

MSTA Newsletter



A publication of the Michigan Science Teachers Association • Volume 66.3 • Winter 2016

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From the President's Desk

By Charles Buciencki, MSTA President

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

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

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

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From The Desk of Your Executive Director

From Robby Cramer, MSTA Executive Director

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

The State of Michigan Has New Science Standards!

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

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

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

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

What Should We Be Doing Right Now?

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

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RESOURCES & IDEAS

Destigmatizing Mistakes in the Science Classroom

By Joshua Barclay, West Bloomfield High School

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

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

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

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

One excellent way to start is to give every student more opportunities to make mistakes. Using a 'random student selector' app is very effective in keeping all students engaged when asking questions to the class as a whole. My school's student information system, PowerSchool¹, comes with a random student selector built-in, but there are many other random student choosers available for free online such as <http://www.alicekeeler.com/teachertech/2014/03/30/random-student-chooser-template/>² and <http://www.flippity.net/RandomNamePicker.asp>³

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

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

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

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

Mistakes as Learning Opportunities

In my opinion, the most powerful tool that I use in my classroom is the WebAssign⁴ internet-based homework and evaluation system (free or low cost alternatives exist such as LON-CAPA⁵, Quest⁶, WebWork⁷ and using Google Forms with the Flubaroo^{8,9} add-on). WebAssign randomizes numbers in homework, gives students immediate feedback as to whether their answers are right or wrong, and most importantly allows as many submissions as desired by the teacher, with very flexible scoring rubrics, so that students getting the answer wrong can resubmit more times. Once a student makes a mistake, WebAssign can be programmed to give hints after a specified number of tries, or different hints depending on the wrong answer given. When a student has been clearly shown that they got an answer incorrect, they may be more receptive to hints challenging their current conceptual framework.

In an empirical study¹⁰, Gerd Kortemeyer concludes that when using online homework systems, the optimal number of submissions to allow students for free-response questions is five, though most teachers in that study allowed more than twice that. By contrast, that same study suggests that granting extremely large numbers of submissions, for example, over 20 submissions per problem, is not helpful at all for students, as it leads to random guessing and other non-beneficial behaviors, and paradoxically, fewer right answers! Personally, I allow five submissions with no penalty, and then five more submissions subtracting 20% for each submission beyond the first five.

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RESOURCES & IDEAS

Destigmatizing Mistakes in the Science Classroom

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Many other practices can support student learning from mistakes.

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

I am mindful that my determination of the level of mastery of my students, like every measurement in science, has built-in uncertainty. I also want to show students that making mistakes in science need not have permanent, unredeemable negative consequences. For these reasons, I allow numerous extra credit opportunities. As long as students complete a set of required interactive activities (on WebAssign), they

can do multiple extra credit projects to compensate for low test grades. They can also earn extensions on assignments by doing community service.

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

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

— Joshua Barclay, Joshua.Barclay@wbsd.org

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Endnotes

¹PowerSchool Student Information System. (n.d.). Retrieved January 8, 2016, from <http://www.powerschool.com/>

²Keeler, A. (2014, March 30). Random Student Chooser Template. Retrieved January 8, 2016, from <http://www.alicekeeler.com/teachertech/2014/03/30/random-student-chooser-template/>

³Random Name Picker. (n.d.). Retrieved January 8, 2016, from <http://www.flippity.net/RandomNamePicker.asp>

⁴WebAssign. (n.d.). Retrieved January 8, 2016, from <http://www.webassign.net>

⁵LON-CAPA - Open-Source Free CMS/LCMS. (n.d.). Retrieved January 8, 2016, from <http://www.lon-capa.org/>

⁶Quest Learning & Assessment. (n.d.). Retrieved January 8, 2016, from <https://quest.cns.utexas.edu>

⁷Welcome to WeBWork. (n.d.). Retrieved January 8, 2016, from <http://webwork.maa.org/>

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

⁹Hochsprung, P. (2014, May 2). Creating Self Grading Quizzes with Google Forms and the Flubaroo Add On. Retrieved January 8, 2016, from https://www.youtube.com/watch?v=n_lRmW0I8A

¹⁰Kortemeyer, G. (2015). An empirical study of the effect of granting multiple tries for online homework. *American Journal of Physics*, 646-653. <http://dx.doi.org/10.1119/1.4922256>

¹¹Developing and Using Models of Electrical Interactions: What NGSS Looks Like in the Classroom. (2015, May 12). Retrieved January 8, 2016, from <https://www.youtube.com/watch?v=BANW37RM6JM>

¹²Niels Bohr. (n.d.). Retrieved January 8, 2016, from http://www.newworldencyclopedia.org/entry/Niels_Bohr