Investigate the State:

Collaborating to Study Science Issues in Michigan

MSTA 2009 Annual Conference

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More information at:
http://mmstlc.net

INVESTIGATE THE STATE: COLLABORATING TO STUDY SCIENCE ISSUES IN MICHIGAN

Overview of this Session:

This session is intended to provide an orientation to interested individuals to participate in a statewide investigation of air or water quality issues as a way to better understand inquiry learning, and to turn local investigations into large scale efforts.

In this session, we are going to introduce this new initiative of the Michigan Mathematics and Science Teacher Leadership Collaborative. The effort is intended to help teachers in our participating centers and regions have a common set of tools and experiences to draw from to both better understand issues of air or water quality on a local and state level, and to better understand elements of inquiry-learning and the considerations we need to make in our instruction to make this type of learning possible for students.

We'll address the approaches we are going to take, the resources we'll use, and the professional development that will be provided to support this new effort.

About the Presenters and Resources:

These resources are generated from the Michigan Mathematics and Science Teacher Leadership Collaborative (MMSTLC), a statewide effort to support instructional leadership at many levels in local schools, regional support agencies, and higher education. These resources are a part of the broader set of resources being provided to project participants to help them support other teachers in their schools and region.

For more information about the project or any of these tools, visit the MMSTLC Web site: http://mmstlc.net

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Nancy Williams is a science outreach consultant with the University of Michigan School of Education working specifically with the MMSTLC program. Prior to this role, she spent over a decade teaching at the Mecosta-Osceola Mathematics and Science Center, and has been involved in science education efforts at Ferris State University.

The Typical Classroom Investigation

A teacher is working on water quality issues with his 6th grade students. They are starting the year studying ecosystems, and decide that they would like to explore the local creek that flows just down the street from the school. He has a list of different types of organisms in creeks, and would like to have the students explore this as an example of an ecosystem. The teacher has had some experience with water quality studies from a past workshop and some use of the Michigan Department of Environmental Quality Environmental Education curricula. He schedules a day near the end of September to walk down to the creek with his students, and has them conduct some basic tests of the river to see how "healthy" it is for the organisms in that local ecosystem. Students conduct their tests, post them on the wall, and continue on with their studies. The teacher is the only one in his small district doing this (he finds it quite valuable for his students to do, when it is still warm enough to get outside), and it has become an annual practice for his classes. But, beyond that, nothing else is done with the data they collect and analyze. And the teacher goes back to his other units and texts for much of the remainder of the year.

Now, imagine that same teacher doing some of the same things, but with a slight difference. Instead of just studying ecosystems from a text and adding on this activity, imagine that he starts the year asking his students, "What is the water like in our creek?", and that the students begin exploring various aspects of water, the water cycle, and where the water comes from. He has students explore maps of the local area, noting what types of land uses there are, having kids bring in pictures of different areas, and exploring online tools to see satellite maps that show where local industry, farms, and other local factors that might influence the water in the creek. The students create models of different land features to see how they effect erosion and deposition, among other things. Instead of creating some specific handouts or resources, he has these, and has been put in touch with the watershed council for the river that their creek flows into.

Because of the new studies his students are doing, his walk to the river to do water quality studies is postponed a bit, and will happen just after the MEAP tests in mid-October. But, he learns there are now four other groups of students who are doing similar studies on the larger river that their creek feeds, and they are sharing their work and questions leading up to the investigations. They all conduct their water quality tests the same week on the river, and are able to plot out where the did the test online, and post their data there. His students can now see that the phosphate levels in their creek are relatively high compared to those of the river it feeds into, but that these levels in the large river increase more at the test site of the next schools tests, five more miles down river. His students can view pictures and ask questions of the other students to see what bugs (benthics for all of us) each found, and can look at similar (and some very different) pictures and data from schools around the state. The teacher is part of an online learning community with several other 6th grade teachers who are discussing the effectiveness of the models they used, and are tweaking the handouts they had to include some new components they want their students to explore. Later that year, the teacher is able to work with another group of teachers who decide they want to create a similar set of investigations on fossils that have been found locally.

This second scenario describes the potential we are hoping for in introducing the Investigate the State project. This project is based upon ideas from the Science in the City project in Grand Rapids from 2004-6. For more information on this, see resources posted at the MMSTLC web site: http://mmstlc.net

The Problem

The Michigan Mathematics and Science Teacher Leadership Collaborative (MMSTLC) is a statewide effort to develop instructional leadership and support among teachers, higher education faculty, and support personnel at the Math and Science Centers throughout Michigan. This group is exploring issues in science that these participants would focus on and support their colleagues in using, focusing on the notion of "inquiry" and "doing science" with students. While focusing on some big picture ideas around this, such as the notion of project-based science, this group has examined four specific areas in particular that are known to be challenges for teachers and students:

- implementing student-designed investigations
- using models to build understanding
- data collection and analysis
- assessing student work to ensure understanding

During the first year of MMSTLC, we began to address these through samples of instructional materials, lessons, activities, and resources from various scientific content topics, leaving it to participants to address the specifics of these at "home" with colleagues, MSC staff, and STEM faculty. However, there are a variety of challenges and issues which have arisen that limit the potential impact on instruction in your classrooms, schools, and region, including:

- there are still no common set of experiences to reflect upon as a group, because there is no common curriculum that everyone uses
- there is little organized opportunity to collaborate on instruction or PD design
- teacher leaders rely heavily on other partners and roles for mentoring and support for implementation (which can be problematic if any of these roles does not support the effort as needed)
- there is no common structured set of activities the participants can engage their teacher colleagues with to assess understanding or instructional practice, build upon experience, or explore student understanding and interest
- there is ongoing tension between the long-term instructional needs we are focusing on, and the short term needs of the teachers and schools you support (i.e. MEAP and the textbook curriculum, as well as other non-science specific issues, can dominate over the less-tangible results of inquiry learning)

The Solution: Investigate the State

Investigate the State is a program that will support teachers by addressing the following:

- Providing a common set of lessons and curricular resources that all teachers involved can use, which also include research-tested lessons and resources that support student learning, and provide models to guide teachers in using inquiry-learning practices
- Providing a professional development program that provides support through local educators (current MMSTLC participants), regional and statewide experts, a summer academy that immerses teachers in the activities themselves, and a rich set of online resources that support teachers as they use these materials on a daily basis with their students
- An online learning community of teachers and scientists who can collaborate with each other about the investigations they are doing with students.
- An opportunity to study large scale phenomena, such was water quality in a system of watersheds, or air quality throughout the state, that one could not do on one's own.
- An extended opportunity for the teachers that participate to begin collaborating with each other and other experts in the state on new investigations that address other challenging curriculum topics within the Michigan Curriculum Framework and Grade Level expectations.

How it will work:

The project will rely on a few things that are otherwise unavailable to teachers that are easily leveraged in as an element of the MMSTLC program.

Lessons and Instructional Materials

As mentioned, the project will provide access to a research-tested set of curriculum resources that include teacher lessons, support materials for teachers to learn about the content and inquiry used, sample student readers and other student materials. These are detailed in the sheets that follow, but basically include the following project-based inquiry learning units:

- "What is the water like in our river?" (which studies not only water quality, but hydrology and geology, human impact on the environment, ecosystems, and a variety of inquiry skills and related content.
- "What is the quality of air in our community?" (which uses air and air pollution as a vehicle for investigating the particulate nature of matter, chemical reactions, phases of matter, and other related topics)
- Possible future materials that explore other topics using a project-based inquiry learning approach.

A Network of Experts and Instructional Support Specialists

In addition to us, the organizers of this effort, we'll have participating teachers from the MMSTLC, as well as content experts from local colleges and universities and select Math and Science Centers from throughout Michigan. Our goal is to also tie into other groups of teachers who are doing such investigations on their own, as well as other organizations (such as the various watershed councils, professional organizations, etc) to support the effort. And, the more of you that get involved, the easier it is for all of us to do the work and get others on board.

Professional Development Resources and Activities

This is really a professional development effort... on a large scale. The underlying goal is not just to get people to collaborate on a water quality study; it is really to get educators to collaborate around the processes of doing authentic science with students, and to get them engaged in deeper learning opportunities than are afforded by a textbook or kit. So, to support this, we'll be training our MMSTLC participants to support teachers, and will be running a summer academy for some basic support for interested teachers. In addition, we are leveraging the growing online professional development resources of the MMSTLC, and will be adding a number of lessons, videos, and other PD supports for teachers to these sites.

Online Collaboration Tools

In addition to the online professional development tools, we are creating an online resource from existing commercial tools (like Google Maps, Flickr, and others) to create a site where students and teachers can share and research data, find useful content resources, and communicate with other classrooms about their investigations.

Timeline:

March - June 2009

Professional development support for MMSTLC Participants, including:

- Introductory 2 hour PD for MMSTLC participants
  - Overview of curriculum materials for each unit, which will be handed out then
  - Sample activity from water unit - creating a simple watershed model
  - Review student work from a sample activity - pictures of clean and dirty air
  - Address the resources and expectations of the project.
- Sample activities uses in regular MMSTLC professional development
  - Physical models (gum-drop / human molecular models)
  - Conceptual models (cause - effect concept maps)
  - Some of the data sets we will be looking at come from investigations done in each of the curriculum units, and will include the lessons from those units (as well as other lessons we use to explore issues with data collection and analysis.
- Wrap up event at The Henry Ford on June 17
  - Review of roll-out of Investigate the State proposal
  - Final PD opportunity, including meeting with ecology specialists, and conducting a water quality and air quality study on site.

August 3-6 or 10-13 (still working our final arrangements)

We would like to have a summer academy in either Grand Rapids or Ann Arbor specifically for this effort, which would include:

- At least two full days of PD on each of the curriculum units
- An opportunity to do some of the final activities of each unit first hand
- An optional opportunity to explore some of the technology resources on the topics in the curriculum units
- A chance to work specifically with the online collaboration tools we are creating for the project.
- A pre-cursor to the more advanced work (curriculum development and/or collaborative lesson study) that we would intend to do in 2010.

We are looking at having a similar event in the Upper Peninsula this summer as well. In addition, we will be rolling out all of the project tools online at http://www.investigatethestate.org

Beyond…

- We would figure on some involvement for MMSTLC teachers as a PD session on how to facilitate this effort locally.
- We would like to have much more going on in online forums or resources to support teachers.
- We see one or two more days during the 2009-10 school year for PD to address what was done, what teachers found, and ensure that some cross collaboration was going on. We also would want to use this to focus on some of the embedded inquiry skills in the units and look at these more reflectively.
- We would want to plan a scaling of the effort and the next stages for people who already participated (collaborative curriculum development, action research, or other efforts).

For more information:

http://www.investigatethestate.org

What is the Air Like in My Community?

This air quality curriculum unit engages students in an extended inquiry into the question "What is the air like in my community?" Students develop an understanding of factors that affect air quality, their sources, and their effects on the health of humans, plants and the environment by engaging in a number of investigations based upon their hypothesis about the initial question.

In the context of learning about air pollution, the student develops an integrated understanding of science concepts such as composition of air; states of matter; chemical and physical changes; chemical reactions; atoms, elements, compounds, and mixtures. Students begin by walking through their neighboring area to notice potential sources and effects of pollution, which is referred to throughout the unit to help contextualize the more abstract scientific concepts. Students then begin in investigate the nature of air, focusing on its composition and the atoms and molecules that comprise air. Through a variety of hands-on tasks, simulations, and experiments, students gain an understanding of the particulate nature of matter. Students use this understanding to then analyze the composition of known air pollutants, investigating potential sources and analyzing their impact upon the environment.

This unit culminates with two activities, including an investigation of their own community as compared with urban areas around the nation. By examining data from the Environmental Protection Agency and comparing this data with the results of the other activity, and investigation of tropospheric (ground-level) ozone in their community, student can better understand local, regional, and global factors which influence air quality.

Conceptual understanding of these phenomena is facilitated through the use of software tools such as e-Chem, a tool for making visual models of molecules, and a supplemental interactive CD-ROM, which provides opportunities for data analysis and comparison with cities around the country. Through the use of Model-It, a dynamic modeling tool developed at the University of Michigan, students model their emerging understanding of factors that affect the quality of the air in their community.

Michigan Curriculum Standards Addressed by this unit:

Michigan Curriculum Framework Strand	Curriculum Standard(s) and Level
Constructing New Scientific Knowledge (C) I.1	1, 2, 3, 5, 6 – Middle School 1, 2, 5, 6 – Elementary 1, 4, 5 – High School
Reflecting on Scientific Knowledge (R) II.1	1, 3, 5 – Middle School 1, 2, 4 – Elementary 1, 3, 5, 6 – High School
Matter and Energy (PME) IV.1	1, 2, 3, 4 – Middle School 1 – Elementary
Changes in Matter (PCM) IV.2	1, 2, 3 – Middle School 1, 2 – Elementary
Atmosphere and Weather (EAW) V.3	2, 4 – Middle School 4 – High School

What is The Water Like in Our River?

In the context of learning about water ecology, learners construct an integrated understanding of science concepts such as ecosystems, watersheds, rivers, biodiversity, macroinvertebrates, biotic index, bio-indicators, topography, and various water quality tests, such as fecal chloroform, pH, and dissolved oxygen. Process skills of making observations, asking questions, designing and carrying out investigations, analyzing and interpreting data, and drawing conclusions are emphasized as students conduct biological and chemical water quality tests on the local body of water.

The driving question of this project leads students to investigate watersheds, the movement of water, and relationships among the surrounding landscape and an aquatic ecosystem. When students look more closely at the quality of the water in their river they investigate chemical and physical factors that affect water quality, and the relationship between water quality and biodiversity.

Student understanding is facilitated by actively engaging with phenomena. During the project, students ask questions, conduct experiments and draw conclusions. Learning is also supported through the construction of physical and dynamic models. Constructing models of their river helps learners integrate each concept into their understanding of aquatic ecosystems. Learning technologies are an integral part of this inquiry process. Specifically, learners use Model-It, a dynamic modeling tool, to construct a model of their aquatic ecosystem. As student understanding grows so does their model. Students continually plan, build, test and evaluate their model based on the inquiry activities they engage in. The use of Model-It is supported through the construction of classroom river-boards. Probes provide an opportunity for the students to collect and visualize real-time data in the field direct from the aquatic ecosystem under study.

The community component of this project is maintained through the involvement of community members, both parents and experts, and the use of articles from local newspapers. The community promotes students' feelings of agency as they begin developing action plans to maintain or improve water quality.

At the conclusion of the project students construct a final artifact. Students choose the format and the focus of their artifact. Using multimedia displays or Model-It, students present their model of how land use or physical or chemical variables affect water quality in their river or how water quality can impact the biodiversity of their river.

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Reflecting on Scientific Knowledge (R) II.1	1, 3, 5 – Middle School 1, 2, 4 – Elementary 1, 3, 5, 6 – High School
Ecosystems (LEC) III.5	1, 5, 6 – Middle School 2, 3, 4 – Elementary 1, 4, 6 – High School
Geosphere (EG) V.1	1, 3, 5 – Middle School 1, 2, 3, 6 – Elementary
Hydrosphere (EH) V.2	1, 2, 3, 4 – Middle School 2, 3 – Elementary 1, 2 – High School