LINKS

LESSONS, INNOVATION & NEW KNOWLEDGE IN SCIENCE

SPRING 2022

MICHIGAN SCIENCE TEACHERS ASSOCIATION

THE OFFICIAL MEMBER NEWSLETTER OF MICHIGAN SCIENCE TEACHERS ASSOCIATION

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The MSTA Conference – A New Experience for a New Graduate

Lynn Heiple | Central Michigan University

What a jam-packed weekend! There was a smorgasbord of keynotes, field trips, and breakout sessions; not to mention all the exhibitors. Hello! My name is Lynn Heiple. I am a wife, mother, and substitute teacher. As a recent graduate of CMU's teacher education program, I am very excited to be entering the field of science education. I would not have been able to attend this conference if it weren't for receiving an MSTA scholarship. Thank you, MSTA!

Conference Newbies

For those of you who have never been to an MSTA conference or if you know someone who will be attending for the first time, here are a few pointers. Be your own best friend and PLAN AHEAD! Read ALL the information provided to you beforehand. Plan your breakout sessions and field trips. Find out where to park your vehicle and how much it will cost. For lunch or dinner, I recommend "The Nuthouse" or "La Cocina Cubana". Try to stick to your schedule if you can. A backpack might come in handy, too.

Keynotes

One of the keynote speakers was Dr. Gina Cervetti. Her topic was Integrating Science and Literacy Instruction in Elementary Classrooms. She shared a whole lot of great information; these are just a few take-aways from her speech.

- Strive for deeper understanding by letting students figure some things out on their own
- Based on your topic or phenomenon create a Unit Question
- Break down the Unit Question and connect the topic or phenomenon to students' lives
- Use the Do-Talk-Read-Write strategy to engage students
- Discuss the purpose of the reading, i.e., reading for context, reading scientists' investigations, gathering data, or making sense of data
- Show students how to Do-Talk-Read-Write like a scientist; i.e., use scientific language
- Teach and model effective discussion skills

Another keynote speaker, Dr. Carrie Tzou, revealed an eye-opening study during her presentation, *Science Education Towards Just and Thriving Futures.* The study beautifully demonstrated how easy it can be to overlook a teachable moment and unintentionally hinder equity. As teachers, we may get impatient with students' behavior, but that's when we are most likely to miss an opportunity to teach a curious student. Instead of unconsciously reacting, I want to be mindful of how I can promote equity among students.

Field Trips

I. Love. Field. Trips. Who doesn't? Sadly, the Potter Park Zoo field trip was full, but I was able to sign up for Preuss Pets and Fenner Nature Center. Preuss Pets is kind of like a pet store on steroids. No kidding. They sell a wide variety of animals and supplies. The store looks like a jungle inside. It is truly amazing! It is also an animal education center because the staff ensures that anyone looking for a new pet is well-educated and able to take care of that animal. They literally will not sell an animal unless they are sure that it will be going to a good home. I love that. preusspets.com

A Frilled Lizard at Preuss Pets

My second field trip venue, Fenner Nature Center, was a beautiful place to visit. It is an environmental education center encompassing 134 acres of publicly accessible green space. The property includes over four miles of trails, rolling glacial eskers, towering maple groves and much more. The Visitor Center contains live native reptiles and amphibians; a viewing area to watch songbirds, deer, and wild turkeys; and newly renovated hands-on exhibits. Our program guide at Fenner, Sam Ansaldi, was very knowledgeable and very entertaining. He let each of us tap a sugar maple tree and gave us samples of syrup from various tree species including sugar maples. mynaturecenter.org

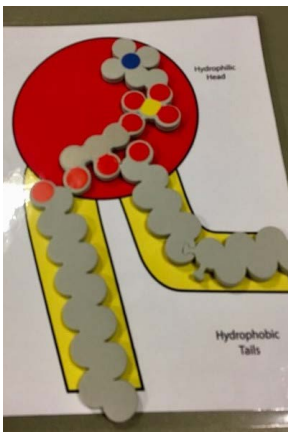
We tapped Sugar Maples at Fenner Nature Center

Worth It!

The collective knowledge at this event was tremendous! I collected many little gems, literally and figuratively. I left the conference with a bag full of minerals, fossils, and jewelry from the Michigan Earth Science Teacher Association (MESTA) Rock Shop and loads of great ideas for my future classes!

(Photos courtesy of Lynn Heiple)

Rocks and Minerals purchased from the Rock Shop



Molecule models

Molecule models

"Portrait of a Dreamer" sculpture

Brilliance of Children and Strengths of Educators On Display at MSTA 2022

Rich Bacolor | Wayne County RESA

In her 2021 Keynote address for the MSTA Conference, Dr. Gloria Ladson-Billings asked us to imagine how schools might look if science was positioned at the center of the curriculum. A year later, as the global pandemic continued to impact children's lives inside and outside of school, the 2022 MSTA Conference Committee turned to The National Academies of Science, Engineering, and Medicine's report "Science and Engineering in Preschool Through Elementary Grades: The Brilliance of Children and the Strengths of Educators" for guidance. On Friday, March 4, 2022, researchers and practitioners gathered at the Lansing Center to share examples of how such science-forward thinking can transform the learning experiences of all students.

University of Michigan education professor Dr. Betsy Davis served as the Chair of the report committee, and committee member, Ms. Jeanane Charara, currently an instructional coach with the SOLID Start team at Michigan State University, led the proceedings with an overview of the report's purpose, methods, and findings. Following the overview, panelists and speakers addressed the recommendations from each section of the report with personal accounts of the challenges, connections, and ongoing commitments to provide opportunities for the brilliance of students to shine and to build on the strengths of educators across the state. Participants in the symposium were asked to connect and reflect through surveys and sketch-notes.

The following highlights key elements from the presentations. We encourage members to peruse and share. And let us know: How do you support the brilliance of students and the strengths of educators PreK through the Elementary Grades? How can MSTA support you or the teachers in your area on this critically important topic in science education? Send your comments to info@msta-mich.org.

Keynote 1: Overview
Dr. Betsy Davis, University of Michigan
Jeanane Charara, Science Coach, SOLID Start

The Golden Circle concept, popularized by Simon Sinek, says to start with "Why." In their overview of the report, Dr. Davis and Ms. Charara did just that. Their remarks outlined four approaches to more equitable and justice-centered elementary science classrooms: 1) To provide better access and opportunity for all students to engage in science; 2) To elevate student achievement, representation, and identities in science in a system that narrowly focuses on mathematics and literacy in isolation; 3) To expand what counts as science and engineering; and 4) To use science learning as

a context of creating a more just and equitable future. Creating systemic change is often an engineering challenge. The opening keynote asked us to look at the system and examine our roles in making it better.

Read the full report here:
https://nap.nationalacademies.org/catalog/26215/science-and-engineering-in-preschool-through-elementary-grades-the-brilliance

View the presentation slides here:
https://drive.google.com/file/d/1x0ddYWQBPN60vXhPK5KXTrzIXTmg_j7e/view?usp=sharing

Panel 1: Prioritizing Science and Engineering in Preschool Through Elementary Grades
Sarah Coleman, Science Consultant, Muskegon Area ISD
Andrea Brook, STEM Instructional Coach, Lake Orion Community Schools
Will Lepech, Assistant Principal, Kent City Community Schools

Two well-worn adages summarize the stories told by the three panelists who discussed Recommendations 1-4 and Prioritizing Science and Engineering: "Failure to plan is planning to fail," and "It takes a village." Sarah Coleman emphasized the importance of focusing change on people rather than things. She also emphasized having a designer's iterative mindset throughout the process. Andrea Brooke picked up that theme by sharing her district's coaching model for science and reminding us that it takes more than a curriculum to be able to fill our buckets as science educators. Will Lepech shared his school's innovative model that creates a schedule to protect instructional time for science, sets teachers up for success, and sets students up for growth.

Read the Recommendations 1-5 here:
https://nap.nationalacademies.org/read/26215/chapter/2
View the presentation slides here:
https://drive.google.com/file/d/1z5N6crpwrkQaUt7PW7k-cQep085ZS2UW/view?usp=sharing

Keynote 2: Curriculum and Content Integration
Dr. Gina Cervetti, University of Michigan

Content integration is a commonly suggested remedy for the time demands of ELA and Mathematics on elementary instructional schedules. Dr. Cervetti's presentation emphasized the benefits of using phenomenon-based lessons as a means to engage students in authentic science and literacy tasks. For example, instead of learning about "Food Webs" as a topic, students could be presented with a cause-effect driving question, such as "What is causing a boom in the Zebra Mussel population?" which requires both firsthand (doing-talking) investigations and secondhand (reading-writing) investigations. Her presentation encouraged both literacy and science educators to collaborate under the well-documented idea that neither reading alone nor inquiry alone will produce the long-term outcomes our students deserve.

Read the Recommendations 10-13 here:
https://nap.nationalacademies.org/read/26215/chapter/2

View the presentation slides here:
https://drive.google.com/drive folders/1aVW9DrAJtkUrteVyPLz8mKY8jRx20Vy4

Panel 2: Supporting Children's Learning, Engagement, and Proficiency in Science and Engineering

Dr. T.J. Heck, Michigan Department of Education
Chiara Kirkland, Detroit Public Schools Community District
Dr. Cory Miller, Michigan State University
Amber Richmond, Detroit Public Schools Community District

The term "Learning Loss" has been tossed around liberally throughout the pandemic. Some have tried to reframe the issue using principles of "Accelerated Learning" through Tier One instruction and regular Formative Assessment rather than remediation. In this panel, Dr. Miller described what's possible when curriculum materials were designed for phenomenon-based learning and formative assessments from the ground up. DPSCD Training and Support Coordinators, Ms. Kirkland and Ms. Richmond, described the supports teachers need in order to implement and bring these curriculum materials to life inside classrooms. Finally, Dr. Heck reminded us that all assessments are reflections of what we value, what trade-offs we make, and ultimately what we want children to take with them from educational experiences.

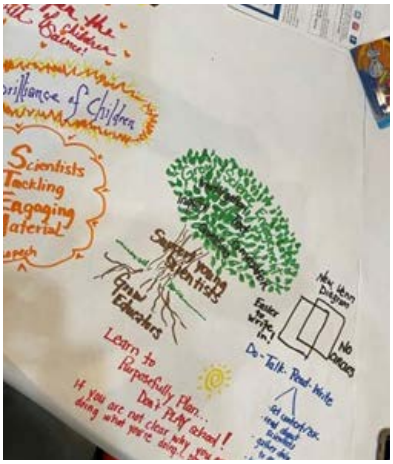
Read the Recommendations 5-9 here:
https://nap.nationalacademies.org/read/26215/chapter/2

View the presentation slides here:
https://drive.google.com/file/d/1faUbWUwRvovuBz_00sDkCLSwrQ-IP8xw/view?usp=sharing

Panel 3: Supporting Educators: Playbook, Blueprint, Plan for Building on the Strengths of Educators

Dr. Christina Schwarz, Michigan State University
Dr. Sandy Yarema, Wayne State University
Nancy Karre, Cereal City Science

The final panel of the day brought us back to the primary mission of MSTA: supporting teachers and improving science education. Dr. Schwarz set the stage from the teacher preparation lens. She outlined the need to embrace the new standards for learning science as well as supporting



teachers to engage in practices of teaching science that reach all students. She also gave us examples of how that is being done to help new teachers build relationships and community, experience the joy in exploration, and minimize barriers to effective science teaching. Dr. Sandy Yarema's personal narrative of 2+ decades in education from the middle school to college classroom echoed these ideas. Dr. Yarema said we should follow the research that shows how partnerships and collaboration among community, government, and school entities can support teacher development and ultimately benefit all students. Nancy Karre's impassioned finale to the day contained the kind of energy physicists might wish to investigate. She argued that supporting teachers to do this work with our children requires leaders rather than gatekeepers. She added that those leaders need to intentionally build communities working together rather than leaving individual science teachers to struggle on islands alone.

Read the Recommendations 14-17 here:
https://nap.nationalacademies.org/read/26215/chapter/2

View the presentation slides here:
https://drive.google.com/file/d/17WV1DkwLTOex3aKg5n8bdzEwgwM2g_lH/view?usp=sharing

Read or Download the Report Here:
https://nap.nationalacademies.org/catalog/26215/science-and-engineering-in-preschool-through-elementary-grades-the-brilliance

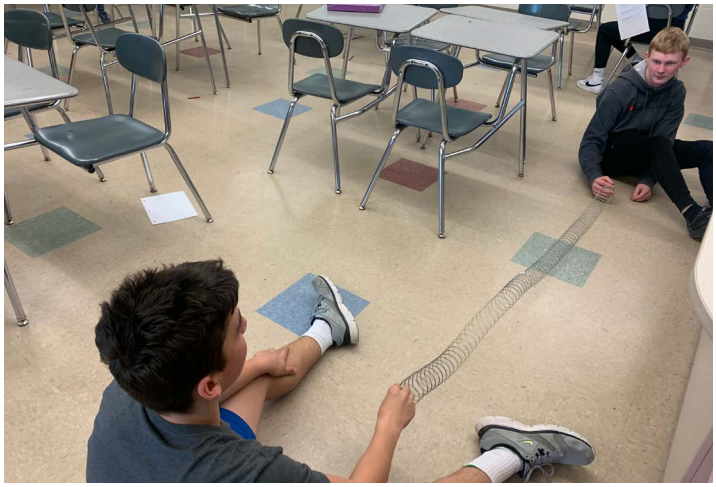
Modeling with Waves: An MSTA Conference Connection

Jenne VandePanne | Newaygo Middle School

As science teachers, we understand that energy travels in waves. Sometimes what we struggle with is giving our students concrete opportunities in real life to internalize the concept in an engaging way. Enter the Slinky. It's the beginning step for most wave units. What would we do without it? Look at the waves moving up and down! Look at the waves moving side to side! As physical science teachers, we've all been there and it's good stuff, but shouldn't there be more to it?

At the 2022 MSTA Science Conference, James Gell and Laura Ritter took the Slinky one step further, which was genius in my opinion. They challenged participants to consider using the slinky and its energy to communicate through Morse Code. To begin, a Morse Code Chart was displayed showing an overwhelming amount of dots and dashes to symbolize letters. Participants were asked to make observations about the complicated communication system: dashes, dots, spaces, long dashes, long spaces, etc. Some participants even questioned how you could tell letters apart; they are so similar. Gell steps in with his challenge: use Slinky movements to communicate a Morse Code message to a partner. Ladies and gentlemen, we have just tapped into using wave energy for communication. My first thought was teenagers LOVE communication! I just had to try it in my classroom to add to my MISTAR Unit 8.3 lesson about wave energy.

What a happy little mess my students found themselves in -- the perfect learning environment. Most student partnerships thought it best to start with a simple message, "Hi". Two things happened here: 1) the message was guessed right away (where else would an 8th grader start?) and 2) it was a simple code of just dots and spaces, so it was hard to differentiate letters from each other or other letters. After a class discussion of what was noticed during the first attempt, students realized that they need to be deliberate about distinguishing spaces. Some partnerships



decided to use an extra-long wait time while others decided to try adding a space marking wave of a different movement. With renewed determination, students tackled messages that were simple yet unique, with consideration given to the receiver's ability to decode it.

I am telling you firsthand that this introduction to wave energy gave my students a better experience to draw from to start the lesson than simple Slinky observations they've relied on in the past. This time, I had several students refer back to that experience in classroom discussions, Claim Evidence, and Reasoning statements, and even in explanations beyond the wave energy lesson itself. Students applied the knowledge gained from the Morse Code activity to various places throughout the unit. To me, that is a priceless student experience and I just had to share it.

For more information about Modeling with Waves or Modeling PD in general, please visit https://www.mimodelinginstruction.org/workshops.html for workshops available this summer.

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A Lab Safety Class Project by Preservice Teachers at Eastern Michigan University

Caroline Barrett, Antonio Divetta, Heather Evans, Madeline Mahnke, Dane Peterson, Kyle Smith, Jacob Wade and Larry Kolopajlo, Ph.D., | Eastern Michigan University

Introduction

During the spring 2022 semester, preservice science teachers taking a Science Methods[1,2] course from Professor Kolopajlo[3] (Chemistry) undertook a project in lab safety. In addition to taking the Flinn Science Safety course[4], students integrated safety into their teaching experiences and assignments. Moreover, they decided to jointly contribute this lab safety article to the MSTA Links publication. Contributions from each student follow in the narrative below, beginning with general safety concepts from Kyle Smith, followed by chemical demo safety tips and tricks by Antonio Divetta. The article then moves on to lab safety in physics, earth science, and biology.

Safety Pedagogy: How to Build Effective Rules for Lab Safety

by Kyle Smith

Labs are a vital part of learning the sciences. Labs provide students with an opportunity to actually observe the consequences of the theories and facts they have learned. Moreover, labs provide valuable empirical evidence to reinforce the concept knowledge students gain from lectures and activities. But before any of that learning can take place, it is vitally important that students understand the principles of laboratory safety. Luckily, the same tools that help teach concepts like conservation of momentum or photosynthesis – tools like direct instruction, demonstrations, and class discussions – can be used to help students learn the fundamentals of laboratory safety.

In traditional classrooms, direct instruction is particularly effective for teaching simple or foundational concepts. In a direct instruction style lesson, otherwise known as a traditional lecture, the teacher *directly* tells the students the facts about the lesson topic. These lessons are useful because they are easy and quick, but they can fail to leave students with a deep understanding of the lesson topic.

When a particular lab only requires one or two special safety considerations (such as an otherwise simple chemistry lab that involves the use of a single dangerous chemical), direct instruction may be a great way to get that information across quickly and easily. The goal is to simply let students know the relevant information as part of the pre-lab phase of the lesson. It may be apparent that this approach is less effective for communicating large amounts of safety knowledge, since students may begin to lose focus, or the teacher may run out of time.

For more advanced safety techniques, a visual demonstration may be more effective – both in terms of time and knowledge retention – than a verbal explanation. Again, use-cases from a traditional classroom can make it easier to understand the application of this strategy for lab safety. In a traditional classroom, demonstrations can help show students that a certain theory or principle is true for *all* cases, such as demonstrating that all objects experience the same acceleration due to gravity by dropping two differently sized objects at the same time.

Alternatively, examples can help demonstrate a *specific case* where a principle is true, such as comparing the magnetism of a superconductor above and below its critical temperature.

When using demonstrations to teach lab safety, teachers can use the same principles as using demonstrations in the classroom. Demonstrations can be a good way to show students what actions are *always* safe (like demonstrating the proper way to rinse glassware), or what *specific* actions will turn a usually safe situation into an unsafe one (like heating a wet beaker). Demonstrations work best for teaching safety principles that are universally relevant or applicable only in a few specific cases.

When it comes to helping students develop a deep understanding of complex topics, class discussions are one of the most valuable and effective tools a teacher can use. Class discussions let students apply their content knowledge abstractly by creating and solving problems verbally. Class discussions can also create a "buy in" effect, where students feel more confident in knowledge that they have helped create with their peers than knowledge handed down to them by the teacher.

When a lab lesson or lab unit calls for a number of new and specific safety practices, class discussion can be a helpful way to ensure student knowledge retention. As in a traditional class discussion, the role of the teacher is to use guiding questions to focus student thought on core ideas. In this situation, students make the safety rules for the class while the teacher acts as a facilitator. The teacher can facilitate these discussions by asking how the rules cover possible dangerous scenarios, or by asking clarifying questions about the rules the students have picked. Once a satisfactory list of rules is established, students can work together to make a poster containing all the rules, which can then be displayed in the classroom as a reminder. You may even ask each student to sign the poster, as a way of showing that they agree that the rules are satisfactory, and also that they agree to follow the rules.

As an example, a physics lab may involve using liquid nitrogen to cool superconductors. Students can be told to wear cryogenic gloves when handling cold substances, and to avoid any bare skin contact with the superconductor, but these two practices do not begin to cover all the safety concerns of a lab like this. A class discussion is a much better way to make students mindful of all the safety concerns present, and what actions they can take to prevent injury. The teacher can start a discussion of lab safety using guiding questions like, "What safety hazards are present in this lab setup?" or "What safety precautions do you think it would be most important to implement for this lab, and why?" Questions like these and the discussions that follow can help students create a safety mindset and make connections about the best practices for lab safety.

Finally, no matter what method establishes the rules of classroom safety, any science lab teacher should have their students sign a safety contract. Like signing the poster in the class discussion example, a safety contract is a document that shows the student acknowledges that they know the rules of classroom lab safety, and they agree to follow such rules. This document should reference documents where the full list of safety rules can be found and should include general practices like agreeing to wear appropriate clothing and agreeing not to

rough-house. This document should contain the signatures of both the student and their guardian. It may be a good gesture as a teacher to sign a safety contract as well, agreeing to give the students adequate instruction and equipment to perform all labs safely.

Arguably the most important thing students learn in a laboratory classroom is how to safely use and handle lab equipment and perform experiments. Luckily, the same techniques that work for teaching subject area content can be used to teach lab safety. From simple practices like wearing eye-protection to complex procedures such as properly handling dangerous chemicals, teaching techniques like direct instruction, demonstrations, and class discussions can help ensure students have the tools they need to perform labs safely.

Chemical Demonstration Safety Tips and Tricks
by Antonio Divetta
One of the most dangerous activities a science teacher can do is have students complete in-class chemical laboratories. Therefore, many teachers opt to complete the demonstrations while in front of the class. This lessens the risks of injury or harm but does not eliminate these risks. There are many tips and tricks that a science teacher can do to ensure that no one gets hurt while they are doing demonstrations.

The first tip that is to ensure that the chemical demonstrations are done on a reasonable scale. A reasonable scale can be described specifically as the procedures correct amount and avoiding trying to go over to get larger effects. Even though teachers do demonstrations to teach the students in a fun and creative way, doing the demonstrations using more than the correct amounts of chemicals can put both the teacher as well as the students at risk. The reason is doing chemical demonstrations at larger scales than originally intended can change the reaction rates of the demonstration as well as the overall size of the reactions. Teachers in the past had to learn this the hard way. For example, as reported by the web publication *AllonGeorgia*[5] by Jessica Szilagyi, a teacher performed the "rainbow flame" experiment using a gallon size jug of methanol. The actual amount, listed for the safe ethanol alternative, is only fifty cubic centimeters (ml) according to the Royal Society of Chemistry. This large amount quickly reacted into a large fireball and ended up severely injuring one of the student audience members.

Furthermore, teachers need to understand the maturity level of their class. This also relates to choosing demonstrations that have a proper scale for their class. Teachers need to understand the maturity of their class to properly choose appropriate demonstrations to do. For example, a teacher who teaches lower elementary should choose demonstrations that

are on smaller scales with less violent reactions, the main reason is that the students are less mature and therefore, could reach out and try to touch the demonstrations or act out in other ways that older students would not do. Choosing a proper scale for the proper maturity level could be the difference between a fun and interesting demonstration for a class or injury.

This brings us to the next tip. This is for teachers to understand exactly what is being used in the demonstrations. For a demonstration the teacher should know how reactive, how fast it will react, and what are the exact products of any demonstration reaction. If the aforementioned teacher understood exactly what she was using in the experiment she would have understood that methanol is incredibly

flammable and reacts incredibly quickly. If she understood the chemical properties of methanol by studying Safety Data Sheets, she most likely would have chosen to not use methanol, and instead she would have used a safer alternative in ethanol as suggested by the Royal Chemistry Society. She thus would have avoided the life-changing injuries sustained by the injured student. Alternatively, the teacher could have rehearsed the demonstration without a student audience. This preparation would have allowed her to see firsthand the characteristics of methanol and may have led her to the decision to either not use as much, or use an alternate chemical, or even choose a safer demonstration entirely. Consulting *Safety Data Sheets* before using chemicals is a must.

Knowing the class is just as important as knowing the chemical for safety reasons. Some students may have a light or sound sensitivity, or even be allergic to certain chemicals. Therefore, a teacher should always survey his or her class prior to any demonstration to avoid unnecessary allergic or sensory reactions to the demonstration.

A fifth tip a teacher can use to increase the safety of in-class demonstrations is to ensure students understand emergency procedures. Much like fires, accidents can and will eventually occur unpredictably. Student and teacher safety must be approached before accidents happen. This is done by informing students and fellow teachers of the risks and remedies, so that an injured individual can be tended to quickly and correctly. Using the rainbow fire incident again, Szilagyi had stated that teacher had failed to inform her students about fire safety procedures; the main victim suffered painful burn injuries for longer than he should have. Those grievous injuries could have been minimized if participants had previously been informed on how to safely use a fire blanket.

Finally, a sixth tip that a teacher can do to increase safety is to respect proper safe distances. One such measure includes having students wear proper eye protection and proper lab attire. Even though it is important for students to be able to properly see the demonstrations, if an accident does occur, it is better for them to be farther away with their eyes protected. Moreover, students should wear proper attire. Safety shields and fume hoods can also protect students from unintended effects. Using the safe version of the rainbow flame experiment, the Royal Society suggests that students stay approximately 3 meters away to properly protect the students from any unintentional reactions.

Even though demonstrations help students learn firsthand many different scientific facts, they can quickly become dangerous if safety is not the priority. Therefore, teachers must understand what they are using, understand any allergy or sensory reaction that may occur, and make sure not to do a too large-scale experiment. Factors for teachers to consider include amount of chemical used, age appropriateness, the teaching of proper safety techniques, proper distancing and proper personal protection equipment (PPE). By meeting all the preceding safety guidelines, teachers will avoid and minimize any injuries within the laboratory.

Rocks and Minerals Safety

by Dane Peterson

While an earth science Laboratory doesn't conjure up frightening images of hazards, it is important to not to overlook safety in regard to the earth sciences. In earth science, the rocks and minerals are usually not the primary hazard. Instead, the chemicals used to test them (like hydrochloric acid) are often more dangerous. The NSTA has published several articles relating to earth science safety[7].

However there serious dangerous are associated with certain rocks and minerals. For example, mineral collections may contain radioactive substances such as pitchblende (uranium). These dangers are quickly detected with a Geiger Counter. But minerals often

contain dangerous chemicals. For example, Orpiment contains arsenic, as does Fool's Gold (Arsenpyrite). Cinnabar and Coloradoite contain mercury while Galena contains lead. Chalcanthite contains copper. Hutchinsonite contains thallium.

Another important point to keep in mind with regards to earth science safety is hammer safety. Teachers and students often use hammers. Though they are simple tools, they can cause much harm if used improperly. The first thing to note is that safety goggles or glasses must be required when dealing with hammers. Small pieces of rock or even shards of metal from the hammer can fly off the impact zone and cause devastating damage to an unprotected eye. Other rules like, never strike tow hammers together, always wear protective gloves when using a hammer, and never use hammers with chips, dents, or other defects, need to be put in place.

Other safety rules that need to be enforced are those that have changed. In the past, even when many preservice teachers were in high school and college, students were encouraged to lick rocks. As funny as this may sound to non-geology people, this is very commonplace. Wetness on the rock reveals its true color and for a long time, licking the rock was a quick an easy way to wet the rock. Now, especially during a global pandemic (at the time of writing), licking rocks is not a good idea as it could potentially spread disease among the students. It is now preferable that a student or educator apply water from a sink (if in the laboratory) or water bottle (if in the field).

This brings us to field safety. A big part of what makes earth science so fun and interesting to students and educators alike is the outdoor portion of the subject. But many hazards are associated with field trips. Students must wear proper attire; closed-toed shoes, long pants, a long sleeve shirt, and a hat should all be utilized. Proper attire protects the feet from damage, the legs from brushing against hazardous plants, and the arms and face from sunburn.

Laser Safety in the Lab

by Jacob Wade

At this point in time, many students who may read this article will have had a course in lab safety or have some general understanding of lab safety and what it covers. However, there is one sector of lab safety that is not often covered so well that we may not even think about it: safety with lasers.

We may not think a whole lot about safety with lasers since we rarely use them, and the ones we do use, we know to not to shine in our eyes, stare at, or point towards others to keep them safe from harm. With some lasers, however, one may not be able to see the beam so well, and even if one does, it could still be dangerous if proper precautions are not taken upon use. It is well known that looking at or having a laser shined into your eyes can be damaging, but there are other situations to be avoided as well. If proper care is not taken, one could accidentally shine a laser at a surface, and the reflected, diffracted, or refracted laser ray could then injure a bystander, or the user. How can these dangerous situations be avoided?

According to a safety guide produced by MIT Environment Health and Safety[8], lasers can come in several different classes ranging from being incapable of causing injury to being a fire hazard. But for the lower-class lasers, there are still precautions and safe practices that can be considered and utilized to avoid potential harm to the user and surrounding individuals. Safe practices include not wearing jewelry, watches, or having other potential reflective surfaces around. Never allowing the laser to escape its designated area of use is also very important and can be done by maintaining safe areas to point and use such a laser. It is also very useful to keep the laser's line of usage either below or above eyeline to minimize possible exposure as well as using highly diffusive surfaces surrounding the area of use to dampen the strength of possible laser reflection. However, most importantly, users should never point

lasers at open doorways or toward areas where other people could walk through. Often, table and beam curbs can be used to control exposure to laser light.

An exposed person may experience a burning feeling inside the eye if exposed to a laser higher than class 1 (where class 1 is the lowest of the classes) for a time possible longer than a second. In such cases, the injured party should seek emergency medical attention.
In lab, there is nothing more important than a safe working environment for everyone.

Live Animal Safety in the Classroom
by Madeline Mahnke
Adherence to safety protocols in the classroom is of the utmost importance, including when coming into contact with live animals. Nobody expects an accident to occur, but they still happen, so a plan should be in place to reduce unfortunate outcomes. Students should be made aware of the classroom safety guidelines before any exposure to lab animals.

Animals used for education must be treated both ethically and humanely, even if they are otherwise seen as repulsive or pests. Students have a wide range of reactions when observing animals at close proximity, from disgust and horror to entrancement and delight. When keeping animals in the classroom as pets, it is important to consider the kind of commitment teachers are making. Also, animals will need to be removed from the classroom for extended school breaks and be properly cared for. Non-native animals purchased for a classroom should not be released into the wild under any circumstances.

Invertebrate kits are readily available and are typically a shorter, lower-maintenance commitment than other types of animals. Ant or worm farms have few risks for students as they are self-contained and are available at low cost. Enclosures for insects like cockroaches often include a hatch on the lid for easy feeding and so they don't escape into the classroom. There are many types of fish or hermit crabs that can be an excellent way to start out as they require less attention and maintenance than reptiles or rodents.

The requirements for different reptiles and amphibians vary greatly across species, so it is important for teachers to prepare by doing research. Some reptiles and amphibians, such as chameleons, are climbers and therefore require more vertical space than a terrestrial species such as a corn snake. Small rodents can also be a good option for a class pet. Mice and hamsters are good choices for beginning pet owners, while guinea pigs have more specific needs. Reptiles and small mammals can carry salmonella and should see a veterinarian trained in exotic pets at least annually. Humans may

become infected with a zoonotic viral, bacterial, fungal, or parasitic disease after handling the animal or its bedding and excrement. Anyone who has handled such animals should immediately wash their hands thoroughly and avoid contact with their eyes, mouth and open sores to reduce the likelihood of infection.

Before any animal is handled for demonstration, students should be instructed to keep noise levels down and not to make any sudden movements, even though they will likely be excited to meet this animal.

Outside the classroom, the type of animal students encounter the most are insects. Students should take care to avoid stinging insects such as wasps and bees, and students

with allergies to stings need to be in close range to their EpiPen. In the summer, insect repellent is effective at reducing the number of mosquito and tick bites received by students in wooded and grassy areas. Any student who does get a bee sting or a tick bite should receive immediate medical attention, especially if they are allergic to bees. In the field, students may also encounter larger animals like squirrels and deer. Typically, these animals will flee from loud groups of humans, but they are wild animals and can act unpredictably. Students should not approach wild animals as they can carry zoonotic diseases. For example, certain populations of white-tail deer in Michigan are known to carry bovine tuberculosis; the outbreak zones are well documented by the Department of Natural Resources.

Animals can be used for educational purposes for as long as the right protocol is taken to ensure the safety of all living creatures.

Sharps in Biology and Earth Science
by Heather Evans
As a preservice educator in the fields of biology and earth science, conducting labs is one way to make concepts tangible to students. Safety[9] is a top priority in any classroom due to the many hazards that can be present in a lab. *Lab safety begins with following the instructions of the educator.* This is a crucial step in order to remain safe. Dressing correctly for the lab (including goggles, closed-toe shoes, lab coat, etc.) and knowing the location of safety equipment are next. In Earth science and Biology, teachers work with a few chemicals. However, it is still crucial that no eating or drinking occurs, and absolutely no tasting or smelling of lab materials. Moreover, lab waste must be disposed of properly.

In this author's classroom, students have needed to conduct experiments using tools that could have cut them. This article will go into detail about what kinds of "sharps" accidents can happen and how to avoid them and keep your student body safe in the lab.

Earth science is one of the safest fields of science as far as laboratory equipment is concerned but injuries from sharps can easily occur. In an Earth science Laboratory, to test the hardness of various materials, one performs a scratch test using a small glass slide. This glass slide must remain on the lab counter. If a student were to hold the slide when performing the scratch test, the slide could break and cause a laceration to the hand. The glass slides should never leave the surface of the lab counter. Another example of a "sharps hazard" in an Earth science lab, is that a rock or mineral material can be sharp enough to cut someone. For example, the volcanic rock, Obsidian, can be extremely sharp when broken or chipped. In the Northwest United States, one can find arrowheads made from Obsidian that were left by indigenous populations. As the reader can tell, these rocks can form incredibly sharp objects.

In Biology, more sharps hazards exist when compared to Earth science. To begin, when learning molecular Biology or any other type of Biology that requires the use of microscopes, the use of glass slides is standard practice. These slides differ from the ones discussed in the earth science section in that they are much thinner. They can easily break. Moreover, their edges may be sharp.

When teaching ecology, typically, a class would do a dissection. Dissection inherently requires the cutting of an organism (frog/fetal piglet) or a byproduct of an organism (owl pellet). The most important way to remain safe is to ensure that students are not cutting anywhere near their other hand and also that their cuts are small and precise. If the students need to hold onto the object of dissection, they can use tweezers to ensure they are remaining safe.

Sharps should be disposed of properly in all lab activities. Sharps will be placed into a sharps disposal container that is puncture-proof. This container must not be filled beyond ¾ full, and

all sharps must be contained and not stick out of the container. When biohazardous (plants or animals) materials are involved, the sharps should be run through an autoclave prior to disposal. When the container is full, the teacher is responsible for disposal through a vendor, **not** the school's dumpster.

Biology Safety: Cadavers and Dissecting Animals
by Caroline Barrett

Biology is an academic area where the concepts are sometimes abstract and hard to visualize. Topics like anatomy, body systems, and cell makeup can sometimes be difficult to teach in school because these parts of science cannot always be seen and held by students. It is important that science educators find ways to teach these topics so that students have the opportunity to see them up close and personal. When students can interact with the different concepts they learn, there is a better chance they will understand the material. One way that body systems and anatomy are taught in schools is through dissection in the laboratory. There are many different ways to stay safe while in a dissection lab, but the first rule is to listen to the teachers' instructions at all times. Students must not be goofing around with each other; they must show that they can follow the instructions of the teacher. Other general lab safety rules include wearing correct clothing for lab days (no shorts, no open-toe/open-heel shoes, no baggy clothing, etc.); knowing and understanding how to use safety equipment like the emergency shower and eye wash station; proper clean up techniques; etc. When working in Biology labs that include dissections, there are strict safety rules that need to be followed.

When working with animals to be dissected, it is important that lab stations are clear of any extraneous materials prior to receiving the animals for dissection. The only things that should be on the station are the tools needed for dissection as well as a lab notebook and the lab instructions themselves. Cellphones and other items like laptops and notebooks should be stored in backpacks in designated areas. Students should wear lab coats and gloves while performing dissections. Lab tools, such as scalpels, are extremely sharp and need to be handled with extreme caution. Before using dissecting tools, it is important to listen to the teacher explain how the tools are to be used and to only use the tools as instructed; if students are caught messing around with lab tools, they will be talked to and not allowed to use the tools for the remainder of the period. The cuts used to dissect animals or animal biproducts must be small and precise to ensure safety of the student performing the cuts, as well as the students around them. When handling the animals, students need to be cautious about where they are holding the animal, as well as cautious of any bodily fluids that may leak onto the lab area.

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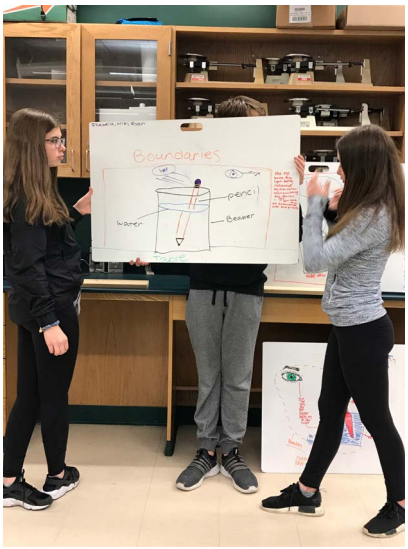
Innovations from Mi-STAR for Your Classroom

Tony Matthys and Marcia Goodrich | Mi-STAR

Quality lessons and labs don't materialize out of thin air. In addition to creating our own teaching tools, Mi-STAR's curriculum developers and teachers have drawn on dozens of helpful resources while refining our standards-based middle school science curriculum.

Here are some tools and professional learning opportunities that may help in your classroom, no matter which NGSS-aligned curriculum you use.

Student-driven Learning Facilitation Techniques
Mi-STAR is offering all teachers an excerpt from its new Visible Thinking and Discussion Routines table, including handouts. The excerpt features some of our favorite easy-to-use routines for guiding students through various learning activities, including eliciting new or prior knowledge, making small-group understandings visible, and generating whole-group discussions.



The strategies inject novelty and variety into the classroom and encourage collaboration and productive talk. In Mi-STAR's latest units, we offer suggested routines based on recommendations from expert teachers, helping to keep discussion in your classroom fresh and engaging. Subscribers can access the full table as well as the enhanced units as they are published this summer.

Additionally, free professional learning on using these routines will be offered in the fall. Keep an eye out on our Events for Educators page for more information.

Grade-appropriate Readings
Mi-STAR's latest units offer more opportunities for reading integration than ever. As Mi-STAR worked to incorporate more scientifically rich, grade-appropriate readings into our lessons, a couple of sources stood out. Science News's publication for young people, Science News for Students, offers the latest scientific findings, along with explanations of complex phenomena. Plus, it's searchable by Disciplinary Core Idea, making it easy to find readings related to learning targets. FlexBooks, searchable textbooks by CK-12, also offers great short readings supplemented with videos and simulations.

This content can be incorporated into lessons to confirm or expand on student discoveries.

Mi-STAR used these readings as the basis for differentiated resources tailored for substitute teachers and independent learning. Each of our new enhanced units feature multiple examples of these differentiated resources.

In addition, Mi-STAR has hosted two Mi-STAR Learning Series sessions related to integrating text and language into science learning. You can review recordings of these sessions and related resources using the following links:

- Text based inquiry in MS science, an overview of the Reading Apprenticeship at WestEd program designed to help students make sense of obtained information
- Developing Language for English Learners, an introduction into strategies to help support English language learners in the science classroom.

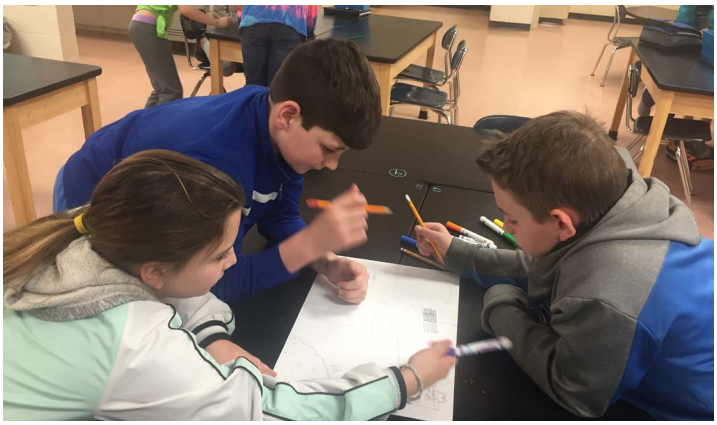
The Mi-STAR Learning Series is free, open to everyone, and focused on topics of interest to any teacher teaching NGSS.

Literacy Supports

Reading Apprenticeship at WestEd uses extensive reading in the classroom as a context for academic and social-emotional learning for all students. Teachers deploy strategies to help students make sense of readings, graphs, and videos, while learning to metacognate—skills with applications far beyond science class. Mi-STAR is partnering with WestEd to incorporate this approach into its updated versions of Units 7.1 and 8.1 set for release this summer.

As part of its Learning Series, Mi-STAR hosted a fireside chat with two expert Reading Apprenticeship teachers, Nell Bielecki of Anderson Middle School (Berkley Schools) and David Bates of Unis Middle School (Dearborn Public Schools). They discussed their experiences creating the partnership with Mi-STAR and fielded questions from teachers throughout the state. **Find the recording here.**

We are invigorated by the partnership and the excellent strategies used in the Reading Apprenticeship. We encourage everyone to participate in a professional learning opportunity to learn more.



Learn More

If you would like to learn more about Mi-STAR, our curriculum, our professional learning program, or how to subscribe, visit our website: https://mi-star.mtu.edu/

Also stay up to date on the latest Mi-STAR Learning Series by visiting https://mi-star.mtu.edu/professional-learning/events-for-educators/ or follow us on Facebook or Twitter.

Is Elementary Science Instruction Guaranteed in Michigan? -- and, Why Should We Care?

Jessica Ashley, Science Education Consultant | Oakland Schools

Substantial contributions to conception, design and data analysis from Jonathon Good (Continuous Improvement Consultant, Oakland Schools), James Emmerling (Science Education Consultant, Oakland Schools) and Michael Gallagher (Oakland MiSTEM Director)

To achieve excellence in the upper grades, science instruction must be guaranteed in the lower grades. There is no such thing as instant excellence. Excellence is an output of several synergistic inputs such as commitment, consistency, and passion. Excellence requires a commitment of time (both in the moment and the long term), resources, and building knowledge. It requires consistency over time through aim and focus. Passion is what motivates and sustains the continuation of these inputs for long-term success. This is why a team of Intermediate School District (ISD) science consultants in Michigan set out on a quest to figure out: *Is Elementary Science Instruction Guaranteed in Michigan?* This article examines data for three key ingredients required for guaranteeing science education: Time; Curricular Resources; and Professional Learning and Growth Opportunities.

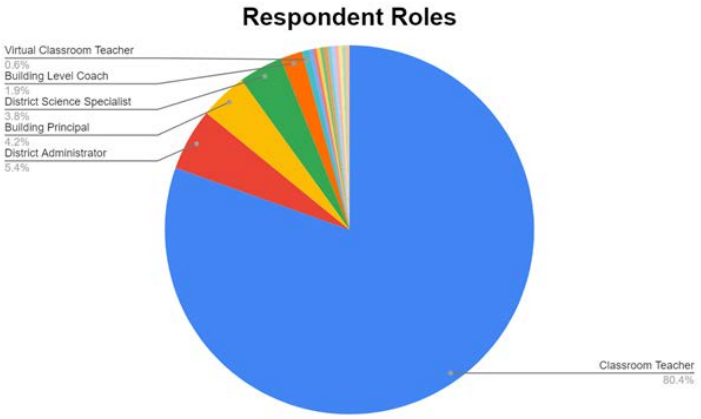
The Vision for Science Education

The Framework for K-12 Science Education defines a new vision for science education for *all* K-12 students. *The overarching goal of our Framework for K-12 Science Education is to ensure that by the end of 12th grade, all students have some appreciation of the beauty and wonder of science; possess sufficient knowledge of science and engineering to engage in public discussions on related issues; are careful consumers of scientific and technological information related to their everyday lives; are able to continue to learn about science outside school; and have the skills to enter careers of their choice, including (but not limited to) careers in science, engineering, and technology. Currently, K-12 science education in the United States fails to achieve these outcomes, in part because it is not organized systematically across multiple years of school, emphasizes discrete facts with a focus on breadth over depth, and does not provide students with engaging opportunities to experience how science is actually done. The Framework is designed to directly address and overcome these weaknesses. (National Academies of Sciences, Engineering, and Medicine. 2012. A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas. Washington, DC: The National Academies Press. https://doi.org/10.17226/13165.)* This vision is inspirational, requires excellence,

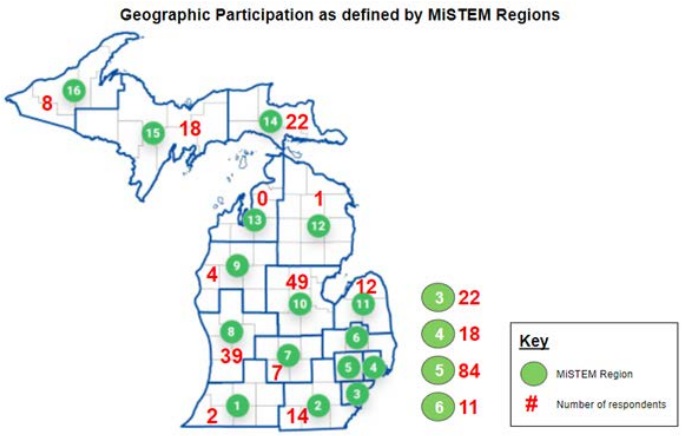
and the need to guarantee elementary science instruction.

Survey Participation Summary

The survey was designed, constructed, and distributed to ascertain the status of elementary science education across the state of Michigan. The survey was distributed to K-5 educators through multiple contact channels including ISD consultants, MiSTEM Directors, Michigan Math and Science Leaders Network (MMSLN), MiSci Professional Learning Network (MiSciPLN), Michigan Department of Education (MDE), informal distribution lists, and Twitter to name a few. Three hundred and twelve educators responded. A wide range of educator roles were represented in the data including K-5 classroom teachers, virtual teachers, building level coaches, principals, district science specialists, and district level administrators (e.g., curriculum directors / superintendents). Location data was collected by school name, district, county, and MiSTEM Region. Participants' responses were anonymous with an option to include email addresses in the final question if educators wanted a copy of the data. While a convenience sample is not necessarily representative, with 312 participants, our level of response is enough to acknowledge some realities and inspire additional questions. One limitation of the study is the sampling practice and responses.



Of the 312 respondents, classroom teachers were the primary respondents.



There are over 800 public and charter school districts in Michigan (National Center for Education Statistics). Based on 312 responses, it's evident that additional sampling would provide a more representative data set for our state. This map illustrates participation by geographic lines as defined by MiSTEM Regions. To learn more about The MiSTEM Network which unites education, business and community partners across the state to create pathways for all students to consider and pursue high-wage, high-demand careers, visit: https://www.michigan.gov/leo/boards-comms-councils/mistem

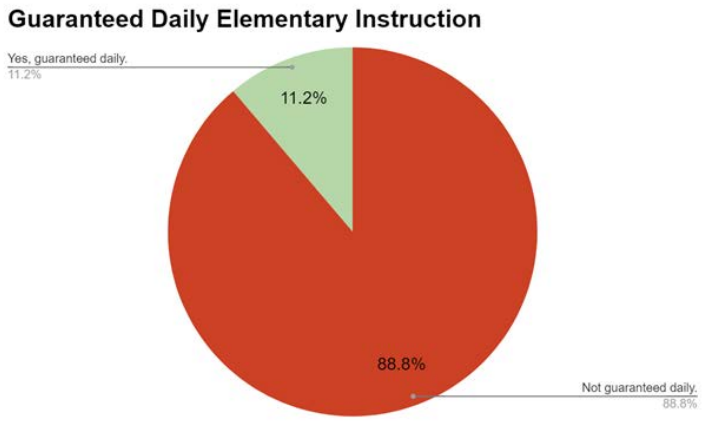
Data Highlights

There are three key ingredients required for guaranteeing science education. They are:

- **Time**
- **Curricular Resources**
- **Professional Learning and Growth Opportunities**

Time

Time in this survey was examined as the amount of guaranteed time scheduled to teach elementary science determined by the daily schedule. Adequate time for teachers to teach



science, and students to learn the science, is what makes a curriculum viable. 88.8% of respondents report that elementary science is NOT guaranteed daily, as in every day that school is in session.

To further analyze the data the survey asked about the frequency of instructional time for science. This is what the data show:

- 37.5% of respondents report that elementary science occurs on **alternating days of the week when a science unit is underway** (e.g., Monday, Wednesday, Friday).
- 16% of respondents report that elementary science **occurs every day of the week when a science unit is underway**.
- 23.1% of respondents report that they **fit in elementary science when they can.**
- 11.2% of respondents report that elementary **science is guaranteed every day.**

This data reveals inequitable opportunities for K-5 students to learn science. Unfortunately, this inequity is not just in Michigan. The National Survey of Science and Mathematics Education (NSSME+) conducted a nationally representative survey of 7,600 science, mathematics, and computer science teachers in schools across the United States. The report published in 2018 examined the frequency of self-contained elementary teachers that teach science and the number of minutes typically spent teaching science. The data show that only 17% of grades K-3 classes and 35% for grades 4-6 receive science instruction all or most days of the school year. In addition, K-3 students spent 18 minutes engaged in learning science and 27 minutes for grades 4-6. The full report can be found here: http://horizon-research.com/NSSME/2018-nssme/research-products/reports/technical-report

Curricular Resources

Providing curricular resources should include teachers' guides, student print materials, and hands-on materials needed to do science. Resources designed for the NGSS likely build in formative assessment routines and tasks, and summative assessments. Comprehensive curricular resources are a strong mechanism for equitable opportunities to learn science, by doing science, in all K-5 classrooms.

Just over 70% of respondents report that their elementary science resource is implemented district wide. Additionally, respondents reported to the extent to which hands-on science materials and equipment are provided and refurbished.

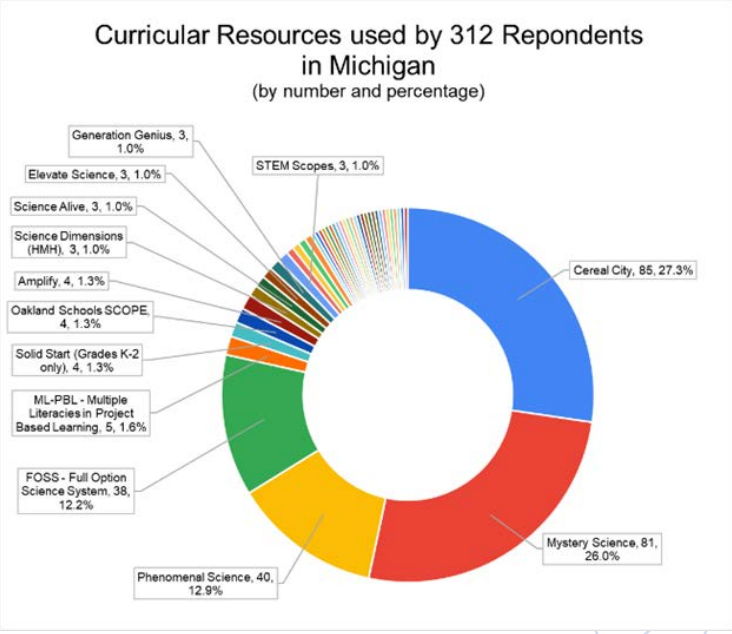
District Provides Hands-on Materials and Equipment and Refurbishes Consumables Annually Respondents reported receiving the required hands-on science materials and equipment needed to do science, in the form of science kits during the initial adoption of the resource, and their district has an annual plan for refurbishing consumable equipment.	48.7 %
Individual Teachers Provide Hands-on Materials and Equipment Respondents (who are teachers) reported that they individually gather hands-on materials and equipment needed to do science with the curriculum.	18.6%
District Does Not Provide Hands-on Science Materials Respondents reported that they didn't receive any hands-on science materials during the adoption process.	13.5%
District Provided Hands-on Materials During Adoption with No Plan for Refurbishing Consumables Respondents reported receiving required hands-on science materials needed to learn with the curriculum in the form of science kits during the initial adoption with no refurbishment plan for consumable equipment.	6.0%
District Provided Hands-on Materials During Adoption, and Teachers Personally Refurbish Consumables Respondents reported that they received the required hands-on science materials in order to learn with the curriculum during the initial adoption of the resource and personally refurbish consumable equipment.	3.2%
The remaining 10% of data represents a variety of responses such as: the district provided some materials, but not all; grants are written to provide funding to provide the hands-on materials; the professional development provider provided some kits; and some respondents were unsure to what extent hands-on materials are provided and refurbished.	

The National Academy Press explains that *Students learn science by **actively engaging in the practices of science, including conducting investigations;** sharing ideas with peers; specialized ways of talking and writing; mechanical, mathematical, and computer-based modeling; and development of representations of phenomena (National Academies of Sciences, Engineering, and Medicine. 2007. Taking Science to School: Learning and Teaching Science in Grades K-8. Washington, DC: The National Academies Press. https://doi.org/10.17226/11625.)* Interpretation of what respondents report suggests that 51.3% of science learning is not fully resourced and the hands-on materials and equipment that are required by their curriculum are not provided by their districts. This is

inequitable. Would we ask children to learn to read, but not provide books? I think not.

The Framework for K-12 Science Education provides even more clarity around the vision for science education ---- simply put, students should be figuring out phenomena and solving problems. Curriculum designed for the NGSS is a key ingredient for guaranteeing science time; high quality resources encourage science learning in this way. The Michigan K-12 Science Standards (MSS) are written as a list of three-dimensional statements and are not enough to fully realize what science looks like and sounds like, therefore, we must implement curricular resources that are steeped in research-based practices for how students actually learn science. At the time of the initial adoption of the NGSS/MSS in Michigan in 2015, commercial and non-commercial developers began sorting standards and *aligning* past resources to the new standards. Seven years later, we now have access to resources that have been *designed* for the NGSS. Tools such as the EQuIP Rubric and the Lesson Screener allow independent review of materials. Most recently, the NGSS Design Badge affords unit submissions the highest quality design badge. Districts and Schools have the opportunity to select curricular resources that have been *designed* for the NGSS that also best meet the needs of their community. These well-designed resources keep students motivated to figure out their questions about the things they observe, boosting interest and engagement. Students need multiple opportunities to do *science* by exploring, collecting data, making and revising models, reading, writing, and making their thinking visible like scientists. All of this is possible through a well-crafted storyline that launches with a phenomenon or problem, allows kids to uncover their ideas through observations, notice patterns in data, argue and reason with each other, ask new questions, and figure something out! A wise principal, Dr. Lara Dixon, once said, "Who is doing the talking is doing the learning." Curricular resources of the highest quality are designed so that students have experiential learning opportunities and time to think with each other. The teacher's role is to facilitate the process.

There is not a one-size-fits-all approach to selecting a curricular resource. Educators who are making decisions about curriculum should be more concerned about student experiences as defined by The Framework for K-12 Science Education rather than the comfort of teachers during science time. Schools and districts must take into account needs for emergent bilinguals, technology requirements and availability, and other local relevant factors. While some readers' interest may be piqued by the graph below displaying primary curricular resources used in Michigan, keep in mind our voluntary sample size of 312 respondents. Responsibly reflect on the quality of design for your resource used in your school or district. Ask how your curricular resource scores on research-based evaluation tools such as the EQuiP Rubric, Lesson Screener, the NGSS Design Badge and EdReports.

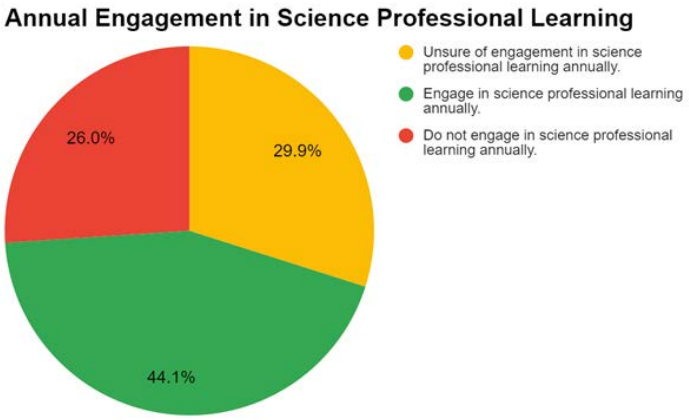


To review or evaluate the quality of a curricular resource designed for the NGSS use the following research-based tools: EQuiP Rubric, Lesson Screener, the NGSS Design Badge and EdReports.

Professional Learning

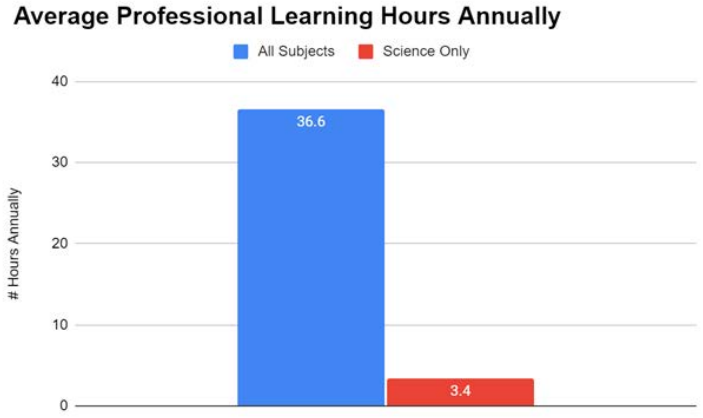
Growing the capacity of educators is both a great responsibility and privilege. The Michigan Department of Education specifies, Education-related professional learning is any opportunity intended to improve an educator's practice and capacity to perform the work within the profession of education, with a focus on improving student achievement. (Michigan Department of Education, 2021) Professional learning is expected for all educators responsible for teaching or leading science educational programs, not just classroom teachers. And, due to the ever-present changing needs of students and flux in educator workforce, professional learning opportunities provided by districts should include both foundational learning for the district-provided curriculum as well as growth opportunities for pedagogical and assessment practices.

Our survey asked respondents to reflect on science professional learning engagement annually.



The number of hours of professional learning engagement varied from 1 hour of learning annually to 60+ hours. This variability is likely due to several factors such as the current state of the curriculum adoption cycle and the roles of survey respondents. (For example: It could be that more professional learning is offered at the onset of adopting a new curricular resource. A person in a science coach role may engage in more specific professional learning for science on an annual basis, as compared to an elementary classroom teacher.)

The survey also asked respondents to compare the amount of annual **science** professional learning offered as compared to **other subject areas**. The responses showed the following:



Less than 10% of annual professional learning that educators participate in is focused on elementary science, according to respondents.

The State of Michigan mandates education-related professional learning to maintain a teaching certificate. The Standard Teaching Certificate is a five-year teaching certificate that requires teachers to take 150 hours of approved learning (DPPD or SCECHs) or 6 semester credit hours of appropriate content. This results in an annual average of 30 hours of professional learning. Additionally, new teachers within their first 3 years of teaching must complete another 90 hours. District leaders can support their teachers in selecting highly effective professional growth opportunities that impact student outcomes positively. District leaders also have an opportunity to offer customized learning options for teachers to meet each of them right where they are. At a minimum, districts should annually offer *foundational learning opportunities* such as NGSx, curriculum implementation opportunities, and maintenance and strengthening opportunities centered around high leverage instructional practices. This systems-level approach to professional growth allows for a minimum standard of care for teachers so that students receive equitable access to high quality instruction.

Teachers and district leaders can reflect by asking, "What is it that we want to see happening in science classrooms that is not happening now? What student artifacts (both tangible or verbal) could provide evidence we're looking for in terms of student learning? Then ask, what support might teachers/principals/admin/coaches need in order to be able to achieve this? Using the sentence frame *"[Teachers] will _____ so that [students] can_____"* can help focus direction for professional learning opportunities for educators. Lastly, build in choice and flexibility. All learners, both children and adults, are more motivated to fully engage in the learning when they are interested in it. Local opportunities abound for high quality learning through ISDs, universities, MiSTEM, MDE, MSTA, and science professional learning networks. Consultants also offer customized learning opportunities. Grow relationships with the people in your geographic proximity and ask for what you need!

Recommendations:

This data reveals only part of the answer to whether elementary science education is guaranteed in Michigan schools. Historically, standardized testing has been a long-lasting metric for proficiency that some may call excellence. One must ask, how accurately does the data describe proficiency if students are denied the sufficient opportunities to engage in science learning in the elementary grades? Educators and state leaders who are motivated to change what the data reflects so that all students have the opportunity to learn science are encouraged to get really curious about what is happening in their local districts and regions. Each of us has a sphere of influence to change what these data reflect. This requires one to analyze and interpret the data more closely and then ask critical questions.

Recommendation #1: Analyze local respondents. Ask the following:

- Who participated in this survey that is in your sphere of influence (school/district/county/region/state)? Survey Responses
- Who did not participate? Why?
- Redistribute the survey using these steps. Proceed through the recommendations below.

Recommendation #2: Schedule time for science. Still focusing on your local data, get really curious about instructional time available and actual time students are engaged in learning science. If there is no time to teach science, it will not happen. Stephen Covey said, *"The key is not to prioritize what's on your schedule, but to schedule your priorities."* Ask the following:

- What is the school/district recommended amount of time for all subjects that teachers are responsible for teaching in K-5? Review the artifacts available, such as the building schedule, teachers' daily schedules, etc.
- Is this "wheel of time" equitable?
- Is there a difference between the suggested instructional time for subjects and the enacted instructional time? What is causing this difference?
- Find out who is guaranteeing science in his/her classrooms or districts. Learn from their approach. Are self-contained classroom teachers integrating science with other subjects? Are teachers departmentalizing to offer specialization? Are some schools on a block style schedule to minimize transitional time loss and maximize time on task?

Recommendation #3: Fully-resource elementary science classrooms including curriculum and investigational materials. Ask the following:

- What science curriculum is provided that has been designed for the NGSS and enacts the vision of The Framework?
- Are classrooms fully resourced to include teacher guides, student print materials, and investigation equipment to do science? Are consumables refurbished annually?

Recommendation #4: Require foundational professional learning for teaching elementary science and opportunities for continued growth.
Ask the following:

- What professional learning is provided to ensure all teachers have the foundational knowledge to implement the science curriculum?
- What professional learning is provided to ensure all teachers are confident in the research-based science instructional practices so that students can do science by figuring out phenomena and solving problems?
- How regular are opportunities available for teachers to maintain and strengthen their practice as elementary science teachers based on interest and needs?

Why Should We Care?
If nothing changes, what's at stake? Socrates said, *"Wisdom begins in wonder."* If elementary science education remains a sporadic learning experience until grade six, which is middle school for most students, then that means that half of a child's education is void of science instruction. Children are naturally curious! Science is an opportunity to wonder and explore. This is what the real world is all about -- asking questions, problem solving, and determining the next right step based on patterns of information. It is about being innovative with solutions. Scientific thinking is a necessary life skill that transcends all learning disciplines and everyday life. All people need to be able to break down complex problems into smaller parts, test their ideas, reason with others' ideas and function as a team. What else is at stake? Literacy! It is estimated that up to 60% of the work of a scientist involves reading and writing. Scientists read articles, journals, models, data, etc. They write for purposes of peer review, validity, and explanation. Curricular resources that are designed for the NGSS embed these reading and writing practices in. When students do science, they are strengthening literacy skills. According to Nell Duke, Professor of Literacy, Language and Culture at the University of Michigan, *"If you lack relevant knowledge related to what you are reading, it can be very difficult to comprehend it."*

When students are given the opportunity to learn science, they are given a chance to wonder and explore the world around them. They are motivated by questions they are curious about and get to be innovative while solving problems. The complex problems of our future will be solved by people who have learned an approach to figuring out phenomena and leveraging the collective knowledge of a multidisciplinary team to ask really good questions, analyze data, and argue with evidence before taking the next right step. This is made possible when schools and districts commit to teaching science by designing a daily schedule that values science learning. When students consistently do science they develop a rhythm of thinking. When schools and districts choose to prioritize time for science they are consistently saying, *"Yes, learning science matters."* Furthermore, when schools and districts say yes to teaching and learning science, they are saying, *"Yes, this matters because we're equipping the next generation to solve the world's most complex problems."*

In closing, teachers, principals, district leaders and state education leaders all play an important role in guaranteeing elementary science. There are multiple entry-points for any one person or an entire district system to begin making changes to guarantee elementary science instruction. Anyone who is motivated to change should consider starting small so that they can start now! While a roadmap that charts a course may be nice, we must remain tuned in to what students *are learning*, what students are *not learning*, and the resources and support available to teachers and educators responsible for science education. We must ask the extent to which the three key

ingredients are in place in our school systems -- time for science, curricular resources designed for the NGSS, and professional learning and growth opportunities to equip, support, and expand our educators. Then we can take our next steps towards excellence.

Get Involved

The elevated concern and commitment for elementary science education has rippled through our state. The 2022 annual Michigan Science Teachers Association conference designed an entire day of learning to support district leaders with systemic change for elementary science. The MiSciPLN has dedicated this entire year towards focusing on the challenges and opportunities for elementary science education. The MiSTEM Directors also committed to supporting elementary science efforts through grant dollars. If you have additional questions, or want to get involved with statewide efforts, connect with these main contact points: Your local ISD science consultants, the MiSciPLN, your region's MSTA and MiSTEM Directors, or Dr. TJ Heck at Michigan Department of Education.

Call for 2023 Teacher of the Year Award Nominations!

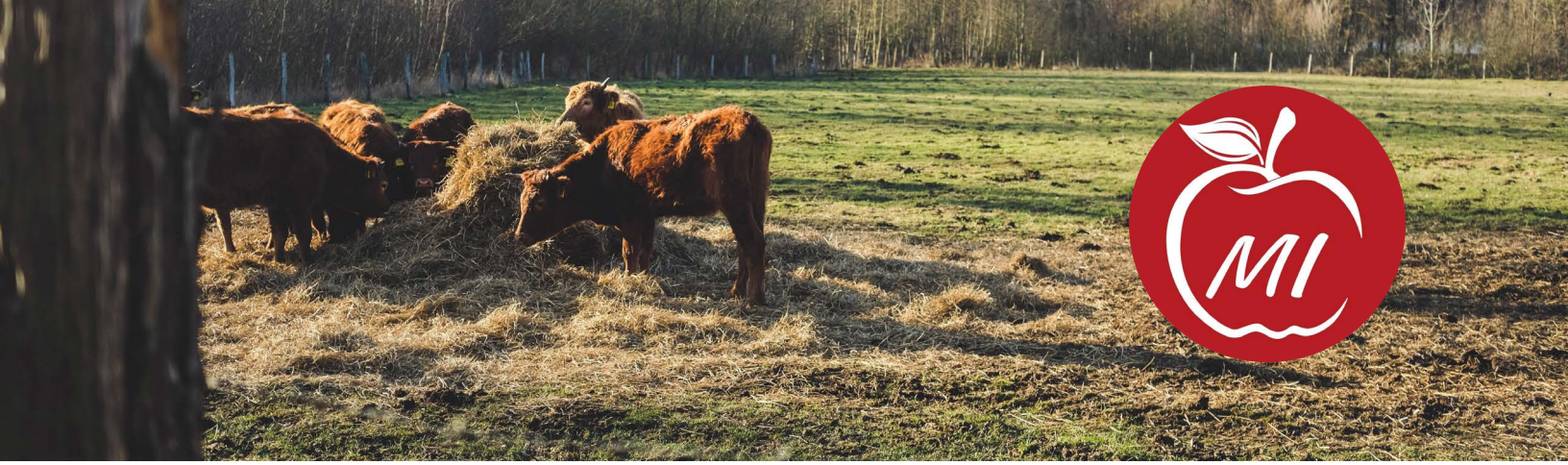
Look around you! Are you working with someone whom you consider an excellent science educator? Does this person do an outstanding job in the classroom and/or in your school district? Does this person contribute to the profession by taking leadership roles within the educational community and show a willingness to share ideas with colleagues by presenting seminars and workshops, and by publishing science related articles in professional journals?

If you know someone who exhibits these attributes, then please NOMINATE them for one of the following categories:

- College Teacher of the Year
- Elementary Teacher of the Year
- Middle School Teacher of the Year
- High School Teacher of the Year
- Teacher of Promise
- Administrator of the Year
- Informal Science Educator of the Year

Nominate a Teacher

Nominations are due by Thursday, June 30, 2022!



Find Your Way to a Farm

Amelia Miller | Michigan Agriculture in the Classroom

Permission slips, bus reservations, chaperone background checks, collecting money, name tags... The field trip to-do list goes on and on. Throw in a global pandemic bringing additional protocols and limitations -- why leave the comfortable confines of your classroom?

Students need experiences. Students need introduction to career opportunities. Students need exposure to cultural institutions (West, 2016). Currently employed scientists working in chemistry or physics across the United States have indicated their interest in a science-based career began as early as third grade through learning extensions like science fair projects, guest speakers, experiments, and field trips (Maltese & Tai, 2010).

Even prior to the pandemic, field trips were on the decline. Museums and science centers nationwide reported less school groups visiting each year. Yet, students who participate in museum field trips show positive impacts on their critical thinking ability, historical empathy, tolerance of differing viewpoints, and interest in future museum visits (West, 2016). Contributing further to the field trip decline, teachers receive little formal training on how to plan, execute, and build content connections for field trips (Behrendt & Franklin, 2014).
Before you close up the classroom for the summer, make reservations or save the date for next year's field trips. Wading through field trip logistics can seem daunting. Simplify your out-of-classroom experiences with these five easy steps:

1. **Brainstorm local venues that have content connections.** Don't limit yourself to the science center in the big city (although this is great too!). Even simple trips to local businesses, county parks, or farms could create big connections to real-world content for your students. If you are working with a new location, consider meeting with their staff to build talking points that align with your content standards.
2. **Visit the location.** Take a day in the summer to visit the location, talk with staff, tour the facility, park, museum, etc. Use a pre-field trip visit as a time to take your own family on a local adventure. Many facilities offering field trips host free or low-cost teacher open house days or workshops to help you prepare.
3. **Refresh an old standard.** Has the kindergarten visited the apple orchard in the fall for 20 years? How can you add new life to this tradition? Ask the orchard if you can visit in the spring to see the apple blossoms, ask the farmer to come to your classroom to read during March is Reading month. Whether it's an orchard, museum, or other stand-by field trip, find ways to build new connections to your content.

4. **Plan how you will engage.** On the day of the field trip, your students will be more engaged if they observe you engaging as well (Behrendt & Franklin, 2014). Help your students interact with the site, encourage asking questions of facility demonstrators, use questioning strategies to help students build connections to in-class content, all to foster a curious environment on the field trip and beyond.
5. **Keep the experience alive.** With effective content connections, a field trip can live long beyond the one-day adventure. Pay close attention to presenters' content, online resources from the facility, local media resources about the site, books related to the content, possible future speakers, and other ways to make sure the field trip is not a one-hit-wonder. If your school has a career day, invite a staff person from the location to host a booth. Ask to collaborate on a student research project, letting students analyze real data from a real business or science project.

Michigan farmers invite you to a field trip on the farm. Whether the tradition of a fall apple orchard visit runs generations deep in your district, or you are looking for a real-world application of high school genetics content, agriculture provides real-world connections to your curriculum. Through our partnership with the National Agriculture in the Classroom Organization, Michigan Agriculture in the Classroom provides a database of free-to-download lessons ready to build upon your out of classroom experiences. Read agricultural books about field trip content prior to visiting. Participate in the Purple Plow STEM Challenge or sign up for an On The Farm STEM experience, a field trip for teachers to learn more ways to use agricultural connections in class.

Sources:

Behrendt, M. & Franklin, T. (2014). A review of research on school field trips and their value in education. International Journal of Environmental and Science Education, 9(3), 235-245. https://doi.org/ 10.12973/ijese.2014.213a

Maltese, A. & Tai, R. (2010). Eyeballs in the fridge: Sources of early interest in science. International Journal of Science Education. 32(5), 669-685. https://doi.org/10.1080/09500690902792385

West, M. (Host). (2016, November 2). Why do field trips matter? (No. 59)[Audio podcast episode]. EdNext. https://soundcloud.com/education-next/ep-59-nov-2-2016-jay-greene-on-field-trips

Amelia Miller is Michigan Farm Bureau's Promotion and Education Specialist. Michigan Farm Bureau is home to the Michigan Agriculture in the Classroom Program, which works to increase students' understanding and application of the ways agriculture connects to our daily lives. For more information visit www.miagclassroom.org or follow us on Facebook!

Research Validates Professional Development

Kevin Frailey, DNR Education Services Manager | Michigan Department of Natural Resources

There are many forms of professional development. You could attend 45-minute sessions at conferences, four-hour workshops, and daylong seminars. Most facilitators use some type of evaluation tool to see if their PD was a success. Comments like "great session," "learned a lot," and "very good presentation" litter the evaluation forms and tell us, to an extent, how we did.

The question is, "Did you retain anything that would stay with you five years from now?" In 2018, Cindy Fitzwilliams-Heck, a faculty member at Ferris State University set out to find the answer. "I wanted to know if people retained or used the knowledge they gathered from taking professional development years later. I'd read plenty of success stories about PD but none that studied long-term effects. This became the basis for my PhD, *Experiences and Practices of Environmental Adult Education Participants*. I thought the best place to study this was ANR."

The Academy of Natural Resources was established in 2008 by the Michigan Department of Natural Resources at their conference center on Higgins Lake. Fitzwilliams-Heck attended ANR as a participant in 2012. "It was a great experience. Lots of field work. Tremendous instructors. And an amazing social atmosphere. This weeklong experience seemed like it had all the ingredients for long-term recall, but I wanted to find out if it truly did."

Fitzwilliams-Heck interviewed participants that had attended the Academy at least five years prior and asked a series of questions probing their retention of knowledge and social influence. Was the knowledge gained after a week in Northern Michigan worthwhile? Was it just exciting at the moment they learned it but forgotten within months of being back home?

The results were positive. Five or more years after attending the DNR's academy, all those interviewed claimed they were a more effective

ANR North participants pose near the bygone Jackson Iron Mine near Marquette, MI.

educator due to their experience. They also felt they were more aware and concerned with issues related to conservation and natural resources. The participants continue to apply what they learned at ANR in their classrooms, with the public, or in their personal lives. According to Fitzwilliams-Heck, another theme that emerged was that "All the participants I interviewed brought up the positive emotional effects of the ANR experience, both short term and long term. People bond at ANR and feel connected to the other participants, instructors, and facilitators."

ANR continues to flourish and has expanded to Michigan's Upper Peninsula in a program called ANR North. Eight different courses are rotated in and out of the annual schedule. SCECHs and university credits, facilitated by Fitzwilliams-Heck, are available for all courses. The Safari Club – Novi Chapter, has funded more than $100,000 in scholarships in past years.

While Fitzwilliams-Heck's research established ANR's academic credibility, weekly and daily evaluations are also used to monitor program quality and meet the needs of students. Fitzwilliams-Heck has been on the ANR planning team since 2013 and still enjoys reading the "simple" evaluations and testimonials. "One participant stated it was the best experience of their life. I wondered a bit about that."

To learn more about ANR Classic and ANR North, click here Academy of Natural Resources

To read the about the research, click here recent doctoral study

Fitzwilliams-Heck, C. (2021). Exploration of environmental adult education participant experiences and implications for future practices. *UCLA's Electronic Green Journal, 45.*

SAVE THE DATE!

MSTA 70th Annual Conferece

MARCH 3-4, 2023

Lansing Center & Radisson Hotel
Lansing, Michigan

The Joy of Wonder: The Chemical Reaction of Slime

Megan Kasik, Eighth Grade Science Teacher | Chesaning Middle School

SLIME. I have come to learn that it does not matter what age students you teach, all students love slime. Early in the year, my students would bring in the slime they made at home or show me videos of other kids making slime, and they started to ask me questions about why it happens. The lightbulb in my head went off, and I decided to take advantage of this moment, and started researching all I could about how to make different types of slime, chemical formulas, equations, and trials and errors of slime chemistry. Thus, I present to you MS-PS1-2 as slime.

The Next Generation Science Standards ask us to teach students to analyze and interpret data on the properties of substances before and after they interact to determine if a chemical reaction has occurred. What better way to incorporate students' curiosity about specific things than to make slime? Rather than just jumping right into making slime, I started by asking students to hypothesize, question and wonder about how combining the simple ingredients of glue, water, borax, and food coloring could turn them into slime. Why does this happen? How could this happen? *What data can you collect to analyze what is happening? What can you see with your eyes, and what would you see at the molecular level?* Draw your thinking.

Students then took the opportunity to draw their initial explanatory models of their hypotheses and compared their ideas with their group. Students began asking powerful questions to their group members like, *"What type of molecules are in glue?" or "Can atoms move from one molecule to another and make something new, like when I pull these building blocks apart and move them?" "What kind of molecules are stretchy?" or "Did the state change?"* Students ARE scientists. I give my students the room to think, *wonder*, and hypothesize about the real-life events happening around them, while I am just the facilitator.

When students finally were able to make the slime in the lab, they were analyzing different properties of the original ingredients compared to the end result. We discussed some common changes in properties during chemical reactions too. Students dove into research about chemical formulas of the ingredients, before and after the reaction to see how the atoms may have moved to create new substances, but nothing was destroyed because of the Law of Conservation of Mass.

Lean into your students' curiosity about the world, even if it is something you know nothing about. Meet them where they are, give them the space to *wonder*, and I promise the results will not disappoint you.

The 58th Annual Southeast Michigan Regional Junior Science & Humanities Symposium (JSHS)

By Dr. Sandra Yarema | Wayne State University | MSTA

The 58th Annual Southeast Michigan Regional Junior Science & Humanities Symposium (JSHS) was hosted virtually, for the second time, by Wayne State University on February 25, 2022.

The JSHS was established by the Army Educational Outreach Programs (AEOP) to promote three primary goals: (1) STEM Literate Citizenry – Broaden, deepen and diversify the pool of STEM talent in support of our defense industry base; (2) STEM Savvy Educators – Support and empower educators with unique Army research and technology resources; and (3) Sustainable Infrastructure – Develop and implement a cohesive, coordinated, and sustainable STEM education outreach infrastructure across the country.

The JSHS is a showcase for high school students, grades 9-12, to engage in original STEM research, and present their results in a competitive symposium. Despite plans to conduct the regional symposium in person, rising infection rates early in the year prevented the University from welcoming visitors to campus. The regional JSHS events occurred across the entire day, hosted by Wayne State University, on the Zoom platform. Twenty eight students from fifteen high schools across Michigan shared oral or poster presentations of their research. Research projects were judged across STEM categories (Biomedical/Environmental Life Sciences; Biomedical/Health/Behavioral Sciences; Chemistry/Biomedical/Molecular/Cellular Sciences; and Environmental, Life Sciences & Engineering) by a panel including STEM faculty from Wayne State University, STEM researchers from the U.S. Army Combat Development Command (DEVCOM) Ground Vehicle Systems Center (GVSC), coordinated by Greg Chappelle, Great Lakes Region and Tribal Nations DoD STEM Coordinator & Historical Black College University and Minority Institution Liaison Officer, (HBCU/MI) and STEM educators affiliated with the Michigan Sea Grant Extension at Michigan State University.

Oral Presentations

Name	School
Sarah Abubaker	Edsel Ford High School
Sanjidah Ahmed	International Academy East
Noah Black	Herbert Henry Dow High School
Jonathan Bryant	Renaissance High School
Kasey Conklin	BCAMSC
Keerthana Danasekaran	Northville High School
Vikram Goddla	Detroit Country Day School
Michelle Hua	Cranbrook Schools
Julia Huang	Northville High School
Manish Ileni	Novi High School
Mounika Katta	Northville High School
Drue Keys	Renaissance High School

Sohan Madishetty	Northville High School
Veda Mantena	Detroit Country Day School
Nadia Niha	Cass Technical High School
Sanjana Pingili	Northville High School
Rania Rafiq	International Academy
Jibraan Rahman	Canton High School
Tahsina Rahman	Dr. Benjamin Carson High School
Diya Ramesh	International Academy
Debarati Roy	Cass Technical High School
Mikul Saravanan	Cranbrook Schools
Na'ja Stokes	Cass Technical High School
Eric Wan	Northville High School
Sonnet Xu	Troy High School
Andy Yao	Herbert Henry Dow High School

Poster Presentations

Aanchal Jain	Okemos High School
Yara Mashal	International Academy East

The symposium also included virtual tours of Wayne State University's main campus, the School of Medicine, and Law School. Regional finalists were announced following the live-streamed keynote speakers. Nikhil Mantena, finalist at the 2017, 2018, 2019, & 2020 Regional and National JSHS, spoke about his research experiences during high school and how his participation in the JSHS has impacted his college experience and future research interests.

Dr. Amanda Bryant-Friedrich, Dean of the Wayne State University Graduate School and Professor of Pharmaceutical Sciences, discussed *The Treatment of Infectious Disease: The Role of Nucleic Acids* in our understanding of many infectious diseases and their treatment.

The top 3 Regional finalists were awarded scholarships: $2,000 for 1st place, $1,500 for 2nd place, and $1,000 for 3rd place. All five finalists were invited to compete at National JSHS; 1st and 2nd place to present their research orally, and the 3rd, 4th, and 5th place finalists to present posters. The regional poster presenters were also awarded cash prizes: 1st place $300 and 2nd place $200.

The Michigan teacher of the top regional finalist was also awarded $500 for their school.

The Regional Finalists were as follows:

ORAL RESEARCH PAPER PRESENTATIONS:

1st Place Regional, Mathematics & Computer Science - $2,000 Scholarship- Michelle Hua (Cranbrook Schools) - *GC-SSN: A Novel Geometric Consistency-based Self-Supervised Neural Network for 3D Human Shape and Motion Reconstruction*, **oral presentation at National JSHS** (for the second consecutive year) **2nd Place National-Oral Presentation, Mathematics & Computer Science: $8,000 Scholarship**

2nd Place Regional, Medicine, Health & Behavioral Sciences - $1,500 Scholarship- Diya Ramesh (International Academy, Bloomfield)- *Sputum-Based mRNA-Targeting Probes in Lung Cancer - An Early Diagnostic Tool*, **oral presentation at National JSHS**

3rd Place Regional, Environmental Science - $1,000 Scholarship, Sonnet Xu (Troy High School) - *Drought Affects Mangrove Recovery Patterns Following Tropical Cyclones*, **Poster Presentation at National JSHS**

4th Place Regional, Medicine, Health & Behavioral Sciences - Mounika Katta (Northville High School) - *Can the success of metronidazole treatment of bacterial vaginosis patients be predicted from initial microbiomes?* **Poster Presentation at National JSHS**

5th Place Regional, Engineering, Technology- Jonathan Bryant (Renaissance High School, DPSCD) - *Designing and 30 Printing PLA Based Universal Charging Adapters for Use In Charging Electric Vehicles*, **Poster Presentation at National JSHS**

POSTERS (Regional Presentation)

1st Yara Mashal $300 Cash - regional
(International Academy - East)
Comparing Tau and Amyloid- Targeted Nanoparticle Immunotherapy for Alzheimer's Disease: a review

2nd Aanchal Jain $200 Cash - regional
(Okemos High School) *RIPK2 and IRF1 T cell genes as therapeutic targets to remedy Celiac Disease*

This year's **Regional Teacher award for promoting STEM research** again went to **Ms. Stephanie Kokoszka, Cranbrook Schools.**

The National JSHS returned to an in-person event, April 20-23; sponsored by the NSTA, AEOP, and the U.S. Army, Air Force, and Naval offices, hosted by the U.S Air Force and Space Force Research Center in Albuquerque, NM. The first in-person national event since 2019 brought together 224 high school students and approximately 130 teachers, mentors, university faculty, military personnel, and more to compete and celebrate student achievement in the sciences. Delegates from each of 49 regions shared their presentations and posters during scheduled presentation times with Judges from the Tri-Services and other STEM professional researchers. Prizes were awarded across 8 STEM categories as follows: For the oral research paper competition, $12,000 undergraduate tuition scholarships were awarded to each of the 1st place finalists; $8,000 undergraduate tuition scholarships were awarded to each of the 2nd place finalists; and $4,000 undergraduate tuition scholarships were awarded to each of the 3rd place finalists. For the Poster Competition $550 cash awards were awarded to each of the 1st place finalists; $450 cash awards were awarded to each of the 2nd place finalists; and $350 cash awards were awarded to each of the 3rd place finalists in the National poster competition.

This year, Michelle Hua, a junior at Cranbrook Schools, represented the Michigan Southeast delegation for the second consecutive year as the 1st place regional finalist. She was awarded a 2nd place at National JSHS for her oral presentation in Mathematics & Computer Science, thus far earning a total of $24,000 in scholarships to the College or University she chooses to attend.

For more information, or to participate in JSHS 2023, please contact the SE MI regional director, Dr. Sandra Yarema, or visit the regional www.go.wayne.edu/JSHS-symposium or National http://www.jshs.org websites.

Michigan SE Delegation - National JSHS Welcome Dinner

**All student participants signed media release forms to publish their names and photographs in association with their research projects submitted for Regional and National JSHS Events.

Resources:
Awards Banquet/Ceremony: https://youtu.be/jwTV68SkJTc

https://www.abqjournal.com/2493693/high-school-researchers-wow-judges-at-symposium.html

https://www.kob.com/albuquerque-news/albuquerque-hosts-national-junior-science-and-humanities-symposium/6453676/

www.msta-mich.org