://learningcenter.nsta.org/search/

Celebrate:
Celebrate every opportunity you get! When a child takes her first step we celebrate, even if the second step causes her to tumble. Remember this as you being to dive into the Michigan Science Standards with students. Chances are that some things will go well and others will not. Keep your energy up by celebrating success and learning from failures with others!

3 Ways to Celebrate

1. Post pictures and lesson ideas on Twitter.
2. Start a blog to share your experiences. My Blog can be found at https://jenarnswaldblog.wordpress.com/
3. Write an article for the MSTA newsletter or journal.

I look forward to connecting, collaborating, and celebrating with you this upcoming year! You are the key to unlocking the science potential in Michigan children.

Best,
Jen

Assessment Update from the Michigan Department of Education

By TJ Smolek, Science Education Research Consultant, Michigan Department of Education

The Office of Standards and Assessment is in the process of developing state-level science assessments to address the three-dimensional nature of the new Michigan K-12 Science Standards. The state-level science assessment is one piece of the larger assessment system necessary for providing information about what our students know and can do in science. The multiple measures utilized throughout the assessment system should build upon one another, provide a variety of perspectives on learning, and work together to formulate a cohesive picture of student performance. The Michigan Department of Education (MDE) is working with many of the science networks in Michigan to further develop the science assessment system.

Design work is progressing on state-level item clusters (a group of items centered a specific phenomenon) that were written over the course of five weeks during the summer of 2016. Using the guidance provided by the *Michigan K-12 Science Standards* and *Framework for K-12 Science Education* (NRC, 2011) science assessment content leads have been preparing the first set of item clusters for Content Advisory Committee and Equity (Bias and Sensitivity) Committee reviews to be held in November. The feedback from the science educators serving on these committees will help refine the item clusters prior to conducting cognitive labs (interviews with students to better understand how they respond to the question) and pilot testing in spring 2017.

The science consultants at MDE are partnered with the Michigan Math and Science Center Network, CREATE 4 STEM at Michigan State University, and various Intermediate School Districts (ISDs) to develop classroom level assessments and performance tasks that reflect the vision of the Michigan K-12 Science Standards. Utilizing a workshop format, educators are provided the time and space necessary to think deeply about the standards, determine examples of high quality evidence, and design tasks to elicit such evidence from students. Together, these pieces of evidence support claims about what students know and can do in science.

On October 24, 2016, TJ Smolek presented a Webcast update regarding the timeline for the implementation of the state assessment aligned to the Michigan K-12 Science Standards. To view this Webcast, visit MI Science Curriculum, Instruction, and Assessments on Facebook or search #MSSICD on Twitter. TJ will also be presenting multiple sessions on three-dimensional science assessment at the MSTA conference in March, 2017. Please contact TJ Smolek at smolekt@michigan.gov with questions concerning the state-level science assessment.

What the New Michigan State Science Assessment Design Means for Instruction

By Amelia Wenk Gotwals, Associate Professor of Science Education, Michigan State University

With the adoption of the new Michigan Science Standards (MSS), there are many changes on the horizon. While there is a lot of excitement about the possibilities, there are also several uncertainties. In my work with teachers, I hear concerns including: How well does my current instruction align with the MSS? Do we need new curricular materials to help us teach to the MSS? And, perhaps most of all, I hear: What is the new state science assessment going to look like? As teachers begin thinking about transitioning their instruction to meet the MSS, what the state science assessment is going to look like looms large. Teachers do not necessarily want to solely "teach to the test." However, as we know from work with backwards design (Wiggins & McTighe, 2005), having an end goal in mind helps to make sound instructional choices leading up to the test. While a state standardized test should not be the only measure of achieving a "desired result," it can and should play some role in how we consider instruction in science classrooms.

In 2001, James Popham distinguished between two ways of "teaching to the test:" (1) item teaching, where teachers organize their instruction around actual items on a test or around a set of similar items; and (2) curriculum teaching, where teachers focus their instruction on a body of knowledge represented by a test. Popham argued that item teaching provides a disservice to students and teachers because the purpose of educational testing is to allow stakeholders to make "accurate inferences about the levels of mastery that students have achieved with respect to a *body of knowledge*" (p. 17), not a specific set of items. On the other hand, effective curriculum teaching will, "elevate students' scores on high-stakes tests and, more important, will elevate students' mastery of the knowledge or skills on which the test items are based" (p. 17).

The process that TJ Smolek, at the Michigan Department of Education, has developed for designing the new Michigan state science assessment has many implications for curriculum teaching. By providing an in-depth look at how MDE is conceptualizing the MSS, i.e., the body of knowledge represented by the new test, we can see a vision for what performance of three-dimensional science understanding means at the state level. As a writer of item clusters and a member of the Michigan Science Assessment Advisory Committee, I think that having this clear description of the process for item development has many implications for aligning classroom instruction. You can find excellent "lessons learned" about the item development process in articles by Sandy Erwin and Wendy Johnson in the previous MSTA Newsletter (volume 68.3 Summer 2016), and I don't want to repeat the information that they provided. However, I think that a few things are worth emphasizing:

- The process for writing items begins with unpacking the performance expectations (PEs). This means that having an in-depth understanding of the Framework (https://www.nap.edu/catalog/13165/a-framework-for-k-12-science-education-practices-crosscutting-concepts) that undergirds the MSS and understanding the three-dimensional nature of the PEs is a critical first step in transitioning to the MSS.

- All item clusters (i.e., a set of items written to cover performance expectations in a Topic Bundle (see http://www.nextgenscience.org/overview-topics), are written based on a phenomenon. "Natural phenomena are observable events that occur in the universe and that we can use our science knowledge to explain or predict" (http://www.nextgenscience.org/sites/default/files/Using%20Phenomena%20in%20NGSS.pdf). This means that we are moving away from learning "ideas" and moving toward being better able to explain and predict occurrences the world (and universe) around us. Beginning to use phenomena to anchor instruction is a clear way to begin aligning with the MSS.

While sample items cannot be released until they have undergone the arduous process of test validation, by learning more about the item design process, we can get a sense for what items will eventually look like and we can begin developing our own classroom assessments and aligning our instruction. So, don't wait for specific item examples to start thinking about how to transition your instruction to meet the MSS, because, while helpful, they are not the answer. Instead, using a curriculum teaching approach, you can begin to learn more about the item development *process* as a way to begin better understanding what the new MSS mean for your classroom! If you want to learn more about developing three-dimensional classroom assessments, please join me at the session "Assessing Three-Dimensional Science Learning in the Classroom" at the MSTA Conference in March 2017.

Popham, W.J. (2001). Teaching to the Test? *Educational Leadership* 58(6). 16-20. Retrieved from: http://www.ascd.org/publications/educational-leadership/mar01/vol58/num06/Teaching-to-the-Test%C2%A2.aspx.

Wiggins, G. & McTighe, J. (2005). *Understanding by Design, Expanded 2nd Edition*. Upper Saddle River, NJ: Association for Supervision and Curriculum Development (ASCD).

Master Class for Advocacy Communications Based on the New Michigan Science Standards

By Robby Cramer, MSTA Executive Director

When MSTA spoke in favor of the adoption of the Michigan Science Standards (MSS) in November, 2015, we encouraged all science teachers and leaders to take time to look at the MSS from the perspectives of parents, teachers and communities. We believe the questions and concerns expressed during the statewide public comment sessions provided helpful insight as we answer questions from colleagues, parents and families in our own communities.

To help Michigan educators and leaders consider how to answer questions effectively, MSTA turned to Achieve leadership for support. Achieve responded with a workshop on how to develop answers that simply tell the story of how and why **the Michigan Science Standards expand opportunities for *all* our kids.**

On August 17, MSTA invited science leaders from the Michigan Math & Science Network, MDSTA, MDE, CREATE for STEM Institute, and MSTA to a master class in advocacy and communication skills. The goal was to help the leadership of the many key science groups practice constructing and delivering answers to questions about our new science standards. As science educators, we need to be prepared to answer questions that are bubbling up to the surface as parents, teachers, administrators, and legislators begin to delve into the new Michigan Science Standards.

Together, MSTA leadership and Achieve developed a fact sheet that explained three key messages about our Michigan Science Standards. Michigan State Board of Education President John Austin reviewed and approved the wording on the document, which was titled *Michigan Science Standards: Short Messages*.

President Austin sent the following message used to open the meeting: "I want to thank you for your leadership and continued work to bring engaging, motivating, and effective instruction to our Michigan students, helping inspire and educate the next generation of scientists, engineers, and critical-thinking citizens we need to both transform our economy, and be thoughtful and active participants in our democracy."

The MSTA wants to thank Joe Krajcik and his staff at the CREATE for STEM Institute for providing both the rooms and technology for the meeting. We are grateful Achieve leadership came to Michigan to conduct this master class workshop and for bringing in The Fratelli Group to facilitate the day.

MSTA will continue to collaborate with other state leaders to develop short messaging that can be used as a foundation to answer questions in your schools and communities.

Michigan Science Standards Short Messages

The Michigan Science Standards expand opportunities for all our kids. The Michigan Science Standards prepare more students for advanced science studies, while teaching *all* students to understand the world around them.

1. **The Michigan Science Standards are based on current science.**
   - It has been nearly 20 years since the National Research Council (NRC) released the recommendations on which most state science standards are based.
   - The Michigan Science Standards are based on the NRC's 2011 *Framework for K-12 Science Education,* which reflects current research on how students best learn science.
   - They were benchmarked against STEM powerhouses such as Canada, China, England, Finland, Hungary, Ireland, Japan, Singapore, and South Korea.

2. **The Michigan Science Standards were written for all students.**
   - The Michigan Science Standards allow students to think of science learning as a broad understanding of interrelated concepts.
   - The standards connect scientific principles to real-world situations.
   - A strong science education equips students with skills that are necessary for all careers.

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Master Class for Advocacy Communications *continued from page 4*

3. These are our standards – Michigan reviewed and developed them.

- The Michigan Science Standards are based upon the Next Generation Science Standards (NGSS).
- Michigan actively participated in the development of the NGSS as a Lead State Partner. Lead states created committees of K-12 educators, administrators, higher-education faculty, scientists, engineers, business leaders, policymakers and key organizations to review the NGSS.
- Michigan provided input and leadership as members of the NGSS Writing team, the Michigan Internal Review Team for NGSS, and through "special focus area reviews" of the standards documents and ancillary materials.

Communicating Key Messages About Our New Science Standards With Diverse Audiences

By Wendy R. Johnson, Newsletter Editor & PhD Candidate at Michigan State University

On August 17, 2016, MSTA teamed up with Achieve, Inc. to offer the Michigan Science Standards Advocacy Communications Master Class at Michigan State University. Science education leaders from around the state attended the workshop to learn how to effectively advocate for our new science standards in different contexts. In the morning, we discussed the key points that we wanted to convey about the Michigan Science Standards and the importance of tailoring the message to particular audiences. For example, when talking with lawmakers, school board members, or administrators, we often have only a couple of minutes to convey the key shifts in the new standards, and members of these groups are usually not familiar with the jargon of science teachers. Because their support is vital for obtaining the time and resources that teachers need in order to implement the MSS, it is important to have a concise "elevator speech" ready to share with these stakeholders. At the workshop, we videotaped ourselves delivering these short messages. While it was very uncomfortable to see ourselves on the big screen during the feedback session, it was a great learning experience. Since the workshop, I have continued to refine and practice my elevator speech. I now have it down to about one minute. The quick overview of the standards can then be followed by a specific request for collaboration time, professional development, or other resources that teachers may need in order to successfully implement the standards. Below is the message I have crafted to share with the stakeholders I may meet. Feel free to borrow or adapt it to help you advocate for the support you and your colleagues need to make three-dimensional learning for all students a reality in your classroom.

The main difference between previous science standards and the new Michigan Science Standards is the shift from "learning about science" to "figuring out scientific phenomena." So, instead of focusing on memorizing facts about science, students are asking questions about the world and then using evidence to develop answers. We call this three-dimensional learning because students are not only learning about what scientists know, which are the disciplinary core ideas, but also engaging in the work of scientists, which are the science practices, and thinking like scientists, which are called the crosscutting concepts. The practices, crosscutting concepts, and disciplinary core ideas are woven together into three-dimensional performance expectations that require more engaging, challenging, and authentic learning experiences to achieve than the one-dimensional standards we used previously.

The 64th Michigan Science Teachers Association Conference is quickly approaching. This year's conference will be held on March 24 & 25, 2017 at the Suburban Collection Showplace in Novi. Below are some of the highlights you can expect this year.

Do you want to learn what is happening in our state right now in regards to our Michigan Science Standards (MSS) and how you can align your instruction and assessment?

The MSTA Conference Committee is gathering experts to discuss the most up-to-date transition information for the MSS in Michigan. As science educators, some of you may be viewing the transition to the new MSS with trepidation. There are many sessions being offered by teachers just like you—sharing what they are doing in the classroom to embrace MSS, including the incorporation of engineering practices and more!

Are there professional development sessions that are more in-depth?

The Professional Development workshops on Thursday, March 23rd include half- and full-day options. These popular and informative sessions cover topics such as three-dimensional learning, assessments aligned to the MSS, STEM, Bringing MSS into Your Classroom with Little Fuss, and sessions for administrators and district/building consultants regarding what the new MSS means to their schools and districts. The PD sessions do require pre-registration, so be sure to watch for information on our website regarding these soon.

Do you want to have a more personal relationship with MSTA?

The MSTA Conference is offering an opportunity to meet and greet with your regional director. During the break between the morning and afternoon sessions, the regional directors will gather at the exhibit hall, ready to talk with you and let you know what is happening in your region, as well as listen to your ideas on how they might better meet your needs.

Do you have some new ideas for MSTA or want to get more involved?

Come to the general membership meeting on Saturday morning for Muffins with Members. Chat with Board Members, and have your voice heard regarding how we can better serve you.

Do you want to see the newest materials out there to use in your classroom?

Visit the exhibit hall to see the largest collcection of science educational materials available anywhere in the state. Enter drawings for giveaways from the exhibitors. Also visit the always popular MESTA rock shop, MSTA & NSTA book stores, and the Cyber Café.

NOTE: NEW LOCATION
This year's new location is convenient to many hotels and restaurants and is easy to access from various interstates. It features free parking and spacious meeting accommodations. We think you will enjoy our new conference venue.

Please remember that as always, there is an 'early bird' registration savings. Visit the website for details and deadlines.

We look forward to seeing you make this MSTA Conference your *Pure Michigan* destination to see how we are "Putting Legs on the New Michigan Science Standards!"

Karen Kelly, Conference chair
Sandra Yarema, Conference Co-chair
Crystal Brown, Conference Co-chair

Scholarship Winners Reflect on the 2016 MSTA Conference

Kathy Jenkins, Beaverton Rural Schools

With over 200 sessions, the 2016 MSTA Annual Conference provided a smorgasbord of professional development for K-12 science teachers addressing STEM, Common Core, community partnerships, vendors and much more. The conference program was organized among various strands so you could save time organizing your day. Add to this, fellowship and collaboration with educators from around the state, and you've got a powerful and exciting conference!

The most immediately helpful session for me was called "Encourage Reading in the Science Classroom" by Stephanie Niedermeyer and Kimberly Sharplin of Wayne Memorial High School, Wayne, MI. (They also did a writing conference session which was equally helpful.) The session focused on the question: What would you want your student science reader to look like?

Stephanie and Kimberly started by talking about metacognition and the importance of getting students to think about their thinking. Then they discussed basic CLOSE Reading techniques (highlighting, underlining, interacting with the text by asking questions, making connections, etc.) and the necessity of modeling the reading process with CHALLENGING reading. They also emphasized the importance of after-reading strategies (re-read, relate the text to something else, etc.) and asking students, "How did you get through the challenges?"

Kim and Stephanie gave many reading strategies to help address reading difficulties from tackling words and their roots to identifying evidence to interactive learning logs. They also gave ideas for anchor charts about what can be done when a student hits a wall in his or her reading of science text. For example: What can I, as a student, do immediately? Where can I, the student, go for help? Then the class comes up with the answers.

As a result of attending this session, rather than use the online site that rewords scientific articles, I'm now going to that site less frequently and asking students more questions like, "How did you figure out the meaning of . . .?" I plan to begin using anchor charts with helpful hints (strategies) and selecting more specifically focused articles for use in class. More and more, I'm eliciting student input which enables me to identify misconceptions earlier and enables more students to participate in the discussions that show their thinking.

I wish I could say that all my students no longer have reading difficulties. However, I can say they are becoming less reluctant to try the reading and are more open to sharing their thoughts and ideas. All of these outcomes are steps in the right direction.

Thank you to the MSTA and Meemic who made my attendance at the 2016 MSTA Conference possible. I left with a gold mine of ideas to try with my students!

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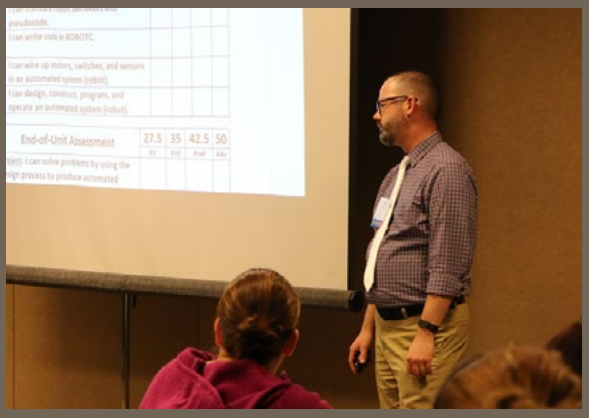
MSTA 2016 Conference

Scholarship Winners Reflect on the 2016 MSTA Conference *continued from page 8*



Kathleen Schwach, Sashabaw Middle School

It was great to be back at the MSTA conference after many years of not attending due to lack of funding. I attended many great presentations on both Friday and Saturday. One session I particularly appreciated was called "Free Teacher/Student STEM Labs and Career Exploration Labs" by Robert Tonti from Macomb Community College. This session was very relevant since I teach both 7th grade Science and Career Awareness classes. During the session, we made a small hovercraft using a CD and simple craft supplies. I was also given an opportunity to set an appointment for a hands-on STEM lab at our school. We are very excited to be able to offer this program to our students and parents later this year, and we look forward to other programs for next year as well.

Another session that was particularly helpful was "Developing NGSS Assessments for 3D Learning" presented by Jane Lee, Phyllis Haugabook Pennock and Deborah Peek-Brown from the CREATE for STEM Institute at Michigan State University. The presenters were very knowledgeable and well-versed in NGSS and integrating the three dimensions into assessments. As the science department chair at my school, I am currently involved in developing new assessments, so this session was particularly useful. I literally took pages of notes to share with my colleagues!

I am very thankful that I was given this opportunity to attend MSTA in 2016, and I look forward to attending next year!

Alexandria Steffke, Oscoda Area Schools

This March, I attended my first MSTA conference as a scholarship recipient. As a first year teacher going to the conference, I wasn't exactly sure what to expect, but I am so delighted that I went. The conference provided the opportunity to meet and learn from educators all over the state of Michigan. I attended numerous presentations with topics ranging from the Next Generation Science Standards, interactive science notebooks, STEM lesson plans, hands-on activities, classroom management, and so much more! I walked away from the conference with my eyes opened to all of the science opportunities I can use to engage my students within the classroom. I would definitely attend again, and recommend anyone that teaches K-12 science to attend!

Brad Gerbe, Manchester High School

I try to attend the MSTA conference every other year. I make it my goal to find one laboratory, activity or strategy that I can immediately implement. Further, I try to attend sessions that will challenge me to "think outside the box" and "get out of my comfort zone". I also appreciate the opportunity that I have at the conference to network with colleagues. These conversations often lead to follow-up opportunities where we share materials with one another. I always leave the conference with a renewed vigor to teach science.

This year, I found the session with Joe Krajcik to be of particular interest. I've worked with Joe previously and continue to do so. Joe's emphasis on modeling and on guiding student inquiry through NGSS integration is powerful. I was fortunate to receive scholarship to attend the MSTA conference, and I am grateful for the support of businesses who made my attendance possible.

MSTA 2016 Conference

Piloting a Mi-STAR Unit on Climate Change with Eighth Graders

By Dawn Kahler, Milwood Magnet School, Kalamazoo Public Schools; with contributions by Kendall Grazul, Jenison Public Schools

How do you determine if humans are causing global climate change? Designing an experiment is problematic because we can't simply create another Earth and compare it to our own planet. Even the most sophisticated computer models have a hard time recreating many aspects of our planet's 4.5 billion-year climate history. Nevertheless, we can make thoughtful inferences from data, and that's exactly what my eighth graders did last year.

My class piloted an eight-week unit on global climate change developed by the Michigan Science Teaching and Assessment Reform (Mi-STAR) project. Based at Michigan Technological University, Mi-STAR is bringing together curriculum developers, content experts, and classroom teachers to create a new middle school curriculum that aligns with the Michigan Science Standards and the Next Generation Science Standards. Kendall Grazul and I are among the teachers helping to write the Mi-STAR curriculum's climate change unit.

My class truly enjoyed the unit, in part because it involved Michigan Tech, which they thought was awesome. Since the Kalamazoo Promise, we've become a college-going community, and Michigan Tech is now very much on my students' radar as a possible destination. They were also enthusiastic about tackling climate change, which is perhaps the biggest social and scientific challenge of our time. During one lesson, they play a carbon-cycle game, and I could almost see the light bulbs going on in their heads.

Like many Mi-STAR units, this one begins with a question: What factors have caused the rise in global temperatures over the past century? We didn't present it as, 'Is climate change happening?' because the data is clear on that. Students started their investigation by writing a "grant proposal" to conduct research on the causes of global climate change. They gathered data linking the release of greenhouse gases to changes in climate and investigated different ways humans impact global climate change, from making concrete to burning fossil fuels.

Through their investigations, students saw how global climate change affects Michigan and zeroed in on the maple syrup industry. They discovered that our climate is getting warmer, and that the increasing temperatures are affecting sap production. The students expanded their view to other aspects of the Great Lakes ecosystem and concluded that even small increases in temperature can have a big effect. For example, increases in extreme weather events such as tornadoes become more likely when our climate warms.

The students drew on many sources of data, from leaf fossils in the Smithsonian to 150-year-old records of the ice cover on Wisconsin's Lake Mendota. They learned that drawing conclusions from a few data points is risky. Students also came to the conclusion that they need a minimum of fifteen years of data to make interpretations about "climate" rather than those we can attribute to "weather."

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Piloting a Mi-STAR Unit *continued from page 10*

The unit addressed a particularly complex concept in an age of global warming: why climate change doesn't always mean it gets hotter. We talked about the polar vortex, and how when it weakens it alters the jet stream and causes colder than average temperatures throughout the Midwest.

Climate change is complex, and to the general public it can be controversial. For these reasons, this unit is the culmination of the Mi-STAR curriculum. The unit engages students in analyzing real data demonstrating both natural and human causes for global climate change, and helps students think about and develop their own understanding of what's behind the current changes.

The unit also gives eighth-graders tools to help reduce their own carbon footprint. We want them to feel empowered. They realize this is a big issue for them and will continue to be for the next generation as well. They will have to deal with global climate change and its consequences, so it's important that they have the scientific knowledge regardless of their career path. Climate change is not just a topic for scientists!

As the unit progressed, I watched my students develop not only scientific knowledge, but also the reasoning skills they will need in adulthood. In the past, that's been a struggle, and throughout this unit I could see some real progress. I was surprised to find that there wasn't much "pushback" from my students in terms of climate change skepticism. As my students evaluated the science, they became convinced that humans were behind the surge in average global temperature.

Modeling Tectonic Plate Boundaries

Terry W. Grabill, Fremont Middle School, MSTA Region 7 Director

Introduction

The new Michigan Science Standards emphasize the importance of engaging students in developing and using models. While models have always played a role in science classrooms, the emphasis is now on students developing their own models to explain and predict phenomena rather than simply making representations of science ideas or learning about "textbook" models. A colleague of mine recently suggested that of all the sciences, Earth science lends itself the least to students developing their own models. With this in mind, I set out to challenge my eighth grade Earth science students to model interactions at the margins of tectonic plates. These students had been given a basic overview of plate tectonics in sixth grade, and in a previous unit this year they learned about earthquakes. A series of phenomena represented by images found online were used as the starting point for each modeling challenge. The photographs showed only Earth's surface and progressed in complexity each day.

The Modeling Activities

Lesson one: At the outset, I realized that it would be necessary to develop a basic model of the lithosphere and asthenosphere as a starting point. I had the students develop a definition of these words that the class can understand and agree on and write them on the board. From there, we came up with a basic model as our starting point. The rule was that our base model had to explain both definitions. Next year, I will have students develop the base model from the definitions on their huddle-boards and use a class talk to reach consensus on a model.

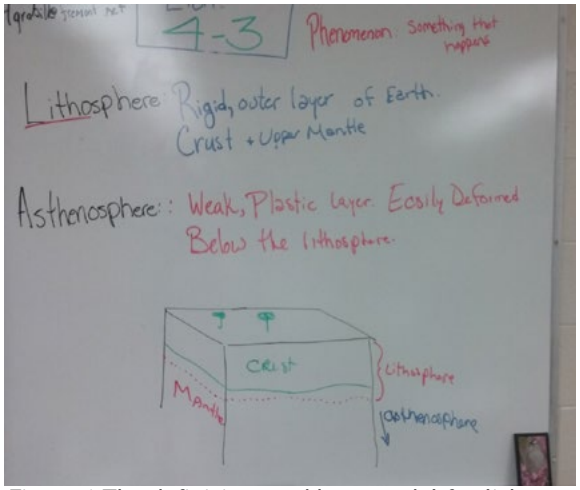

Figure 1 The definitions and base model for lithosphere and asthenosphere.

With the definitions and base model in their science notebooks and the class divided into groups of four, I displayed the first phenomenon, an orchard displaced with a strike-slip fault. The students were asked to consider the phenomenon only by what could be observed in the illustration. Then, the groups were asked to explain the phenomenon using the base model agreed on by the class. I think it's important to start with this type of a margin because it's probably the simplest to imagine and interpret, since it is neither a constructive nor destructive event.

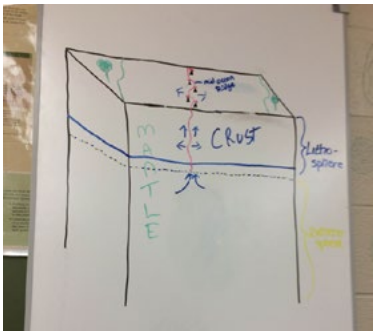

Figure 2 A reconciliation model of a mid-ocean ridge (Note: mantle is mislabeled)

Lesson two: Students were presented an illustration of the Atlantic Ocean basin, a mid-ocean ridge. They were asked to represent the ridge phenomenon in terms of our base model. Students needed some background information in order to make sense of the phenomenon, so I labeled the ocean ridge system, including the area where the youngest rock is, as well as the oldest and where volcanic activity occurs. Modeling the ocean ridge proved to be quite a challenge for the kids and one that they welcomed. By the end of the second day, I also informed students that the basin is widening and asked them to account for that in their models.

Lesson three: On the third day we considered convergence, which includes three types. I decided to have the students begin by considering the boundary to the north of the Indian sub-continent. The only information I gave was that these mountains are not volcanic. Students tackled this model with confidence and enthusiasm. With few exceptions, all groups were successful on this relatively simple phenomenon.

continued on page 13

Modeling Techtonic Plate Boundaries *continued from page 12*

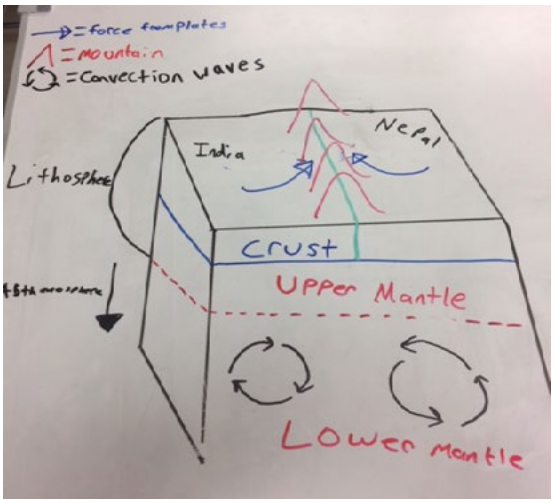

Figure 3 Notice convection in asthenosphere. Students began challenging one another to describe the energy source and forces at work.

Lesson four: On the fourth day, students were presented with a map of the Aleutian Islands showing Alaska and Siberia as well as the Aleutian Trench, and I reminded them of the composition of the oceanic crust. Students were asked to quietly consider and make notes of their impressions before joining their groups. I entered this day with a bit of trepidation, since I thought the concept was considerably more complicated than prior work. Most students were enthusiastic to share their thoughts with the class, even before meeting the groups. I found that this task was not above their abilities, even for those with no training in plate dynamics. Instead of a "gallery walk" as in previous days, students were arranged in a circle with their models so that all could see the collection together. A very lively and positive discussion of the models occurred, and many groups revised and improved their models.

Lesson five: I finished up this mini-unit with a challenging phenomenon. Students were presented a diagram of South America's west coast and asked to model the plate interaction that produces an off-shore trench along with a continental volcanic mountain range. Considering their success with the earlier models, I expected to see a sophisticated understanding of the subduction due to density differences in continental vs oceanic material and orogeny of the continental volcanism.

Conclusion

I feel confident that this group of eighth-graders understand plate dynamics far better than in previous years. By having the students model the unseen mechanisms to explain observable phenomena, they developed models that demonstrated relatively sophisticated understanding. They expressed excitement from the moment they entered the classroom until the final bell, saying things like, "I can't believe class is over!" and "I want to talk about it more!" I saw kids engage in ways that I've never seen, and was proud of their cognitive progression. My colleagues even said the students were talking about the science lesson in their other classes.

One of my main struggles was deciding how much information to give students about each phenomenon. I felt that I needed to adjust my instruction as the day progressed, and sometimes I thought I was giving away too much. However, even when this happened students took the extra information and went farther than I expected. For example, they even included the convection currents that drive the plate movement on day three.

With only 59 minutes per class period, the process was more rushed than the students and I would have liked. My classroom only has a few "huddle boards" and the work had to be erased after each session. I think understanding would have been deeper and reached more students if they would have been able to keep their work until the next meeting and had an opportunity to edit and modify their models. Instead, we had to wrap-up the lesson with a quick consensus that could have been more student-centered if time wasn't such a limiting factor.

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Making Sense of Photosynthesis with the Crosscutting Concepts of Matter and Energy

Andrew J. Frisch, Farwell High School

For students, learning about photosynthesis can be as boring as watching grass grow. As a teacher, it can be difficult to get kids excited to learn about "what plants do," because they have learned about the process of photosynthesis at varying levels of detail in both elementary and middle school. To combat this problem, I have begun teaching photosynthesis as an application of chemistry and physics concepts. Using the crosscutting concept "Energy and matter: Flows, cycles, and conservation" to understand how matter and energy are conserved in the process of photosynthesis helps students to ask new questions about this "familiar" process.
The first objective for the photosynthesis unit is the law of conservation of mass. This is explored with a series of questions:

- What is a tree made of? (Atoms – mostly carbon, hydrogen, and oxygen)
- What is the difference between the material making up a small sapling and a large, mature tree? (The number of atoms)
- Where do all of the extra atoms come from as a tree grows? (Students share many misconceptions in response to this question including the idea that the atoms come from the tree, the seed, or the ground. Of course, most of the atoms actually come from carbon dioxide in the air and water and are made into glucose through the process of photosynthesis. A small amount of matter also comes from inorganic nutrients in the soil.)

The next objective is to remind the students of the chemical equation for photosynthesis:

$$\text{Sunlight} + 6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$$

This equation is a middle school concept. Students may also need to be reminded of the chloroplast organelle within a plant cell, which is the exact location of the photosynthesis chemical reaction.

Now the new learning and teaching can begin. How do the reactants (Sunlight + $6CO_2$ + $6H_2O$) get to the chloroplast? And how do the products ($C_6H_{12}O_6$ + $6O_2$) get from the chloroplast?

The first reactant discussed is carbon dioxide as an atmospheric gas. This is the same gas that comes out of our mouth when we exhale and soda pop when it fizzes. It is on the rise in our atmosphere as we burn more fossil fuels. It simply diffuses into leaves. Therefore, there must be an opening – this is called the stoma. Since carbon dioxide (CO_2) contains only one carbon and glucose ($C_6H_{12}O_6$) has six, there must be six CO_2 used for every one $C_6H_{12}O_6$ that is produced.

But where does the hydrogen come from? Good ole' water (H_2O) is a wondrous liquid. It falls from the sky and soaks into the ground. The students usually understand that the roots absorb the water, but how does the water get from 10 feet underground to 20 feet above ground? This they do not know: transpiration pulls water up the xylem through the veins of a leaf and then evaporates out the stoma. Since one molecule of glucose ($C_6H_{12}O_6$) requires 12 hydrogens and each water molecule (H_2O) can only provide two, there must be six water molecules

Making Sense of Photosynthesis *continued from page 14*

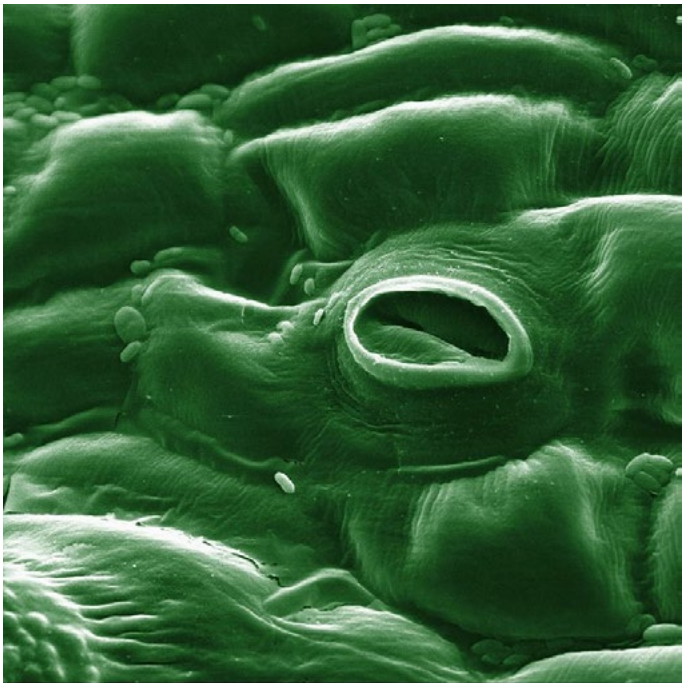
used to (groups of two) make one glucose ($C_6H_{12}O_6$) molecule.
Of course, making glucose out of inorganic materials requires a lot of energy! Students generally know that sunlight provides this energy, but they certainly do not understand how. Sunlight is pure electromagnetic energy. The light shines right through the cuticle (which is made from the same material as your fingernails), the transparent water-proof layer that covers the top of the leaf, and is absorbed by pigments in the chloroplast. This energy is used to convert water and carbon dioxide into glucose and oxygen. While much of the energy is lost as heat, some of it is stored in the bonds of glucose and is then available to fuel the life processes of the plant (and all consumers, since they rely on plants as producers!).

Finally, what happens to those products made in the chloroplast?

1. Oxygen (O_2), the life-sustaining gas used for cellular respiration, diffuses out of the leaf, through the same opening the CO_2 came in, the stoma.
2. The glucose is moved through the phloem to all of the cells of the plant to be used as a matter and energy source for growth (through the process of cellular respiration).

Suggested follow up activities:

- To reinforce the students' understanding, bring in a big heavy log or stick and ask, "What is this log made out of?" Students should be able to explain that the log is mostly carbon, hydrogen, and oxygen atoms which come from air and water in the process of photosynthesis.
- Bring in leaves and plain paper. Have students feel the top of the leaf. It does feel like your finger nail. Feel the bottom of the leaf and you can feel the bumps and ridges, the stoma and veins. Then have them place the leaf under the plain paper and use a pencil to shade or etch over the leaf. This will show all of the details of the leaf. Then use the etching of the leaf to reinforce the structures of a leaf and how these structures provide and remove all of the material of photosynthesis.



- Paint a small area on the underside of the leaf with clear nail polish. Once it is dry, place transparent tape over it and gently pull back the nail polish to create a "leaf print" to view the stomata under the microscope.
- Allow the students to pull, rip, and dissect the leaf and its stem in any way they choose. They come up with all kinds of wonderful observations. How does the structure of the leaf support its function of performing photosynthesis?

Colorized electron microscope image of a stoma on the leaf of a tomato plant. Image from:

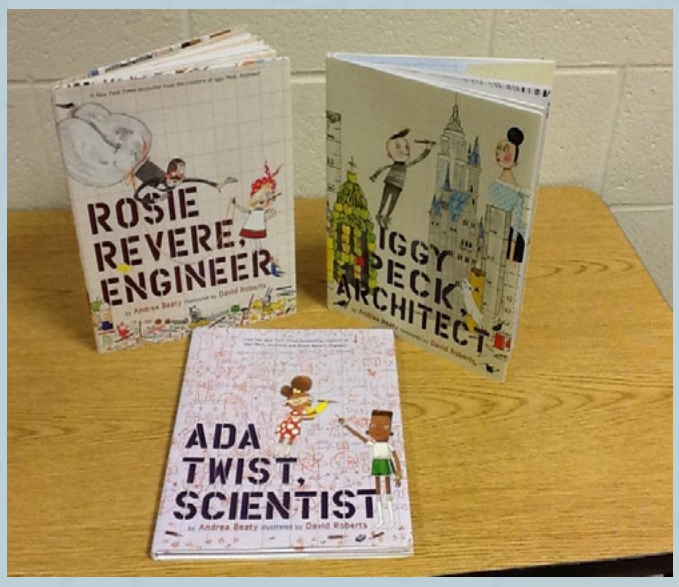
https://commons.wikimedia.org/wiki/Category:Stoma#/media/File:Tomato_leaf_stomate_1-color.jpg

The Use of Children's Books to Encourage Young Scientists and Engineers

By Holly McGoran, Jenison Public School science teacher & STEM instructional specialist, MSTA Curriculum Director

"What do you want to be when you grow up?" is a question often asked of elementary-aged children. Some popular responses in the past have included a doctor, a lawyer, a police officer, or a teacher. But with the implementation of the new Michigan Science Standards, a new set of responses has emerged. Last spring, an enthusiastic first grade boy told his STEM teacher, "I am going to be a civil engineer when I grow up." He had already discovered the perfect place to build his first bridge—on the playground—to help students get across a piece of land that is always muddy or flooded. This fall, I overheard a fourth grade girl tell one of her classmates that she is going to college to become a biomedical engineer, because it's like being a doctor—only better. These responses come, in large part, from incorporating the science and engineering practices in classrooms to engage students in asking and answering questions about phenomena and designing solutions to problems.

According to The National Research Council's A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas, "the actual doing of science and engineering can also pique students' curiosity, capture their interest, and motivate their continued study" (NRC, 2012, p.42-43). And I know many teachers who would love for their students to aspire to become scientists and engineers!



Even after experiencing the joy of science and engineering in the classroom, it can be difficult for young learners to envision themselves as scientists and engineers. Through the use of children's books, students have the opportunity to identify with young characters who are engaging in the science and engineering practices.

Author Andrea Beaty and illustrator David Roberts have brilliantly created three characters—Iggy, Rosie, and Ada—with whom young students can easily relate.

- In *Iggy Peck, Architect*, students learn of a boy who, much to his parent's dismay, loves to build structures out of anything he can get his hands on. As a second grade student in Miss Lila Greer's class, Iggy's love of building ultimately solves a problem for his teacher and classmates.
- One of Iggy's classmates is featured in *Rosie Revere, Engineer*. Rosie is a young girl who dreams of becoming an engineer. Throughout the story, Rosie imagines, plans, and creates many unique things, each with a specific purpose in mind.
- And then there is *Ada Twist, Scientist* who is curious about everything! She asks questions and carries out investigations to explain puzzling phenomena.

In addition to identifying the science and engineering practices, students learn about the perseverance, creativity, and critical thinking involved in science and engineering.

I would encourage elementary science teachers to seek out these books as well as other children's books to support the implementation of the new Michigan Science Standards. Please consider sharing more examples and uses of children's books with other members of the Michigan Science Teachers Association. You can do this by writing an article for the newsletter, by tweeting a brief book review to #MiSciChat, or by presenting at the annual conference on March 24-25, 2017 in Novi.

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The 53rd Annual Junior Science and Humanities Symposium

March 10, 2017 at Wayne State University

High School Science and Mathematics Teachers and their Student Researchers are invited to attend the Junior Science and Humanities Symposium (JSHS) Program, sponsored by the Academy of Applied Sciences and the U.S. Army, Navy, and Air Force. Since its inception in 1958, the primary aims of JSHS are to promote research and experimentation at the secondary school level and to recognize students for original research achievements. Participation in the symposium is FREE for all eligible high school students and their teachers.

In the Southeastern Michigan region, the program is housed in the College of Education at Wayne State University. Every year, students from high schools around the state attend the symposium at Wayne State University. Participants present their research, tour selected science laboratories, and interact with professional science researchers throughout the day. During the dinner banquet, finalists are notified of awards to advance to the National Symposium.

Regional finalists will be invited to attend the National JSHS April 26- 30, 2017, in San Diego, California with all expenses paid by the Army Educational Outreach Program.

The Symposium is a valuable resource for students who plan to participate in this year's Science Fair or Science Olympiad.

Students who present their research at the Symposium have the opportunity to receive significant scholarships, to the university of their choice, at the regional and national levels.

All the application forms, guidelines and other information are available at: http://coe.wayne.edu/ted/science/jshs/

For additional information contact Dr. Sandra Yarema (JSHS Director) at Wayne State University. Email: Yarema@wayne.edu or Tel.: 313/577-5754

The deadline for submission of student research papers and application materials is January 15, 2017.

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Student Scientist Excels at NASA Ames Research Lab in Silicon Valley

Getting the opportunity to work at a national research lab within the NASA organization is at the top of the list for most scientists. There is so much to learn ranging from robotics to supercomputing. There are also opportunities to work with the brightest and smartest people in the world under one roof.

Bria Harris, a senior at Detroit Edison Early College of Excellence and a research scientist in the Ecotek Lab Program, recently completed an internship at the NASA Ames Research Center in Mountain View, California. She secured the position after attending a STEM Conference for Women where she shared her passion of computer science and was able to demonstrate her capacity in developing virtual reality applications.

Bria has been offered another internship at the NASA headquarters in Washington, DC for next summer to continue her work. Wow! She is not even out of high school yet!

Bria is very talented. She created a spot for herself in Ecotek Lab Program. Her passion is computer science. She found a way to link that passion with research that is being done in the lab by other student scientists. During her sophomore year in high school, Bria assisted the Mount Saint Helens expedition team by creating a virtual reality environment of the terrain in and around the volcano using Unity3D. She took the initiative to present this application as part of her portfolio when applying to participate in the NASA Virtual Reality Academy.

While at Ames Research Center, Bria focused her efforts on using Unity3D to enable a person to create multi-platform applications for iPhone, Xbox, Android, and Microsoft HoloLens. This is cutting edge experience and hands-on work in one of the fastest growing technology spaces-augmented reality. She was responsible for designing and developing an application within Unity3D that could be projected using Microsoft HoloLens. The application will allow a person to move an object such as a pencil or pen, across multiple virtual theaters (e.g. surface of a desk, in mid-air or along a wall).

Microsoft HoloLens, now under development as Project Baraboo, is a pair of mixed reality head-mounted smart glasses developed and manufactured by Microsoft. HoloLens gained popularity for being one of the first computers running the Windows Holographic platform under the Windows 10 operating system.

About the Ecotek Science Program

Ecotek is a science research lab program for young inventors and researchers in grades 5 thru 12. Student scientists work on projects aligned with the issues being addressed by world leaders at the United Nations. To learn more about Ecotek Lab go to http://www.ecotek-us.com

ECOTEK
Science at Work!

Presidential Awards for Excellence in Mathematics and Science Teaching

Do you know or are you an exemplary math or science teacher in the seventh through twelfth grade? Please consider nominating him/her/them for the PAEMST Awards. The Presidential Award for Excellence in Mathematics and Science Teaching is the highest recognition a K-12 teacher can receive for outstanding science or mathematics teaching in the United States.

Why apply? Recipients of the award receive the following:

- A certificate signed by the President of the United States.
- A paid trip for two to Washington, D.C., to attend a series of recognition events and professional development opportunities.
- A $10,000 award from the National Science Foundation.

In addition to recognizing outstanding teaching in mathematics or science, the program provides teachers with an opportunity to build lasting partnerships with colleagues across the nation. This growing network of award-winning teachers serves as a vital resource for improving science, technology, engineering, and mathematics education and keeping America globally competitive.

Awardees are recognized for their contributions to teaching and learning and their ability to help students make progress in mathematics and science. In addition to honoring individual achievement, the goal of the award program is to exemplify the highest standards of mathematics and science teaching. Since the program's inception in 1983, more than 4000 outstanding teachers have been recognized for their contributions to mathematics and science education. If you know great teachers, nominate them to join this prestigious network of professionals. If you are a great teacher, you may nominate yourself!

Nominations and the Applications are now available online (www.paemst.org) for the 2017 Presidential Awards for Excellence in Mathematics and Science Teaching. Teachers may nominate themselves or someone else (e.g., principals, teachers, parents, or other members of the general public) may nominate them for this award. To apply, teachers must first be nominated for the award. Once nominated, teachers will receive an email with a login and password to access the online application. The application deadline for 7-12 grade teachers is May 1, 2017. Elementary teachers (K-6) are eligible to apply in 2018.

The Michigan Department of Education has asked the Michigan Science Teachers Association to oversee this program for the State of Michigan. We are honored to be the host of this awards program. If you have any questions, please feel free to contact, Betty Crowder, our State Coordinator, at betty_crowder@msta-mich.org. In the meantime, please visit the Presidential Awards website this fall to find the nomination form for the teacher of your choice! Why not you? www.paemst.org The rewards are worth the effort! You deserve it!