MSTA Newsletter

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In this Issue

From the President's Desk

By Charles Bucienski, MSTA President

With the November passing of the Michigan Science Standards (MSS), the 63rd MSTA conference will focus on informing science teachers on all things MSS.

The regular conference will be held on Friday and Saturday, March 4-5, 2016 at the Lansing Center and will feature over 260 sessions! Many of these sessions include invaluable information on using the MSS in your classroom. A special pre-conference session on Thursday, March 3rd is specifically designed for elementary and middle school teachers and will focus on light, density, forces, and reactions. If you would like to sign up for this session please visit our website at MSTA.org

Our Keynote presentation by Joseph Krajcik from the CREATE for STEM Institute will be at 1:00pm on Friday. In his talk, titled "What Do the New Michigan Science Standards Mean for Instruction and Assessment in your Classroom?," Professor Krajcik will discuss the major shifts in the new standards. This session will be for teachers, curriculum directors and administrators of all levels. It will focus on the shift from science classrooms as places where students learn about science ideas to environments where students use disciplinary core ideas, scientific and engineering practices and crosscutting

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From The Desk of Your Executive Director

From Robby Cramer, MSTA Executive Director

The mission of the MSTA is to stimulate, support and provide leadership for the improvement of science education throughout Michigan.

The State of Michigan Has New Science Standards!

On November 10, 2015, the State Board of Education officially voted to adopt the new ***Michigan Science Standards***. During the discussion the various board members offered comments about the new science standards. Several talked about how much they appreciated all the science teachers who had taken the time to come to Lansing to attend board meetings and the public comment sessions over the past few years. Board members noted the value of teachers sharing information about these new standards and explaining how they teach science using the new practices of science and engineering. The stories and examples we offered as educators framed our passion and belief that ***doing science is important for all students*** in our state.

In a November 12, 2015 press release by the State Board of Education President John Austin stated:

These new Michigan Science Standards will help our terrific Michigan science educators engage young people in the doing of science, solving real world problems, and getting excited about pursuing science and engineering careers. They also send a clear message that Michigan is serious about being the top science and engineering state, preparing the talent to solve the problems of the future right here in Michigan. *(http://www.michigan.gov/mde/0,4615,7-140-5373_5379-369104--, 00.html)*

It was very special to listen that day and hear how telling our story of science education and teaching made a difference. The new Michigan Science Standards are now officially the standards for science education in our state.

What Should We Be Doing Right Now?

- Take time to look at the new **Michigan Science Standards.** They can be found on the Michigan Department of Education website: *www.michigan.gov/science*
- Carefully examine the Guidance Documents. Note that Michigan Science

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From the President's Desk

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concepts to explore, examine and use science ideas to explain how and why phenomena occur or to find solutions to problems. It will also explain how assessments, both summative and formative, will need to shift to provide opportunities where students apply their knowledge to explain phenomena or design solutions to problems.

This year's conference will also include major strands for Elementary, CREATE for STEM, MSELA, and MI Math/ Science Centers.

With the adoption of the new Michigan Science Standards and the resulting shifts in science education in our state, the 63rd MSTA conference should not be missed!

We recently added a Thursday pre-conference session designed specially for administrators. This workshop will answer questions and provide information that will aid in incorporating the Michigan Science Standards (MSS) into educational practice. Peter McLaren, the Director of State and District Support for Science at Achieve will be the featured presenter. Pre-registration is required - so be sure to sign up!

From the Executive Director

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Standards are the topical arrangement of the performance expectations of the Next Generation Science Standards: *http://www.michigan.gov/documents mde/Draft_Guidance_for_Proposed_Michigan_K-12_ ScienceStandards_-_August_2015_499948_7.pdf*

- Think about your educational setting. What are the needs for your district, school, team, and or department?
- Where can you get resources to help begin the dialogs and conversations that need to happen in your educational setting?

Finding Resources to Help Right Now.

- Join us at the MSTA State Conference! Go to the MSTA website. The March 4 and 5, 2016 State Science Conference as well as the March 3 Pre-conference information is posted and has been designed to help you. Check out all the conference sessions, strands, and preconference workshops that could be very useful in planning your next steps.
- Read Stephen Best's article in this MSTA newsletter to learn about the Michigan Department of Education's recommendations for what to do for the remainder of this year.
- Sign up for the NGSS NOW Newsletter: *http://www nextgenscience.org/news*
- Continue to check for updates from the Michigan Department of Education: *www.michigan.gov/science*

We finally have new Michigan Science Standards. Now the real work begins. By working together we can help Michigan educators, parents, and students "do science" to create their own understanding. Let's share together.

Michigan Science Standards – Next Steps

This past November, after more than two years of review, the State Board of Education adopted new standards for science. The new Michigan K-12 Science Standards, based upon the Next Generation Science Standards, replace the standards adopted in 2006, commonly known as the Grade Level Content Expectations and High School Content Expectations for Science.

- The new standards are really a set of student performance expectations. These performance expectations incorporate three main elements:
- Disciplinary Core Ideas (science specific concepts in the life, earth, and physical sciences),
- Science and Engineering Practices (the practices of engaging in scientific investigation to answer questions, and engineering design to solve problems),
- Cross-Cutting Concepts (conceptual ideas common to all areas of science).

These expectations are also interwoven across disciplines, including connections to language arts and mathematics. While we have been working towards the adoption for some time, now that they have been adopted statewide, we want to encourage educators, administrators, and community members to proceed thoughtfully with implementation. The Michigan Department of Education is working with partners like the Michigan Science Teachers Association to help educators and schools transition instruction, course descriptions and curricula, and assessment of student learning to address the new standards. This year will bring a variety of programs and supports to assist everyone in making this transition. Our hope is that everyone will use the remainder of this school year to begin planning for implementation, knowing that it will likely take several years to fully achieve these standards for all of our students.

So, rather than starting with developing a whole new curriculum or purchasing new textbooks, we would like to encourage educators to:

1. **Get to know the standards.** Review the actual standards documents, guidance materials, and some of the resources that have been developed to support implementation.
2. **See what instruction and student learning in science currently look like in your school.** Don't just review scores – look at samples of student work, including projects, classroom assignments, and investigations to see where your students are now, and what you can build upon as you begin this transition.
3. **Identify expertise and resources.** You will not find a textbook that is fully aligned to these standards, nor would such a resource, or probably many of the lessons currently being used in classrooms result in students meeting these new standards. However, identifying expertise and resources in teaching toward the new standards in your building or district will help you identify starting points for implementing them.

We are working with leaders from around the state to help support everyone in improving our students' understanding and appreciation of science. The Michigan K-12 Science Standards, and their supporting resources, are a good first step. You can find these items at *http://mi.gov/science.*

Stephen Best
Assistant Director – Office of Education Improvement and Innovation
Michigan Department of Education

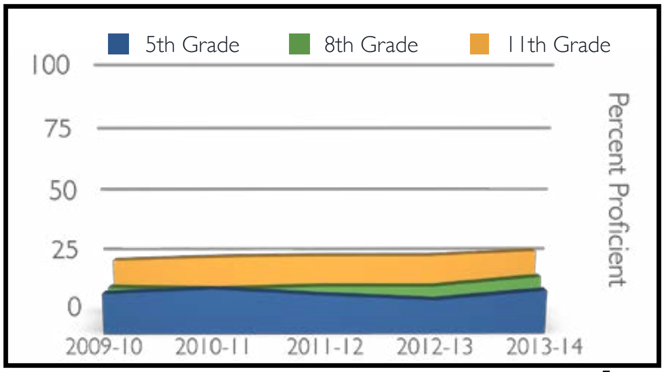
Follow MSTA on

Visit www.msta-mich.org for the latest information on the 2016 Conference and much more.

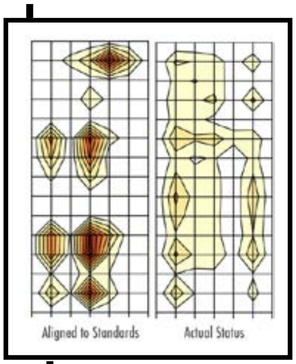
Michigan Science Standards Next Steps
A Plan for Implementation

Michigan's previous K-12 Science Standards were written in 2006 to provide guidance for our state's K-12 science education as described by the Michigan Merit Curriculum. Since that time, the understanding and skill-sets of sciences and engineering, as well as our general understanding of the natural world, has changed considerably. And, research on learning and science education provides a better understanding of how children best learn science and related skills and concepts necessary for science literacy. This research and understanding are encapsulated in the new Michigan Science Standards.

The State of Science Education

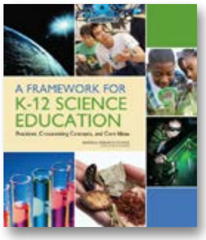


- Michigan lags behind several states in student proficiency, with nearly 3/4 of students in tested grades not proficient in science, for many reasons, including:
  - poor preparation of primary grades educators,
  - district use of outdated resources,
  - diminished time allocated to science instruction,
  - a lack of alignment between focus of the standards (as shown in the left image), and educator focus (as shown on the right).



Michigan's adoption of new standards brings a renewed focus for educators on what students need to be career and college ready, and how to get there.

A Vision for Science Education



The effort to revise science standards comes from a vision for science education that is based on over thirty years of research on how students best learn science, as well as the ever changing needs in our workplaces and communities for scientific understanding.

Starting early on, educators and communities can develop deeper understanding of scientific concepts and practices in children in ways that utilize their natural curiosity about the world. These concepts can be further developed and expanded as children grow through regular investigation of science through hands-on practices and experimentation.

This vision for the learning of science and engineering is the foundation for the Framework for K-12 Science Education, which was used to develop the proposed new standards. The framework provides a new foundation for all educators, to focus on preparing the next generation of learners and leaders in Michigan.

MICHIGAN Department of Education

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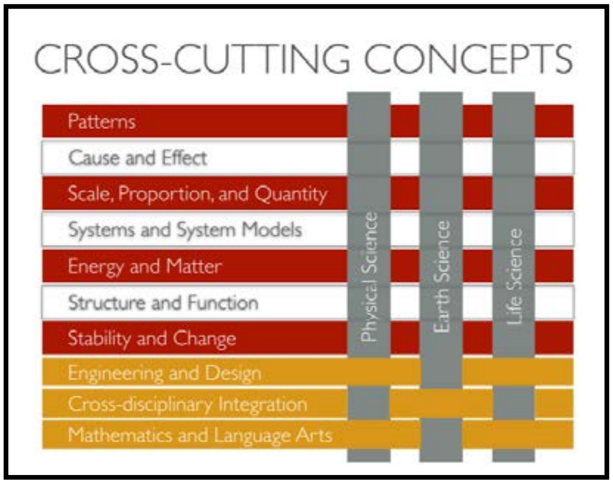
Michigan Science Standards – Next Steps *continued from page 4*

Developing Michigan's New K-12 Science Standards

Michigan became a lead state in the development of the Next Generation Science Standards in 2011, one of 26 lead states involved, with over 60 Michigan educators and scientists participating as lead developers or reviewers. Many college and university professors, teacher educators, business professionals, district and intermediate school district leaders, and classroom teachers became involved in the process, representing several organizations that will now support implementation of the standards, which were adopted in November 2015.

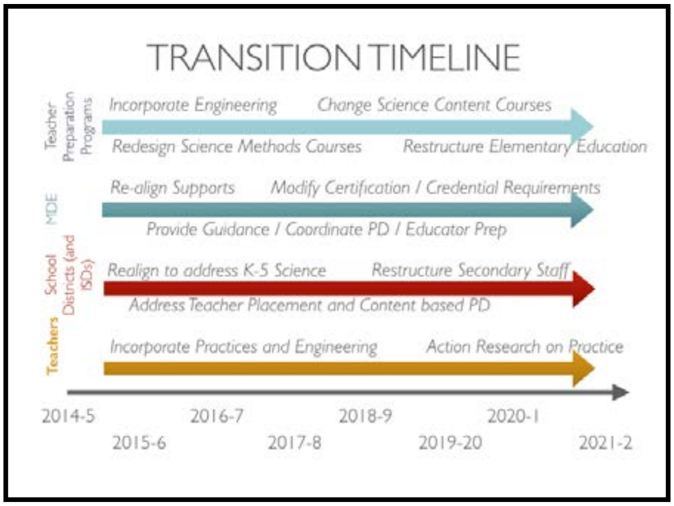


Based upon the Framework, the new standards are really a set of student performance expectations. These performance expectations incorporate three main elements:

- Disciplinary Core Ideas (science specific concepts in the life, earth, and physical sciences),
- Science and Engineering Practices (the practices of engaging in scientific investigation to answer questions, and engineering design to solve problems),
- Cross-Cutting Concepts (conceptual ideas common to all areas of science).

These expectations are also interwoven across disciplines, including connections to language arts and mathematics.

Implementing the Standards



Now that the standards have been adopted by the State Board of Education, the real challenge of implementing the standards throughout Michigan's educational system begins. Parts of this are already in development, including professional development from organizations like the Michigan Science Teachers Association and the Michigan Mathematics and Science Center Network. These efforts need to happen with a variety of stakeholders to develop a new support structure to address school district and higher education systems to engage in continuous improvement.

The Michigan Department of Education is working with the State Board of Education to ensure that the public, our legislature, and the education community at large understand the benefits and challenges of implementation of these new standards. Next steps will include initial stages of an implementation plan, including communication to all stakeholders, identification of instructional and systems exemplars, and development of Michigan-specific guidance for how to incorporate Michigan examples of science and engineering content into classroom instruction for all students.

For additional information, visit http://michigan.gov/science

Things That Make You Go "Hmmm?"

Jen Arnswald, MSTA President Elect, Ionia Public Schools

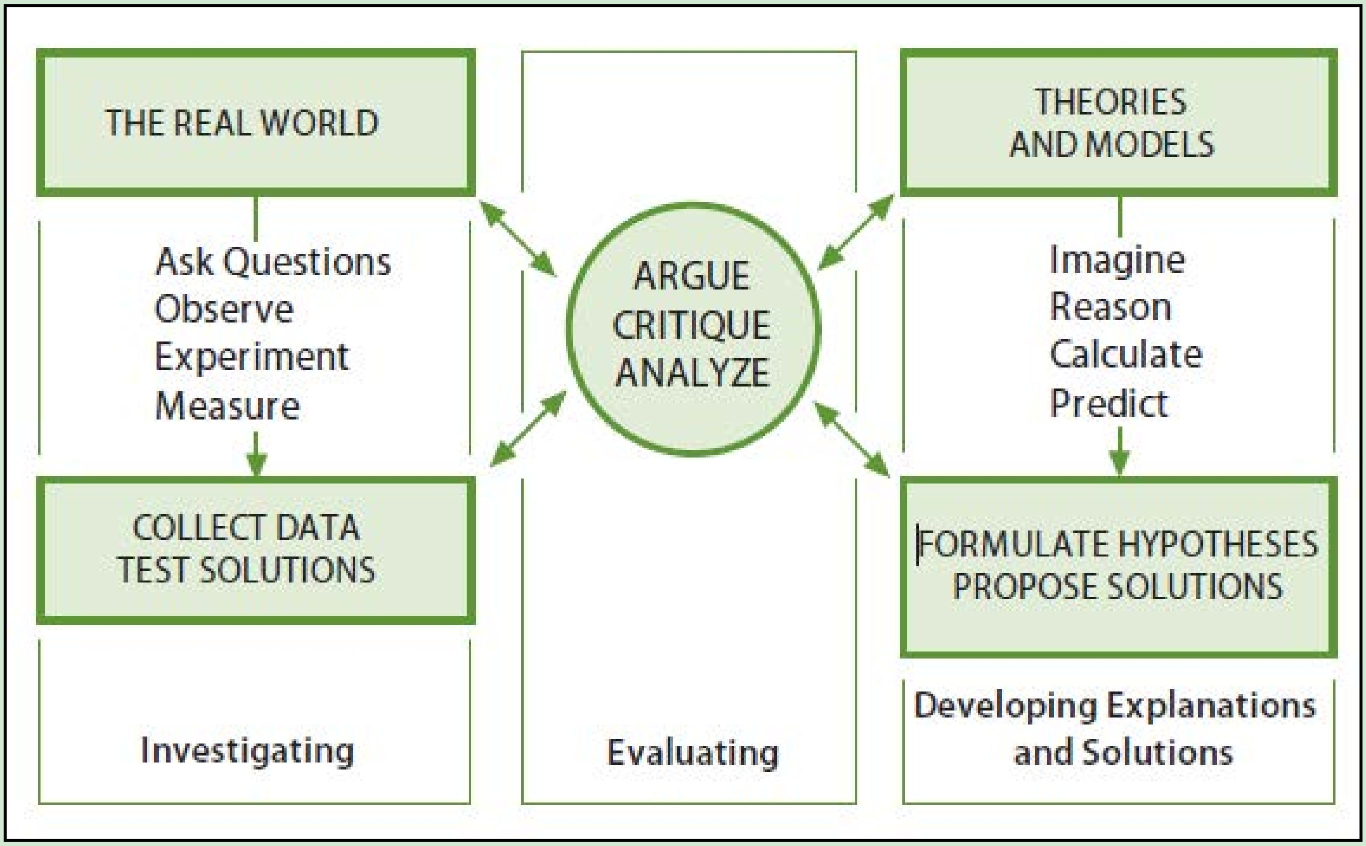
The new Michigan Science Standards call for students to construct explanations and develop explanatory models of natural phenomena. As educators have been attempting this work in classrooms, they often are at a loss for *what* the students should be trying to explain. This article will focus on the role of phenomena in units and lessons.

Imagine that you are a fourth grader. Look around and see what makes you wonder. What questions come to mind? According to the *Framework for K-12 Science Education*, "Building progressively more sophisticated explanations of natural phenomena is central throughout grades K-5, as opposed to focusing only on description in the early grades and leaving explanation to the later grades" (NRC, 2012, p. 26). In K-12 classrooms throughout Michigan we will begin to see students examining the world around them and developing explanations of the phenomena that they are naturally curious about.

What is a phenomenon

The NGSS and new Michigan Science Standards were developed from the National Research Council's *Framework for K-12 Science Education*. This report emphasizes that explaining natural phenomena is central to the work of scientists and should also be the foundation of science teaching and learning. The NRC Framework represents the practices of scientists as three "spheres of activity" shown in the figure below. The left side of the figure depicts investigation of natural phenomena. "In this sphere of activity, scientists determine what needs to be measured; observe phenomena; plan experiments, programs of observation, and methods of data collection; build instruments; engage in disciplined fieldwork; and identify sources of uncertainty" (NRC, 2012, p. 45). There's a new PBL on the block, phenomena based learning. To achieve the vision of *The Framework for K-12 Science Education* students should be engaging in science lessons that provide opportunities for them to develop and revise their explanations of phenomena.

Phenomenon [fi-nom-uh-non, -nuh n]: noun, plural phenomena [fi-nom-uh-nuh]
A fact or situation that is observed to exist or happen, especially one whose cause or explanation is in question:
Example: "Glaciers are unique and interesting natural phenomena."
(http://www.oxforddictionaries.com/us/definition/american_english/phenomenon)



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Things That Make You Go “Hmmm?” *continued from page 6*

Are you ready to try it out?

Look at the world through the eyes of your students. When you wonder why and how something happens take note. These situations or ideas that cause you to be curious are exactly what we should have students interacting with as they are developing their understandings of science.

Create units of instruction around real world phenomena. For example, instead of a “photosynthesis unit” plan a unit around the question “How do plants gain mass?” (for middle or high school) or “What do plants need to grow?” (for elementary school). Students can plant seeds and record the seedlings change in mass or height over time as a way to observe the phenomena of plant growth before learning more about how it occurs.

Give your students opportunities to observe natural phenomena (video clips are a great way to bring natural phenomena into the classroom) and ask their own questions.

Evaluate a lesson using the EQuIP rubric. Notice the emphasis on phenomena in determining whether an activity is NGSS-aligned (and thus, aligned to the new Michigan Science Standards).

References

National Research Council (2012). A framework for K-12 science education: Practices, crosscutting concepts, and core ideas. The National Academies Press.

Achieve (2014). Evaluating Quality Instructional Products (EQuiP) Rubric. http://www.nextgenscience.org/resources

Let’s look at a few examples...

Phenomenon	Possible Student Questions
Christmas Lights	How do they work? Where does the energy come from? How is it transferred? How does my brain understand what I see?
California Droughts	How can there be a drought when there is so much water on Earth? What causes a drought? How much fresh water is on Earth?
River banks	Why isn’t the area around the Grand River like the Grand Canyon? How do plants influence erosion rates? What is in the water?
Animal Observations	Why are there so many bluebirds in my backyard in the winter? Why do birds come to my feeder in a flock? Why do I see birds making nests in the spring? What do birds eat in the winter? Why do I see different birds at different times of year? Is there a connection between cows laying down and rain?
Dead plant	Why did my plant die? What do plants need to survive?
Lake Effect Snow	Why do we get so much snow on the west side of the state? How does Lake Michigan effect precipitation?
Fossils	Why are there patterns in the locations of fossils around the world?
Observing Stick bugs, Katydids	Why do some insects look like the world around them? Why are most katydids green instead of pink?

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Things That Make You Go "Hmmm?" *continued from page 7*

The Educators Evaluating the Quality of Instructional Products (EQuIP) Rubric for science

EQuIP Rubric for Lessons & Units: Science

I. Alignment to the NGSS	II. Instructional Supports	III. Monitoring Student Progress
The lesson or unit aligns with the conceptual shifts of the NGSS: A. Grade-appropriate elements of the science and engineering practice(s), disciplinary core idea(s), and crosscutting concept(s), work together to support students in three-dimensional learning to make sense of phenomena and/or to design solutions to problems. i. Provides opportunities to develop and use specific elements of the practice(s) to make sense of phenomena and/or to design solutions to problems. ii. Provides opportunities to develop and use specific elements of the disciplinary core idea(s) to make sense of phenomena and/or to design solutions to problems. iii. Provides opportunities to develop and use specific elements of the crosscutting concept(s) to make sense of phenomena and/or to design solutions to problems. iv. The three dimensions work together to support students to make sense of phenomena and/or to design solutions to problems. A unit or longer lesson will also: B. Lessons fit together coherently targeting a set of performance expectations. i. Each lesson links to previous lessons and provides a need to engage in the current lesson. ii. The lessons help students develop proficiency on a targeted set of performance expectations. C. Where appropriate, disciplinary core ideas from different disciplines are used together to explain phenomena. D. Where appropriate, crosscutting concepts are used in the explanation of phenomena from a variety of disciplines. E. Provides grade-appropriate connection(s) to the Common Core State Standards in Mathematics and/or English Language Arts & Literacy in History/Social Studies, Science and Technical Subjects.	The lesson or unit supports instruction and learning for all students: A. Engages students in authentic and meaningful scenarios that reflect the practice of science and engineering as experienced in the real world and that provide students with a purpose (e.g., making sense of phenomena and/or designing solutions to problems). i. The context, including phenomena, questions, or problems, motivates students to engage in three-dimensional learning. ii. Provides students with relevant phenomena (either firsthand experiences or through representations) to make sense of and/or relevant problems to solve. iii. Engages students in multiple practices that work together with disciplinary core ideas and crosscutting concepts to support students in making sense of phenomena and/or designing solutions to problems. iv. Provides opportunities for students to connect their explanation of a phenomenon and/or their design solution to a problem to their own experience. v. When engineering performance expectations are included, they are used along with disciplinary core ideas from physical, life, or earth and space sciences. B. Develops deeper understanding of the practices, disciplinary core ideas, and crosscutting concepts by identifying and building on students' prior knowledge. C. Uses scientifically accurate and grade-appropriate scientific information, phenomena, and representations to support students' three-dimensional learning. D. Provides opportunities for students to express, clarify, justify, interpret, and represent their ideas and respond to peer and teacher feedback orally and/or in written form as appropriate to support student's three-dimensional learning. E. Provides guidance for teachers to support differentiated instruction in the classroom so that every student's needs are addressed by including: i. Suggestions for how to connect instruction to the students' home, neighborhood, community and/or culture as appropriate. ii. Appropriate reading, writing, listening, and/or speaking alternatives (e.g., translations, picture support, graphic organizers) for students who are English language learners, have special needs, or read well below the grade level. iii. Suggested extra support (e.g., phenomena, representations, tasks) for students who are struggling to meet the performance expectations. iv. Extensions for students with high interest or who have already met the performance expectations to develop deeper understanding of the practices, disciplinary core ideas, and crosscutting concepts. A unit or longer lesson will also: F. Provides guidance for teachers throughout the unit for how lessons build on each other to support students developing deeper understanding of the practices, disciplinary core ideas, and crosscutting concepts over the course of the unit. G. Provides supports to help students engage in the practices as needed and gradually adjusts supports over time so that students are increasingly responsible for making sense of phenomena and/or designing solutions to problems.	The lesson or unit supports monitoring student progress: A. Elicits direct, observable evidence of three-dimensional learning by students using practices with core ideas and crosscutting concepts to make sense of phenomena and/or to design solutions. B. Formative assessments of three-dimensional learning are embedded throughout the instruction. C. Includes aligned rubrics and scoring guidelines that provide guidance for interpreting student performance along the three dimensions to support teachers in (a) planning instruction and (b) providing ongoing feedback to students. D. Assessing student proficiency using methods, vocabulary, representations, and examples that are accessible and unbiased for all students. A unit or longer lesson will also: E. Includes pre-, formative, summative, and self-assessment measures that assess three-dimensional learning. F. Provides multiple opportunities for students to demonstrate performance of practices connected with their understanding of disciplinary core ideas and crosscutting concepts and receive feedback.

Evaluating Quality Instructional Products Rubric (EQuIP) http://goo.gl/6wJZsH

Curiosity: The Key Ingredient for Three-Dimensional Science Teaching and Learning

Wendy Johnson, MSTA Newsletter Editor, PhD Candidate at Michigan State University

Like so many science educators in Michigan, I am incredibly excited that we have adopted new standards based on the National Research Council's *Framework for K-12 Science Education.* I remember reading the *Framework's* vision for "three-dimensional" science learning shortly after it was released and thinking to myself, *this is exactly what I want students to experience in my classroom, but I have no idea what it looks like!* Neither my experiences as a student nor my teacher preparation program had prepared me to integrate scientific practices, disciplinary core ideas, and crosscutting concepts into the type of rich learning experiences that would be necessary to achieve the vision of the *Framework*. However, the *Framework* gave me a glimpse of what science teaching and learning ***could*** look like that I found irresistible. In 2013, I decided to step away from classroom teaching for now to pursue a PhD in science education.

> *"Amazing things happen when classroom discourse is driven by curiosity – students spontaneously make connections between topics, draw on previous knowledge, and ask insightful questions."*

At Michigan State University I have been fortunate to work on a curriculum development and research project called Carbon TIME (*http://carbontime.bscs.org*), which has been invaluable to me in figuring out what three-dimensional science curriculum looks like. During the first two years of my doctoral program I also worked on a project interviewing scientists about their research. These experiences have lead me to identify what I believe to be the key ingredient in three-dimensional science teaching and learning – curiosity! The *Framework* argues that science education should build on students' curiosity and should represent science as "driven by curiosity and undertaken with the aim of answering a question about the world or understanding an observed pattern" (p. 47). Similarly, the American Association for the Advancement of Science advocates, "placing a premium on students' curiosity and creativity" (AAAS, 1995).

Unfortunately, curiosity is absent or ignored in most science classrooms. We are so busy teaching scientific content that we forget where all of this information comes from – someone was curious enough to figure it out! For example, often when students are engaging in a laboratory activity, they don't even know what the question is that they are trying to answer. "Doing a lab" without answering a question sends the message that science is about following procedures and getting the "correct answer." Of course, that couldn't be further from the truth!

Although, as a teacher I was keenly aware that I loved science precisely because it was so much fun to ask questions about the natural world and figure out answers, I was not teaching in a way that made that central. Sure there were glimmers curiosity in laboratory investigations, and especially when we discussed my favorite topic, evolution. But, in general, my students were learning about the knowledge that science has produced rather than actually participating in that process for themselves. It is participating in the production of knowledge that three-dimensional science learning is all about. That doesn't mean that students have to rediscover every scientific concept for themselves (scientists don't even do that!). It simply means that classroom science should look a lot more like what scientists actually do.

I am currently working on my dissertation studying the role of curiosity in classroom discourse. My research involves analyzing videos of classroom teaching and comparing this to student outcomes in terms of both learning and motivation. I have found that students are learning the most in classrooms that emphasize questions rather than answers. Instead of presenting activities as a way to rehearse scientific facts, the most effective teachers are presenting activities as a means to answering interesting questions. In addition, they are making students' own ideas and reasoning an important object of attention.

In a way, I feel like my research is just "proving" that the recommendations in the *Framework* really work. However, I am also uncovering how and why three-dimensional teaching leads to deeper learning. For example, when teachers engage students in sharing initial ideas about a phenomenon and developing testable questions about it, students are much more motivated to learn. In addition, they feel like their ideas are valuable and that learning can be exciting and fun. Similarly, when instruction moves beyond "doing labs" to engaging students in argument from evidence, students learn that sound reasoning supported by evidence is more important than facts or vocabulary.

Amazing things happen when classroom discourse is driven by curiosity – students spontaneously make connections between topics, draw on previous knowledge, and ask insightful questions. Of course, all of this means a shift, not just in how science is presented, but also in how teachers manage classroom talk. I think that one of

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Curiosity: The Key Ingredient for Three-Dimensional Science Teaching and Learning *Continued from page 9*

the reasons I often suppressed curiosity in my classroom was because I did not know how to manage so many ideas at once. I had a clear idea of where I wanted to get students, and mistakenly thought that the most direct route (mine!) was the best way to get there. However, I now realize that students must have ample opportunity for discussion to work through the "dead-ends" for themselves. In the three-dimensional classroom, it is the teacher's job to facilitate productive discussions, not by cherry picking the correct answers to highlight, but instead by helping students to articulate their ideas, support them with evidence, and learn to "give up" an idea when the evidence points in a different direction. I still have a long way to go, but a resource that I have found invaluable in learning to do this is the *Talk Science Primer* by Sarah Michaels and Cathy O'Connor.

If you are interested in hearing more about my research and strategies for fostering curiosity in the classroom, please join me at the MSTA Conference on Friday, March 4th from 3:00-3:45 in room 202 of the Lansing Center. The session is called "Fostering Three-Dimensional Learning: Curiosity in the Science Classroom."

References

Anderson C.W., Dauer J.M., Miller H.K., Freed A.L., Johnson W.J. (2015). CarbonTransformations in Matter and Energy (TIME) Curriculum. http://carbontime.bscs.org.

Michaels, S. & O'Connor, C. (2012). Talk science primer. TERC. http://inquiryproject.terc.edu/shared/pd/TalkScience_Primer.pdf

National Research Council (NRC). (2012). A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas. Washington, DC.

Secondary Course Sequence: What Should Be Taught When in Middle and High School?

Wendi Vogel, Kent County Science Consultant

We adopted the new Michigan Science Standards, and one of the questions that I have been getting is, “What do I teach when?” Resources and curriculum are still in development, so this is a good place to start our transition. Ideally, this transition will take place by Fall 2017, but it can come as soon as next fall if your district is *really* planning ahead. So, where do we start?

Before I present the documents that will be helpful for this process, please be aware of a few things. First, the middle school and high school performance expectations, or standards, are by grade span. This means **you** need to make decisions as to what is taught when. It is NOT spelled out what to teach in each grade level. If you purchase a curriculum, this should be done for you. If you are waiting a few years to purchase or can’t afford to purchase, then your district needs to have this conversation relatively soon. Second, please be aware that these standards are built on progressions. This means certain things should be taught ahead of others to build the understanding of a concept vertically (across grade levels). So, be careful how you align the standards. Last, keep in mind what math and Common Core Standards are aligned at each grade level as well. You don’t want to teach a concept that requires 8th grade math in 6th grade science.

Now, the conversation can begin. Let’s start with middle school. The documents linked in the text will help with this process. The MDE Model Course Mapping Sequence *(http://www.michigan.gov/documents/mde/Course__Model_Resource__Std_Neutral_-10-16-14_471740_7.pdf)* is based on Appendix K (see link below) from the NGSS website. They are to be used together. If you look at the orange pages from the MDE document, you will find some suggestions on what to teach in which grade level. To see which standards fit into each category, you need to align it with Appendix K. For instance, the first course model on the MDE proposed page is similar to the Conceptual Progression Model in Appendix K. This is the most vertically aligned progression. However, there are a lot of PEs, or standards, in 6th grade. There is also a Revised Conceptual Progression Model as well, and that is more equally distributed while still aligning vertically and to the Common Core. A third option in Appendix K *(http://www.nextgenscience.org/sites/ngss/files/Appendix%20K_Revised%208.30.13.pdf),* is the Science Domains Model. This is by discipline, where physical is in 6th grade, biology is in 7th grade, and earth systems is in in 8th grade. Remember, these are the MIDDLE SCHOOL earth science standards, NOT the high school earth science standards. Any of these course models will work well. In fact, you can build your classes any way you want; however, you REALLY need to keep the vertical progressions *(http://www.nextgenscience.org/sites/ngss/files/Appendix%20E%20-%20Progressions%20within%20NGSS%20-%20052213.pdf)* aligned.

Now for the high school. This is a tough conversation. If you look at the orange page in the MDE document, you will find that a few of the 9th grade courses contain physical science. This is a combination of physics and chemistry. (Keep in mind, these are baseline courses; an AP track would likely look different.) The 10th grade courses contain biology, and the 11th is recommended as a course. This shifts the typical order of *bio/chem/physics or other* to *physical/biology/earth*—that means, for example, that physics teachers who are used to teaching juniors, will now be teaching freshman. (Remember that the standards are new too, so teachers are not to teach both the HSCEs and the Michigan Science Standards—just the new stuff.)

> *“Certain things should be taught ahead of others to build the understanding of a concept vertically (across grade levels).”*

If that doesn’t appeal to your district, remember that the MDE graduation requirements *(http://www.michigan.gov/documents/mde/Science_CourseCredit_466083_7.pdf)* are only that students are proficient at all of the science standards prior to graduation, so you are given permission to create unique course models. With that said, remember that ***the course you create MUST match the course description and the teacher certification very well***. Another thing to consider is that biology has the highest number of standards to cover, so adding anything to that course could be daunting for a biology teacher. The second highest number of standards are in the earth sciences, and chemistry and physics are significantly lower in number than in the HSCEs.

The last piece of advice that you might want to consider in deciding on a course model is student mobility. If you are in a district with high mobility rates, creating a unique course model for students when they move in and out might not be a great idea. Staying within the basic framework of the ones suggested by Appendix K are probably a better choice. The standards accomplished are supposed to be tracked by your student data warehouse (like your electronic grade book). That sounds great, but you could end up with an individualized education plan for every student that comes in and out of your district—that may or may not be kind of cool. I love the idea of unique course models, but educators must be aware of some of the issues that might come up.

Once your district decides on a course model, you will want to figure out how you are going to communicate this change with your stakeholders. Parents, school board members, and even community members will want to know about these changes, especially since most of them are quite different.

Don’t feel you have to make these decisions without support. Ask your local ISD or Math and Science Network for someone to aid in the process. This is a huge conversation. If you are in Kent County, I’m glad to help. Good luck!

2016 Conference in Lansing

The 63rd Michigan Science Teachers Association Conference is quickly approaching. This year's conference will be held on March 3-5, 2106 at the Radisson Hotel and Lansing Center. Below are some of the highlights you can expect this year:

Anticipation is building about the newly adopted Michigan Science Standards!

Let the MSTA conference be your guide to understanding the new Michigan Science Standards (MSS). With over 250 sessions on March 4-5, 2016, you are sure to find something to take back to your classroom! Special strands exist for Elementary, CREATE for STEM, MSELA, and the MI Math/Science Center. The purpose of the strands is to offer educators the opportunity to attend in-depth, grouped sessions based on a specific need or interest. These strands will be offered in addition to the informative sessions for which MSTA is known. There are many sessions being offered by teachers just like you, sharing what they are doing in the classroom to embrace MSS, including the engineering practices and more.

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

The Professional Development workshops on Thursday, March 3rd last from a half to a whole day. These popular and informative sessions will cover topics such as 3-Dimensional Learning, assessments addressing the MSS, STEM, Bringing MSS into your classroom with little fuss, and sessions for administrators and district consultants regarding what the new MSS means to them. These sessions do require pre-registration, so be sure to watch for this information on our website.

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

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

Visit our bi-annual MSTA Conference Garage Sale in the Exhibitor's Hall.

Is one of your New Year's Resolutions to finally get your classroom or storeroom cleaned out and reorganized? As you undertake that task, think about re-purposing and donate your castaways to the Conference Garage Sale! You'd be surprised how many teachers there are who are looking to pick up various items to complete a class set, etc. While you're at it, make a list of things you need and swing by the Garage Sale to check out the offerings for yourself!

Please remember that as always, there is an 'early bird' registration savings. Visit the website for details and deadlines. *www.msta-mich.org*

We look forward to seeing you make this MSTA Conference your Pure Michigan destination to explore "SCIENCE…What A Capital Idea!"

Karen Kelly
Conference chair

Sandra Yarema
Conference Co-chair

Takeaways from the MSTA Annual Conference

By Tammie Bongard, Onaway Area Schools, 2015 MSTA Conference Scholarship Recipient

The MSTA Annual Conference provides hundreds of sessions with varying topics of interest for K-12 science teachers. Being able to choose what sessions to attend is awesome because you get to customize your own professional development. The opportunity to collaborate with science educators across the state is another bonus of attending the conference.

At last year's conference the session that I found most helpful to me as a middle school teacher was called "Creating a Semi-Self-Paced Classroom without Killing the Teacher." Christa Graham from Morenci Area Schools shared how to create a semi-self-paced, mastery classroom that challenges and supports all levels of learners. I have applied many of her suggestions in my 6th and 7th grade classrooms. For example, I have restructured many of my lessons as centers that groups of students rotate through during the class period. Students collaborate in small groups to complete activities involving technology, building critical thinking skills, practicing with measuring tools, or engaging in scientific investigations. With this setup, my students often don't even realize how hard they are working or how much they are learning because they are having so much fun!

Editor's Note: Did you know that each year Meemic sponsors scholarships to attend the Annual Conference? Applications are available on the MSTA website and due in early December each year. With school budgets tighter than ever, this is a great way to secure funding to attend the conference! If you missed the deadline this year but still need funding, try reaching out to local businesses and parent organizations through your school. These groups are often happy to help a science teacher improve their teaching practice through professional development. We hope to see you in Lansing, March 4 – 5, 2016!

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Something Old, Something New, Something Wild, Something Flew!

by Crystal Brown, 4th Grade Teacher, Gibraltar, MSTA Elementary Director

Lesson Overview

In the old days of fourth grade science, we traditionally taught ecosystems and animal adaptations. At the end of the unit, students were assigned an animal to research and tasked to present their findings in various ways. This year we did something new. This year, students were tasked to ENGINEER AN ANIMAL… a bird specifically. I remembered this amazing idea from my ProjectWILD days. The research and design that followed were expected results of the project. The contagious curiosity, the use of modeling and analysis of a structure and its function, the in depth conversation about the systems of birds, the number of laughs and the amount of pride were completely unintended consequences. The depth of thinking and intensive study of adaptations flew right out of this project.

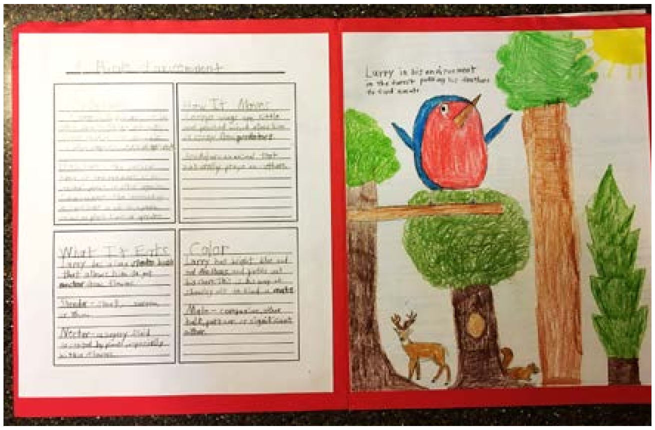
Connections to Michigan Science Standards

Cross Cutting Concepts:

Structure and function. The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.

Students were engaged in research and discussion about the different characteristics of birds, and had deep conversations and questions involving the functions of different characteristics of birds.

Patterns. Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.



Students were actively noticing characteristics of birds from different ecosystems and using the patterns they developed to design a bird from that ecosystem. They questioned the appearance of a characteristic pattern in birds and developed ideas about reasons for the adaptation.

Science and Engineering Practices

Asking Questions: During the research phase, students were asking questions about characteristics they observed in the birds they saw in different ecosystems. They questioned the use of each characteristic and determined whether this characteristic would be applicable to their own bird.

Modeling: Students were analyzing models of birds as they conducted research, and were also developing models of their own birds as they assembled their ideas. As they worked, they continuously questioned, adapted, and redesigned this model.

Obtaining, Evaluating, and Communicating Information: Students were researching bird characteristics, evaluating the use of the characteristics for their own bird ideas, drawing solutions, and creating a written text with nonfiction text features to communicate their bird design.

Performance Expectations:

4-LS1-1 : Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

4-LS1-2 : Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways

Materials

- provide text with various birds
- provide technology to allow students to research birds and their characteristics
- bird design guidance document (included)
- pencils and coloring utensils

Procedure

1. This phase of our unit occurred after students had learned about ecosystems, the systems that interact within ecosystems, different animals and

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Something Old, Something New, Something Wild, Something Flew!

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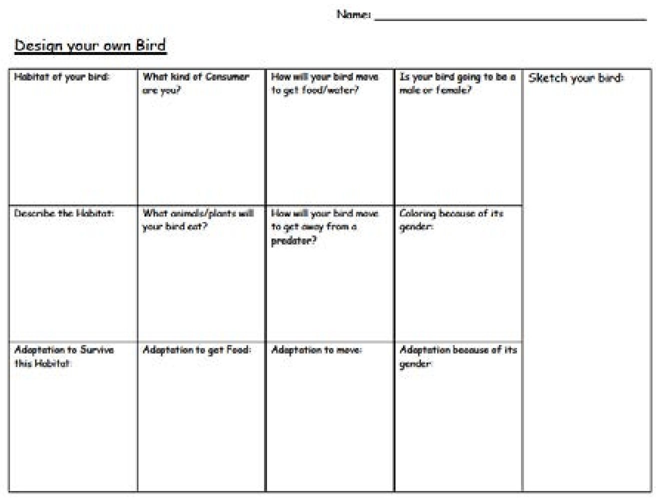
their adaptations, how adaptations develop and serve the animals, and how animals survive in their ecosystem.

2. Engage and Excite! We began by watching snippets of a naturalist video from Australia. The video explored and explained various Australian birds, their adaptations, and place in the ecosystem. (https://goo.gl/y0DM7S) It also explained the important coloration pattern in male vs. female birds. Students continued to develop and challenge this gender coloration pattern later during their research.

3. As scientists, our first job was to choose an ecosystem we wanted our birds to live in, and brainstorm what that ecosystem was like. Students were given a table to list the biotic and abiotic factors in their chosen ecosystem, and an iPad to help facilitate their brainstorming.

4. After students had developed a vision of their ecosystem, they had to choose where in the ecosystem the bird would live, what it would eat, and how it would move. Students were given a development guide to help instruct their bird design process, thinking of each aspect of their bird and then designing adaptations to meet these needs.

5. As students were designing their birds, they were using iPads to continuously research their thinking. Some students were using Google to ask what the shape of a swimming feather would be, and others were using Google to determine what kind of talon would be required to catch the prey they wanted their bird to eat.



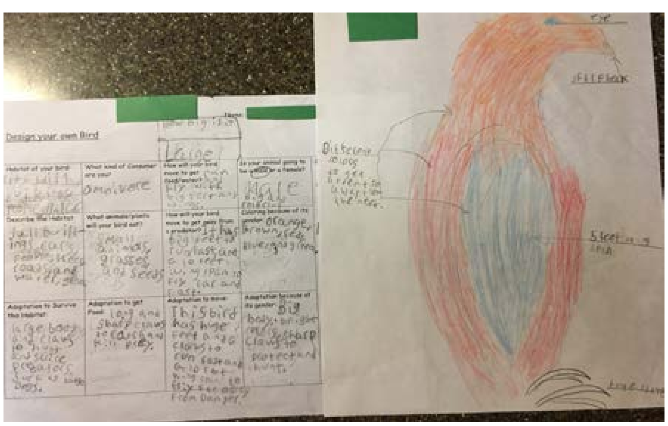
Name: ______________

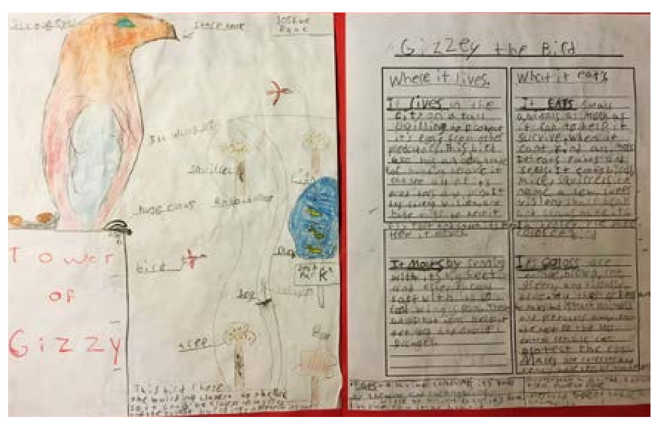
Design your own Bird

Habitat of your bird:	What kind of Consumer are you?	How will your bird move to get food/water?	Is your bird going to be a male or female?	Sketch your bird:
Describe the Habitat:	What animals/plants will your bird eat?	How will your bird move to get away from a predator?	Coloring because of its gender:	
Adaptation to Survive this Habitat:	Adaptation to get Food:	Adaptation to move:	Adaptation because of its gender:	

6. Their first model of their bird was done on this brainstorming paper. As they decided on different aspects of their bird, they added to their model.

7. Their next model was a full length drawing and labeling of characteristics and adaptations and their purposes for the bird's survival.





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8. After students had developed this model, they started drafting their nonfiction text article. They were required to have 4 different sections, explaining the four main aspects of their bird – habitat, food, movement, and gender adaptations. Each section was required to have a heading and bold words. A title and glossary box were also required on the nonfiction text.

9. Their final copy of the bird was drawn and colored after the text was complete. Both the final copy and nonfiction text were placed together for the final product.

References

Council for Environmental Education (2002). Project WILD: K-12 Curriculum & Activity Guide. Houston: Council for Environmental Education.

NGSS: Next Generation Science Standards. http://www.nextgenscience.org/next-generation-science-standards

MSS: Michigan Science Standards. https://www.michigan.gov/documents/mde/K-12_Science_Performance_Expectations_v5_496901_7.pdf

Modeling Dynamic Equilibrium

By Scott Milam, Plymouth-Canton Community Schools

Although modeling pedagogy has been gaining popularity, there remain limited activities for higher-level classes such as AP or IB chemistry. Here I present a classroom activity to introduce dynamic equilibrium that I adapted from a lesson originally developed by Tom Silak of Northville High School. The activity was designed for higher-level equilibrium analysis, but can also be used for much simpler examples of dynamic equilibrium. Rubber bands, molecular model kits and paper clips are used to simulate a dynamic reaction. Rates and concentrations are visually accessible as these materials are assembled into pairs and disassembled by students. These materials allow for a fast forward rate (rubber bands) and slow reverse rate, a slow forward rate and fast reverse rate (model kits) and comparable rates (paper clips).

Students work in groups of four where two students competitively assemble and disassemble diatomic "molecules" of the molecular model kits ($2H \rightarrow H_2$). The other two students track how frequently a molecule is made or destroyed as the reaction rate in minute increments for 5-6 minutes. Students then use the relative rates to plot rate vs. time and concentration vs. time for the reaction. This is done twice for each material, once starting with all diatomic molecules (20 H_2) and once starting with all monatomic samples (40 H). This activity can be used to show links between kinetics and equilibrium, establish how rate affects concentration, introduce reaction quotient (Q), introduce equilibrium constants (Keq) and their magnitude, or simply reinforce the idea that a process can continue reacting despite reaching equilibrium.

The models produced are used to define equilibrium as when the opposing rates are equal—which is generally independent of concentration being equal. This may be confusing to students who hear the term equilibrium and often connect equal with the more visual components—concentration or amount. This activity gives a strong visualization of rate and how rate defines equilibrium as well as impacts concentrations. This visualization is very helpful, as it is not easily shown using chemicals that are too small to be seen and rates are only presented in an abstract manner.

This activity engages students in the science practices of using models and analyzing data. It aligns to three of the performance expectations in the new Michigan Science Standards (HS-PS1-5, HS-PS1-6 and HS-PS1-7). The worksheet for the activity, complete instructions and photos can be found at the following link: *http://ibchemmilam.blogspot.com/2015/12/modeling-dynamic-equilibrium-link-to.html*

High School Science Activity: Poetry Gallery Walk

Lynn Thomas, Region 14 Director

The presiding view among students seems to be that poetry and science have nothing to do with each other. The poet Albert Goldbarth writes, "Perhaps the arts and the sciences have never slept together without one eye kept warily open." However, there has been a connection between science and poetry throughout history. In the late 1700s, scientific treatises were written in poetic form. J.J. Thompson, the discoverer of the electron, wrote a poem entitled "Ions Mine." Roald Hoffman, who won the 1981 Nobel Prize in Chemistry, is also a publisher of poetry. And even Emily Dickinson, upon studying the Principle of the Conservation of Matter, wrote:

The Chemical conviction
That Nought be lost
Enable in Disaster
My fractured Trust-
The Faces of the Atoms
If I shall see
How more the Finished Creatures
Departed me!

The intersection between science and poetry is summed up by the Harvard naturalist E.O. Wilson: "Science and art having the same creative wellspring...the ideal scientist thinks like a poet and works like a bookkeeper."

The use of science poetry in a classroom gallery walk provides an engaging activity to help students explore the nature of science. A gallery walk is a discussion technique that gets students out of their chairs and actively involved in speaking and writing. Students walk throughout the classroom in small groups to share ideas and respond to "exhibits" of poetry. This gallery walk provides students with the opportunity to address science from a different angle, combining the artistic expression of poetry with the terminology of science discipline.

Procedure:

1. Print several poems that relate to science (a suggested list follows). It helps to print the poem in large font that can be read from a distance. The number of poems needed depends on class size and timing. The instructor can use several poems so there are enough poems for each team; or repeat the same set of poems in different locations to complete the activity in a shorter time.
2. Post the poems at separate stations around the classroom.
3. Group students in teams. Each team should select a recorder who is responsible for writing group comments.
4. Direct teams to different stations where they will read the selected poem, either silently or aloud. As they read, they should discuss and jot down their impressions of the poem, addressing the connection to science in their responses. It may help to limit the time spent at each station, instructing the groups to rotate to the next station in a given time period.
5. After they have had a chance to read and comment on each poem, instruct students to select one focus poem for their team. The team's selection can be for any reason: perhaps the poem surprises or engages them in some way, perhaps they disagree with it. The allocation of poems can be "first come, first served" or the instructor can assign a particular poem to each team.
6. The team members should then spend 5-10 minutes expanding their interpretation and comments about their focus poem.
7. The exercise should conclude with each team giving a short oral report of their comments and interpretation of the poem.
8. The instructor has the option of extending this activity with a written assignment.

The following poetry suggestions include both anti-science poems and poems reflecting science facts. Both types initiate good conversation among students.

"Essay on What I Think About Most" *by Anne Carson*
"Constants of Motion" *by Roald Hoffman*
"The Scientific Method" *by Roald Hoffman*
"Science-Fiction Cradle Song" *by C.S. Lewis*
"Ions Mine" *by J. J. Thomson*
"Cosmic Gall" *by John Updike*
"Oh, Leave the Wise" *by Arthur Eddington*
"o sweet spontaneous" *by e.e. cummings*
"A Light Exists in Spring" *by Emily Dickinson*
"The Chemical Conviction" *by Emily Dickinson*
"'Faith' is a Fine Invention" *by Emily Dickinson*
"To Science" *by Edgar Allen Poe*
"The Tables Turned" *by William Wordsworth*
"You don't Believe" *by William Blake*
"Ode to the Amoeba" *by Arthur Guiterman*
"When I Heard the Learn'd Astronomer" *by Walt Whitman*
"This Compost" *by Walt Whitman*
"Parabola" *by A.D. Hope*
"First and Second Law" *by Flanders and Swan*

Reference:

Popova, M. (2014, June 17). The poetic species: Legendary sociobiologist E.O. Wilson in conversation with poet laureate Robert Hass on science and poetry. brainpickings.org.

Motivating Middle School Students to Research!

Colleen Polydoras, Hillside Middle School, Northville Mi, polydoco@northvilleschools.org

Connecting students' learning to the real world is a powerful way to engage them. This year, my colleagues and I chose to incorporate this philosophy, along with the use of technology and ELA Common Core objectives, into research. Students were asked to create a mini slide show, using *Google* Slides, to share their research on a health condition or an advancement in genetics. This project was used as an additional assessment for our cell unit as it enriches students' knowledge of real world applications on human health. As teachers of the Middle Years Program in the International Baccalaureate Program, we assess the students at their level of understanding on the following MYP Rubric: Reflecting on the Impacts of Science. This rubric assesses the following standards:

I. Explain the ways in which science is applied and used to address a specific problem or issue

II. Discuss and evaluate the various implications of using science and its applications to solve a specific problem or issue

III. Apply scientific language effectively

VI. Document the work of others and sources of information used

Below you will find student friendly guidelines of this project. Students were given the option to work alone or with a partner, and they were required to submit their assignment/research in *Google* Classroom. This activity was highly motivating for many students since the end product was digital, and no actual paper had to be submitted.

Please contact me with questions if you would like more details on this project.

Cells And Social Issues Mini Slide Show

Your slide show should have 4-5 slides. Remember not to "cut and paste" information from a website! Take notes and use your own words to share the information.

Health in Society topic

Slide 1: Name of Health condition
Slide 2: Overview of Condition (What is going on with the body?) and any interesting facts
Slide 3: Symptoms of the condition
Slide 4: Treatments *(This will help you address how science is being used to address a problem)*
Slide 5: Cite your sources!! Try to use at least two different sources.

Advancement in Genetics topic

Slide 1: What is the issue? Where is research taking place?
Slide 2: What problems are the advances hoping to solve?
Slide 3: What are the pros and cons?
Slide 4: Who or what are benefiting from the advances?
Slide 5: Cite your sources!! Try to use at least two different sources. Databases should provide the citations for the sources you use.

Citing sources

There are many different tools you can use to help you cite your sources. Google has google bibs, and the media center at Hillside has **Citation Machine**. Most of the databases you use will have the citations included for you, and you will just need to cut and paste these into your slideshow.

Additional Slideshow Requirements

- Each slide should have at least one detailed/thoughtful/creative graphic.
- Information should be written in your own words, in complete thoughts and sentences. Utilize bullet points. Avoid writing in long paragraphs. Remember not to cut and paste information from databases and use as your own words.
- Choose a font that is clear and large enough to be seen (easily readable).
- Avoid using distracting backgrounds and flashy transitions.

A Puzzling Activity

Kathy Mirakovits, Portage Northern High School

A scientist spends time putting observed data to together to try to make sense of our natural world. A forensic investigator collects evidence and pieces it together in order to determine what happened at a crime scene. A child dumps out a box of puzzle pieces and sections them together to make a picture.

The first week of my forensic science class we "play" with puzzles as an introductory activity with the goal to find similarities and differences between solving a puzzle and solving a crime scene. It occurred to me that this activity could be used in any science class to spark great discussion about the process of science and scientific research.

I use ten puzzle boxes from a local dollar store. Puzzles chosen were very basic, under 50 pieces per box, because the goal was not to spend lots of time trying to put the puzzle together, but for each team to think about the process and steps they used to complete the task. Prior to the activity, students are asked to respond to the following questions about protocol, which is a huge part of the criminal justice system.

1. What is protocol?
2. Why is protocol necessary in problem solving?
3. Why is it beneficial to have more than one person investigating a crime scene?
4. Is following a procedure unique to crime scene investigation? Explain.

Protocol is following a prescribed procedure when completing a task. In class we discuss how protocol is everywhere, not just in forensic science. In school we have protocols, at work there is protocol to follow and even at home. Scientific research also has protocols that scientists follow so that their research is credible and can be verified. The above questions can be modified for any science class doing this activity. Instead of crime scene, substitute words that fit your subject area.

Before giving student teams a puzzle, modify the contents. Teams are given different difficulties to overcome, such as:

- Missing pieces. Pull 2-5 pieces from a box. Code the boxes and pieces, so you can return them later.
- Missing 1/3 of the pieces.
- No box and missing 1-2 pieces. Pieces are in a Ziploc bag so students do not get the "answer".
- No box, missing 1-2 pieces, and must solve with painted side down. Only the shapes are used to put it together.
- Add 1-2 pieces from a *different* puzzle to the box or bag.

These anomalies create many parallels about how real world puzzles are presented and solved by scientists and forensic investigators. The real value of this activity comes from the discussion after the exercise.

Below are the basic instructions that I give students before the activity. They are given a table, similar to Table 1, to complete.

1. Before beginning the exercise, discuss methods that can be used to solve a puzzle. Design a plan that the team will use to complete the puzzle. Record the plan in Table 1, Part A.
2. As you put the puzzle together, discuss as a team how completing the puzzle is similar to investigating a crime scene. List these in Table 1, Part B.
3. As you put the puzzle together, discuss as a team how completing the puzzle is different from investigating a crime scene. List these in Table 1, Part C.
4. After completing the puzzle, review any problems or changes to the plan that had to be made. List these in Table 1, Part D.

Table 1: Discussion Points—Putting A Puzzle Together

Introduction to Forensic Investigation: Solving a Problem
Team Members:
Part A. Puzzle Plan
Part B. Similarities
Part C. Differences
Part D. Review

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A Puzzling Activity

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After all teams have completed the exercise and the table is complete, we discuss the similarities and differences as a class. Some points that usually come out are:

- We had to modify our plan once we found that the puzzle was upside down.
- It took longer to do it painted side down because we only had one trait to use
- You stole our puzzle pieces (evidence or data is not always there or we cannot find it)
- If we all worked together using the same method, it went quicker
- When pieces were missing, we went back to the box (back to the crime scene) to see if we missed it
- Sometimes you have to decide if the puzzle piece fits or if it does not belong (evidence, data may not always be relevant to your problem)
- And many more.....

Resources & Ideas

A Favorite Destination for Science Teachers

By Kara Haas, Science Education & Outreach Coordinator

W.K. Kellogg Biological Station

Kellogg Bird Sanctuary in Augusta, MI is one of my favorite destinations with students (or family). The Sanctuary is home to wild and captive birds of many species, including waterfowl, birds of prey and upland gamebirds. The Sanctuary grounds are open every day of the year for exploration. For a more in depth experience book a guided tour - compare beaks, feet and what the birds eat for a great lesson on adaptations! The Sanctuary is part of Michigan State University's Kellogg Biological Station. Lots of information, including lesson plans are available at: www.kbs.msu.edu

What Happened to Winter? Exploring Climate Change with Your Students

By Erica M. Ballard, M.A.

"Where is the snow? Why isn't it cold? When can I ride my sled?" All good questions and all worth asking. My seven-year old is not trying to get to the bottom of what experts are calling the second hottest year on record and why she has had only a few opportunities to catch snowflakes on her tongue! Inevitably, she, like many other students, simply wants to know, "What happened to winter?"

While many of us adults are certainly not complaining or missing the slush, the bitter cold, or the mile-high snow drifts, we as educators must seize this sun-drenched winter and teach the science of climate change and how it is affecting animals, plants, and humans alike. Where to begin?

I found a huge reservoir of information at the U. S. Environmental Protection Agency's website, "A student's guide to Global Climate Change" *http://www3.epa.gov/climatechange/kids/index.html*. Here students are able to click on tabs that allow them to learn the basics of global climate change, see the impacts, think like a scientist, and respond to a call to action by becoming part of the solution. The website offers different experiences from short videos to climate clue games to actual ways students can lesson their carbon footprint by traveling green and using less energy. The site, while definitely user and student friendly, offers up some serious science as to how our global climate is changing and why, as well as what we can do about it.

The National Park Service offers a great lesson plan to start the conversation about climate change with upper elementary students. It can be found at *http://www.nps.gov/teachers/classrooms/exploring-climate-science-climate-change.htm*. The lesson plan is aligned with several Common Core standards and addresses the new Michigan Science Standard Performance Expectation 5-ESS3-1 (Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment). I appreciated the simplicity of the lesson as well as the easily acquired lesson materials—strips of white and yellow paper and a globe. The reading material for the lesson is easily downloaded and can be displayed on a smart board or given to each student group. The site gives good background information on global climate change, how it has impacted animals, and policies surrounding climate change. It's an excellent way to start the journey.

So, as we don our light jackets and shun our barely used snow shovels this winter, let's remember that climate change is real and our students need to understand its causes and what we can do to slow it down. After all, what's a Michigan winter without snowflakes on our tongues?

Destigmatizing Mistakes in the Science Classroom

By Joshua Barclay, West Bloomfield High School

"Science, my lad, is made up of mistakes, but they are mistakes which it is useful to make because they lead little by little to the truth." Jules Verne, A Journey to the Center of the Earth.

Mistakes are the key to science. Indeed, mistakes are our only true teacher. Unlike students in a classroom, scientists don't have any 'authority' to whom to appeal, saying, "we give up-what is the right answer?" Only more experiments, and evolving hypotheses (i.e. mistakes), can gradually steer science toward truth.

Why then, do we as teachers have such an obsession with students getting answers "right?" Traditionally, to reach the exalted 'A', students must get ninety percent of their answers (i.e. hypotheses) correct. How many professional scientists get nine out of ten of their hypotheses correct?

The new Michigan Science Standards based on the National Research Council's Framework for K-12 Science Education will necessitate that we allow students to make many more mistakes as they learn to learn like scientists. By destigmatizing mistakes in the science classroom, we as teachers can much more accurately and honestly model how science works. Doing so can have a truly revolutionary effect on our teaching, reduce the stress level of students, and encourage all students to reach their highest potential.

One excellent way to start is to give every student more opportunities to make mistakes. Using a 'random student selector' app is very effective in keeping all students engaged when asking questions to the class as a whole. My school's student information system, PowerSchool[1], comes with a random student selector built-in, but there are many other random student choosers available for free online such as http://www.alicekeeler.com/teachertech/2014/03/30/random-student-chooser-template/[2] and http://www.flippity.net/RandomNamePicker.asp[3]

When I use the 'random student selector' function, I ask the class a question, give appropriate wait time, sometimes asking students to compare answers in pairs, then project the name of the randomly selected student on the smart board. I reward all student responses with raffle tickets. (My classes have raffles every other week for dollar store prizes, extra credit, free extensions, late passes, and other privileges.) I give out two raffle tickets for a correct response, and one raffle ticket for an incorrect response. The only response that is not rewarded by raffle tickets is "I don't know," or no response at all. I am trying to drive home the message to students that learning will not happen without experimentation.

The way in which we acknowledge student mistakes is an important aspect of destigmatizing such mistakes. See the inset for some phrases that, with little effort, can replace "you're wrong" in our teaching vocabulary.

What to say instead of "YOU'RE WRONG."

- Keep trying, I appreciate your effort
- Thank you for offering your hypothesis
- Interesting answer
- I like your enthusiasm
- I can tell you are thinking hard about this
- You are getting close — it is a related concept
- You've clearly got the scientific spirit
- I can see how you might think that
- I can tell you've been studying this week's vocabulary words
- In science, many wrongs eventually do make a right!
- You are right that (grain of truth or correct aspect in student's answer) which brings us to (alternate restatement of question)

Mistakes as Learning Opportunities

In my opinion, the most powerful tool that I use in my classroom is the WebAssign®[4] internet-based homework and evaluation system (free or low cost alternatives exist such as LON-CAPA[5], Quest[6], WeBWorK[7] and using Google Forms with the Flubaroo[8,9] add-on). WebAssign randomizes numbers in homework, gives students immediate feedback as to whether their answers are right or wrong, and most importantly allows as many submissions as desired by the teacher, with very flexible scoring rubrics, so that students getting the answer wrong can resubmit more times. Once a student makes a mistake, WebAssign can be programmed to give hints after a specified number of tries, or different hints depending on the wrong answer given. When a student has been clearly shown that they got an answer incorrect, they may be more receptive to hints challenging their current conceptual framework.

In an empirical study[10], Gerd Kortemeyer concludes that when using online homework systems, the optimal number of submissions to allow students for free-response questions is five, though most teachers in that study allowed more than twice that. By contrast, that same study suggests that granting extremely large numbers of submissions, for example, over 20 submissions per problem, is not helpful at all for students, as it leads to random guessing and other non-beneficial behaviors, and paradoxically, fewer right answers! Personally, I allow five submissions with no penalty, and then five more submissions subtracting 20% for each submission beyond the first five.

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Many other practices can support student learning from mistakes.

- Allowing test corrections for partial credit (I accompany this with "retro" problems–every test has at least one repeat problem from the prior test, to make sure students do their corrections with the intent of understanding.)
- Allowing quiz retakes for partial or full credit.
- Reframing mistakes – I'm often heard to say, "This last test has offered us some fantastic learning opportunities. Let's get started on corrections."
- When students present models and solutions to the class on whiteboards, keeping authorship of whiteboards anonymously allows other students to give more constructive feedback.[11]
- Giving examples of mistakes made by prominent scientists – Einstein, like everyone of his day, assumed the universe was static, neither expanding nor contracting. When his equations said gravity should pull everything together, he added a "cosmological constant" to hold the universe apart. Ironically, though Einstein may have considered this a blunder, the discovery of dark energy suggests that he might have been correct after all!
- I model making mistakes plenty of times. Not by design at all, it just happens naturally, and often. Each time I make a mistake, rather than waving off or obscuring it, I call attention to it to show students that teachers make mistakes too, and to try to make it a useful learning opportunity.
- On all returned tests, regardless of grade, I put a smiley face, and/or a positive comment about some problem, problem part, or just encouraging words such as, "nice on question 3, part a," "keep trying, you are getting there" or "I would love to see you for help after school Thursday." Before I return such tests, I explain to my students that I care about them unconditionally, and they don't have score highly on my tests for me to continue caring about them. Be careful and clear with this option, lest students misinterpret a smiley face accompanying a low grade as snark.

I am mindful that my determination of the level of mastery of my students, like every measurement in science, has built-in uncertainty. I also want to show students that making mistakes in science need not have permanent, unredeemable negative consequences. For these reasons, I allow numerous extra credit opportunities. As long as students complete a set of required interactive activities (on WebAssign), they can do multiple extra credit projects to compensate for low test grades. They can also earn extensions on assignments by doing community service.

I am also mindful that I am no expert, and continue to learn about how to destigmatize mistakes, and from time to time, probably make a student feel bad for making a mistake. I would love to hear your techniques for destigmatizing mistakes at my email address included below.

If, as Neils Bohr said, "An expert is a person who has made all the mistakes that can be made in a very narrow field,"[12] we must start encouraging our students to not be afraid to make more mistakes, and to do so right away!

— Joshua Barclay, Joshua.Barclay@wbsd.org

Joshua Barclay teaches AP Physics, Honors Physics, and Physics at West Bloomfield High School, and is the MSTA High School Science Teacher of the Year for 2016.

Endnotes

[1]PowerSchool Student Information System. (n.d.). Retrieved January 8, 2016, from http://www.powerschool.com/
[2]Keeler, A. (2014, March 30). Random Student Chooser Template. Retrieved January 8, 2016, from http://www.alicekeeler.com/teachertech/2014/03/30/random-student-chooser-template/

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[7]*Welcome to WeBWorK. (n.d.). Retrieved January 8, 2016, from http://webwork.maa.org/*

[8]Welcome to Flubaroo. (n.d.). Retrieved January 8, 2016, from http://www.flubaroo.com/

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Resources for Incorporating Geography in Science: Causality Depends on Where You Are

By Phil Gersmehl, Research Professor, Michigan Geographic Alliance, Central Michigan University

Science looks for cause-and-effect relationships that can be observed and predicted whenever we can control for all other conditions surrounding an event. Geography looks at the influence of location – the changes in cause-effect relationships that occur as a result of the unique set of conditions in each place on earth. Location has an influence on a wide range of scientific topics, from altitude sickness and animal migration to flood prediction, solar power, and zonal winds.

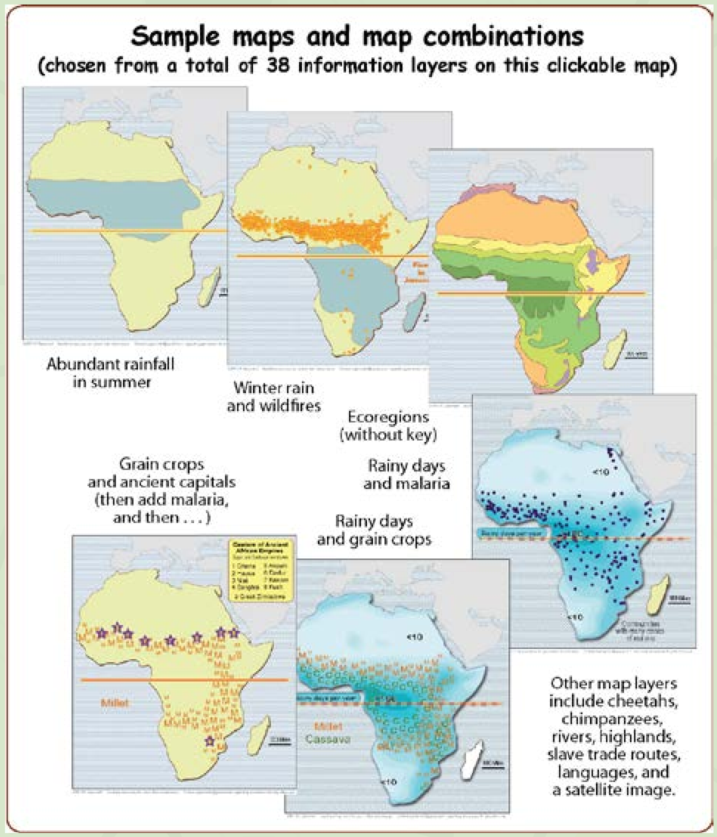
For three years, the Michigan Geographic Alliance has been developing and testing a package of "Big Idea" educational materials. Their purpose is to teach the "bare-minimum" geographic ideas that citizens need for responsible stewardship of natural and human resources. One part of the package is a set of clickable-pdf "mini-atlases" of each major world region. A clickable pdf is a file that allows users to turn separate "layers" of information on or off. This provides easy visualization of the geographic pattern of individual kinds of information, and it also lets us investigate how any two, three, or more different kinds of information may be related.

The internet already has a variety of layered maps that show a wide range of information for a given area. Using these resources in the classroom, however, is often difficult. One issue is focus – the topics were seldom chosen to be clearly related to a specific kind of inquiry. A related issue is complexity – an electronic map with many layers is unwieldy and difficult to use "in real time" as part of a classroom demonstration or guided inquiry.

Each of the MGA mini-atlases has a tight focus on a single causally important geographic idea and its consequences in one world region. These ideas include latitude in Africa, elevation in South America, population density in China, region in North America, etc. The MGA tried to choose a world region in which each specific idea is especially easy to teach. This big idea then guides the selection of topics for the map layers. Once mastered, each idea can be applied in other world regions and other investigations.

In Africa, for example, the big idea is latitude, which has an easy-to-see influence on solar energy and length of the rainy season. These variables, in turn, have direct causal links to many other environmental features, including plant cover, wildfire, animal ranges, soil quality, crop options, human population density, endemic diseases, and even the locations of ancient capitals, slave trade networks, languages, and religions (see Figure 1).

In the Russia unit, the big idea is physical area, which is related to continentality, air pressure, jet stream location, permafrost, soil quality, transportation networks, population density, and the persistence of "autonomous ethnic groups" within this huge country. And so forth – hundreds of maps carefully designed and packaged for ease of use in supporting specific kinds of inquiry.



Each clickable mini-atlas has a teacher's guide in the form of a Powerpoint presentation that models one important "story" that could be presented with different map layers. This editable Powerpoint has annotated maps and question-frames to guide discussions. Each regional package also includes a printable planning index to the map layers, an orientation activity that meets several Common Core objectives, and a work map (though you can customize your own maps and print them from the clickable pdf, once you have selected the layers of information that you want).

See for yourself at the MGA website or *http://www.ourspatialbrains.com/ppts-and-clickable-maps/.*

While your're there, nose around the website. The Student Activities folder has a subfolder of earth science activities. This part is just started, with more on the way, but it already has a few Powerpoints about climate patterns and climate change. Another folder has an in-depth review of the neuroscience of spatial reasoning – the empirically tested theories about human cognition that serve as a foundation for the inquiry activities (This section also includes a strong caution about the self-defeating nature of obsessive focus on high-stakes standardized

Color Coding Claim, Evidence, Reason

By Ellen Karel, Byron Center High School

Five years ago I began focusing on my instructional practice and the assessment of my 9th grade science students' scientific argumentative thinking, writing, speaking, and listening. I started with easy strategies such as the one I will describe here called "Color Coding Claim, Evidence, Reason." This strategy is very basic, and a fundamental step as you introduce claim, evidence, and reasoning to your students. Furthermore, this strategy will also help your students on their Evidence Based Reading and Writing on the SAT!

Close reading that requires critical thinking can be accomplished with this strategy. Students should be given an "Anchor" text that represents a quality scientific argument and an "Anchor" text that lacks quality. Anchor text is the term used by Common Core and Next Generation to generalize all types of complex, data rich texts or background knowledge text. Various authors such as a scientist, journalist, or a former science student may write the anchor text. Students will be engaged in the reading by looking for essential components of a quality argument, which include a claim, evidence, reason, and counter-argument. When students analyze different levels of quality arguments they begin to see how various authors use the same components of scientific argumentative writing in a variety of ways. Students then can draw their own conclusions about what makes a "best" piece of argumentative writing versus a "good" piece of argumentative writing.

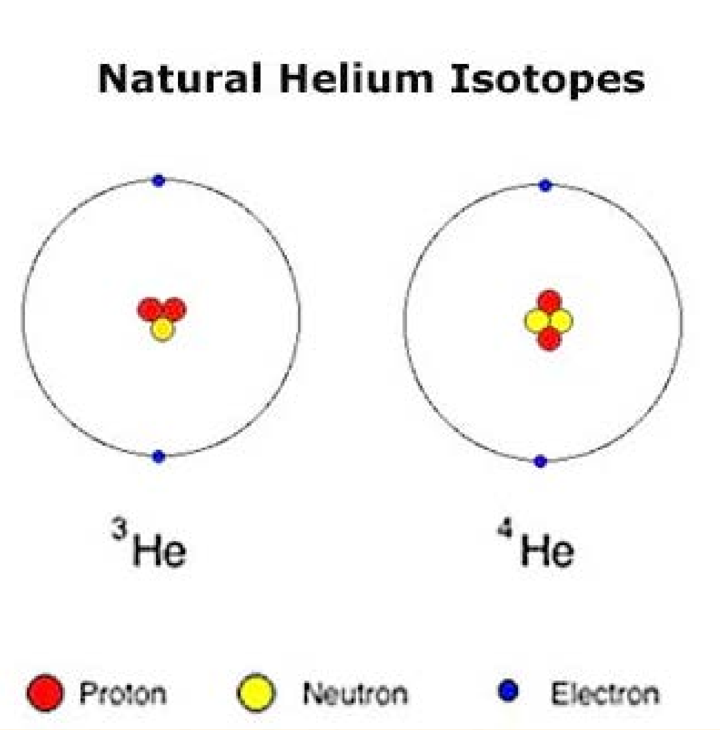
This activity can be used at any point in the learning continuum. Students will be engaged with the identification of the claim, evidence, reasoning, and counter examples. This activity is similar to what students are required to do for ACT, SAT, and model SMARTER Balance assessment items. This simple strategy can include both written and oral discourse to help make the learning collaborative during and/or after the activity.

Implementing the Strategy

Provide an "Anchor" text with a high quality argument and a low quality argument for students to analyze. Explain and demonstrate the color-coding procedure using the following:

- green for the claim
- yellow for evidence
- red for reasons
- blue for the counter argument

Use a reflection strategy about what suggestions the student might make to the author about the quality of their argument. To make a connection to argumentative writing, ask students to make their own claim, use evidence from the reading, and reasons for their position. Students may be given time to collaborate about the reflection questions as long as the time is sufficient and students are engaged in the thinking. Modified from (Know, 2013, p. 39).



Example Anchor Text for Analysis: This was written by a 9th grade physical science student (no counter argument expected at this point in the year).

The atoms shown in the diagram are both a combination of an isotope and a neutral atom of Helium because of the number of protons in each nucleus of each atom, which decides what the atom is. The net charge of an atom, which, decides if it is neutral or not is decided by the difference of the electrons and protons. The key under the diagram of atoms explains that the red circles represent protons, which have a positive charge. In the atom on the left there

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Color Coding Claim, Evidence, Reason

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are 2 protons, making that atom Helium. In the atom on the left side of the diagram, there are also 2 red circles that represent protons; therefore, this atom is also Helium. Protons have a positive charge, so in each of the atoms, the charge when just the protons are counted, is a +2 charge. The number of electrons also has a say in what the charge of the atom is. In the case of the atom on the left, there are 2 electrons, each holding a -1 charge, around the nucleus. The same is true for the Helium atom on the right; it also has 2 electrons around the nucleus. Because there are 2 protons and 2 electrons in both of these Helium atoms, each subatomic particle holding a charge of + or - 1, the charges cancel each other out, making the charge of the atom 0, or neutral. Both of these atoms are isotopes of Helium because an isotope is a different version, meaning in atomic mass, of the same atom. Atomic mass is figured by the number of protons in the nucleus added to the number of neutrons because each has a mass of 1amu or atomic mass unit. In both of these atoms there are 2 protons in each nucleus. But, in the atom on the left there is only one neutron, which is represented by a yellow circle. This makes the atomic mass of the left atom 3, because the 2 protons and the 1 neutron equal 3amu. In the atom on the right hand side of the diagram, there are 2 yellow circles, neutrons, in the nucleus. This makes the atomic mass of the atom on the right 4, because the 2 protons and the 2 neutrons equal 4amu. Because the atom on the left and the atom on the right of the diagram have different masses, they are different versions of the Helium atom making them isotopes. These atoms are a combination of an isotope and a neutral atom, based on the atoms' atomic mass and the atoms' lack of a net charge.

Know, C. (2013). Backwards planning for success with writing with the new California common core standards. Retrieved from https://classes.svvsd.org/pluginfile.php/138524/ mod_resource/content/1/Opinion-Argument%20Resource%20 packet%203%20-6.pdf

Professional Resources & Opportunities

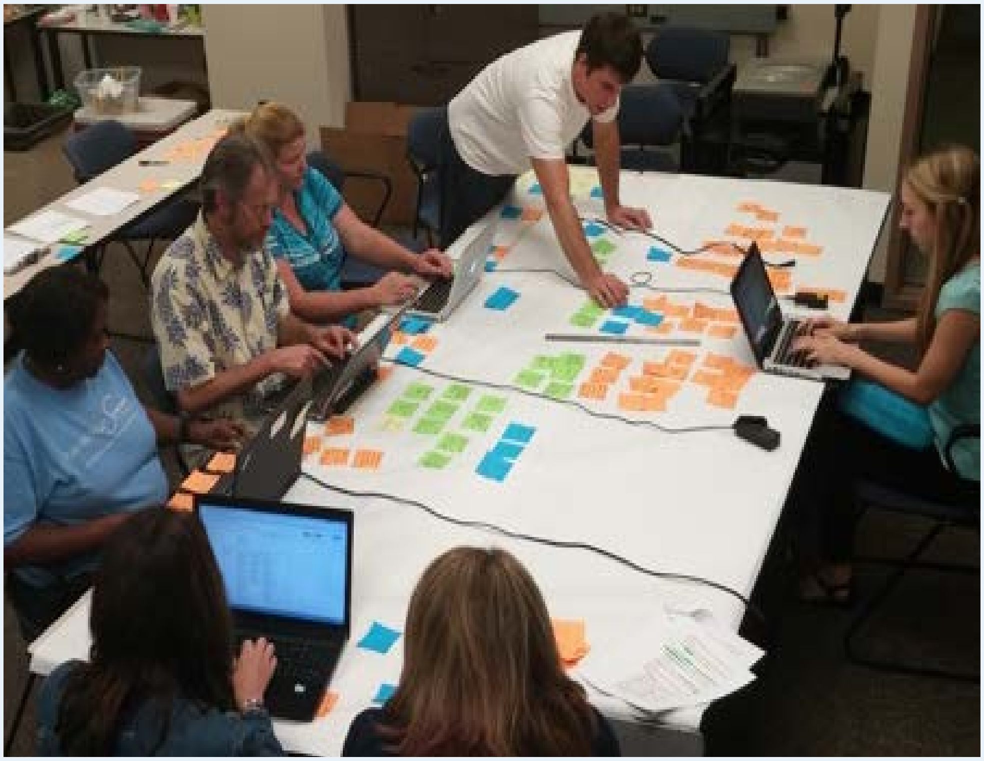
Curriculum Development as Professional Development: Creating Teacher Leaders Through the Mi-STAR Initiative

Amy Lark, Brenda Bergman, and Jacqueline Huntoon, Michigan Technological University

It has finally happened: In November, Michigan officially adopted new science standards that align with the *Framework for K-12 Science Education*. These new standards have some teachers in Michigan concerned – how will science teaching have to change to meet them?

Faculty and staff from universities around the state who are involved with the Michigan Science Teaching and Assessment Reform initiative, or Mi-STAR, anticipated the state's adoption of the new Michigan Science Standards (MSS). Mi-STAR, funded by the Herbert H. and Grace A. Dow Foundation, is developing curriculum and professional development to help teachers of the middle grades adopt the three-dimensional teaching approaches advocated by the MSS. One aspect of Mi-STAR that sets it apart from similar initiatives is that it engages secondary science teachers in the process of curriculum development, in partnership with scientists and curriculum design specialists. During the summer of 2015, 49 teachers from partner districts met for two-week blocks (called "hubs") to create units that integrate physical, biological, and earth sciences as well as engineering. Each of the units focuses on real-world topics that are of interest to students and families in Michigan.

Most commercially available curricula developed for use in schools are created by private organizations or corporations, e.g., Pearson and Delta Education. Teachers who do not have access to these products, or choose not to use them in their entirety, frequently find themselves in the position of needing to develop their own materials. The rationale for employing teachers as the primary authors of the Mi-STAR curriculum is based on acknowledgment that teachers are pedagogical experts who know what works in their own classrooms to engage students' interest and promote deep understanding of science. Mi-STAR is building on these teachers' prior experiences and is helping to prepare a cadre of teacher leaders well-versed in the MSS. Teachers have been providing useful feedback on their experiences with Mi-STAR. Many emphasize the benefits of participating in curriculum development experience:



"In a general sense, I think that this experience has made me a better teacher. It allowed me to think critically about how to dissect and conceptualize standards in a way that can be translated to the classroom." – Teacher working on Mi-STAR Unit 8.2

"Far and away the best part of this is the new, deeper understanding of NGSS. My prior understanding was simply so shallow… I thought I had a good understanding, but now I've been referencing the darn things so frequently that I really understand what they are shooting for." – Teacher working on Mi-STAR Unit 7.4

One aspect of the project that teachers found to be most valuable was the opportunity to work closely with other educators in a professional capacity. In addition, Mi-STAR teachers appreciated the chance to generate ideas and engage in the curriculum development process as professionals with valued expertise:

"Being able to work collaboratively with other teachers - the benefit cannot be overstated." – Teacher working on Mi-STAR Unit 6.2

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"I think for some of us, this really possibly also helps that credibility of being a teacher. And what we do is really important too... it helps to give credibility to what we already know as teachers what we can do." – Teacher working on Mi-STAR Unit 6.1

One unanticipated outcome of teachers' participation in developing curriculum for Mi-STAR was a high degree of teacher ownership over the units they helped to create. On a questionnaire administered after the two-week hubs had ended, over 90% of teachers indicated that they felt strong ownership of their units.

Arguably, one of the most valuable outcomes of Mi-STAR is not the curricular materials being developed, but the professional development and enthusiasm of science teachers who are both motivated to improve science teaching in our state and prepared to lead the way for other teachers:

"By participating, I have the influence to develop a curriculum that will help prepare my middle school students for high school and life." – Teacher working on Mi-STAR Unit 6.1

"I'm leaving this process excited about it but I can't wait for a few more years down the line to really see where it goes …" – Teacher working on Mi-STAR Unit 6.5

"I am very excited to implement this curriculum! And I very much appreciate all the work that everyone has put into this. It seriously has changed my view on how to develop my lessons and my students will greatly benefit. THANK YOU!!!!!!!! This project is so extremely important!" – Teacher working on Mi-STAR Unit 8.5

The success of the Mi-STAR initiative to date has served as testament to the value of engaging teachers in curriculum design. Since the fall of 2015, teachers in 5 Michigan schools have been piloting three Mi-STAR units and assessments. As 2016 unfolds, Mi-STAR will be continuing to review, revise, and test curriculum and professional development in partnership with Michigan educators, scientists, and educational specialists. More information about the project is available at: http://mi-star.mtu.edu/

Tom Kelly, Inland Seas Founder remembered

The Inland Seas Education Association is extremely saddened to announce that Thomas M. Kelly passed away at home surrounded by his family on January 8, 2016.

The staff and volunteers of Inland Seas are devastated that Tom Kelly, Captain and founder has left us, but grateful for time spent and lessons learned from him.

We will miss him dearly, and carry his vision forward with us. Although he may no longer be among us, his mark on the world is indelible, and we are better for it.

Visit Tom Kelly's tribute page and donate to memorial scholarships at http://schoolship.org/news-events/tomkelly/

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Professional Resources & Opportunities

Spark STEM Imagination and Creativity at the Michigan Science Center!

By Steve Zoski

As Manager of Volunteer Services at the Michigan Science Center, I get to witness the daily science "stampede" but also the daily science spark.

I get to see hundreds of students from across Michigan excitedly step off school buses and enter our doors. By the time they leave and return to their buses, they have witnessed over two-hundred exhibits and interacted with volunteers who have introduced truly exhilarating concepts. Perhaps, one day, these students will be the innovators making groundbreaking discoveries that transform our world. And perhaps, our volunteers will be the ones to thank, along with their teachers.

The Michigan Science Center (MiSci) recently celebrated its third anniversary on December 26, 2015. In 2016, our volunteer program is offering science educators a multitude of exciting opportunities to inspire children and their families to discover, explore and appreciate science, technology and engineering (STEM) in a fun, dynamic learning environment. I invite you to consider joining us on our mission.

Whether you help us as a Volunteer Explainer directly interacting with our guests, in our office, or at special events, your contribution makes a massive difference. You'll be among others passionate about science. You'll be able to wander among rocket ships and planets, diagrams, and massive Tesla coils. You'll see so many smiles on the faces, young and old, as you run science demos and assist with workshops.

Soon, there'll even be a space where you can make an even greater impact as a volunteer. This April, we are proudly unveiling a new volunteer-led interactive learning area that hopes to inspire a new generation of STEM leaders. MiSci, Smithsonian, Lemelson Center and Ford Motor Company Fund have all come together to open a brand new gallery in MiSci in April, 2016 called Spark!Lab.

In Spark!Lab, visitors will direct their creativity and knowledge toward solving problems, just like real inventors do. They will also build skills that real inventors need to be successful—such as problem solving, critical thinking, collaboration, flexibility, and other 21st Century skills. Through hands-on activities, interactions with volunteer facilitators, and even conversations with inventors from the community, children and families will engage in the process of invention. Spark!Lab will allow science center visitors to become inventors and innovators.

"A place like MiSci can spark a child's passion for science and encourage them to explore careers that can transform our world," our December 2015 Volunteer of the Month, Zahraa Aljebori wrote. "I'm confident about this because fifteen years ago, I was one of those children who never knew science was an option until given the chance to try it on my own."

At MiSci, we value our role as a hub, spark, and neighbor. Volunteers are essential to our success. They inspire guests with hands-on experiments, lead tours, and give directions. Their ability to think creatively and help illustrate science concepts help make visits to MiSci incredibly memorable.

I encourage you to consider volunteering at the Michigan Science Center located at 5020 John R. Street in Detroit, Michigan. For those interested in hearing more about volunteering at MiSci, please go to *http://www.mi-sci.org/join-and-give/donate/volunteer/ Or call me at 313-494-5307 or email me at steve.zoski@mi-sci.org*

Professional Resources & Opportunities

The PAEMST: A Race Worth Running?

by Walt and Gretchen Erhardt

A young man asked his track coach if there was a secret to winning the 100-yard dash. The coach said “Certainly! You start by running the first 50 yards as absolutely fast as you can . . . and after that, you slowly increase your speed.”[1]

If you’ve been nominated for the Presidential Award for Excellence in Mathematics and Science Teaching (PAEMST), someone who knows your teaching is saying you’re outstanding in your field. But, you might have mixed feelings about that honor because of the complexity of the application. I felt the same way. In retrospect, I view the whole process like a race. I was in the starting blocks four times for the PAEMST competition. I faulted twice, lost in my preliminary heat (my third chance), and finally won on my fourth attempt. This article recounts my change in thinking over eight years and the hurdles I encountered in the race: lack of time, work involved, and self-doubt. My race and training suggestions might help as you consider joining this race or, in the future, nominating someone else for it.

It’s An Invitational

Every year many teachers are nominated. A nomination is simply an invitation to apply. Most do not complete an application. The application takes up to three months to complete, allowing for time to make and critique a video and to write and edit an analysis of it. To learn the details of the application process, go to *paemst.org*.

A Sprinter Doesn’t Win Every Race

The upside of this invitation is that, no matter what the outcome, this race offers a chance to do your own personalized professional development. Having participated in various professional development activities over many years, I can say now that the PAEMST application was one of the most effective in my growth as a teacher. The completed application process provided me with a video and written analysis of a class lesson. The invitation to examine any aspect of my teaching gave me freedom to reflect on what I most enjoyed in the classroom and explain what I was proud of in my teaching.

The challenge is that the application process for the PAEMST can feel like a 100-yard dash. My “dash” to an award was anything *but* that. I just looked at the application the first two times I was nominated and deleted it. The normal demands of my work were already like running the first 50 yards of a 100-yard dash. Applying meant increasing my speed. I was doing all I could, keeping up with class preparation, grading, and extra-curricular commitments. My job and family commitments filled all the free space in my life. Writing essays about my classroom and teaching was not an attractive addition. In short, lack of time made it easy for me to hit that delete button.

My response would have been the same for the next two nominations, except then it was my school director who nominated me, and by that time, my family commitments had lightened somewhat. Three other people also encouraged me to give it a try—our state PAEMST coordinator, my wife, and a former award recipient from Michigan. *Continued* encouragement from others was the biggest factor in my “suiting up” for races three and four.

Obviously, it’s a compliment to be nominated. Knowing that others see you as a good teacher is reassuring, but compliments can inflate your ego, and once on a pedestal, you don’t want to fall off. That can be debilitating. My first completed application and subsequent failure to advance to the state-finalist level in 2011 pushed me off the pedestal. There is an intimidating element of truth to Homer Simpson’s statement that, “trying is the first step towards failure.”[2]

Several things contributed to my submitting another application two years later. Encouragement from others, especially my school director, was crucial. The reapplication task was not nearly as daunting as my first attempt, since the hardest work was already done. I had kept my files of large parts of the previous application. Now I had time to listen to critics of the videoed lesson and written analysis, make changes, and even re-do the video. Turning my previous failure around in my second completed application was a high point in my own learning.

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The PAEMST: A Race Worth Running?

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Essentials of the PAEMST Race

A completed application includes

1. A video (45 minutes or less) of a lesson of your choice, made in the school year of your application.
2. A written analysis of the lesson. The application provides writing prompts.
3. Your resumé.
4. Your school district's demographic data.
5. Supporting evidence of your work as an educator, or supplementary material related to your lesson, e.g. evaluation instruments, handouts, or a copy of actual graded work, like labs or a written assignment.

The Race Has One Heat and A Final

The "heat" is your state's PAEMST committee's evaluation of applications. This committee chooses up to five state-finalist applications in each category—science and mathematics/technology—to forward to the National Science Foundation. An NSF committee evaluates the state finalists' applications and then selects two award recipients from each state.

Why Train for This Race?

The material benefits of winning this race are substantial. They include a four-day, expense-paid trip for two to Washington, DC. While there, you'll visit the NSF, hear relevant lectures from experts in their fields, participate in the award ceremony, visit the White House, and meet the president. You also receive a $10,000 honorarium. This race is a wonderful way the federal government honors the nation's outstanding teachers.

Training for this race means you could, at the same time, be getting ready for races not yet anticipated. While it's true that only two of the possible ten state finalists will actually receive the award, the application can open doors you may not yet have considered such as:

- A completed and evaluated application **positions you well to apply for the PAEMST again**, if your first application is not successful. You will already have copies of the supporting documentation, resumé, and school demographics, and can focus on improving specific shortcomings. Luke Wilcox, 2013 PAEMST mathematics recipient from Michigan, notes, "Whether you win or lose, state-level reviewers send you scores on the rubrics and also specific reviewer feedback."[iii]
- Your school district may accept a completed application as evidence of a year's professional development effort.
- You may be able to use this material to earn required CPE or graduate credit for independent study through a local college or university.
- Elements of the PAEMST application may be used for other programs, such as National Board Certification or for future job applications.

Race Strategy – Even Sprints Take Long-Term Planning.

Training for each section of a race is more beneficial and satisfying than imagining the entire race as a whole. Think of this race preparation in five sections:

1. Talk With Your Administrator

a. Explain the PAEMST to your administrator. Some know nothing about it. Let them know you're in this race. Administrators take pride in having a nominee from their school district.

b. Let her/him know you need to record a lesson. Determine if you could ask your school's AV staff to shoot the video, help you select the portion you want, and upload the video to your computer.

c. Ask him/her about using your completed application for credit toward your district's professional development requirement.

2. Choose a Lesson

Pick a *rigorous* lesson that you and your students enjoy and that you teach regularly. The lesson should

a. Show your strengths as a mathematics or science teacher.

b. Fit into a broad educational goal you have for students.

Questions like these will guide your choice of a lesson:

- Why am I teaching this lesson now?
- What future lessons or ideas am I preparing students for?
- What previously learned concepts is it building on?
- How does this lesson fit into the overall sequence of learning I have prepared for students this year?

c. Allow you to be genuinely reflective about your lesson's value.

Start saving supporting work associated with your lesson. This could be evaluations, handouts, or writing assignments.

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Professional Resources & Opportunities

The PAEMST: A Race Worth Running?

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3. Start Early and Make a Schedule

a. Create a time line for completing each section of the application. Start your schedule at least three months before the due date.

b. Finish parts of the application that do not require reference to the completed video.

c. Schedule the video at least two months before the application is due. Allow a month in which to re-do the video and make changes in the analysis, based on the feedback of your critics.

4. Record and Analyze Your Lesson

a. Make a video of your lesson. Select the section of the lesson you want to submit.

b. Contact your state coordinator (listed on paemst.org). He or she can put you in touch with former awardees willing to look at your video. *Send it to them.* They'll analyze your video and see things you don't.

c. Be willing to re-do your video after this critique. I videoed my lesson only once for my first application, but twice for my second, before being satisfied with the result.

d. Write the remaining parts of the analysis.

5. Solicit Feedback on the Draft of Your Analysis.

a. Submit your analysis to the coach who looked at your video. Ask for comments on the analysis.

b. Find an editor who will read and constructively criticize you're the content and form of your writing. Ask:

- Is my answer logically arranged?
- Does it respond to the prompt attentively?
- Is it not only a good answer, but also one that clearly answers the question?
- Does it provide concrete examples, where appropriate?
- Are spelling, grammar, and punctuation correct?

The Finish Line

Running the PAEMST race doesn't have to be as exhausting as it first appears. Should you run this race? A "yes" answer means time, effort, and commitment, but over time, the benefits outweigh the difficulty of the work. Whether the rewards are local, statewide, or national, step to the starting line and start your race.

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Author Bio

Walt, the 2013 PAEMST science recipient from Michigan, taught chemistry at the Battle Creek Area Mathematics and Science Center and retired in 2014. Gretchen taught in the English Dept. at Western Michigan University.

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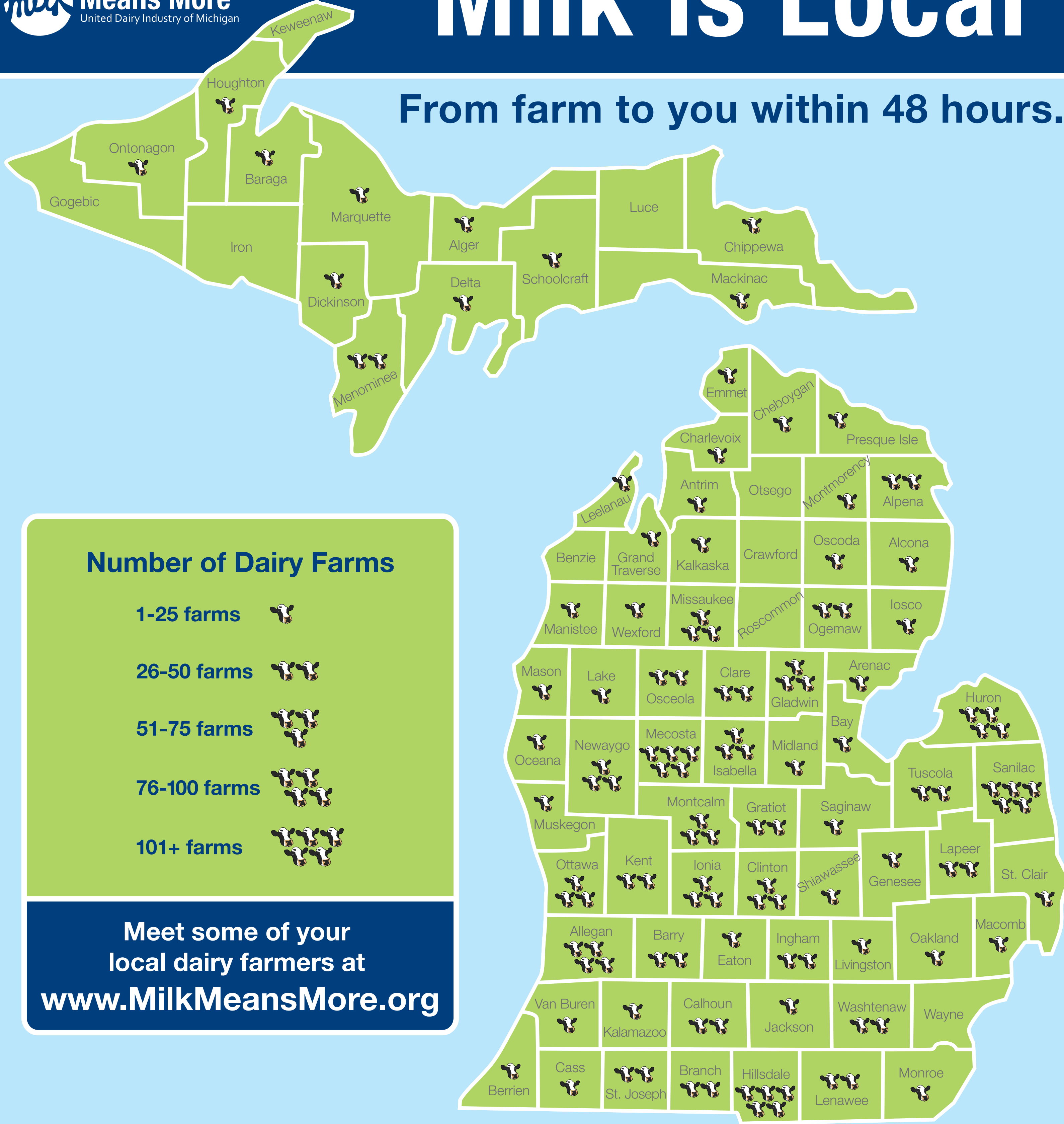

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