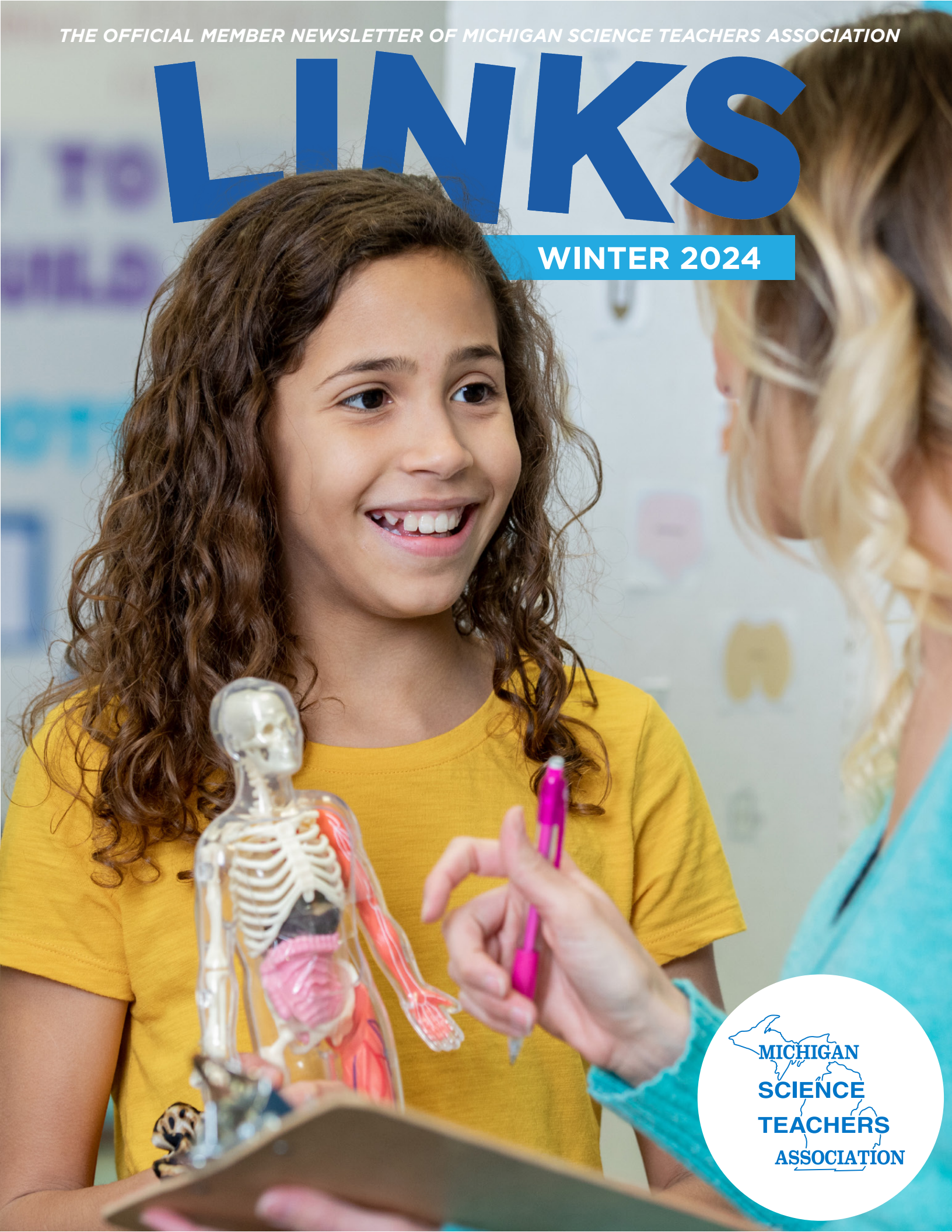
THE OFFICIAL MEMBER NEWSLETTER OF MICHIGAN SCIENCE TEACHERS ASSOCIATION

LINKS

WINTER 2024



MICHIGAN SCIENCE TEACHERS ASSOCIATION

"MSTA IS THE FOREMOST LEADERSHIP AND ADVOCACY GROUP FOR SCIENCE EDUCATION IN MICHIGAN."

PRESIDENT'S MESSAGE

Have you seen the recent meme, "We're (insert group identifier), of course we're going to...."? Like most viral trends, there are some examples that make me chuckle and others I scroll by without a second thought. This one did make me wonder about what MSTA Members would create. One thing I hope we would include right now is "We're science teachers, of course we vote in elections." Because at its core science is a human endeavor, practicing and teaching science always has been and always will be impacted by political forces. No Child Left Behind (ESSA) and the 3rd Grade reading law are just two examples that have dramatically impacted our jobs as science educators. It is cliché but true that votes matter, and I believe that is true for local elections like school board or drain commissioner to state and national elections like the ones we're going to have later this year.

The MSTA Board Vision Statement begins with this sentence: "MSTA is the foremost leadership and advocacy group for science education in Michigan." This statement is also one of the key indicators of our success as a Board. Does the statement, "We're MSTA, of course we lead and advocate for science education" ring true for members? If it doesn't, please let me know how you think we can do better. But I hope that it does and will try to use the remaining months of my term as president to make sure that we are moving science education in Michigan in the right direction.

This year's MSTA Board Election cycle has already begun, and voting will conclude at the upcoming 71st MSTA "Homegrown Science" Conference. As a member, you will have the opportunity to vote for regional representation and other key directorships in the coming weeks. The educators in these positions and running for these positions give their time and resources to serve the 700+ members of MSTA through leadership and advocacy. Look at the current Leadership page on the website and make connections. Reach out to stay informed and communicate your needs, ideas, and suggestions for science education. And vote! That's how democracy is supposed to work and it's how we can all participate in making Michigan a great place to grow science.

Sincerely in Science,
Richard Bacolor

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Meeting the Mother Earth Water Walkers: A Native Perspective on the Spiritual Wonders of Water

Carol Trembath | Lakeside Publishing MI

For a long time, Native people have been viewed as the first environmentalists. Their ideals of caring for Mother Earth and her lifeblood water, have always been at the forefront of their actions. However, today Mother Earth's traumas have brought humanity to an environmental crossroads.

How are Native people responding? In many ways! My life has connected with one of the most remarkable and unusual efforts, led by Native women.

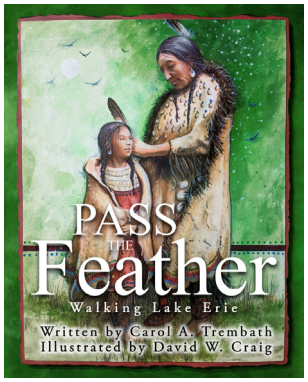
In 2013, while attending a National Endowment for Humanities project in Chicago, I saw the exquisite Fountain of the Great Lakes. It depicts five women each representing one of the Great Lakes, dressed in Greek garb, pouring water from their conch shells from one figure to the next in a beautiful cascade. At that point I had chills and I knew I had to write a book about water—but where to begin?

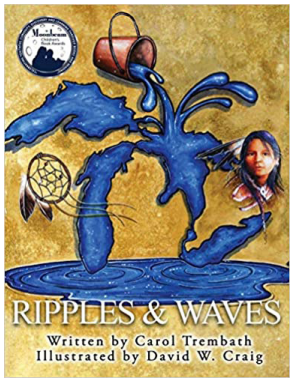
I found that the fountain's sculptor, Lorado Taft, also created a three-story monolith of Chief Black Hawk, which stands over the Rock River in Illinois. That was another stepping stone in my research.

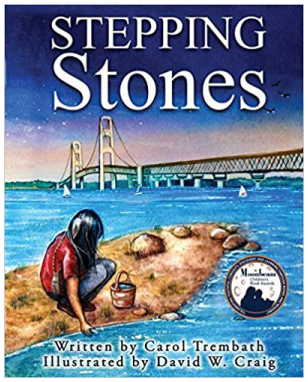
My journey then led me to a group of Anishinabek women called the Mother Earth Water Walkers. They were Ojibway members from Canada and the United States that were led by Grandmother Josephine Mandamin.
A decade earlier, the Chief of the Council of Three Fires in Michigan (Ojibway, Odawa, and Potawatomi) told the Anishinabek people including Josephine, that he had a vision. He warned, "If we don't take care of the water, in thirty years the price of an ounce of water, will be the price of an ounce of gold." Josephine heard the prophecy and decided with a group of supporters, to take up the challenge. She began water-walking around the Great Lakes.

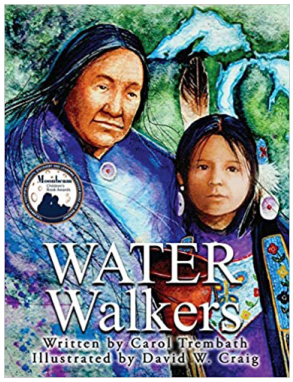
In the spring of 2003, the Mother Earth Water Walkers—carrying a copper pail of water and holding an eagle staff, began their first journey walking the circumference of Lake Superior. Each morning, they would visit the big lake and say sacred words and sing songs for the water. They would leave behind their gift of tobacco, then walk 30, 40, or 50 miles a day. Their belief was that their prayers would be lifted to the Creator.

Their first walk around Gichigami—Lake Superior was 1,372 miles. Walking—the slowest form of transportation, reinforced an ancient value of taking a stand. Each step was a prayer for Mother Earth, the winged-ones, four-leggeds on the land, swimming creatures, insects, trees, and the









human family. Since then they have walked over 20,000 miles around lakes, rivers, and waterways across the United States and Canada. Over time, water from lakes and even oceans has been carried in copper pails over countless roads in an effort to show the importance of water—which they believe is alive and has a spirit.

Admiring their efforts, I too took up the challenge. I began writing a series of picture books about their story. In 2014, with the help of my Ojibway artist, David W. Craig, I self-published my first picture book, Water Walkers: Walking Lake Superior. Since then, I have published three more titles: Stepping Stones: Walking Lake Michigan, Ripples and Waves: Walking Lake Huron, and Pass the Feather: Walking Lake Erie. These are fiction stories telling the tale about a young girl's journey with her grandmother and family members walking the circumference of the Great Lakes.

At this time, the fifth book in the series, Rolling Thunder: Walking Lake Ontario, is being prepared for publication.
One of the important messages of this series is that everything on earth has been given a gift by the Creator—but each carries a responsibility. The gift to humans is that we, among all living things, have the ability to say, 'Thank you'. Mother Earth provides for us and that is what all good mothers do. But, we too need to say, 'Thank you' and honor and care for our Mother Earth and her lifeblood water. It is time to pass the feather and for others to continue the journey.

When Grandmother Josephine was asked why she is doing all of this, she answered, **"We are not doing this for us, we're doing this for you. What will you tell your children when they ask, 'What did you do for the water?'**

The Hopi have said, "The time for the lone wolf is over. Gather yourselves. We are the ones we've been waiting for."

So, what can you do to help?

Visit: http://www.motherearthwaterwalk.com/ Check out the side panel to view the history of the Mother Earth Water Walkers and the current issues with the water crises.

Visit my website and check out my various projects, awards, author visits—including a historical novel about the life of another strong and prophetic woman: Harriet Tubman. http://www.caroltrembath.com/

Visit Amazon: enter my name to see my list of publications or if you email me, I can personalize a book and send copies within the United States. Email: Carol.trembath3@gmail.com

Commit: to a cleaner earth by starting in your own community. Start composting at home, go on a walk to pick up trash in your neighborhood, or plant a tree. Learn the power of community. There are plenty of activist groups. Visit your local Sierra Club. Organize a local water walk.

To all: Chi-Miigwetch (Big thank-you)

Tiny Acorn People = Big Win

Diana Matthews | Detroit Country Day School

Tiny acorn people for the big win! After becoming enthralled with the artwork by David M. Bird, Diana Matthews of Detroit Country Day School decided to tackle the creations with her second grade students. Working off of Bird's videos and prints, Mrs. Matthews engaged her students, filling them with a sense of awe and wonder. Students were invited to create little creatures out of natural items like sticks, acorns, leaves, pine-cones and more.

Prior to the start of the project, friends collected acorns- hundreds of acorns. Unbeknownst to the science teacher, acorns were prone to get "wormy". After observation and research, it was determined that the acorn weevil lays an egg or two in the developing acorn- the larva and the acorn develop together. The larva chews its way out in early autumn and burrows into the ground to pupate and develop into an adult over the course of several months.

The acorn weevil is the strangest little critter to literally drop into an elementary science unit. With its oversized eyes, acorn-like body, jointed legs, long snout called a rostrum complete with attached antennae and hidden wings, it truly is the "unicorn of the insect world". The goofy little bugs look like something from Star Wars or like AI generated bots. They are prevalent in oak trees, but don't seem to pose a threat as so many viable acorns are still produced. As they emerge from the acorn, the grub-like larvae create small perfect ⅛ inch circles in the flesh of the nut.

The small insect lended itself to dynamic learning that was both organic and genuine, as students pondered the life cycle and the micro ecosystem that was flourishing in the acorn collection and at the base of oak trees. (NGSS- KLS1-1). Videos and research articles stimulated curiosity and assisted in answering questions about the little known insect. Students discovered that the rostrum was studied due to the uncanny way that it is both strong, yet flexible.

After learning about the acorn weevil, its larva and life cycle, the Becorn unit formally began. The project took on a life of its own; the children were eager to create their little woodland creatures. They designed their “Becorns” on paper plates and used child safe glue guns to put them together. Unfortunately, the cool glue failed; hot glue, paper clip pegs and a small dremel were used by the teacher to secure the students’ designs.

The Becorns were adorned with epitaphs, helmets, spears, shields and different qualities rivaling the children’s unique personalities and imagination. Truly, they were each remarkable in their own right. The students were excited and proud to showcase their fabrications that exuded charm, whimsical fantasy and artistic prowess.

As the students created their Becorns, they unwittingly learned about proportion and sizing as they wanted stick legs to be of similar thickness and length. The young engineers tried to balance their creations hoping they would stand. The artist, David Bird used small spikes at the base of the legs to support his creations, but this was not feasible for seventy two 2nd graders; instead a small amount of brown playdough was used to prop the Becorns up when taken to nearby woods.

The woods were an integral part of this project, as the overriding objective was to take students to nearby woods to observe seasonal changes three times a year. Children were given a small food storage container housing their Becorn, moss, and a ping pong sized ball of brown playdough that would ultimately support the Becorn in an outdoor setting.

Students took their creations to the woods and posed them in natural scenes. Then using their iPads, they photographed the vignettes complete with fallen leaves and trees in the background. Sometimes, the Becorns would fall apart and children performed “emergency surgery” with glue dots reconnecting broken limbs or helmets.

Children identified the trees next to the acorns that had fallen on the ground. They recognized that the leaves were different and ultimately learned that red oaks and white oaks were indigenous trees in our small, local woods.

Educational benchmarks reached in this unit included, but were not limited to: observing seasonal changes in a natural setting, designing and creating a unique project, understanding the life cycle of an insect,

identifying indigenous trees in local woods. Furthermore, students showed compassion, grit, resilience, excitement, appreciation for the natural world and pride in their creations.

Extensions might include writing a story about their character, photographing the Becorns with class pets using green screens and stop motion technology/apps. Coding could be incorporated by using a photo of their Becorn as a sprite in Scratch Jr. The materials are free or relatively inexpensive, so learners in different socio-economic backgrounds could participate as well. Students that struggle with the rigor of the classroom, thrived when tackling the Becorn project, showcasing their talent and persistence. Even the most basic of designs proved to be excellent subject matter when photographed in the majesty of the autumnal woods. Becorns substantiated learning in an unconventional; yet, holistic way that was meaningful to students creating buy-in and ownership.

David M. Bird's Becorns captivate learners both young and old alike. Enthralled with the relationships and stories that his carefully crafted marvels tell through epic photographic journeys of creativity and ingenuity, elementary students were engaged participants who readily tried to create their own unique forest dwellers to defend and celebrate the wonders of nature.

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April 12, 2024

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Cattle on Century Farm, Overland Park, Kansas 1996; Photo by Amy Lilienfeld 1996.

PLACE-BASED TEACHING ABOUT SOILS WITH THE "WEB SOIL SURVEY"

Amy Lilienfeld PhD | Circle of Illumination Science Education

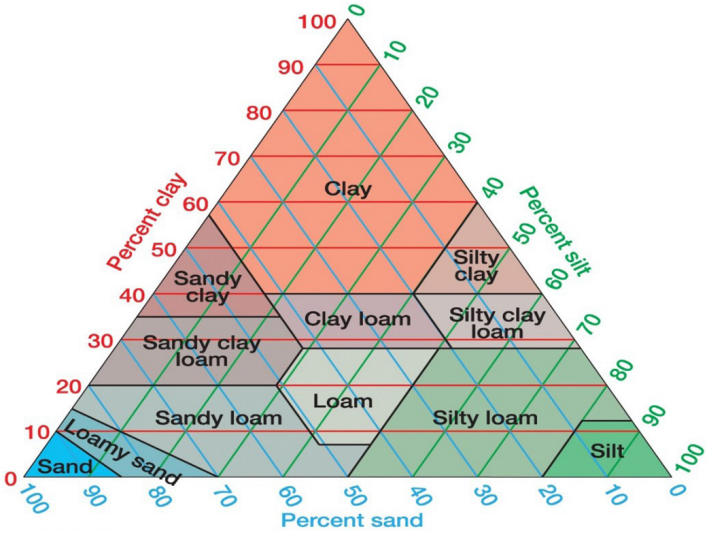
INTRODUCTION

When I first starting teaching geography at Central Michigan University in 2002 I discovered an intriguing set of books on the back shelf of my classroom called "Soil Surveys". Intended for use primarily by farmers these surveys had been published by the U.S. Department of Agriculture. Each survey was comprised of a series of aerial photos of the land in a particular county with a large number of tables. Although numerous the tables were generally divided into two main categories: 1) the physical characteristics of the soils found in a particular county and 2) the suitability of each of the county's soils for different types of land use.

I already had a serious interest in soils since working as a freelance photographer on a project with the U.S. Geological Survey: The "Omaha-Kansas City Urban Corridor Geologic Map Project"[1]. One of the main goals of this project was to convey to developers who were converting large tracts of farmland in urban fringe areas into residential subdivisions the importance of understanding the characteristics of the soils.

Most soils characteristics relate to the two components that make up most soils: 1) An "organic" component which is decomposed organic matter such as leaves. This is often referred to by the term "humus" and 2) An "inorganic" component which is primarily weathered rock of greatly varying particle sizes. An especially important characteristic of the inorganic component of soils is something called "soil texture" which is the relative proportions of sand, silt and clay. It is represented nicely in a diagram referred to as a "Soil Texture Triangle" as shown below.

SOIL TEXTURE TRIANGLE



Each side of the triangle represents one of the three components mentioned above ranging in content from 0-100%. All of the names shown within the triangle, e.g., sandy loam, sandy clay, loam, etc. represent individual soil textures. As you can see these are distinguished from each other in the diagram by different colored areas. Each texture can contain a range of each of the three components. So this is essentially a classification scheme for soils. Please note that, however, that reading off of the sides of the triangle can be a bit tricky as one is reading off of both diagonal and horizontal lines to get to a particular soil texture. What must guide you is that they must add up to 100%. If greater than that you know you have misread something on the diagram! But, for example, the center of the dark blue arrow in the area associated with loams corresponds to the following combination: 40% sand, 40% silt and 20% clay. If, however, the sand content was increased to 60% , clay content was reduced to 10% and the silt content was reduced to 30% and you would then have a different soil texture: A sandy loam!

To give students the opportunity to literally "get a better feel" for soil texture a great online activity sheet, "Activity 3.1, Determining Soil Textural Class", would be a great resource. Although originally produced by the U.S.D.A. and Colorado State University Extension it is available at the following link: https://marioncomga.org/wp-content/uploads/2020/01/Soil-Texture-Activity-1.pdf. This activity includes not only questions related to the soil texture triangle but has more hands-on activities including one of my favorites called the "ribbon test". This test is actually used by soil scientists in the field to determine soil texture! But in order to do this activity students will need to either collect soil samples somewhere outside or teachers may need to purchase bags of soils at a local hardware store.

THE WEB SOIL SURVEY

Fortunately soil surveys were eventually digitized into what is now called the "Web Soil Survey" [2]. So rather than being constrained to a small set of individual counties this opened up limitless opportunities to explore! Although the Web Soil Survey is a web-based Geographic Information System, which sounds a bit formidable, it contains much of the same information that was in the hard copy version but just in a different form. Once you learn a few simple steps you can access any one of a variety of layers stored in the database and create maps for a particular location. For example one could create a map of physical characterics of the soils that relate to soil texture such as percent sand or percent organic matter.

Alternatively, one can create maps of the suitability of a particular soil for a particular type of land use, such as houses with basements or septic tank absorption fields. It is especially interesting to point out to students that suitabilities for particular uses are based on the physical characteristics of the soil. For example if a soil has high sand content, making it highly permeable, any location with such a soil would not be suitable for a septic tank absorption field which, as its name implies, needs to be somewhat "absorbent"! Similarly soils with high clay content are not suitable for houses with basements because clays have "shrink-swell" characteristics meaning their volume changes dramatically depending on if they are very dry or wet.
I have now used the software for approximately 15 years and continue to be fascinated by the many ways in which it can be used!

REAL WORLD APPLICATIONS of the WEB SOIL SURVEY

I especially enjoy when students become more convinced of the software's value when it can be used to solve problems in the "real world". For example, after learning how to use the software a student of mine

at a community college in Minnesota was very excited when she found a newspaper article which described that the city of Pierz, Minnesota purchased a tract of farmland that was just south of their existing golf course. The city planners, however, decided it would be prudent to find out about the characteristics of the soils on that plot of land before making any decisions about its potential uses. In fact they felt it would be worth a few thousand dollars to get an analysis of the soils done by a consulting firm! According to them "knowing the quality of the soil beneath the surface reduces the risk of the city planning an improvement that may not be feasible, given the soil quality..... an example would be if the soil borings reveal that the soil underneath is made up of a lot of organic matter, placing a building on the site without first replacing the soil might result in the soil settling and the building sinking"[3]. This proved to be an outstanding case study for the students in my class who were very enthusiastic about solving such a real world problem! The map that they came up with-- shown below -- demonstrated that the organic matter of the soils was actually quite low, ranging from less than 0.33 % to something less than 6.7% (see legend to the left of the map). For those of you astute observers out there you may note that the highest organic matter content happens to be around a..... stream!

Screenshot from Web Soil Survey, Organic Matter Content of Soils on Newly Acquired Parcel of Land, Pierz, MN

SOURCE: Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Available online at the following link: http://websoilsurvey.sc.egov.usda.gov/. Accessed [1/16/2024].

In addition to being fun the use of this software coupled with the study of soils fit with many NGSS standards in second, fourth and fifth grades as follows: 2-PS1-1, 2-PS1-2, 4-ESS2-1, 4-ESS2-2, 4-ESS3-2 and 5-ESS2-1.

For those of you interested in exploring this software go to the U.S.D.A./N.R.C.S. Web Soil Survey site at: https://websoilsurvey.nrcs.usda.gov/app/. Detailed instructions on the software's basic use in the form of a sequence of screenshots will be available by2/1/2024 at www.circleofillumination.com.

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Time to Shake off the Road Dust

Maureen Stine | Natureology

In 2023, the Michigan Science Teachers Association (MSTA) celebrated their 70th annual conference in Lansing welcoming over 650 attendees. I submitted a presentation proposal to join them, but I wasn't sure it would fly because my offer months earlier to implement a free guided walk for attendees at the Michigan Alliance for Environmental and Outdoor Education's 2023 annual conference on Beaver Island was denied. As luck would have it, the MSTA conference committee recognized the value of my topic, Forest Bathing for Teachers and I got my first chance to speak at MSTA. My aim was to inspire teachers to practice forest bathing with their students and for themselves to nurture mindfulness in nature and glean its scientifically proven health benefits of clarity and restoration. What an experience!

Twenty-two teachers arrived for my talk, and I began by interpreting the somatic practice of forest bathing. The term somatic comes from the Greek root word, 'soma' meaning "whole self". Forest bathing fosters our deeper connections with natural places including our natural self and it's important to remember that the practice supports every aspect of our well-being. The University of Michigan, Michigan State, Stanford University, and the Nippon School in Tokyo have all researched and proven the health benefits of forest bathing. A slow forest saunter inhaling phytoncides (terpenes diffused by trees) lowers blood pressure, lowers cortisol levels, lowers nervous system activity, increases cerebral blood flow, improves memory, and prompts rest. But these effects are really the collateral impacts of a repaired relationship between people and places. Especially for those dealing with ecological grief, or personal trauma the restoration of relationship to place is the beginning of the healing process.

Heads nodded as I reminded the teachers that we have all been forest bathing this whole time without ever calling it that. But since anyone can forest bathe anywhere, whenever they want, why be guided? What does a guide do? Well, not always but often, when we are in a park, along a trail, or in our

backyards without an agenda, it's possible our minds can begin to move in cycles of distraction. We may start to dwell on that nagging mental baggage such as the laundry spoiling in the hamper, the overdue oil change, the banking, the shopping, the dentist appointment we need to make, the person who awaits our email/text/call, the meeting we're not prepared for next week and we may start psyching ourselves out, "I've got more important things to be doing!" and cut the outing short. However, if we make plans to meet a forest bathing group at a state park or hatchery on a Saturday morning, it gives us an excuse to fully engage in the practice. Forest bathing guides hold time and space for others to fully enjoy wandering in nature.

University of Michigan psychology researchers, Marc Berman, John Jonides, and Stephen Kaplan discovered that after spending one hour outdoors in nature, people experienced a 20% increase in memory and attention span. Incorporating forest bathing outings into semester curriculum can make a positive difference on student performance and mood.

I closed my 2023 presentation by offering MSTA teachers an invitation to travel to their favorite landscape. Leave behind the phone, music, and any distractions. Wear comfortable clothing, bring water, a snack, something to sit on, and something to write with. And importantly, upon arrival, congratulate themselves for being there. Then meander slowly and notice a being from the more-than-human-world. Allowing whatever it is to emerge naturally to their gaze like a slow reveal. Once discovering the being, get comfortable, nest into a spot, and sit with it for a while and simply notice. I distributed pads of paper and pencils so that the teachers might sketch the being or write something down about what they were noticing.

During this long Michigan winter season of indoor screentime, poor air quality, electromagnetic light pollution, and other environmental stressors now is the time to shake off the mental road dust and challenge ourselves to put the cell phone down for some overdue agenda-free outdoor immersions. Let's get outside and wander where the Wi-Fi is weak.

Learn more about the somatic practice of forest bathing through my book, a non-fiction work titled, Grass Left Standing: A Park Interpreter's Road Map to Forest Bathing - available for public release in Spring, 2024 by Mission Point Press, Traverse City. Find a forest bathing guide this year by visiting: www.anft.earth or www.forestbathingfinder.com or watch for my walks at: www.natureology.me.

Time in nature is not leisure time; it's an essential investment in our children's health (and also, by the way, in our own)

-Richard Louv

Project- Problem- and Place-Based Learning (PBL3): A Pedagogical MultiTool for Vibrant Teaching and Learning

Jennifer Gabrys, Kari Keith, and Michelle Smith | InnovatED313

With Project- Problem- and Place-Based Learning (PBL3), educators work together with students to design investigations based on real-world scenarios, problems, and challenges. By incorporating complex questions or problems, and harnessing the insights and assistance from local community experts, students have the opportunity to take ownership of their learning and develop critical thinking, problem-solving, and teamwork in more authentic, meaningful ways.

Learning to design and enact robust PBL3 units can be a challenge for busy educators, but for the past several years three Michigan organizations have partnered to provide guidance and support. The PBL3 STEAM Institute in Detroit is a multi-day professional learning experience introducing teachers to Project-, Problem-, and Place-Based Learning. Staff from InnovatED 313, CMU's Center for Excellence in STEM Education, and the Belle Isle Aquarium have conducted this workshop using Detroit's histories and culture, museums and outdoor spaces as launching pads for PBL3 unit ideation. Teachers are energized and empowered to then craft lessons connected to their own communities, designing units where students to tackle meaningful issues of social justice, environmental protection, bias in access to services, and more. As an additional support after the summer institute concludes, teachers are invited to participate in a PBL3 Fellowship, meeting virtually during the academic year to support one another as each teacher enacts their new unit.

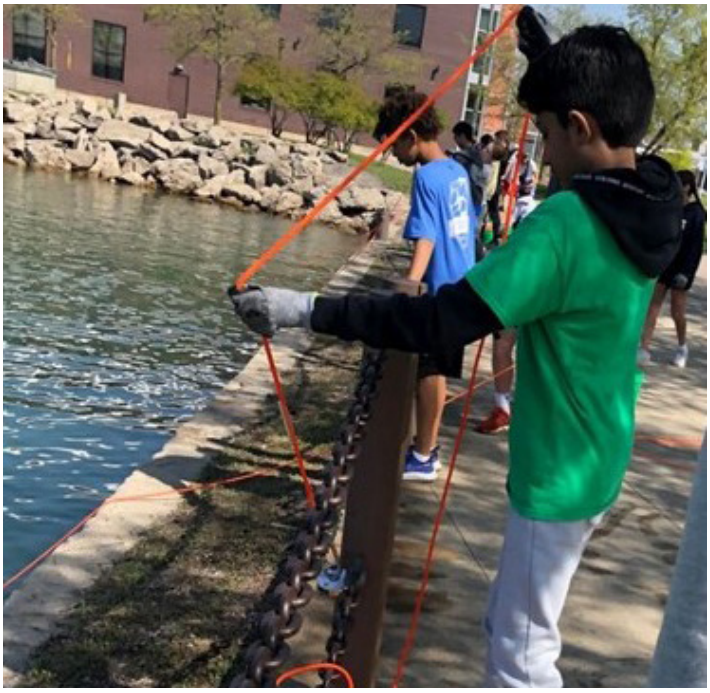
So, with a vibrant new tool in our educators' pedagogical toolkit, how did it go back in the classroom for our participating teachers? We have stories below from three program alumni, outlining why they chose to explore PBL3, how they felt during the "messy middle" enacting this new strategy, and sharing lessons learned.

Jen Gabrys - DCDS, Beverly Hills

Even though I am a 25 year veteran teacher and have seen many trends come and go in education, I still felt like I was missing something in my science classroom. Project-Based Learning (PBL) was not a new concept to me and, in theory, it sounded like learning magic. And yet, I could still never quite get it off the ground. It was not until I participated in the PBL STEM

workshop on Belle Isle that a lightbulb went on and things seemed to fall into place and I truly embraced not just PBL, but leveled up with PBL3, adding place, problem, and problem based components. After initiating my own environmental stewardship project, called "Think Big, Act Local" I realized that PBL3 stands out as a powerful approach because it emphasizes student choice, increases engagement, promotes community building, and offers opportunities for social-emotional growth. In this PBL3 exercise, middle school student groups observed an environmental issue on school grounds, designed a solution for positive change, chose the best plan in their class, and executed that project.

One of the cornerstones of PBL3 is the freedom it affords students in choosing topics. Allowing students to select projects that align with their interests that have personal significance taps into their intrinsic motivation and gives them ownership and purpose in their learning.
In addition, students, particularly adolescents, are at a stage where they are seeking relevance and connection in their education. PBL3 uses real-world applications in science in the form of the problem that needs attention. Students can see the impact of their work on the real world and, as a result, their engagement increases. Students want to make a difference and with this method, they can. PBL3 moves learning from passive to active exploration, getting students excited and engaged in their learning.



Much of this engagement comes as a result of the community building that naturally happens, not only among classroom peers, but within the broader community as well. Students work together on their chosen projects, developing leadership, teamwork, and communication skills. They become "real scientists", supporting one another, and investigating solutions to complex questions. Since PBL3 involves place, they also have the opportunity to engage with stakeholders in the community, beyond the walls of the classroom.
In addition to the acquisition of improved science process skills and content, PBL3 seamlessly integrates social-emotional learning into the curriculum. Students develop empathy, navigate interpersonal relationships, and appreciate different perspectives as they collaborate with others. In addition, students must learn to be resilient, often confronting challenges and reiterating their ideas.

PBL3 is a potent tool for science classrooms! It is a vehicle that offers choice, increases engagement, fosters community, and provides opportunities for social-emotional growth. The trifecta helps prepare the next generation of scientists, problem solvers, and collaborators while instilling a love of learning.

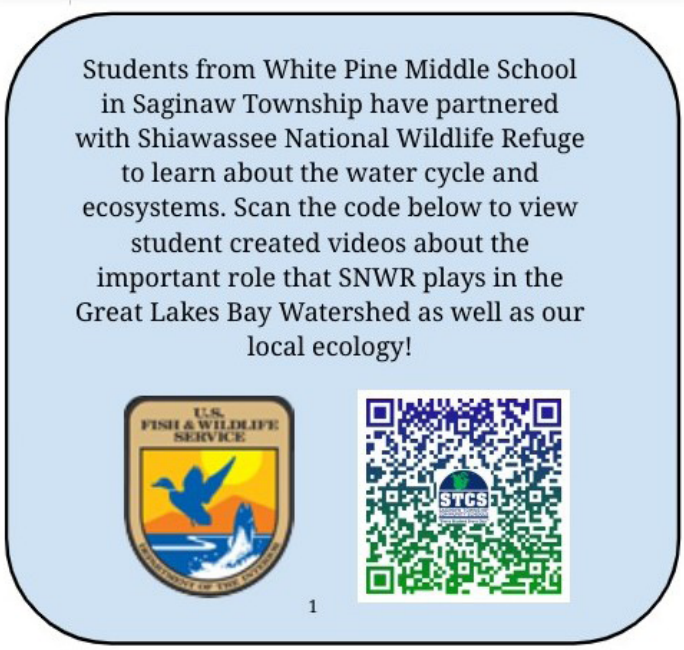
Kari Keith- White Pine Middle School, Saginaw

Intrigued. Intimidated. Invested. This was the range of emotions I experienced as I tentatively stepped, then plunged headlong, into the realm of Place- Problem-Project-Based Learning (PBL3). Like many educators, my first encounter with PBL was at a conference, sparking an immediate

sense of intrigue. It aligned seamlessly with my early visions of teaching and learning. This was exactly what I had envisioned teaching and learning would be when I first decided upon an education major all those years ago However, standards and assessments, curriculum maps and pacing guides, and a myriad of other demands all began to cloud those early visions.

The allure of PBL reignited my passion, prompting me to explore its integration into my middle school classes. My transition from INTRIGUED to INTIMIDATED was swift. Delving deeper into PBL projects created by other teachers, I was filled with self-doubt, questioning, "Can I really pull this off? Where will I find funding? Do I possess the time and energy for such an endeavor?" My biggest fear loomed large - that my ideas would pale in comparison to the projects I had witnessed.

Taking a breath, I decided on a singular first step - a phone call. A colleague and I reached out to our local parks and rec department, inquiring about potential collaboration. Surprisingly, the answer was a resounding yes. When you begin your own PBL journey, you will likely find there are many community partners who would eagerly join you. As discussions



unfolded with the director, emotions ranged from excitement to lingering doubts, yet I pressed forward.

Those tentative initial steps occurred five years ago. Over this period, I progressed from feeling intimidated to becoming fully invested. So invested, in fact, that I cultivated a second place-based partnership. Emphasizing the evolution of these projects, it's crucial to note that they progressed modestly and expanded incrementally each year.

The inaugural partnership, with Saginaw County Parks and Recreation, supported my sixth-grade ecology unit. Focused on the impact of invasive species on Michigan ecosystems, students received a video message from the park director, prompting them to apply their newfound knowledge to address a decline in bird species. The culmination involved students identifying and removing invasive garlic mustard, a task that saw them remove 823 pounds in the first year. Despite a hiatus due to Covid, subsequent years saw consistent removal efforts, supported by grants for transportation, plant identification cards, signage, and the installation of a boot scrubber brush near a walking trail.

The interaction with our place-based partner enriched students' comprehension

and gave each lesson a sense of purpose. Seeking professional development opportunities, such as the Belle Isle Institute, allowed me to delve deeper into PBL methodologies.

While nurturing the existing partnership, another opportunity arose, courtesy of a colleague who introduced me to Shiawassee National Wildlife Refuge, practically in our backyard. Yet again, small steps led to phenomenal outcomes. Partnering for our water cycle and ecology units, students engaged in a range of activities, from evaporation labs to nature walks and even a bus ride through the almost 7 mile long wildlife drive. They created videos showcasing their knowledge, linked to QR codes displayed throughout the refuge, allowing community members to scan and learn from their insights.

Each year it seems that I have something new to add to both of our PBL units. Sometimes I have to remind myself to slow down and take it one step at a time! I have become fully invested in these place based partnerships because of how much they enhance the learning experience for my students. In turn, my students are fully invested because their learning has value and meaning and is positively impacting their own community.

To those intrigued yet slightly intimidated by PBL, my advice is to take that initial step. In no time, you and your students will be fully invested!

Michelle Smith - Beacon Elementary, Harper Woods

While I had heard of PBL3 Learning, it wasn't until I had participated in the PBL STEM Summer Institute on Belle Isle in Detroit that I really delved into it. After this four-day conference talking with educators from across Michigan, I was really excited to bring this idea to my school. The Summer Institute offered a fellowship that met virtually through the school year and also allowed for a grant to purchase needed items for the project. While I was quite overwhelmed to make it happen, I felt that I should take the opportunity offered to me and stretch my thinking. I am so glad that I did!

At the time, I taught K-5 STEM traveling to two buildings. I saw each class once a week for 50 minutes. I was trying to figure out a way to work with a grade level on a project and this was stressing me out a bit. I felt that a project would need more time than I usually allocated for our STEM challenges. I also taught a writing specials class for one semester with a second grade class. So I talked with my K-2 administrator and he agreed to allow me to use the whole semester to still teach writing but combine it with a project.

This was the beginning of our Pollinators in Our Community project. My second graders and I spent the semester learning about the life cycle of plants and the importance of pollinators. My students grew Wisconsin Fast Plants and pollinated them. After

we made observations and understood more about pollinators, we discussed the problems facing our area. One idea that came up was that pollinators needed more places to live and also the back courtyard where the playground was had a lot of bees. My students wrote to our principal asking permission to make a native pollinator garden. We looked at our grounds and students wrote about which spot would be best and why. They chose a spot away from the playground and door to attract the bees away from our common spaces. We gathered information from local experts about which native plants would be best for our area. The PBL workshop staff helped us identify and contact those experts. Students then chose the plants, what kind of border, and sign we should have.

The second graders loved being outside weeding the area, planting and placing rocks for the border. It seemed like all of the students enjoyed it, but some really took to gardening. We also had a daily watering group and a few that would weed. My students were very proud of their work!

I wanted to continue the work but in year two, my schedule had changed. I did have some time so I worked with another second grade class by pushing in with their teacher. We again learned about pollinators and grew Wisconsin Fast Plants. This class wanted to improve the garden so they chose to add a butterfly and bee house. They did the spring clean up and continued to take care of the garden until the end of the school year.

I have learned that the time and effort it takes to create a PBL3-based project is so worth it! I have grown as an educator with my interactions with the amazing facilitators and teachers that I have learned from these past three years. But most importantly my students thrived when they were able to be outside working on a project they were invested in

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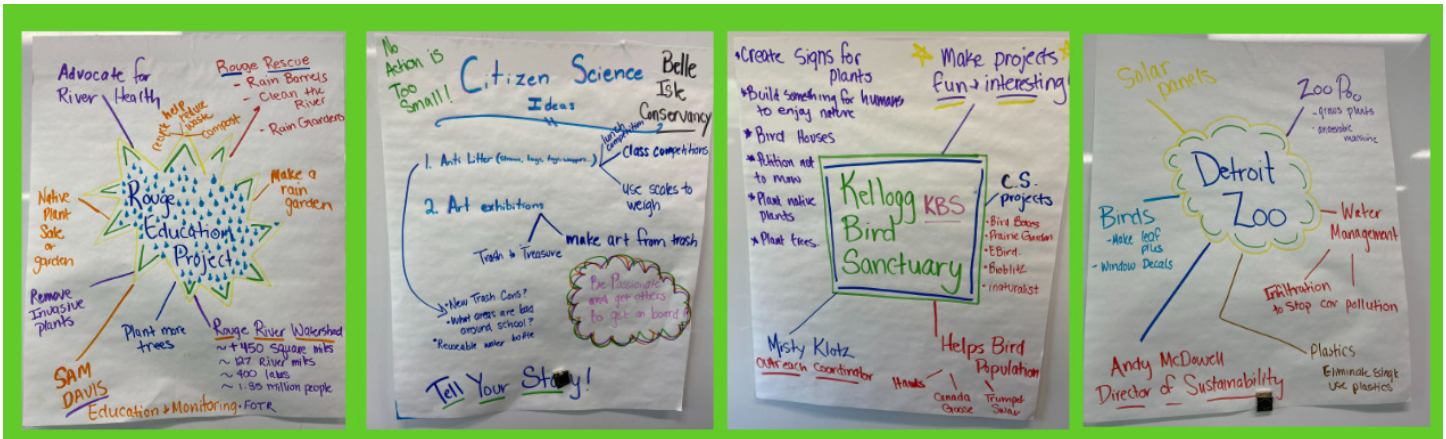
Jen Gabrys - Take 2!

“Think Big, Act Local ‘’ is a three-part environmental stewardship project that evolved over several years of more traditional teacher-directed environment based projects. Although well-organized and thoughtful, feedback was ho hum and I knew the student agency was missing. After learning about PBL3, I redesigned the activity to incorporate the elements of project, place and problem. This turned out to be the secret sauce to an activity that earned rave reviews from students and became a great capstone project at the end of the 6th grade year.
Throughout the school year, students had opportunities to make observations about



Step 2: Zoom with experts

concerns they saw in the school and on the school grounds. Whether it was the deer eating from our bird feeding stations, the amount of food waste at lunch, or germy places, we made note of concerns as part of other science units. Students also participated in whole class citizen science projects counting birds and collecting water quality data. Now, it was time for students to choose areas that interest them the most and to work toward affecting real change.

First, students participated in the citizen science project of their choice, using the searchable SciStarter database. In doing so, students not only picked something they were passionate about, but further understood how they could contribute to the scientific community. They were so surprised by range of projects they could help with around the country.

Next, inspired by the citizen science projects, it was their turn to consider how they could make a difference in their own community. They considered their own citizen science projects, thought about what they had observed throughout the year, and designed ways that they could be the positive change-makers. To help students, they met virtually with community stakeholders and experts in creating positive human impact projects. From leaders in places such as the Detroit Zoo, Belle Isle Conservancy, Friends of the Rouge, and The Kellogg Bird Sanctuary, students became inspired.

Groups presented their ideas to their classmates in a "Shark Tank" style poster-session. We called this "Sea Lamprey Tank" after learning about these invasive species. Students had to persuade their peers that their project met the criteria the most. The projects had to have high human impact and student enjoyment, remain within budget, have roles for everyone in the class, be completed within 60 minutes, and be sustainable.

Once the project was chosen by class vote, the group with the winning project ordered materials and led their classmates to carry out the project.
"My favorite part of the class was the posters because it was fun to see people's ideas." and "My favorite part of the class was the Community Science Project because it was fun to be able to choose what we are interested in and make a project about that." These are just a few of what students reported after the project. By refashioning an established activity to include project-, place-, and problem-based learning, student voice and choice increased engagement and learning while improving community, collaboration, and student agency.

Circle of Illuminations Science Education Professional Development Workshops

Climate and Weather Basics

for third and sixth grade teachers

In almost every K-12 classroom across the United States you will find a globe and on many of those globes you will see a ribbon-like diagram like this. Do you know what this is and why it is important?

It is called an analemma. It explicitly shows where the "subsolar point" is, i.e., the latitude at which the sun is directly overhead at noon, on the Earth's surface and on what dates of the year that occurs. Migrating annually between the parallels the Tropics of Cancer and Capricorn the subsolar point is one of the primary factors behind global climates through its influence upon annual patterns of both temperature and precipitation. In addition, however, it triggers a cascade of other events such as changes in atmospheric pressure as well as in global winds.

Circle of Illumination Science Education invites third and sixth grade teachers for an invaluable opportunity to gain deep content mastery about these large-scale global processes associated with climate, as well as more local and regional processes associated with weather, in a series of workshops to be held in schools and school districts in Michigan starting in late March 2024.

A variety of web-based resources will be used including many real-time weather web sites. To find descriptions of specific workshops and additional information go to www.circleofillumination.com. Participants in workshops will be able to obtain CEUs or SCECHES. Any questions? Please contact Dr. Lilienfeld at amy@circleofillumination.com,

To see a sample of Dr. Lilienfeld's writing she is an author in this issue of LINKS. In addition she will be making a presentation at the 71st Annual MSTA Conference on meteograms, an important form of data visualization in weather with which students can observe real-time changes in a number of weather variables and be stimulated to speculate about relationships between them. Hope to see you there!

NASA astronaut Jessica Meir tends to mustard greens grown on the International Space Station. Photo credit: NASA

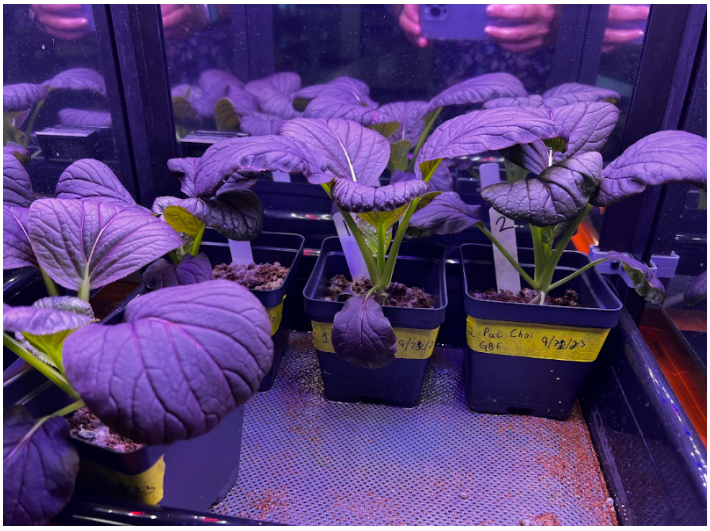
Exploring Crop Production in Space with Growing Beyond Earth

Susan Tate | Whitehall Middle School

Are you looking for a way to engage your middle or high school students in agriscience? Growing Beyond Earth (GBE), a partnership between Miami's Fairchild Tropical Botanic Garden and NASA, leverages student interest in space travel and exploration with a citizen-science investigation to support NASA research on growing plants in space. Participating schools are sent a growing chamber, manufactured by MARSfarm (marsfarm.com), that simulates the Vegetable Production System (Veggie) on the International Space Station. Schools are then assigned experimental protocols, and provided with seeds, plant growth medium, and fertilizer. At the conclusion of their experiment, students submit their data to Fairchild Garden, which aggregates the data and shares it with NASA plant scientists. Students are excited to learn that the NASA scientists actually use GBE data to determine future crops on board the ISS.

WMS student makes observations of the pak choi plants inside the growing chamber. Photo credit: Susan Tate

While the program is currently in year seven, 7th grade STEM students at Whitehall Middle School have recently finished their second year as "space farmers". They are one of approximately 440 middle and high schools around the country involved in the program that have tested over 200 varieties of edible plants for NASA. This year, WMS students were assigned the Irradiated Seeds protocol, in which they were responsible for two 28-day grow-outs of Pak Choi F1 "Rosie Hybrid" seeds, some of which had been irradiated to mimic the effect of radiation on seeds sent to space. Pak choi, also known as bok choy, is a type of Chinese cabbage that grows easily and has tender, nutrient-rich leaves. Students followed very detailed instructions to ensure that water, light composition, humidity, and temperature were monitored



“Space plants” ready for harvest! Photo credit: Susan Tate

and maintained, and they kept track of these parameters and plant growth on a spreadsheet provided by the program manager at Fairchild. At the end of the 28-day grow-out, students carefully conducted final measurements on each plant, and recorded edible and non-edible mass.

In addition to the experience of conducting hands-on scientific research, the Growing Beyond Earth program also provides rich opportunities for students to expand their literacy around the topic of food production in space, and space travel and colonization in general. Fairchild Garden and NASA provide participating teachers with a plethora of articles and presentations on the program website that cover topics such as how plants grow in space, the logistics of growing safe and nutritious food in space, and a detailed fact sheet about the ISS Vegetable Production System (Veggie). Students learn about the importance of growing fresh vegetables in space for better nutrition and astronaut morale.

Teachers interested in learning more about the Growing Beyond Earth program or applying to be a participating school, should check out the program website at: https://fairchildgarden.org/gbe/

Nonfiction Reading Month

Katie Stevenson | Vandenberg Elementary/South Redford School District

As an instructional coach, I am always looking for ways to integrate science in meaningful ways in the elementary classroom. Finding the time is the challenge!

Earlier this year, I participated in a professional learning opportunity that highlighted connections to nonfiction texts by well-known science author Jessica Fries-Gaither. Sparking my curiosity, I started to share my learning with colleagues and discuss ways in which we could get something happening in our school. As a building we have noticed dips in nonfiction reading achievement, as well as, interest levels by teachers and students.

To integrate nonfiction reading with science in the elementary classroom, a small team was formed and we considered three areas of focus: reading levels, general science understanding, and student engagement. How could we address these areas and not put something else on the teacher's plates? We developed a plan in preparation for March's reading month.

The planning and development team for our project consisted of myself, the Instructional Technology Coach, Media Specialist, and classroom teachers. The project has three phases: (1) introduction of nonfiction texts with STEM activities, (2) classroom March Madness bracket competition, and (3) an individual student reading challenge and raffle.

Phase 1 began in January upon returning from winter break and will continue through February. Every week, students are

beginning their check-out time with a read aloud done by the media specialist, or the instructional technology coach. All students, grade level pre-k through fifth grade, are listening to a book based on a weekly theme. During the story, students are asked questions that are centered around the cross-cutting concepts: patterns, cause-and-effect, and systems. Following the story, students get to participate in a quick STEM connection. Some of the planned activities are balloon cars, seed germination bags, sink or float explorations, and nature walks. After books are read, they are put on display with photos of activities that were done. We are just a few weeks into the new year and everyone is loving the nonfiction texts so far!

Phase 2 will start in March. Throughout the month, classes will listen to a fictional read aloud done during morning meeting, or at a time the classroom teacher has built in their schedule. The team has given a list of options to the classroom teachers already. During check-out classes will take a vote choosing the read aloud that was done in class versus the nonfiction text that was done during phase 1. The competition will pose fiction against nonfiction in a set of brackets that narrow choices through 4 rounds - similar to the NCAA basketball teams. The results after each round of voting will be shown on the school's morning announcement videos. The winning title will be featured in the Media Center and copies will be available for check-out.

Phase 3 is all about the students. They will have the opportunity to compete in an individual reading challenge. Throughout the month of March and during spring break, they will record how many nonfiction texts they read. On their log, students will include the following: title, author, and something they have learned. For every book read, they will receive a ticket to be entered into a raffle for a STEM kit.

Exploring STEM concepts through nonfiction at the elementary level can enhance learning experiences. Integrating real-world examples, engaging in hands-on activities, and highlighting connections between scientific principles and everyday life to make STEM education more accessible and relatable for young learners have been proven to increase student achievement. We are excited to see the impact of this project across all ages!

Science is a Slow (Thinking) Process

Tony Matthys and Chris Geerer | Mi-STAR

This past Fall, Mi-STAR staff had the opportunity to meet with Dr. Christie Morrison Thomas from Michigan State University to discuss her work to understand and address a common challenge in NGSS learning — "phenomenon fatigue."

Phenomenon fatigue happens when students start a unit or lesson feeling engaged and excited about figuring out the driving phenomenon, but gradually lose interest and motivation as they work to make sense of the phenomenon. What started as a vibrant, energetic learning experience at the start of the unit slowly devolves into a chore. Phenomenon fatigue is noticeably common across NGSS-aligned curricula.

The disconnect between students' perception of problem-solving as a quick process and the reality of scientific investigation as a slower, deeper experience can result in frustration. Nevertheless, coming to terms with the need to take the time to test solutions is central to the very nature of science, argues Dr. Morrison Thomas.

Students may feel an investigation is complete once they have an idea of how to address the problem or explain a phenomenon. Their intuitive solutions and explanations are based on their own, often idiosyncratic, models of how the world works. These models are not necessarily supported by evidence, however. Students get a lot of practice using this type of "fast thinking", which can be valuable while moving through the world on a daily basis - just imagine trying to draft a rigorous, evidence-based argument for daily decisions like what to wear, what to eat, or what to watch on TV each night.

The scientific community makes decisions differently. Scientists do not reach a conclusion until all claims are supported by evidence and reasoning. For example, Casey Huckins, a professor of Biological Sciences at Michigan Technological University, shared that his "masters and PhD students spend most of their time figuring out how to get their data, why to get it, and what it means. They might only spend three weeks [out of their years of graduate studies] in the field gathering the data." In real labs, science work is much more than a series of quick, engaging hands-on experiences.

Even though it is difficult, slower, effortful thinking is the very heart of the culture of science; there is no way to do science like a scientist without engaging in this process of deliberate thinking and argumentation. So how can we support students and help them practice engaging in "slow thinking" while also combating phenomenon fatigue?

Dr. Morrison-Thomas' research suggests we start by building students' identities as science learners. Fostering a classroom culture where good students are active participants who ask questions, make good observations, and argue from evidence, as opposed to just answering questions correctly, allows them to experience slow thinking like professional scientists. And in Dr. Thomas' research shows that fostering a classroom culture centered on slow thinking practices correlates with better scores on three-dimensional assessments.1

At Mi-STAR we embrace slow scientific thinking, but understand the struggle that comes with asking students to think deeply. As we work through our current unit revision process, we're looking at several ways to help teachers build science identities and reduce phenomenon fatigue in their classrooms, for example:

- We're streamlining storylines. We want to make sure that every lesson of a unit is building toward student understanding of the problem or phenomenon at the heart of the unit. Our revised units are more clearly focused on the problem or phenomenon under investigation - and most are shorter.

- We're placing greater emphasis on explaining the storyline to ensure that both teachers and students know how each lesson fits into the ongoing Unit Challenge. We've added navigation guidance boxes at the end of each lesson to suggest classroom dialogue and routines that connect student questions and lesson investigations with the ultimate goal of solving the Unit Challenge.

- We're streamlining hands-on activities to reduce cognitive demand. We want to ensure that students focus on the target practices and concepts without getting bogged down in too many instructions or questions.

At the end of the day, our goal is to support teachers in their quest to help students believe they can do hard things - including thinking deeply and slowly like scientists.

1 Covitt, Beth A., Elizabeth Xeng de los Santos, Qinyun Lin, Christie Morrison Thomas, and Charles W. Anderson. "Instructional practices in secondary science: How teachers achieve local and standards-based success." Journal of Research in Science Teaching 61, no. 1 (2024): 170-202.

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