MSTA Newsletter

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In this Issue

From the President's Desk

By Jen Arnswald, MSTA President

It's like Christmas in October! The Michigan Department of Education has released sample items that were on the Michigan Science Standards pilot assessment last spring. This is a moment that I'm sure we will all remember. Developing three-dimensional assessment items is truly a tough task, and we must applaud the educators that assisted in the development of these items over the last two summers. Below you will find a link to the sample items as well as other resources that science educators have developed to support the implementation of the Michigan Science Standards and a timeline of what to expect over the next few years on the M-STEP.

Michigan Science Standard Sample Items
https://goo.gl/fSqq1K

The Center on Standards & Assessment Implementation (WestEd) Sample Items
https://goo.gl/xNCe3J

The Center on Standards & Assessment Implementation (WestEd) Developing Assessments for NGSS Resources
https://goo.gl/9CxNSp

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From The Desk of Your Executive Director

From Betty Crowder and Robby Cramer, MSTA Executive Directors

We have some exciting changes going on behind the scenes that we want to share with MSTA members.

Restructuring our Office Staff

Angela Richardson is our new MSTA Association Manager. She will manage our day-to-day office by answering members' questions either by phone or email. She will also manage membership, promote our teacher scholarships programs, and organize our board meetings. During her first three weeks Angela met many MSTA Board members and gained insight on our goals and conference plans as she participated in our first Board meetings on September 22 and 23. Two weeks later she joined us at the Regional Directors Retreat in Traverse City on October 6 and 7. These discussions helped her to understand our mission, goals and our needs.

Angela comes to us with many years of experience working with nonprofit organizations. On a personal note, Angela's last family vacation was a trip to Hopkinsville, KY to see the solar eclipse. So, not only does she have valuable professional experience, but she is a science-lover at heart just like us! We are sure she will be a good fit for our Michigan Science Teachers Association.

Joint Membership Opportunities are Expanding and Increasing

We are pleased to announce that a joint membership opportunity enables you to join the Reading, Science, Math, Social Studies, Detroit Science and Detroit Math Teachers Associations for one low price! You can still have an individual or an institutional joint membership.

For several months the leadership of several professional groups dialoged

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From the President's Desk

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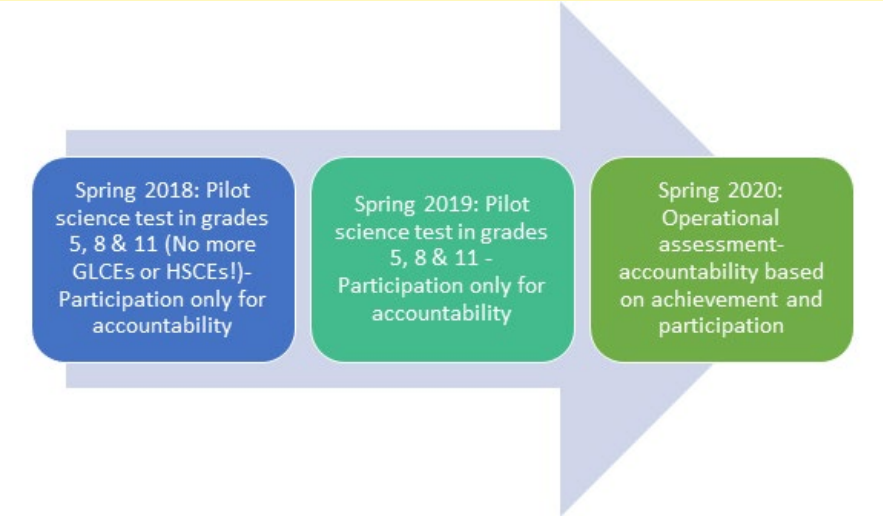

NGSS Evidence Statements
https://goo.gl/1CwqXm

STEM Teaching Tool- How teachers can develop formative assessments that fit a three-dimensional view of science learning
https://goo.gl/DiQorf

STEM Teaching Tool- Steps to Designing three Dimensional Assessment
https://goo.gl/uQ1xrB

From the Executive Director

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about the benefits of joint membership for our state's educators. These discussions resulted with Michigan Reading Association, the Metro Detroit Science and Math Teachers Associations deciding to join us.

Joint (Individual) – This individual membership provides membership with MSTA, MCTM, MCSS, MRA. MDSTA and DACTM. With this membership you are eligible to receive membership rates to all six association conferences and meetings, access to the six organizations websites, and receive publications from all six associations. You must initiate or renew this membership via the MCTM website.

Joint (Institutional) – This membership provides membership to a school or group. It is not an individual membership. With this membership, the school or group will receive: membership rates to all six association's conferences and meetings for up to 3 individuals, access to the six organizations websites, and receive publications from all six groups. NOTE: You DO NOT have to send the same three individuals to each of the conferences/meetings, they can be 3 different individuals for each association. You must initiate or renew this membership via the MCTM website and download the pdf.

Follow MSTA on

Visit www.msta-mich.org for the latest information.

Phenomena Do Not Need to be Phenomenal or Overwhelming for Teachers

This year we are introducing a new section in our newsletter. This section will provide easy strategies, resources and examples of phenomena used in Michigan classrooms to facilitate our Michigan Science Standards. The format will be designed in a "recipe card" style so you can create a rich collection of phenomena strategies, resources and examples to use and share with your colleagues.

Tips for using whiteboards in the classroom

By Brian Peterson

Whiteboards are an incredible tool that can be used in the classroom to make student thinking visible. When students engage in figuring out phenomena, they need a way to communicate their ideas with others as well as opportunities to refine those ideas over time. Whiteboards accomplish both goals because they can be publicly displayed and easily revised.

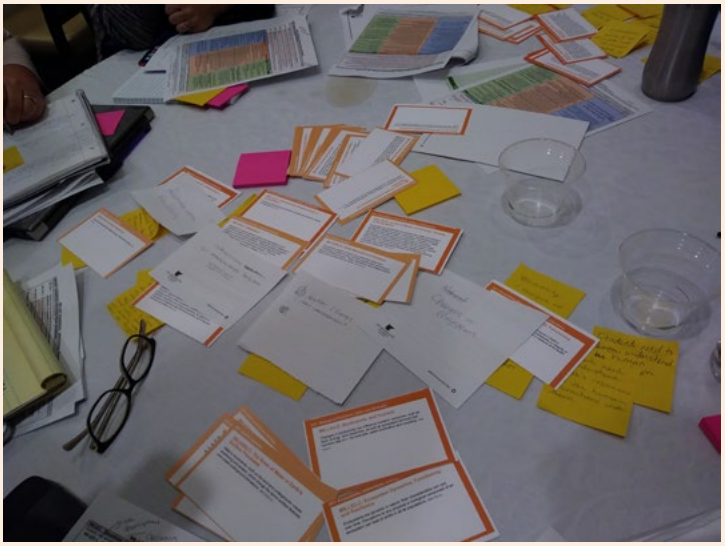
Below is a collection of tips that Michigan teachers have shared work effectively in their classrooms:

- Use a gently used sock that the students can put on their hand as an eraser. For a smaller eraser, students can use baby socks.
- Use the double-sided boards so students can use one side for a first draft and the opposite side for revisions.
- On the back of the board put some questioning prompts to help students ask good questions that enhance students' thinking and talking.
- To increase the longevity of the whiteboards, buff the boards with turtle wax (hard shell) but do not use whiteboard cleaner.
- Save money by having your own whiteboards cut at the local hardware. https://fairydustteaching.com/2012/03/diy-white-boards-so-cheap/
- Use colorful (whimsical) duct tape to edge your boards and put the same tape on Gladware containers that have Expos, some type of eraser, and Post-it notes. Teams get their board and matching tub of supplies.
- Hot glue gun craft poms on the end of dry erase markers so they have erasers.
- Create whiteboard stands. https://drive.google.com/file/d/0B55WIlACH38PWnA2bUVMMWFjLWs/view?usp=sharing

Making It All Fit: Course Mapping for the Michigan Science Standards

By Linda Bradlin, MSTA Region 3 Director

I teach at *Benjamin Carson High School of Science and Medicine*, a small public high school in midtown Detroit. We have been preparing to implement the Next Generation Science Standards since before they were even adopted as the Michigan Science Standards (MSS). My colleagues and I have gone to professional development workshops, read articles and books, sat in on webinars, and attended both MSTA and NSTA conferences. Along the way we've learned about performance expectations, modeling strategies, the 5E instructional model, and using phenomena to lead off storylines. However, now it's getting real! Incoming freshmen will be assessed on the three dimensions of the MSS topic bundles during their junior year when they take the M-STEP in the spring of 2020.



As a department, we had to figure out how to ensure the standards are taught to all of our students. After attending a session at the MSTA conference presented by teachers from Novi, I met with my principal and recommended distributing Earth science standards across the other science courses our students take. All of our students take an integrated science course (one semester for freshmen), biology, anatomy, chemistry and physics. See Appendix K of the NGSS for more information on course mapping (make Appedix K a hyperlink to https://www.nextgenscience.org/sites/default/files/resource/files/Appendix%20K_Revised%208.30.13.pdf).

At the NSTA conference, we learned about the "Five Tools and Processes for NGSS" Developed by the American Museum of Natural History. Tool 1 includes an NGSS Card Deck to plan instruction and assessment (link to: https://www.amnh.org/explore/curriculum-collections/five-tools-and-processes-for-ngss/tool-1/ngss-card-decks/). We printed and cut up all the cards, which took a long time and lots of card stock. In hindsight, we could have only printed the Earth and physical science DCIs (Disciplinary Core Ideas), SEPs (Science and Engineering Practices), CCCs (Cross Cutting Concepts), and PEs (Performance Expectations) for this phase of our planning.

After the cards were printed and cut, we used our 16 hours of summer curriculum mapping professional development to move the cards into each course. We distributed the physical science DCIs between chemistry and physics. Then we distributed the Earth science cards between the integrated science course, biology, chemistry and physics. Most of the Earth science ended up in the integrated course, but the standards our teachers judged most relevant to biology, chemistry and physics were included with those courses.

We created a spreadsheet with tabs for each subject to list the standards for each course. We used the *Access to the Next Generation Science Standards by Topic* webpage at the *NGSS Hub* (link: http://ngss.nsta.org/AccessStandardsByTopic.aspx) to copy and paste standards into the *Google* sheet. Our teachers were able to collaborate from their own homes to bundle SEPs, CCCs and PEs for their own courses.

The integrated science course our freshmen take will include introductory units on both the metric system and experimental design. Following those units, we will provide a review of waves from the middle school DCIs but a high school PE (HS.PS4.C: Information Technologies and Instrumentation). We wanted to be sure our students understood the basics of waves before taking chemistry and physics. The wave unit will be followed by the Earth science standards that were not included in chemistry or physics.

Distributing the standards among our core science courses is just the beginning of our implementation of the MSS. We plan to use some of our bimonthly departmental planning time to review the timeline of the standards, bundling, and other matters arising from engaging our students with the three dimensions. We are fortunate to have a staff that is willing to work together and draw on each other's strengths. We will need each other's expertise to ensure three dimensional learning for our students and to develop quality performance assessments to measure their growth.

MSTA 2018
GARAGE SALE

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

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

Whether you are getting rid of "great stuff" or in need of "great stuff", we can help you out at the conference. Any items you want to put in the garage sale can be dropped off Thursday afternoon or early Friday morning of the conference. The sale will begin at 10:00 on Friday and again on Saturday. Prices will fit any budget, no matter how limited. Proceeds go directly to MSTA. Tax deductible receipts will be available.

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

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

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

Reflections on the 2017 Annual Conference from Scholarship Winners

Andrea Thelen, LakeVille Community Schools

Winning a scholarship allowed me to attend my third MSTA conference. It was my first time going alone. I was a bit nervous venturing out by myself, but secretly I enjoyed the ability to choose my sessions independently. I felt duty bound to explore new curricula as we figure out how to implement the new Michigan Science Standards here at LakeVille Community Schools. I thoroughly enjoyed the Mi-STAR presentation. Hearing from classroom teachers who have piloted the units in their classrooms' allowed me to better understand how these units engage students and foster learning.

I've wanted to implement standards based grading in my classroom, but I wasn't sure where to begin. I attended "Making Grades More Meaningful," on Saturday morning, presented by Brian Langley. I enjoyed seeing his grading process, and his focus on making grades a method of communication between himself, students, and parents. He took the time to explain his rubrics, and process, as well as showing that this method is a work in progress. He also has the students monitor their areas of weakness and proficiency. I took a baby step and graded my first quiz on a rubric and the students really seemed to understand that their grade was based on whether or not they understood the material versus whether or not they got the questions correct. I just sent it home, so we will see how their parents react. This concept is something that I would like to implement with fidelity as we switch to the Michigan Science Standards.

I also like new, quick ideas for my classroom. I attended the Middle School Share-A-Thon and picked up some great ideas that were easy to implement. If you have never seen a mystery tube before, you need to google it! It's been a great activity during M-STEP for the students to practice their inquiry, modeling, and reasoning skills. Just in case you are wondering, I did not give them the answer as to how the tube was constructed!

I thoroughly enjoyed my experience at the MSTA conference. I was able to meet new people, bring ideas back to my classroom, and begin planning for next year. Thank you for this amazing opportunity.

Amanda Bennick, Whitehall District Schools

As an educator of the visual arts, I felt like an undercover agent at the MTSA 64th Annual Conference. I was happy to find that the conference included a variety of sessions related to integrating art and STEM topics, which is referred to as STEAM. I am very interested in integrating the visual arts and STEM activities to create exciting co-curricular learning experiences. I especially enjoyed three outdoor-themed sessions.

Wil Reding presented "Using the Outdoors to Teach About Sustainability." The session highlighted the 3-Nested-Dependencies Model, which consists of three nested circles representing the economy, society, and environment. In this model, the economy is situated within society while society sits within the environment. It seemed each step on the dewy grass led to a new conversation: death, the world's trash problem, the potential of biomimicry. I had to ask myself, 'Did my teaching style also reflect my commitment to the environment?' Perhaps the arts could provide hands-on ways that bring such topics into the classroom--or, better yet, out.

Science Teacher Jelane Richardson and Art Teacher Mary McMaster of Allen Park High School shared their ideas in "Science, Media, and Art." Students in their project-

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Reflections on the 2017 Annual Conference from Scholarship Winners *continued from page 6*

based learning art-science hybrid class were tasked with solving a real-world conservation problem. Moreover, science students presented their research on the earth's waste issue to art students who, in turn, used the design process to upcycle cafeteria trash. Richardson and McMaster achieved their goal to unite science and art, and to help students make a positive impact. Better yet, while students created sustainable, aesthetically pleasing, and revenue-generating products, they also experienced the relevant relationship between designer, maker, and user. "Imagine what [students] will do in the world," they beamed. Regreening cafeteria waste is something I know my students would get excited about!

As an Art Teacher, the specifics of the general education classroom are often left to my imagination. "Outdoor Education on a Budget" with fourth grade teachers Rebecca Sandee and Gabriel Knowles of Early Elementary School encouraged me to reach out for assistance. I learned their students, and coincidentally my own, participated in outdoor learning, community walks, gardening, and more. Like Richardson and McMaster, their teaching style required a supportive team and admirable flexibility. After all, a student's inquiry about the natural world may unlock the next lesson or activity. Be it observations of changing leaves, questioning shadow movements, or cultivating a community of curiosity, I was reminded how much scientists and artists have in common.

I arrived to the MSTA 64th Annual Conference seeking ways to put the 'A' in STEAM. The enthusiasm of knowledgeable presenters was contagious, and I was pleased to leave with more questions than answers. Providing outdoor learning and real-world problem solving opportunities are one way the arts may successfully enter the conversation. Although STEAM seems to be gaining momentum, there is still progress to be made. I feel encouraged to be part of the journey.

Elementary STEM Students 'Blast off' with an Old Fashioned Paper Rocket Design Challenge

By Crystal Brown, STEM teacher Gibraltar School District

In terms of STEM projects, some might say designing paper rockets is 'Old Hat.' I honestly began this project with my 3rd, 4th, and 5th graders feeling the same way. I'm not sure if it was the project-based approach, or the spark of energy my students have at the beginning of the year, but by the end of the first session, I knew that this was not going to be the project I had planned for my 300 upper elementary students… it was going to be so much more!

Introduction

After teaching 4th grade for 14 years, I decided to accept a new position in my district—teaching a STEM special for Young 5's to 5th grade. Since STEM has been a passion of mine for so many years, 60 minutes of STEM a week for approximately 680 students is a dream come true! All STEM, all the time! My goal is to provide students with Project-based STEM experiences. Quickly I realized that the kind of STEM I wanted to teach would be limited, not only by time, but also by resources. Therefore, I decided to keep the projects simple but that doesn't stop me from really pushing their thinking. Below I describe how a rocket challenge can be used to teach the engineering design process while also engaging students in scientific and mathematical reasoning.

Engage

We begin the lesson brainstorming traits of an engineer. "An Engineer is someone who…" They respond with 'designs,' 'tries hard,' 'doesn't give up,' 'builds models.' Older students will even add 'uses math,' 'works with a team,' 'shares ideas with others.' Eventually we distill our ideas down to the idea that 'Engineers Solve Problems.'

Then I present the problem:

"Engineers, I have a problem. I live just one mile from the Metroparks. When it's time for the annual fireworks, all the neighbors gather to see but can only see sparks through the trees. After asking all around, we've discovered that they fireworks are not designed to go any higher… the trees are not the problem, it's the fireworks! Can you design me a rocket to launch the fireworks higher in the sky?"

Explore and Explain

I tell students, "The company that provides the fireworks sent over their design for us to use as a model… here it is." I show a basic paper rocket design: paper cylinder with folded over top, fitting over a drinking straw (launching apparatus.) I ask students to describe the model and push them to use mathematical terms and 3 dimensional shapes (e.g. cylinder, face, edges). Students then begin the engineering design process by asking questions about the model rocket they need to design. (Students had previously discussed and have an understanding that engineers do not build the actual item they design… they build a model to test. This is difficult for young or early STEM learners and should be explicitly taught.) Students ask questions such as "How high does the model need to launch?" and "What materials can we use?" which helps to define the parameters.

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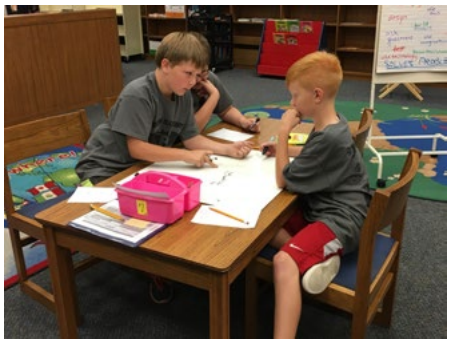
Elementary STEM Students 'Blast off'... *continued from page 8*

I give the students the following challenge:

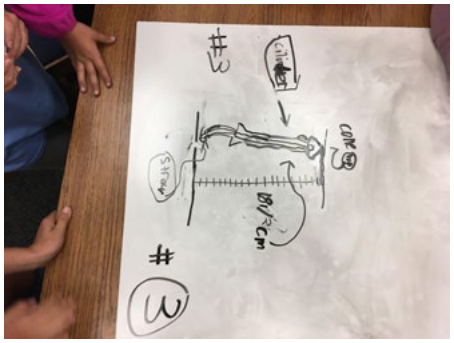
The rocket model must be launched with the power of a single puff of air, through the launching apparatus, a drinking straw. You will need to make it reach the ceiling, within the target (red circle taped to the ceiling.) The fireworks not only needs to be launched high, but at almost a 90 degree angle so they can explode safely in the sky. You will be given paper for the cylinder, extra paper scraps, tape and scissors.



Elaborate

After answering questions and defining the parameters of the challenge, students are sent off to independently design the rocket. They are given 5 silent minutes to design on their own before coming together to collaborate on a group design. During team collaboration time, students are expected to express what they would like the rocket to look like, and to provide support for their opinion. We use this activity for later direct instruction on the practice of argumentation from evidence. Students must provide evidence of their argument for the design of the rocket and all the group must agree to the design changes. Since our class time is 60 minutes, our designs are saved to Seesaw for access the next week.

During the next session, students build rockets! They use Chromebooks to access their group plans on Seesaw, build and test their rockets, then work to improve them by adding features, trimming down the design, and making adjustments based on their observations.



The key to making this a true STEM lesson lies in student questioning. If students are not asked to explain their thinking, or to express their reasoning to other students, they would build, test and improve. While that might be an engineering project, there would be little to no connection to science or mathematics. When students have to explain their ideas though they must use scientific principles such as Newton's law, energy, forces, friction, and aerodynamics. As students express to me and one another their design ideas and changes after testing, we hear them speaking like a mathematician as they describe the 3 dimensional shapes with the least edges or most aerodynamic shapes. They compare the angle of flight to the angle needed to reach the target. They describe how it can't be too heavy and they need to change the shape of the wings to lighten the load but still provide straight guidance up.

Evaluation

This project began as a simple way to re-introduce our STEM students to the Engineering Design Process. It became so much more when it was a project-based experience, integrated with math and scientific principles. With the help of rich student conversation, exciting rocket testing, and reflection time with the teacher, this project has exceeded my expectations.

During the final session, students discuss what they think would be a reasonable number of hits to the target to decide the design was a success. Having students qualify the criteria for success is important to create

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Elementary STEM Students 'Blast off'... *continued from page 9*

ownership and make a connection to the work of real engineers. One successful trial is not the end. Most classes decided somewhere between 10 and 20 hits would mark a success. At the end of our last session, students work as a team to complete a design report to their 'Project Manager' evaluating the success of their model. They are asked to draw the rocket model with specific labels and measurements, and then to recommend that this model be shipped for manufacturing or sent back for further testing and redesign. On their own, students must support the team's recommendation with evidence.

If you're looking for a STEM project on a dime, that pushes your upper elementary students to create, collaborate, communicate, and think critically, this is the project for you!

Resources

Rocket Activity 3...2...1... Puff! NASA, NSTA Engineering Design Classroom Resources http://ngss.nsta.org/Resource.aspx?ResourceID=628

Engaging in Argument from Evidence, NGSS Science and Engineering Practices http://ngss.nsta.org/Practices.aspx?id=7

The Engineering Design Process, Engineering is Elementary, https://www.eie.org/overview/engineering-design-process

Creating Citizen Scientists: A Study of the Raisin River

By Jacqueline Murray, Clinton Community Schools

Purpose

When I began working at Clinton Middle School I wanted to find a way to develop hands-on science that got students out into their environment. I had noticed that many kids were not familiar with the natural resources around them nor the impact their behaviors could have on these things. I sought to develop an annual project that would teach my students about freshwater while also creating citizen scientists.

What do we do?

I developed my curriculum to keep water resources at the end of the year when weather is more cooperative. During the last quarter I build up the hype around our River Raisin water quality project. Students will conduct water sampling ideally on a weekly basis (this is dependent mainly on weather conditions). Clinton Middle School is a short walk away from Tate Park, a point that we can safely access the River Raisin.

Students walk with me to the river at which point they independently conduct the testing procedures. I turn my car into a mobile lab station, to help with logistics, management, and safety procedures. Students remove test kits, first aid kits, and flotation devices from my car and bring them to the canoe launch where we conduct our testing.

I have used the World Water Monitoring Day test kit since 2011. This is an excellent resource for any classroom. The kits are relatively affordable, approximately $13 a kit, and testing tablets can easily be restocked from LaMotte each year to make many of the materials more durable. The tests that students conduct include: water temperature, air temperature, dissolved oxygen, pH, turbidity, and if materials allow, nitrate and phosphate conditions.

I introduced the nitrate and phosphate tests after obtaining a grant that included the supplies through the River Raisin Watershed Council "Discover the Raisin" Grant. This particular test kit is supported by Earth Echo International which allows for students to upload water quality information onto the web. The website compiles all of this data and allows students to see in real time who is conducting a similar study. It also allows students to dig deeper and see that particular data set. A fun thing that we have done with this technology is to monitor where our classroom is on the world wide rankings. Last year after our collections, we managed to get into the 14th position.

The Clinton Local June 20, 2013

River Raisin Water Collection Project

Below are pictures and a few articles from Clinton Middle School 8th graders that visited Tate Park this Spring, taking on a more hands-on approach to learning about fresh water resources. They spent the month of May collecting water samples and researching about our very own River Raisin in Tate Park. Students were split into partnerships to do a variety of tests, such as Dissolved Oxygen, pH, turbidity, water temperature, and % saturation of oxygen. The eighth graders then reported back to the class about their findings in the form of a presentation. Students were also instructed to communicate their scientific findings with the public, so they have written articles for our community members.

Donnie Hawkins, Danny Spence, and Hailey Skiff

Abi Smith, Jessica Boegel, and Justin Trapp analyze the data from their collection.

Josh Brown, center, an 8th grader at CMS scoops water from the river and hands to his team of scientists!

Top picture—8th grade students gather their water samples to test. Below are 8th graders Trevyr Curtis and Ian Pizzo bringing the water samples to the table

8th grade Science students work hard on their samples and research of the River Raisin.

Water Collection Article, By: Hope Ross & Dylan Pounders. The River Raisin is said to the crookedest river ever. It runs through south-east Michigan and North West Ohio. Its watershed spreads throughout the counties: Lenawee (MI); Hillsdale (MI); Jackson (MI); Washtenaw (MI); Monroe (MI); and Fulton (OH). This article is all about the Raisin River and the tests we performed on it. The procedure for water collecting includes steps for each of the tests taken. We took a total of 7 tests on the water. They included: air temperature, water temperature, DO, %saturation, PH, turbidity, and general observations. The steps for air temperature are simple; you use the thermometer on the side of the collection lid cup and record the information. Water temperature is pretty close to air temperature, only this test requires that you hold the thermometer under the water then recording the information. saturation, 41%; pH, 7; turbidity, 40 JTU; and general observations, there were branches. Some things that surprised us was when we measured turbidity, we got a different result than every other group. All the other groups got a result of 40 JTU, but we got 0 JTU. We weren't sure if we tested it wrong, or if we were in a different part of the river. Some interesting things we saw were the other people going into the deep water. We just stayed on shore and recorded our data from there. We did that because neither of us wanted to put on water boots and go into the water. On the second data collection day though, we looked at a little tadpole that was caught by a different group. Also on the second day, we took our shoes off and went into the water. One suggestion that we were thinking of was to not pollute the water or air around it. Also, you could help by using less fresh water like turning off a dripping faucet, or take less time in the shower. You could pick up trash around rivers or lakes and respect the living organisms that live in the water.

River Article, By Faith Newman and Lindsey Brown.

How did we take this further?

A significant part of any scientific study is the ability to effectively communicate the resulting information. The second part of this water quality project focuses on that effort by communicating to our peers and our local community. Each group is required to develop a presentation where they present their findings to their classmates. Groups discuss their data, the implications that it could have, and their suggestions based on this evidence. Groups must also write a newspaper article, something that we have submitted to our local newspaper *The Clinton Local*. Students have had their articles published in the past, which really emphasizes their role as a citizen scientist. This has been a wonderful hands-on activity that students look forward to each spring. They have become more responsible for the care of our park and the river that runs through it.

Helpful Websites

http://www.worldwatermonitoringday.org - This gives some nice background information and you are able to find out about ordering kits (supplied by LaMotte)

http://www.lamotte.com/en/education/water-monitoring/5848.html - This is a more comprehensive kit that includes supplies for macroinvertebrates, nitrates, phosphates and choliform bacteria

Using 21st Century Themes to Make Curricula Relevant to Society

By: Emily Gochis, Alex Guth, and Jackie Huntoon, Mi-STAR and Michigan Technological University

Introduction

Science curricula can sometimes consist of a series of seemingly unrelated courses that include content that appears to be entirely disconnected from students' lives. Using 21st-century themes (figure 1) that emphasize important societal concerns can naturally connect state and national standards to real-world questions and engage students in topics that are relevant to their own lives and communities. The development of curricula using themes can help students explore science and engineering in ways that emphasize crosscutting concepts and promote the integration of learning across traditional disciplinary boundaries.

Selecting Themes

By reviewing documents published by professional scientific and engineering organizations such as the American Chemical Society, American Geosciences Institute, American Physical Society, Federation of American Scientists, Intergovernmental Panel on Climate Change, National Academy of Engineering, National Academy of Science and the National Research Council, we were able to identify several transdisciplinary topics (or themes) that are related to science and engineering and will be important to society throughout the 21st century. Despite the fact that we reviewed documents from a wide variety of disciplinary sources, there was remarkable agreement about many of the important themes. For example, each organization identified aspects related to energy resources (table 1) as a 21st-century challenge.

Table 1: Examples of topics related to "Energy Resources" and the source of the information.

Topics Aligned with Energy Resources Theme	Sources
• Developing new sources of energy; biofuels and fuels from ice, water and sunshine	American Chemical Society, *Global Challenges/Chemistry Solutions*
• Ensure reliable energy supplies in an increasingly carbon-constrained world	American Geosciences Institute, *Critical Needs for the Twenty First Century: The Role of the Geosciences*
• Reduce emissions of greenhouse gases • Develop renewable and nuclear energy sources and adopt new methods of using fossil fuels	American Physical Society, *Issues*
• Nanotechnology for energy production	Federation of American Scientists, *21st Century Physics: Grand Challenges*
• Decarbonize electricity generation	Intergovernmental Panel on Climate Change, *Climate Change 2014: Impacts, Adaptation, and Vulnerability*
• Provide energy from fusion • Engineer the tools of scientific discovery (fuels)	National Academy of Engineering, *Grand Challenges for Engineering*
• Energy Efficiency Energy Generation	National Academy of Science, *America's Energy Future*
• Understand the interactions between social institutions and resource use • Document & monitor current actions and develop predictive models to guide fossil fuel and energy policies	National Research Council's Committee on Grand Challenges in Environmental Sciences, *Grand Challenges in Environmental Sciences*
• Expand sustainable alternatives to fossil fuels	National Research Council's Committee on a New Biology for the 21st Century, *A New Biology for the 21st century: Ensuring the United States Leads the Coming Biology Revolution*

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Using 21st Century Themes... *continued from page 12*

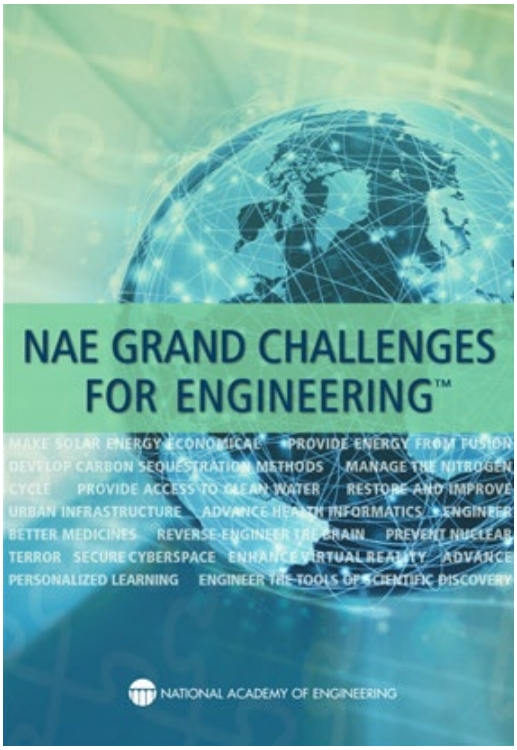

Figure 1: The National Academy of Engineering is just one of the many organizations that have identified topics anticipated to be important for society during the 21st century. From http://www.engineeringchallenges.org/File.aspx?id=11574&v=34765dff

Using Themes in a Curriculum

As an example of how 21st-century themes can be used in curriculum development, the Mi-STAR project selected a set of themes and used them to guide the planning of units in the Mi-STAR middle-school curriculum. The themes selected by Mi-STAR are:

- Infrastructure and the built environment
- Human and public health
- Food and agriculture
- Water resources
- Sustainable ecosystems
- Earth and space systems
- Earth and energy resources

Each Mi-STAR unit is based on a 'unit challenge' that requires students to apply science and engineering concepts and practices to investigate and address a real-world problem related to one or more of the Mi-STAR themes. For example, the first unit in the 6th grade challenges students to describe why a local community is having flooding problems and to evaluate proposed solutions to address the flooding. This particular unit investigates the water cycle and how humans can alter the way that water moves through the cycle in any community. The unit challenge question, related to the unit's water resources theme, is "How does human development affect how water moves through our community?" The "big ideas" or "key concepts" for the unit are: 1) Water is continuously cycling from one earth reservoir to another through multiple pathways and changes in state, due to the effects of gravity and thermal energy on water particles, and 2) Solutions to water quantity related issues should take into account the scientific phenomena dictating the water cycle and how human activity affects the pathway water molecules take. This particular unit uses human impacts on the water cycle in a local community to help students investigate three of the Michigan Science Standards' performance expectations, one from Earth and space science, one from physical sciences and one from engineering, technology and society. By focusing on real-world problems connected to 21st-century themes, the unit's challenge naturally engages students in three-dimensional learning of science and engineering practices, disciplinary core ideas and crosscutting concepts.

In classroom pilot testing, unit challenges based on 21st century themes have proven highly effective, both for engaging students and in seamlessly incorporating the fundamentals of the Michigan Science Standards. "The 21st century challenge themes are what make Mi-STAR unique and so engaging for students," said Christine Geerer, a sixth grade science teacher at Parcells Middle School in Grosse Pointe. "When you build a unit around a real-life science and engineering problem, the science and engineering practices and crosscutting concepts flow naturally into the content of the lessons. In 6.1, for example, the students take the role of environmental engineers, evaluating solutions proposed by adults and coming to consensus as a class about which solution is preferable. Criteria, constraints, and arguing from evidence are natural parts of the process. Students clearly see the reason for learning the science and the practices. It's a beautiful thing."

Jayme Swanson, who teaches science to sixth graders at Northeast Middle School, in Midland, has also piloted Mi-STAR units, including 6.1. "One of the things I love about Mi-STAR is that not only does it stick to 21st century themes, it's also Michigan-centric," he said. "You want young minds to connect to the subject matter, and it's easy for Michigan kids to connect to water. Whether they are affluent or not, water is a common denominator for every student in our state. We'll talk in class about times they've gone fishing, swimming, or boating on the

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Using 21st Century Themes... *continued from page 13*

water, and then I'll ask, 'What if that memory was erased?' That's what happens in unit 6.1: what was once a wonderful little stream now dries up in the summer and floods in the spring. That makes this unit challenge very powerful, even for an 11-year-old. When the students break into groups to work on engineering a fix, they take it very seriously. After all, they aren't just learning vocabulary; they are solving an important problem using science, technology, engineering, and math—and while they are at it, they are learning key disciplinary concepts. The beauty and the power lies in the fact that it involves something they've experienced first hand, something they really care about—water."

The Mi-STAR network has, to date, completed six of the 22 planned units. These include two units each for the 6th, 7th, and 8th grades. The completed units are related to the themes of water resources, sustainable ecosystems, Earth and energy resources, infrastructure and the built environment, and Earth and space systems. An additional six units were developed by teams of teachers, scientists, and engineers during the summer of 2017 and are currently being prepared for pilot testing during the 2017-2018 academic year. The complete Mi-STAR unit progression model, which outlines the bundling and sequencing of the NGSS performance expectations for grades 6-8 with the all themes and their corresponding topics is available at http://mi-star.mtu.edu/curriculum/mi-star-units/#unitprogresson. The Mi-STAR unit progression model includes the themes and topics incorporated into each of the units.

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Curricular Transformation and Hidden Figures: A STEAM Middle School Camp for DPS Students

By Sibrina N. Collins,1 LaVetta Appleby,2 Michelle Kustarz,3 Guang-Chong Zhu4, Thomas Phillips,5 Tiffany Brown6 and Meaghan Markiewicz1,6*

Introduction

Diversity in STEM (Science, Technology, Engineering and Mathematics) fields is critical to develop a sustainable pipeline of STEM professionals. Furthermore, effective engagement of students from diverse backgrounds is important to fill the STEM talent gap. Our approach to engaging middle school students with STEM subjects focused on using the *Hidden Figures* theme to develop an integrated STEAM (Science, Technology, Engineering, Architecture/Art and Mathematics) program.

The film *Hidden Figures* is based on the book by Margot Lee Shetterly that focuses on the intellectual achievements of several African American women working as "computers" for NASA (National Aeronautics and Space Administration) during the Civil Rights era.[1,2] In this article, we describe STEAM activities and workshops for a two-week middle school camp, specifically for Sampson-Webber Leadership Academy, a DPSCD (Detroit Public School Community District) institution.

STEAM Middle School Camp: *Hidden Figures, Math and More!*

Hands-on interactive activities and summer camp experiences are important to engage students in the STEM and design-based fields.[3] As part of the Blue Devil Scholars partnership between Lawrence Tech and DPSCD, we offered a middle school camp for Sampson-Webber students. The summer camp curriculum focused on mathematics, English, and science with the overall theme "Hidden Figures, Math and More!" This year, 12 students and 3 Sampson-Webber Leadership Academy teachers attended the camp, July 17 – July 27, 2017.

You Be the Engineer Workshop (July 17, 2017)

On the first day of the middle school summer camp, students, teachers and parents participated in an engineering workshop led by two graduates from LTU and DPSCD schools (Mr. Thomas Phillips and Professor Tiffany Brown). The goal of this workshop focused on the students working in teams to build a city using Legos and play dough. The students played the roles of city planners to build the features of the city, specifically, a school, church, one story and two-story buildings, and a park. After building features of their city, each team spokesperson described the features of their city (Figure 1). Thus, this workshop provided an opportunity for students to work in diverse teams, gain hands-on experience with the design process, enhance their communication skills, and expand their knowledge base about engineering and design-based careers.

Figure 1. You Be the Engineer Workshop group discussions in the Studio for Entrepreneurial Design (SEED) space in LTU's Marburger STEM Center.

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Curricular Transformation and Hidden Figures: *continued from page 16*

The English Workshop for the students focused on reading excerpts from the book, *Hidden Figures, Young Readers' Edition* authored by Margot Shetterly. Incorporating historical and biographical narratives into the curriculum is a strategy to create inclusive classrooms. The goal of the English Workshop focused on developing critical reading strategies and skills, specifically strategies related to pre-reading and active reading. The workshop, led by Professor Michelle Kustarz focused on discussing critical questions of the text in order to gain a better understanding of the reading materials and become stronger readers overall.

Students worked in teams to prepare a final art project, a "word cloud," based on vocabulary learned from the reading (Figure 2). Each student received his or her own copy of the book at the end of the summer camp. The students were asked to write a brief reflection about what they learned in the English workshop. One student wrote, "I learned that the three women helped plan the first launch to space. I've learned new reading skills. Such as reading to understand and summarize my reading. The book relates to today also, Black people still struggle in daily activities and basic life." Another student stated, "The theme of the book is to always persevere and to never give up on your hopes and dreams."

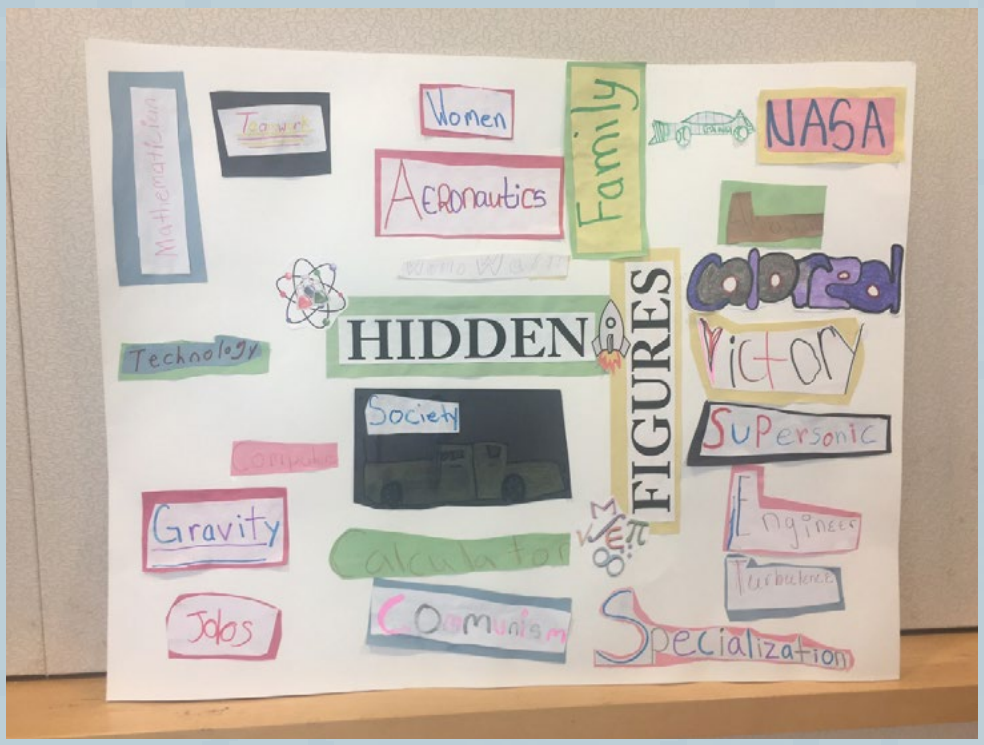

Figure 2. Final Art Project based on the reading of the text, Hidden Figures.

In the Mathematics Workshop, led by Dr. Guang-Chong Zhu, the focus was on building a strong foundation in algebra concepts for the middle school students. Dr. Zhu focused on enhancing the mathematics skills of the students through creative thinking and deep conceptual understanding, instead of meaningless memorization. For example, a simple multiplication problem such as 23 x 102 can illustrate fundamental algebra concepts:

$$23 \times 102 = 23 \times (100 + 2)$$
$$a \times (b + c)$$
$$= 23 \times 100 + 23 \times 2$$
$$= 2300 + 46$$
$$= 2346$$

Hence:

$$a \times (b + c) = a \times b + a \times c$$
$$= ab + ac$$

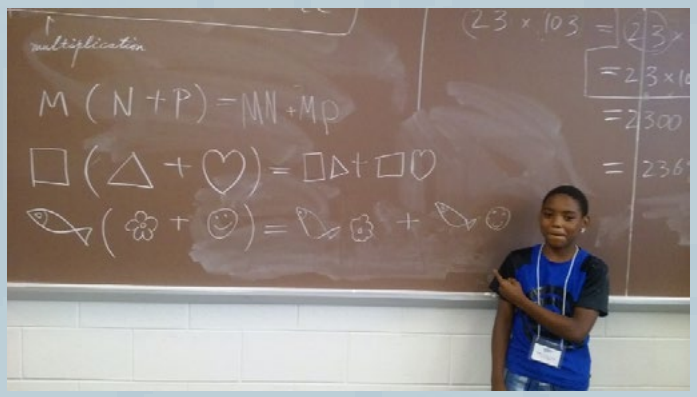

Figure 3. A Sampson-Webber student after completing an algebra problem on the chalkboard.

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Curricular Transformation and Hidden Figures: *continued from page 17*

Figure 4. Science Workshop with Sampson-Webber Students and Professor LaVetta Appleby.

Figure 5. A Sampson-Webber student receives a Certificate of Achievement with LTU President and CEO, Dr. Virinder Moudgil.

The Science Workshop led by Professor LaVetta Appleby, focused on "things that fly," which was aligned with the theme, *Hidden Figures*. The middle school students explored rockets, parachutes, kites, airplanes and gliders. Students explored physical science concepts such as motion, forces and energy through these activities.

Conclusions and Future Programming

At the end of the two-week middle school summer camp, each student received a Certificate of Achievement during the 2017 Camp Celebration. The students were very proud to receive the certificates as tangible evidence of their efforts. Dr. Virinder Moudgil, President and CEO of LTU gave brief remarks during the celebration and emphasized the importance of pursuing a college education. The 2018 Sampson-Webber Middle School Summer Camp is tentatively scheduled for July 16 – July 26, 2018 at Lawrence Technological University. Since the grand opening in September 2016, LTU's Marburger STEM Center has held over 25 STEM and Design outreach programs focused on engaging K-12 audiences.[4-7]

Lawrence Technological University and the Marburger STEM Center

The acronym STEM (science, technology, engineering, and mathematics) is a buzzword today, but it is deeply embedded in the DNA of Lawrence Technological University, when it was established in 1932 adjacent to Henry Ford's Model T Factory in Highland Park, Michigan. Lawrence Tech is nationally recognized as a premier STEM-focused institution in the United States, which specializes in a curriculum, focused on applied science, engineering and design-based fields that incorporates active-collaborative learning (ACL) and project-based learning (PBL) methodologies.[8]

Established in September 2016, LTU's Marburger STEM Center is the home of the STEM and Design programs and initiatives on LTU's campus.[9] These initiatives include high school summer camps, Robofest, an international outreach program that teaches young people to program autonomous robots, and the Blue Devil Scholars Program, an innovative partnership with the Detroit Public Schools Community District (DPSCD) to enhance the STEAM curriculum in DPSCD institutions.[10]

The BDSP Program (also known as the *Blue Devil Promise*) has four key components: student academic preparation, support services and workshops for Blue Devil Scholar parents, professional development for DPSCD teachers, and student scholarships. During the 2016-17 academic year, 39 DPSCD teachers participated in professional development workshops focused on ACL/PBL strategies, hands-on science and forensic science. We are collaboratively working with teachers and students at two DPSCD schools, namely Sampson-Webber Leadership Academy, which is a K-8 school and Detroit Collegiate Prep at Northwestern High School. When the Scholars graduate from Northwestern, they earn a high school diploma and a certificate representing 12-15 college credit hours, which they can use towards an LTU STEAM degree with scholarship support.

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Curricular Transformation and Hidden Figures: *continued from page 19*

Acknowledgments

Lawrence Technological University gratefully acknowledges the generous funding from the PNC Foundation to support the professional development workshops for DPSCD teachers.

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KNIGHT CENTER for Environmental Journalism
ej.msu.edu

Collaboration between High School Journalism & Environmental Science Courses: Request for Proposals from the Knight Center for Environmental Journalism at Michigan State University

To encourage collaboration between high school journalism and environmental science classes, we invite teachers to submit proposals for innovative class projects in which journalism students will report about field research by environmental science students. Our principal goals are:

- to help young prospective journalists better understand and explain to the public how science is done
- to help environmental science students learn to use the media to explain their work to the public.
- to promote environmental and science journalism.

The Knight Center intends to award 1-year competitive grants of $2,000 to up to 3 high schools: $1,000 to the journalism program and $1,000 to the environmental science program for equipment, software or scholarships. There is a possibility of renewal for 1 or 2 more years. In addition, the Knight Center will pair each school with a professional journalist to serve as a mentor to participating students and teachers.

Here are the details:

Your proposal must include a project description (750 words maximum), the names and contact information for a partnering journalism and environmental science teacher from the same high school; grade levels of participating classes; and the estimated number of students in the participating classes. A proposal form is attached.

Your projects must generate student-produced news or feature stories with visuals (photos and/ or graphics) for print, online, audio and/or video that your school will disseminate. The Knight Center will also disseminate these stories to the public through our website, and some stories may be posted on Great Lakes Echo (www.greatlakesecho.org), the center's award-winning online regional environmental news service.

Grantees must comply with MSU financial reporting procedures.
Grantees (students, teachers and professional mentors) must attend a one-day workshop at MSU in Fall 2018.
Application deadline: December 1, 2017. Awards will be announced by January 31, 2018. Projects should begin in February 2018 and be completed with a final report by the end of December 2018. A progress report is required by June 15, 2018.
Read about the successful 2015-2016 grantees at http://j-school.jrn.msu.edu/ kc/?s=High+school

Grant Application Requirements

- Cover Sheet
- School name and address:
- Participating journalism teacher (name, email, phone)
- Participating environmental science teacher (name, email, phone)
- Project description (750 words maximum): What do you intend to do (scientific research and journalistic coverage) and how? What are your goals for the project? How will you assess accomplishments?
- Titles and grade levels of participating classes: Journalism, Environmental Science
- Name, title, email and phone of administrator authorizing submission of the proposal

Submit grant application by December 1, 2017 to Barb Miller at mille384@msu.edu. If you have questions, email Eric Freedman at freedma5@msu.edu

The Junior Science & Humanities Symposium: A Way to Engage High School Students in STEM Research

The southeastern Michigan region's **54th annual Junior Science & Humanities Symposium (JSHS) will be held at Wayne State University** on **March 9, 2018**. All high school students in Michigan who have completed original research in a STEM field are encouraged to submit an application to participate in the regional JSHS. Participants will have the opportunity to present their research paper to a panel of judges, comprised of professors and researchers from Wayne State University and from the U.S. Army Tank-Automotive Research, Development, and Engineering Center (TARDEC). All participants will also have the opportunity to showcase their work in a poster session, and experience a guided tour of the campus, including one of the Science and Engineering laboratory research facilities. This FREE, full-day symposium will include a continental breakfast, lunch, and a formal dinner banquet. All participants will have the opportunity to network with their peers, JSHS Alumni, and with STEM professionals throughout the day.

The Academy of Applied Sciences will distribute $4,500 in academic scholarships to the top three regional finalists: $2,000 to first place, $1,500 to second place; and $1,000 to third place. **The teacher of the first place finalist is awarded $500 honoring that teacher's and their school's contributions to advancing student participation in research.**

In addition, the top 5 finalists from the SE MI JSHS are invited to participate in the National JSHS, all expenses paid, to be held in Hunt Valley, Maryland, May 2 – 5, 2018.

- Registration opens beginning **October 1, 2017**
- The deadline for submission of application materials is **January 16, 2018**

For more information, application forms, and guidelines including format and submission of required documents, visit: http://coe.wayne.edu/ted/science/jshs/

For additional information, or **to arrange a presentation about JSHS at your school**, please contact **Dr. Sandra Yarema (JSHS Director) at Wayne State University. Email: Yarema@wayne.edu or Tel.: 313/577-5754**

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ARMY EDUCATIONAL OUTREACH PROGRAM

Alternatives to Brazilian Elodea in the Classroom

by Jesse Endert and Paige Filice, Michigan State University

Why can't I purchase Brazilian elodea?

Brazilian elodea, formally known as Egeria densa, is a common plant recommended for use in classroom science labs to show photosynthesis and cellular formation. While many lab lesson plans call for Brazilian elodea, it is unlawful to possess, introduce, import, or sell it in Michigan. This species has an invasive nature and can quickly create dense mats on the surface of water. These dense mats inhibit recreational activities and can suffocate native aquatic plants and animals.

What alternatives are there for Brazilian elodea?

Brazilian elodea is suggested in lab manuals because it is easy to grow in aquariums, is a vibrant green color, and has thin leaves with a simple cell composition. Instead of using the invasive Brazilian elodea, you could use a native aquatic plant found commonly in Michigan lakes such as American elodea or chara. Your local pet store may have suggestions of alternative species as well.

Try a native aquatic plant such as American elodea, formally Elodea canadensis, for photosynthesis and cell formation labs. The leaves of American elodea are smaller and not as light in color as Brazilian elodea, but it has a similar cell structure. If it is difficult to find American elodea, consider using chara, formally Chara spp., as a native alternative to Brazilian elodea. Chara is a good choice for photosynthesis labs that look at how oxygen and carbon dioxide affect plants, but microscopic labs would be more difficult with chara due to its thick leaf structure.

Both American elodea and chara are common in Michigan inland lakes and online resources may assist you in identifying them in the wild. The Michigan State University Extension publication "A Citizen's Guide for the Identification, Mapping, and Management of the Common Rooted Aquatic Plants of Michigan Lakes" has a user friendly dichotomous key, including information on chara and American elodea. The "Common Aquatic Plants of Michigan" guide written by the Michigan Department of Environmental Quality also has examples of native aquatic plants.

How should I dispose of aquatic plants when the lab is complete?

Never dispose of aquatic plants in waterways. They can have fragments of other plants or carry disease that would be detrimental to aquatic ecosystems. The Reduce Invasive Pet & PLant Escapes (RIPPLE) campaign suggests that plants are sealed in a plastic bag and disposed of in the trash. To learn more about RIPPLE suggestions as well as prohibited and restricted species in Michigan, visit www.mi.gov/invasives.

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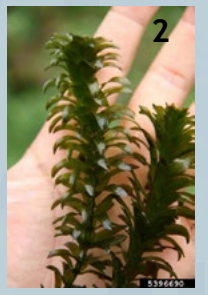

1. *Photo credit: Robert Vidéki, Doronicum Kft., Bugwood.org Photo of Brazilian elodea, Egeria densa*
2. *Photo credit: Robert Vidéki, Doronicum Kft., Bugwood.org Photo of American elodea, Elodea canadensis*
3. *Photo credit: Rebekah D. Wallace, University of Georgia, Bugwood.org Photo of chara, Chara spp.*

Energizing Science Educators at Wayne State University

By James Gell

On April 22nd, 2017 more than twenty K-16 teachers gathered at Wayne State University's Oakland Campus for the Energizing All Science Educators (EASE) conference. The event was organized and sponsored by the Detroit Metropolitan Area Physics Teachers (DMAPT) as an exploration of concepts and misconceptions about energy. There was also reference to the cross-cutting relationship of energy concepts across grade levels and disciplines as a part of the new Michigan Science Standards.

The DMAPT kicked things off by engaging the participants in interactive demonstrations of energy storage and transfer: burning cheetos, a bouncing ball, an ice cube in water, a "popper" toy bouncing off the floor, and a foam arrow shot from a nerf gun. These initiated discussions about how teachers and their students understand the idea of energy storage and transfer. Later, there were breakout sessions, organized by grade level, to address the specific challenges faced by teachers in guiding their students to a more robust understanding of energy.

Teachers had the opportunity to work with several representations of energy storage and transfer and to make multi-colored paper energy representation manipulatives, in the form of adjustable pie charts, to take back to their students and colleagues. Participants also came away with an appreciation for the challenges for creating student understanding at the different grade levels.

(Photo Credits: Steve Dickie)

Why Chemistry 'Matters'
Okay, so maybe we're having a little fun with the title and the topic of this article. Chemistry, after all, is the study of matter and, in very basic terms, the changes it can undergo. But it's precisely because chemistry involves everything that we can see, hear, touch, smell and taste that it is essential children have an introduction to this field of science early in their educations. When children understand chemistry, they understand the world around them. Chemistry really does matter.

Ideally, children will be introduced to chemistry concepts in the classroom as early as preschool. Research indicates that children have already developed an opinion about science, whether negative or positive, by the time they reach age seven, so early, positive exposure is essential. Fun, hands-on science experiments and activities such as mixing ingredients to make a cake or creating slime or flubber can spark children's imaginations and get them excited about chemistry and science. It can also help lay the foundation for an interest in science, technology, engineering and math (STEM), and possibly open doors to future careers.

Children are natural scientists
According to Steve Spangler, a teacher, science toy designer, speaker, author and Emmy Award-winning television personality, when science is fun and playful, children will be open to learning more. Educators who hone in on that natural curiosity and engage young learners through simple science experiments that make them ask "How did that happen?" can influence the way their students feel and think about science for the rest of their lives. That's pretty cool.

National Chemistry Week is a community-based program of the American Chemical Society that seeks to promote the value of chemistry in everyday life, and inspire children to be curious about the world around them. This annual event unites ACS local sections, businesses, schools and individuals in communicating the importance of chemistry to our quality of life. This year's theme is "Chemistry Rocks!" and the focus is on geochemistry.

Imagination Station will be celebrating National Chemistry Weekend November 17 – 19 with activities to explore rocks, minerals and gemstones. Rocks can be thousands of years old, and this makes them the perfect chemistry storytellers.

New Workshop on Wheels offerings
Educators who want to bring the National Chemistry Week theme into their classroom can book our newest Workshop on Wheels for grades 6 – 8 in the Earth and Space Science Series: Rocks, Minerals and Soil. In this engaging workshop, students will experiment and determine the properties of various rocks and minerals and identify their common and practical uses. The Making Matter series is another new addition to our Workshop on Wheels that introduces chemistry concepts via hands-on experiments and is sure to get students asking "Why did that happen?" and more importantly, "How can I make that happen, too?"

To schedule a Workshop on Wheels, call 419-244-2674, ext. 134, or check out our website at imaginationstationtoledo.org.