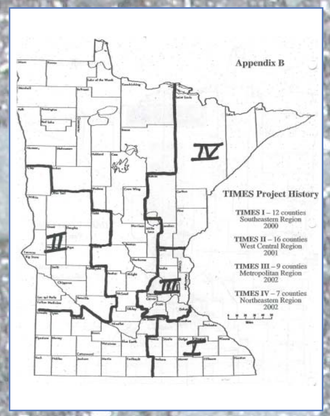
The TIMES Project (Teaching Inquiry-based Minnesota Earth Science): How an intensive field-based course builds teacher content knowledge & prepares teachers to provide Earth Science field investigations for their students

Lee Schmitt, Teacher Programs, Science Museum of Minnesota, 120 West Kellogg Blvd., St. Paul, Minnesota*
Kate Pound, Earth & Atmospheric Sciences, St. Cloud State University, St. Cloud Minnesota kspound@stcloudstate.edu
Megan H. Jones, Geology, North Hennepin Community College, Brooklyn Park, Minnesota megan.jones@nhcc.edu
Jim Meyers, Geosciences, Winona State University, Winona, Minnesota 55987 jmeyers@winona.edu
*** Now at Hamline University (CGEE), 1536 Hewitt Ave. MS-A1760, St. Paul, Minnesota lschmitt@hamline.edu**

Inquiry is NOT	Inquiry IS
Set questions, answers	Spontaneous "why?"
Giving right answers	Formulating questions based on observations
Research = look it up	Research = gather & examine information
Structured research paper	Messy information & hypotheses
Linear	Cyclical
Hypotheses stated first - proving a point	Hypotheses stated later based on observations
Science Lab = replicating experiments	Science Lab = collecting raw data
Assessment as trivial pursuit	Assessment = real-world Q & A
Owned by a single discipline	Found in all disciplines
All information is good	Challenge information
Memorizing	Critical Thinking



ABSTRACT

The TIMES (Teaching Inquiry-based Minnesota Earth Science) Project is a two-week, intensive, field-based workshop for Middle and High School Earth Science Teachers. A needs assessment survey of Earth Science teachers in Minnesota led the TIMES Project Planning team to focus on five interconnected strands: 1) an in-depth review of key information regarding Minnesota Geology, 2) Specific emphasis on the geology local to the region where participants teach, 3) Practice in earth science field research techniques, 4) The design of inquiry-based field opportunities for students, and 5) analysis and alignment of curricula to the Minnesota Academic Standards in Earth Science.

The workshop models the use of inquiry-based strategies so teachers experience the process and know how it feels to a learner. By experiencing the student perspective, teachers are better able to head off obstacles to student engagement, promote development of higher-order thinking skills, and learn where they need to add explanation to ease student discomfort. Teachers then approach their classrooms with greater confidence in their grasp of content knowledge and in their ability to use an inquiry-based approach.

Teachers spend 10 days in the field with a core team of several geologists and a science education professional. Each day, visiting earth scientists (e.g. Hydrologists, Glacial geologists) work with the core team to build teacher content knowledge and develop familiarity with local geology, processes, landscapes, and geologic reasoning. This use of 8-10 visiting geoscientists exposes teachers to a variety of approaches and community resources.

Each day is 'bookended' by both structured and free-flowing discussions. Discussions address teacher observations and interpretations and ways in which the field work could be adapted for their situation, as well as ways in which they can use field investigations to meet state and national standards. The regional focus of each TIMES workshop allows participating teachers to be in close proximity for communication, collaboration, and support as they work to implement more inquiry-based learning in their classrooms and undertake the required field investigations with students.

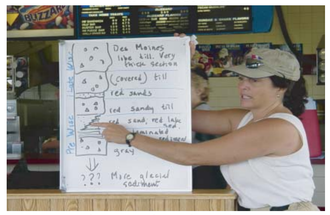
GLACIAL GEOLOGY

TIMES INQUIRY

The Big Picture: Why? What? How?

Closer up: What is this? Why?

The outcrop: "these pebbles are different!"



Piecing together the student observations

TRANSLATION TO CLASSROOM

Marlene Shoeneck, Parkers Prairie High School, Parkers Prairie, Minnesota

Earth Science, Eighth Grade
Unit Title: Glacial Changes-Prairie to Hilltop

Site(s) to Be Used: Parkers Prairie and Glacial Lakes State Park, Starbuck, MN

Content – to integrate:

- Minnesota geological history (change over time)
- General rock types and classification
- Use of Topographic Maps
- Soil type
- Replace and extend present glacial studies and integrate rock, mineral, and soil studies

Student Objectives:

- Students will be able to draw a map of the topography of a given area, using their own devised system to scale and name features.
- Students will be able to collect and develop a classification scheme for rocks and soils from two differing sites
- Students will be able to develop and defend (using evidence) hypotheses regarding the glacial history and topography of the field sites.

Teacher Comments:

"…before doing TIMES glaciers and glacial sediments were always something I didn't really 'get' . doing TIMES really helped me see and understand glacial processes; it cemented things in my mind, and I learned that I didn't have to remember what the names of the landforms were before I understood them…"

"… the time factor is still really hard for kids to grasp, even for the Pleistocene glacial sediments – as far as they are concerned 'long ago' was lunchtime … the time scale is definitely the hardest part to communicate. I have discovered that if I get them to use their journals regularly, then I am able to catch some of the greater misconceptions…for example, many of them started out thinking that rocks got made directly by glaciers … Now, by the end of the unit major misconceptions have been recognized …"

ROCKS AND MINERALS

TIMES INQUIRY

Observing & describing rocks

What are the black specks?

What is the difference?

But that looks like the one we just saw.....

"We need to group these together they all have larger crystals"

"Oh my goodness! that all fits together and makes sense"

TRANSLATION TO CLASSROOM

Cindy Cook, East Central Middle School, Askov, Minnesota
Eighth Grade Unit on Rocks

The Rocks Unit now has 3 parts:
I. Rock Weathering in Cemetery – question generating and field investigation
II. Didactic classroom time on basic rock classification and weathering
III. Field experience to Brighton Beach on Lake Superior for rock identification

Part I. Rock Weathering in Cemetery across from school
1. Started with trip to Cemetery and had students make observations. Back in classroom students listed their observations on the blackboard.

2. From observations on blackboard, students brainstormed possible questions to be investigated. Students listed questions on board and were then were asked to pick one of those questions or they were free
to generate their own question to investigate. Some examples of questions investigated:
*Do smooth polished stones weather more than unpolished stones?
*Do stones under trees weather more than stones out in the open?
*Do stones with 5 colors have more lichens than those with 2 colors?
*Do stones with hand carved lettering weather faster than stones cut by machine?
*Do white sparkly stones weather more than non-sparkly white stones?

3. Students needed quantifiable data. They were required to get 20 data points/measurements related to their question. Students went to cemetery every day for week to collect the necessary data. They:
*Counted numbers of chips and/or cracks on top of 20 stones or on south side of 20 stones
*Measured amount of lichens/sq. in on 20 stones
*Measured depth of lettering on 20 stones
*Students drew conclusions from their data

Teacher note: ***"Some students were able to answer their questions, whereas others concluded that their data was inconclusive. They were required to pose 3 additional questions
that arose from their data or regarding what they would do further to answer their question, if their data was inconclusive."***

Part II. Classroom Work on Rock Classification and Nomenclature

Part III. Field experience to Brighton Beach on Lake Superior.

Each group of 6 students had a copy of the Rock Pickers Guide to the North Shore. The students collected rocks and used the book to identify them.

Teacher note: ***"this experience was a beautiful example of "vocabulary in context." The earlier work that the students did involved using the only the most basic of descriptive terms when referring to the rocks or cemetery stones. However while collecting and identifying rocks on the beach the students began using somewhat more sophisticated terminology (amydaloidal, vesicular, rhyolite) gleaned from the rock guide book that had not been introduced in class or in the cemetery exercise. As a result of the prior inquiry-based unit on rocks the students had an interest and need for the new vocabulary and were not intimidated by it as they might have been had it been introduced in the classroom as a vocabulary list to learn for the rock unit."***