

MSTA Newsletter

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From the President's Desk

Message from the MSTA President, Brian Peterson:



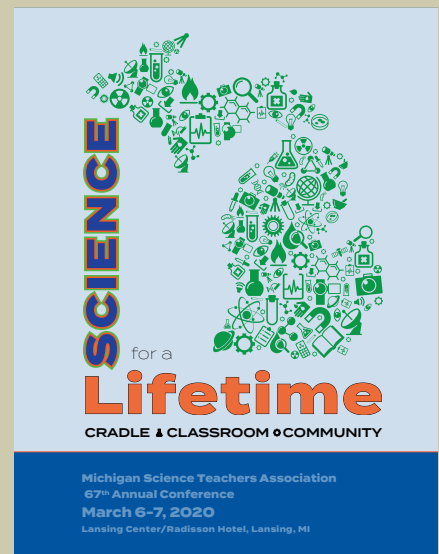
From the Desk of Your Executive Director

Betty Crowder and Robby Cramer, MSTA Co-Executive Directors

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

The MSTA Conference Speaker Proposals forms are on the front page of the MSTA web site! All proposals are due by November 18, 2019. Please consider submitting a proposal for our 67th Michigan Science Teachers Conference! The heart of our state conference is teachers sharing what they are doing in their classrooms! The offering of effective ideas and strategies will help you take resources right back into your classroom on Monday morning March 9, 2020!

The conference this year will be in Lansing Michigan. All sessions will be on March 6, Friday and 7, Saturday at the Lansing Conference Center and Radisson Hotel. We are intentionally working on numerous ways to help you network with other educators



at the conference this year. We will look for ways for you to be able to reach out after the conference to colleagues, speakers and board members. Watch for messaging about the conference via our website, twitter, email and Facebook!

See you at the conference!

MSTA Garage Sale

Please take the following quiz. If you answer “yes” to any of the questions, you will be a perfect participant in the Garage Sale at this year’s conference.

1. Have you been teaching for many years and accumulated lots of “great stuff” that you no longer use or have room to store?
2. Are you retiring soon and want all your “great stuff” to go to someone who will cherish it as much as you did?
3. Have you been banned from storing any more “great stuff” in your basement or garage?
4. Are you in charge of the science storage area at your school and have run out of room because there is so much “great stuff”?
5. Is your principal/supervisor threatening to throw away some of your “great stuff” if you don’t clean it up?
6. Are you changing grade levels and need new “great stuff” or want to get rid of “great stuff”?
7. Did your school get a new science curriculum and you need all new “great stuff”? Or do you need to get rid of “great stuff” because your school got a new curriculum?
8. Are you new to teaching and are in desperate need of “great stuff”?

Whether you are getting rid of “great stuff” or in need of “great stuff”, we can help you out at the conference. Any items you want to put in the garage sale can be dropped off Thursday afternoon or early Friday morning of the conference. The sale will begin at 9:00 on Friday and again on Saturday. Prices will fit any budget, no matter how limited. Proceeds go directly to MSTA. Tax deductible



receipts will be available.

If you are not sure what kind of “great stuff” we are looking for, there really is no right answer. We take pretty much anything that can be used in any classroom pre-K through 12th grade. This can include:

- Leftovers from any of the old science kits that are floating around your building
- Random text book samples
- Classroom sets of items you put together for an activity
- Posters
- Glassware, lab equipment
- Please, no old chemicals or things that are broken

If you have any questions, please contact Liz Larwa at lizlarwa@gmail.com

Michigan is looking for outstanding elementary science educators for the 2019-2020 Presidential Awards for Excellence in Mathematics and Science Teaching (PAMEST).

Starting later this fall, science teachers interested in nominating a colleague who primarily teaches Kindergarten through 6th Grade, or who teach one of those grades and is interested in applying directly, can do so by visiting the program website, www.paemst.org.

Established by the U.S. Congress in 1983, more than 4,800 math and science teachers have been honored as Presidential Awardees. Awardees receive a \$10,000 award from the National Science Foundation and a paid trip to Washington, D.C. to attend recognition events and professional development sessions, among other benefits.

Each year, each state selects up to three finalists in each discipline, alternating annually between teachers in grades K-6 and 7-12. The 2020 state finalists will be selected in the Spring of 2020 by a state selection committee comprised of mathematics and science content experts who review the

applications received in each category. The applications of the finalists are then submitted for national review.

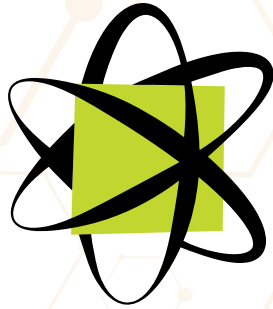
Michigan’s three 2019 Science Finalists are:

- **Christopher Bolhuis, Hudsonville Public Schools**
- **Holly Hereau, Lee M. Thurston High School, South Redford Schools**
- **Scott Milam, Plymouth High School, Plymouth-Canton Community Schools**



For more information about the awards, including exact eligibility requirements, please visit <https://www.paemst.org/about/view> or email Michigan program coordinator Josh Roesner at roesnerj1@michigan.gov.

Ready for the Next Generation!



**CEREAL CITY
SCIENCE™**

by BCAMSC



Designed for the Next Generation Science Standards, Cereal City Science units engage students in sense-making of phenomena or designing of solutions through integrated curriculum of physical science, life science, earth science, engineering, and technology. The STEM-based units are equipped with everything needed to implement three-dimensional learning in Kindergarten through Middle School classrooms.

Curriculum Features:

- Figuring out phenomenon through modeling
- Common Core State Standards for ELA and Mathematics integration
- Tools for formative and summative assessment
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Your partner in science instruction – Cereal City Science supports Kindergarten through Middle School educators with professional learning opportunities including Unit Training, Next Generation Science Exemplar (NGSX), Science Leadership Corps and follow-up “Kit Chats.” Educators are immersed in modeling, science concepts, sense-making, and pedagogical strategies in full-day, in-person trainings and workshops.



Learn more at cerealcityscience.org

Call for 2020 MSTA Speaker Applications

We are currently accepting speaker applications for the Michigan Science Teachers Association's 67th Annual Conference on March 6-7, 2020.

The application is due on Monday, November 18, 2019.

Teacher Application:

https://docs.google.com/forms/d/e/1FAIpQLSdedyMFpdyC_RnCYd0e-tpcefmszj9_jz6q_hi3ZOBL3azg/viewform

Vendor Application:


<https://docs.google.com/forms/d/e/1FAIpQLSc4sJS0-ypRMlxcqGtsVW0ZemwkPKKXjs1hQt9h4G8T3tmdFA/viewform>

NOTE: Vendors who submit an application must also be a vendor/exhibitor at the conference.

Contact the MSTA office with any questions or concerns.

734-973-0433 (phone)
info@msta-mich.org (email)

See you in Lansing!



SCIENCE for a
Lifetime
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Michigan Science Teachers Association
67th Annual Conference
March 6-7, 2020
Lansing Center/Radisson Hotel, Lansing, MI

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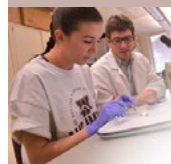


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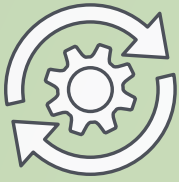
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UPDATES FROM ACROSS THE STATE

GIS Pipeline Created using a Marshall Plan for Talent Grant Award

Overview

The Geospatial Technologies Talent Consortium (GTTC) is a collaboration of the Wayne Regional STEM Network (MiSTEM Region 3), Wayne RESA, university partners including Eastern Michigan University and Northwestern College, Michigan Works, employers, school districts, government agencies, nonprofits and others. The GTTC was awarded a Marshall Plan for Talent Grant totaling \$988,707. The overarching goal is to build a Geospatial Information System (GIS) Talent Pipeline. Specifically, the program will provide students the skills and certifications needed for entry level positions utilizing Geospatial Technologies while still in high school. All students will receive free university credit and support will be given for students who wish to continue their studies at post-secondary institutions. Students will also receive paid internships with local businesses and will be supported by business mentors.

GIS and associated technologies are utilized across all economic sectors including autonomous vehicle infrastructure, emergency preparedness, environmental science including climate change modeling, urban planning, and others. Our students will earn GIS and unmanned drone certifications giving them employability skills that are in demand by our local employers.

Our GTTC Consortium will develop three new pre-internship courses to teach students the skills needed for high-demand, high-wage careers in Geospatial Technologies. The goals of these courses are to teach:

- (1) ArcGIS Pro Software Fundamentals
- (2) Mapping, Visualization, Analysis and Management of Geospatial Data
- (3) Emerging Geospatial Technologies and Skills for Internship. This course teaches the specific skills and techniques needed for the successful completion of internship assignments with participating employers.

We will also develop a new course to prepare students for the ArcGIS certification exam:

- (4) Preparation for the ArcGIS Desktop Entry Level Certification

For the 2nd and 3rd courses, the industry mentors have critical roles. Mapping, visualization, analysis and management of geospatial data are fundamental skills of GIS and geospatial technologies. Our GTTC industry mentors are experts in

these high-demand, technical fields and have rich hands-on experiences and problem-solving skills. They will connect the course content to the skills needed for career readiness.



Additionally, the industry mentors will give the students real-world experiences and an understanding of how the course connects with actual jobs.

The competency based GTTC's curriculum consists of (1) three pre-internship geospatial technology courses as described above; (2) three or six-month hands-on internships working on geospatial technologies projects designed and requested by our GTTC employer members; (3) three, one-semester college dual/concurrent enrolled courses, or one-semester early-middle college courses and (4) three-month construction of professional digital portfolios or/and preparing to take the ArcGIS Desktop Entry-level Certification Exam, or/and FAA Remote Pilot (Drone) Certificate/License Exam.

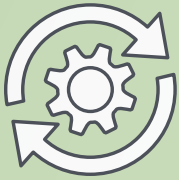
The coursework for the three dual enrolled courses are being developed by Eastern Michigan University and they will be taught by EMU faculty for the first year. Eventually high school teachers will be trained to teach these courses in their local high schools. The first three years of this pilot project will only be offered to the GTTC's collaborative high school partners. However, we hope to offer this opportunity to the whole state later in this initiative.

The MiSTEM Network is a part of this talent consortium. Some, however, may be unfamiliar with the MiSTEM Network. There have been some changes across the state this past school year. During the 2018-19 school year a collaborative network of STEM professionals including business/industry, education, government, and non-profits has established a state-wide MiSTEM Network (short for Michigan STEM Network).

Who are we? The network is a public service that supports STEM education. I am the director of the region that encompasses Wayne County. We are called the [Wayne Regional STEM Network](#) and we are [Region 3](#) of the state-wide [MiSTEM Network](#). This network initially grew out of Governor Snyder's MiSTEM Advisory Council recommendation to make Michigan a world leader in STEM education. This vision is still being championed under Governor Whitmer's administration.

The Council report lists four pillars as necessary components to establish a system that will produce STEM-equipped

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UPDATES FROM ACROSS THE STATE

GIS Pipeline Created using a Marshall Plan *continued*

students and educators. These pillars are: create a STEM culture, empower STEM teachers, integrate business and education, and ensure high quality STEM experiences.

The work of the MiSTEM Network is to build on existing STEM networks to create a STEM ecosystem that supports and implements the components outlined in the four pillars. Per Public Act 108 of 2017 Section 99r, the [MiSTEM Network Plan](#) was submitted by the MiSTEM Network Committee on December 1, 2017.

In its first year of operation, the Wayne Regional STEM Network created a strategic plan for the 2018-19 school year based on the four pillars outlined by the Governor's MiSTEM Advisory Council. A simplified version of these goals are described on our webpage <https://mistem.resa.net/four-pillars/>. A [tri-fold informational flyer](#) is also available on our website and current opportunities are shared utilizing a google group and [Facebook](#). We are currently in the process of creating our 2019-20 strategic plan that will be submitted to the Michigan Department of Education as part of our yearly grant application.

Schools enrolled in the first cohort:

SOUTHEAST MICHIGAN

Delivery
• ArcGIS Pro Software Fundamentals (60 students per cohort)
Van Buren Public Schools
Henry Ford Academy
Monroe High School
• Mapping, Visualization, Analysis and Management of Geospatial Data (60 students per cohort)
Van Buren Public Schools
Henry Ford Academy
Monroe High School
• Emerging Geospatial Technologies and Skills for Internship (CI and CE) (60 students per cohort)
Van Buren Public Schools
Henry Ford Academy
Monroe High School

TRAVERSE CITY AREA:

NMC/NW MI Timeline for Program Delivery
• Intro to GIS (20 students per cohort)
Traverse City High Schools
Suttons Bay High School
Elk Rapids High School
Experiential Learning Internship (20 students per cohort)
Traverse City High Schools
Suttons Bay High School
Elk Rapids High School
Internship Project completion, presentation, Independent Study (20 students per cohort)
Traverse City High Schools
Suttons Bay High School
Elk Rapids High School
GIS Entry Level Professional Certification Course and Exam*** (20 students per cohort)
Suttons Bay High School
Elk Rapids High School

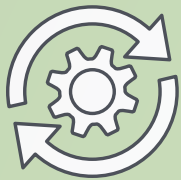
For more information, contact:

Dr. Greg Johnson, Ed.D., Ed.S
 Director, Wayne Regional STEM Network
 Wayne [Regional Education Service Agency](#)

<http://mistem.resa.net/>

<https://www.facebook.com/WayneRESAScience/>





UPDATES FROM ACROSS THE STATE

Great Lakes Bowl: Connect Your Students to Science and Careers Outside of the Classroom

Are you looking for new opportunities for your students to develop interdisciplinary problem-solving skills or connect them to science careers? Do you want to support student science learning outside of the classroom? The annual Great Lakes Bowl, part of the National Ocean Sciences Bowl, is a great way to facilitate these experiences for a team of students while connecting them to water sciences, possible career paths and opportunities for scholarships, trips and other prizes.

The day-long regional ocean-and-freshwater sciences competition takes place in Ann Arbor in early February each year for up to 16 teams from Michigan and northern Ohio.

According to Jeff Moore, a chemistry teacher at Troy High School, “The NOSB brings what the students learn in the classroom into a real-world context. It also gives students an appreciation for the environment and helps them consider their role in preserving the environment.”

While teams, composed of 4 students and an alternate, are typically from a single school, other groups including homeschoolers and Scouting groups are welcome to participate. The Cass City Homeschoolers sent a team to the 2019 competition.

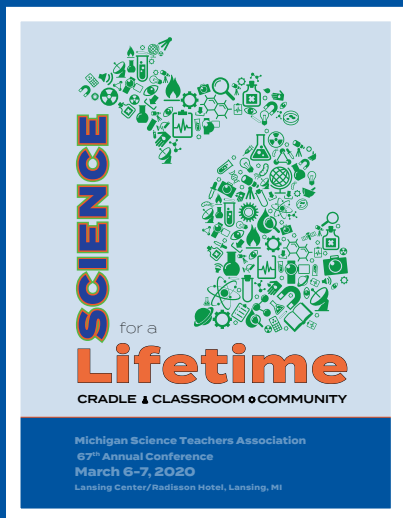
“The event was an engaging way for students to see how the sciences come together in oceanography and marine biology. I think it opened their eyes to careers they never knew about,” said Sue Stuever Battel, leader of the Cass City Homeschoolers.

Students are exposed to science careers through interacting with water science graduate students, faculty and professionals during the science bowl competition as well as provided with web-based resources for schools and agencies that focus on freshwater and marine research.

The competition, made up of both quiz-bowl style and long-answer written questions, focuses on math and science from a spectrum of biology, chemistry, physics, and geology and also includes technology and history. Teams that bring diverse student interest and expertise can be particularly successful.

The 2020 Great Lakes Bowl competition will take place Saturday, February 1. Registration for new and returning teams will begin in late October. Support for teams includes resources such as textbooks and a practice-quiz system, webinars, practice questions from prior years’ competitions, and lodging for teams coming from more than an hour away. Participating students are eligible for prizes, a National Ocean Leadership Consortium scholarship and the winning regional team will compete at the national competition taking place in Gulfport, Mississippi, in April of 2020.

Interested in participating in the 2020 competition? Not ready to commit, but want to volunteer during the regional competition? Just want to bring a colleague to observe this year and consider participating in 2021? Ready to register or simply have more questions about participating? Head over to: www.michiganseagrant.org/educational-programs/great-lakes-bowl-nosb for information and registration.



SAVE THE DATE!!

March 6- 7, 2020

MSTA 67th Annual Conference Lansing Center/Radisson Hotel, Lansing, MI

www.mstaevents.org





UPDATES FROM ACROSS THE STATE

Mi-STAR is Getting Students Excited About STEM Learning and Careers!

By Amanda L Gonczi, Jacqueline Huntoon, Christopher Wojick

Introduction

Implementing Next Generation Science Standards-aligned (NGSS) problem-based learning science units such as those developed by Mi-STAR (Michigan Science Teaching and Assessment Reform) can pose very real challenges to teachers learning new pedagogies and classroom management strategies. These struggles are temporary as teachers develop increased pedagogical content knowledge. Mi-STAR staff works hard to support teachers with the necessary professional learning as the teachers increase focus on making science instruction more student-centered. The evaluation and research data Mi-STAR is collecting indicates that the struggles are worthwhile. With engaging and relevant curriculum, teachers and schools can increase the number of students interested in science and engineering careers and motivate ongoing learning.

Increased Career Interest

To gauge the extent Mi-STAR curriculum is supporting student STEM career interest, a sample of more than 300 middle school students (approximately 100 from each grade) who had participated in the pilot testing of one of three Mi-STAR units completed a survey that asked them to report on any perceived change in interest in science and/or engineering. Depending on the unit, at least 41.5%, and as many as 61.5% of students reported increased interest in at least one of the fields. In addition, approximately one out of every ten students reported increased interest in *both* science and engineering. These outcomes indicate that these three Mi-STAR units, which vary in terms of three-dimensional content, are effective at encouraging increased interest in STEM for approximately half of middle school students.

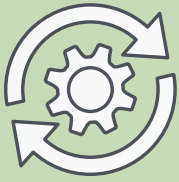
What Did Students Find Interesting and Why?

Students were asked if there was any material from the unit they wanted to learn more about and explain why they were interested in learning more. Students were asked to describe any unit-related material they were interested in learning

more about and why they were interested in learning more. Of the students surveyed, 47.9% of the 6th grade students, 36.6% of the 7th grade students, and 36.5% of the 8th grade students indicated the unit had motivated them to learn more. Sample student comments demonstrate a pattern in *how* Mi-STAR units are stimulating students' interest. First, the units foster the development of "wonderings" as a result of investigations and other unit-related activities. For example, one 7th grade student wrote, "*How is energy here in the first place? I know it cannot be created or destroyed, so how is it here if it cannot be created?*" This comment demonstrates that the unit captured the students' attention, resulted in more questions, and intrigued the student to pursue answers for those questions. Despite the Michigan focus of Mi-STAR units, they appear to support increases in students' interest of related issues outside of Michigan as demonstrated by one student who wrote, "*I want to learn about invasive species outside of the USA.*" In many other cases, the relevant and problem-based focus stimulated students' awareness of how societal decision-making can impact global health. For example, one 8th grade student wrote "*Why is climate change changing so quickly? How can we convince people to help reduce it? The people in the future will have a hard time finding food and stuff because of us and there's nothing they can do when it gets to that point.*"

Conclusion

By aiming to increase students' three-dimensional science knowledge and their interest in how science and engineering can be used to address problems that are relevant to society, Mi-STAR is helping to get more students *enthused* about science. Teachers using Mi-STAR's curriculum report that it is challenging at first because so many instructional changes must be made to implement the new Michigan Science Standards and the vision embraced by the National Academy's *Framework for K-12 Science Education*. Nevertheless, teachers who stick with it and collaborate with others, including professional learning facilitators, are seeing promising results.



UPDATES FROM ACROSS THE STATE

President Donald J. Trump Announces Presidential Excellence Awards in Science, Mathematics, and Engineering



INFRASTRUCTURE & TECHNOLOGY Issued on: October 15, 2019

Today, President Donald J. Trump announced the recipients of the Presidential Awards for Excellence in Mathematics and Science Teaching (PAEMST) and the Presidential Awards for Excellence in Science, Mathematics and Engineering Mentoring (PAESMEM).

Awardees come from schools in all 50 States, the District of Columbia, the Department of Defense Education Activity (DoDEA) schools, and schools in the United States territories of Guam, the Commonwealth of the Northern Mariana Islands, the Commonwealth of Puerto Rico, and the United States Virgin Islands. Nominations and awards are facilitated by the White House Office of Science and Technology Policy (OSTP) and the National Science Foundation. The individuals and organizations announced today are 2017 and 2018 Awardees.

Presidential award for K-12 teachers

Established in 1983, PAEMST is the highest award given by the U.S. Government to kindergarten through 12th grade teachers of mathematics and science, including computer science.

A panel of distinguished mathematicians, scientists, and educators at the State and national levels assess the applications before recommending nominees to OSTP. Teachers are selected based on their distinction in the classroom and dedication to improving science, technology, engineering, and math (STEM) education.

Presidential award for STEM mentors

PAESMEM recognizes the critical roles mentors play outside the traditional classroom setting in the academic and professional development of the future STEM workforce.

Colleagues, administrators, and students nominate individuals and organizations for exemplary mentoring sustained over a minimum of five years. Since 1995, PAESMEM has honored the hard work and dedication which mentors exhibit in broadening participation in the STEM pipeline.

Mentors support learners from kindergarten through the collegiate levels, as well as those who recently started their careers in STEM. Mentors share their expertise and guidance with learners, sometimes through formal mentoring programs. Learners are often from traditionally underrepresented groups in STEM.

Congratulations to the Awardees from Michigan!

Megan Bartley, Benzie Central High School (2017 Science)

Linda Bensyl, Wayland Union High School (2017 Mathematics)

Ellen McDonald, Walled Lake Elementary School (2018 Mathematics)

Katherine Stevenson, Fisher Elementary School (2018 Science)



NEW! GLOBAL SOUNDSCAPES



Immerse your students in the amazing sounds of our planet with the new **Global Soundscapes** film in MiSci's Toyota Engineering Theater!

Through giant screen images, surround sound, and live presentation, **Global Soundscapes** takes you on an ear-opening journey into the science of sound and the emerging field of soundscape ecology.

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FROM AND FOR OUR CLASSROOMS

Making Your Storyline Visible

By Nancy Karre, BCAMSC Outreach Science Consultant

Still writing “I can” statements? Posting lesson objectives? Needing evidence of three-dimensional teaching and learning?

Phenomena and storylines are key elements in the implementation of the Next Generation Science Standards and our Michigan Science Standards. At the same time, we are in the stages of developing “student driven” science classrooms where students raise questions, plan and carry out investigations to answer their questions, and engage in argument from evidence!

Challenges in teaching NGSS and three-dimensional teaching and learning include keeping the story going, keeping a record of learning as the story progresses, making sure the students’ questions steer the story, at the same time steering the story in the direction of the appropriate science standards. We must constantly ask ourselves: Does this lesson help in obtaining information or gathering evidence to answer the driving question or help students figure out the phenomenon? Does this lesson help to provide information for the students to answer their questions?

Teachers across the state are discovering and incorporating a tool that helps make student learning visible and provides evidence of their progression of sense making and learning. The “What We Think” chart is a five-column chart that starts with the first column as “What We Think.” It is a record of their initial ideas with no wrong ideas, just what we think so far in our life experiences and previous learning that help us to explain a phenomenon. The initial What We Think column is added to, and some ideas are removed from, as new ideas and evidence emerge from the science lessons and student thinking progresses. Students are given the opportunity to visualize their initial thinking and have a record of how their thinking has changed due to their scientific endeavors.

The second column is the Questions We Have column. Here is where we make visible all the questions we can think of about the phenomenon. In the process of posting our questions, we sort or begin to categorize them. Students decide what questions are similar in nature and categorize them based on their understandings. Students can use their initial ideas from the first column to develop their questions.

In developing the second column, teachers have also discovered that they get a much more focused and deliberate list of questions if the students have been given the opportunity to develop a model of their thinking and collaborate with peers. In developing their initial models, students begin to ask deeper, more thoughtful questions regarding the science behind the phenomenon. As more questions are generated throughout the lessons, they get added to the chart. As questions are answered, they can be moved to the What We Figured Out column (column #4).

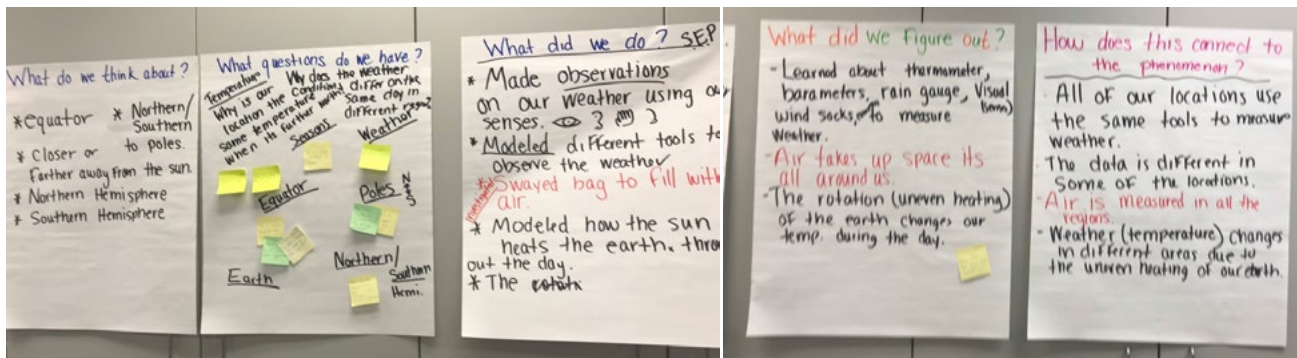
Column three in the chart is the “What We Did” column. It is a reflection of the Science and Engineering Practices the students were engaged in during the lessons. Students may have developed a model to explain (Developing and Using Models), obtained information from reading text (Obtain, Evaluate, and Communicate Information), planned and carried out an investigation (Planning and Carrying Out Investigations), or analyzed data on charts and graphs (Analyzing and Interpreting Data). The “What We Did” column is a reference to the evidence collected to support their claim and a story of how students are acting and thinking like scientists and engineers.

The fourth column “What We Figured Out” is a record of their learning and should connect to the Disciplinary Core Ideas and Crosscutting Concepts. It is their claim for their scientific explanation for the phenomenon. This column also serves as the record of the answers to their questions. When questions are answered, some teachers like to have the students move the questions (if they are posted on Post-It Notes) from the Questions We Have column to the What We Figured Out column. Students feel empowered and in charge of their learning when a question that they asked is valued and answered through their investigations and lessons. The fourth column

continued on page 12

FROM AND FOR OUR CLASSROOMS

Making Your Storyline Visible *continued from page 11*



What We Think Charts - Photo courtesy of Courtney Ray

serves as a formative assessment of student learning. Do the students have sufficient understanding and evidence to support their claims and apply their knowledge to the phenomenon? This column also serves as an assessment of the efficacy of the lesson. It helps the instructor know if the lesson (or series of lessons) provided sufficient experiences for the students to gain a deeper understanding of the science and if their ideas have changed or evolved from the initial ideas in the first What We Think column. When students have started adding information to the What We Figured Out column, it is time to go back to their initial models and make revisions based on new understandings.

The fifth and final column of the What We Think chart is a record of the bits and pieces of information the class has gathered from lessons that they can use to help them explain the phenomenon that drove the lessons. It is the reasoning in their scientific explanation of the phenomenon. The fifth column serves as an assessment of the students' ability to apply what they have discovered to explaining the phenomenon. When the "How Does This Help Us to Figure Out the Phenomenon?" column is complete, students return to their models and develop and present a final model that explains the phenomenon.

"I truly do enjoy using the charts. They take up a lot of space in my room and take extra time to do, but it allows the students to be active participants in science. By formulating questions, the students are driving the learning for the unit. When they are adding questions, what we did, what we figured out, and how it helps, I am able to walk around and check in with students, assessing their knowledge formatively. I have learned a lot by trying this process and it was bumpy, but overall I feel it is an important and necessary contribution to science instruction."

*— Elisha Laninga
Eastern Upper Peninsula*

The What We Think charts are not usually beautiful. They certainly do not resemble the purchased posters and charts that decorate so many classroom walls. As the unit progresses, they can even get pretty messy as they are reviewed and revisited and revised often. There are challenges in using a chart that expands and grows. Space in many classrooms can be an obstacle. It takes practice and discipline to remember to revisit and revise often. But this chart is a useful chart. It tells the story of a classroom filled with exploration and learning. It serves as a record of the students' progression of understanding, and as an assessment of how their knowledge is growing as an instructional unit progresses.



Eastern Upper Peninsula Teacher Leadership Corps working with the Activity Summary Board - Photo courtesy of Elisha Laninga

FROM AND FOR OUR CLASSROOMS

Next Generation Science Standards and Sustainability

Dr. Mark Benvenuto (American Chemical Society Fellow), Steve Kosmas (Beyond Benign Lead Teacher), and Mark Supal (Einstein Fellow and Recycling App Designer/Inventor)

Why aren't we teaching sustainability when it is a perfect tie-in with the Next Generation Science Standards (NGSS)? Let's consider an electric car versus a gas-powered car. Most people would say the electric car will have less of an impact on the environment. Energy is a crosscutting concept in the NGSS. Our question is where is the electricity coming from? If the electricity is coming from coal then the burning of coal will have an impact on the environment. If natural gas (95% methane) is being used to produce electricity, then the burning of natural gas will have an impact on the environment. Which is better? We suggest that we get students thinking about these topics and then have students provide evidence supporting their opinion. According to a September 4th, 2017 article in *Chemical & Engineering News*, "Looking for Methane Leaks", methane is a greenhouse gas that traps 86 times as much heat as does carbon dioxide over a 20-year period. The article goes on to explain how solar power can be used as a low-cost alternative to be part of a methane detection system.

Why not have the students use "practical" labs from Beyond Benign, a leader in Green Chemistry/Sustainability Education? We highly suggest having your students produce biodiesel as part of the energy unit. This way students are exposed to making a fuel from renewable resources. Biodiesel is made from vegetable oil. If you work with polymers, then give your students the opportunity to work with polylactic acid which is used to make plastic cups from corn. This cup can be chemically changed into a cleaning solution and all of these lab alternatives are available from Beyond Benign. The cup from corn-based derivatives and the chemicals needed for the lab still need to be purchased. A large list of sustainability/green chemistry labs are available from Beyond Benign at no cost.

Cutting edge teachers are teaching sustainability through their science courses (e.g. adding solar panels to schools, teaching the lost art of composting, creating recycling apps, etc.). There are many ways to address sustainability issues in a science curriculum, so why are many teachers skipping past this important topic? As we all know, teachers experience time crunches due to curriculum restraints. What if educators just integrated greener labs in place of the ones they have been doing? When discussing diffusion of gases, we can discuss how a perfume/cologne molecule moves across the room. Why not discuss how long it takes a chlorofluorocarbon to reach the stratosphere and impact the ozone? Most chemistry teachers discuss precipitate formation. Why not extend the discussion to how to pull harmful substances out of water (e.g. precipitates, complexes, ligands)?

The Next Generation Science Standards have 8 practices: 1) asking questions and defining problems, 2) developing and using models, 3) planning and carrying out investigations, 4) analyzing and interpreting data, 5) using mathematics and computational thinking, 6) constructing explanations 7) engaging in argument from evidence, and 8) obtaining, evaluating, and communicating information. Complex sustainability issues are a perfect fit for 3-dimensional learning and integrating the 8 science practices into the classroom. How many K12 educators feel that these complex sustainability issues should be taught through the NGSS?

If you are interested in reading more about this topic. Please go to the following link which discusses a Green Chemistry Growth Mindset (GCGM). <http://adsabs.harvard.edu/abs/2017PhSRv...2...56K>

If you are a K12 instructor and interested in writing a book chapter on Green Chemistry/Sustainability, please contact:

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Sources:

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Green Chemistry. <https://www.beyondbenign.org/curriculum/>

FROM AND FOR OUR CLASSROOMS

Why Engineering Belongs in Science Class or Teaching Kids to Boldly Go Where No One Has Gone Before

By Tony Matthys, Doug Oppliger, and Marcia Goodrich

Doug Oppliger and Tony Matthys are curriculum development associates for the Michigan Science Teaching and Assessment Reform Project (Mi-STAR), based at Michigan Technological University. Marcia Goodrich is a journalistic writer for Mi-STAR, which is developing a science curriculum for grades 6-8 that meets the Michigan Science Standards.

Cadet James T. Kirk had a problem. As commander of a starship, he could rescue the *Kobayashi Maru*, a freighter adrift in the Klingon Neutral Zone, and risk annihilation and perhaps interstellar war. Or he could abandon the freighter's crew to certain death. No one had ever found a solution to this Starfleet Academy computer simulation that did not end very, very badly. But on his third try at the *Kobayashi Maru* puzzle, Kirk managed to rescue the freighter and preserve peace in the galaxy. One can only assume Kirk's problem-solving prowess must have been inspired by the Next Generation Science Standards (NGSS).

Most students will never come up against situations as dire as those faced by the swashbuckling heroes of *Star Trek*. But throughout their lives, they will grapple with many challenges, both big and small. Until recently, the typical K-12 education did not provide them tools to address those problems in a systematic way. That is beginning to change.

Engineering is for everyone

When Michigan adopted its own version of NGSS, the Michigan Science Standards (MSS), teachers found much of it familiar. Experiential learning, for example, had already replaced lectures in many classrooms. The Disciplinary Core Ideas (DCIs)—Physical Science, Life Science, and Earth and Space Science—were old friends. But the emphasis on engineering, particularly as a DCI, was new, and not everyone was convinced it was necessary. Engineering instruction is often considered job training, and only a small fraction of our students go on to become engineers.

By the same token, however, few of our students go on to become scientists, yet we don't think twice about teaching much of the traditional science content, such as plate tectonics, photosynthesis, and radioactive decay, which is often forgotten forever after the final exam. After all, when was the last time understanding an electron transport chain helped you in your everyday life?

While the new Engineering DCIs do lay the framework for a career in engineering, they are relevant for an entirely different reason. By internalizing the fundamentals of engineering design embedded in an NGSS-inspired curriculum, students learn defined, methodical processes they can apply throughout their lives to solve any number of problems.

Failure can be the best teacher: criteria and constraints

To help students experience how these fundamental design principles lead to better solutions, developers of the Mi-STAR science curriculum, including Mi-STAR staff and middle school science teachers, embed this engineering content throughout the middle school science units. Students learn engineering design not just through experimentation and hands-on challenges, but also through explicit student reflection on the design process. In past years, a conventional secondary science class might have students participate in, for example, a paper-tower building competition. Students might test a couple designs before pitting their tower against their classmates'. Testing the towers would often result in all of them being destroyed (except perhaps one); then a winner would be declared, and the class would move on to a new lesson. To meet the MSS, a curriculum must go further than just having students build something and test it to destruction. Students must also reflect back on their experience to identify how the engineering design process helped them develop a successful solution.

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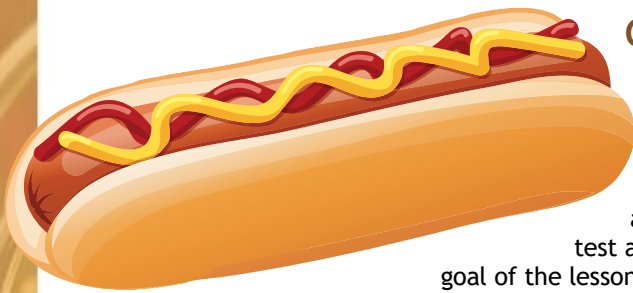
FROM AND FOR OUR CLASSROOMS

Why Engineering Belongs in Science Class *continued from page 14*

In other words, you can tell students that the better their criteria and constraints are defined, the more likely they are to get a good solution. However, there's nothing like bitter experience to drive home a point. In one of Mi-STAR's Off-the-Shelf Lessons (short, "grab and go" lessons that target specific aspects of the new science standards), students learn about criteria and constraints by participating in a manifestly unfair design competition.

In this lesson, the class is divided into teams of three or four students whose task is to design and build a paper tower to display in the hallway. Half of the teams are given well-defined criteria and constraints: the tower has to fit on a shelf of a certain size, they should use a certain amount of tape, etc. The other half get a set of vague, subjective instructions. When the towers are scored, this second group of teams inevitably loses and the students are understandably upset. They had no idea their towers had to stand up to the breeze from a box fan. But ultimately everyone gets to be a loser, because at the last minute the class is introduced to a previously undefined constraint: their towers must withstand a blast from a leaf blower. Typically, none of their creations are up to the task since the students were not given a clear description of the problem.

After all the towers are blown apart, students discuss what went wrong, i.e., some teams received specific directions, while the others got unclear or poorly defined information. That leads them to consider how the criteria and constraints should have been defined in order to yield a successful solution. While building a tower is key, it's only part of the real point of this lesson: The better you define your criteria and constraints, the better your solution will be.



Chilling those hot dogs

Other Mi-STAR lessons address other aspects of engineering design, including having students revisit their original designs and make them better. This iterative process is illustrated in Unit 7.3, in which students design pet crates which must keep dogs cool outside on hot days. They apply what they've learned about thermal transfer to build their crates, and then they also test and refine their designs, as professional engineers would do. The goal of the lesson is not to build the "best" dog crate, but to experience and understand how iterative testing leads to better solutions.

Mi-STAR incorporates fundamental engineering principles like this throughout the curriculum, and not always in situations that most people would recognize as engineering. In one lesson, students learn how to create a decision-making matrix that can be adapted to many types of uses, such as choosing a snack or managing invasive species. Deciding whether to eat an apple or a donut might not seem like an engineering problem. However, the process of systematically weighing the factors that come into play when choosing what to eat is fundamentally no different from determining the criteria and constraints while designing a building. Once students internalize this process, they can apply it to all manner of challenges, from choosing a presidential candidate, to deciding on the perfect vacation . . .

. . . to averting interstellar war.

It's easy to imagine Cadet Kirk applying this iterative process as he wrestles with the *Kobayashi Maru* final exam problem. The first (and most obvious) solutions he attempts—abandoning the freighter or entering Klingon territory to rescue the hapless crew—end in catastrophe; they fail to satisfy the constraint of saving lives. But as he revisits the scenario for his third and final time, Kirk tries a different approach and saves the day. After all, there is nothing in the problem's criteria and constraints to prohibit Starfleet students from reprogramming the simulator.



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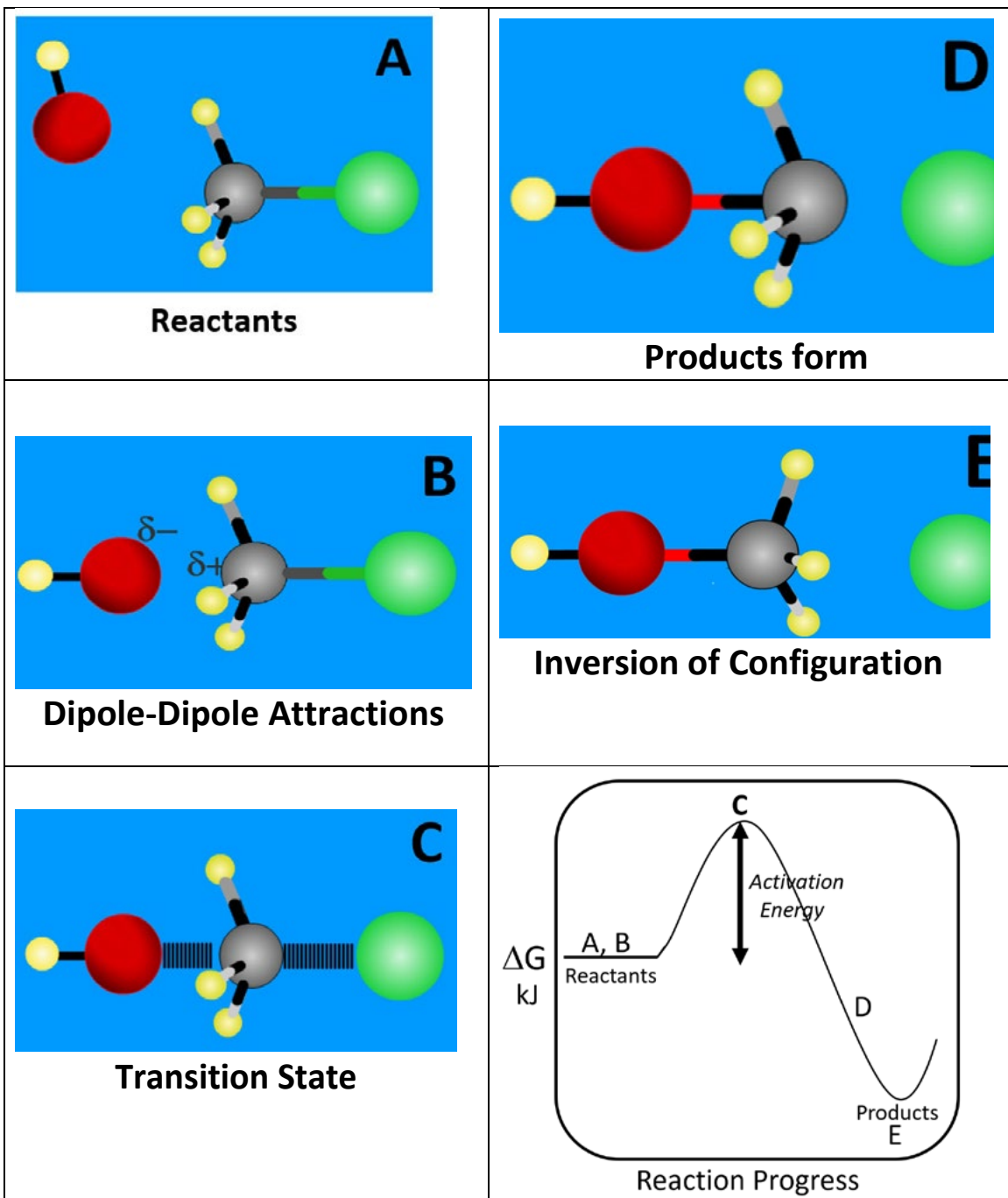


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FROM AND FOR OUR CLASSROOMS

A One-Step Mechanism as a Cartoon

By Larry Kolopajlo, Eastern Michigan University



Reflections from a MSTA 2019 Conference Scholarship Winner

From scholarship winner Caitlin Grabill

As a first year teacher the MSTA Conference was an incredibly uplifting and rewarding experience. I attended several meaningful sessions geared towards the subjects I teach and what I am interested to learn more about. I believe the session I attended that was the most worthwhile was the Muffins with Members session. I got to meet with several of the board members and general members and discuss what we enjoyed about the conference and being a member of MSTA. We also discussed what we believed could be improved about both. Plus, there were some great muffins and coffee. Building relationships with other teachers and networking with veteran teachers were also an irreplaceable experience gained over the course of the two days I attended. It helped me build my confidence in my practice and realize that I am not alone in this crazy science teaching world we call our lives.



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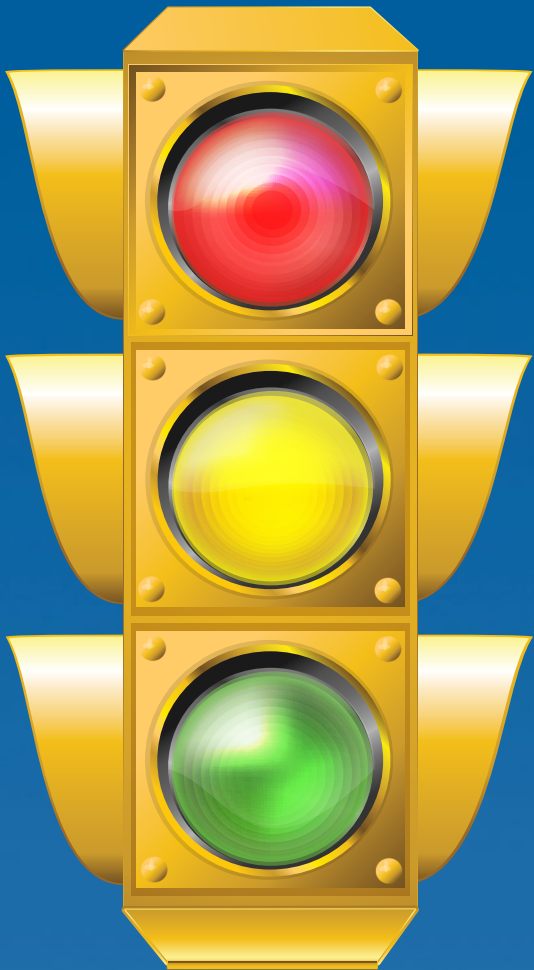
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