Michigan Teacher Excellence Program Experience
Strategies Used to Enhance Pedagogical-Content Knowledge and Leadership

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Houghton, Michigan
MiTEP: Michigan Teacher Excellence Program
Program Goals

- Enhance teachers’ content knowledge and pedagogical skills in using inquiry in the classroom
- Improve student learning outcomes
- Improve teacher leadership by providing opportunities for professional growth
Benefits to Participants

- Earth Science pedagogical-content knowledge
- Release time for professional development
- Leadership opportunities
- Graduate credit - MSASE at Michigan Tech
- Stipends for summer courses, internships
- Confidence!
# The Life of a MiTEPer

<table>
<thead>
<tr>
<th></th>
<th>'10-'11</th>
<th>'11-'12</th>
<th>'12-'13</th>
<th>'13-'14</th>
<th>To summer '14</th>
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<td>Year 2</td>
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<td>Annual Recruitment Planning</td>
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<td>Earth Systems Institute I</td>
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<td>K12 Ed. Workshops for Faculty at MTU</td>
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<td>ESS Ped/Con Workshops</td>
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<td>Scientists on Call</td>
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<td>Sci. Lm, Inq.&amp; Assmnt. Course (Online)</td>
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<td>Earth Systems Institute II</td>
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<td>How the Earth Works Course (Online)</td>
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<td>Lesson Study Course</td>
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<td>Science Leaders Internship (in NPS)</td>
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<td>Action Research (Online)</td>
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<tr>
<td>Institute planning/instr. consultancy</td>
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- cohorts
- sustained courses
# The Life of a MiTEPer

<table>
<thead>
<tr>
<th>Year</th>
<th>Term</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1</td>
<td>Spring</td>
<td>Recruiting</td>
</tr>
<tr>
<td></td>
<td>Summer</td>
<td>Earth Systems Institute I (2 wks)</td>
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<tr>
<td></td>
<td>Fall</td>
<td>2 days Ped/Con Workshops How the Earth Works Course</td>
</tr>
<tr>
<td>Year 2</td>
<td>Spring</td>
<td>2 days Ped/Con Workshops Attendance at State Meeting Lesson Study Course</td>
</tr>
<tr>
<td></td>
<td>Summer</td>
<td>Earth Systems Institute II (2 wks)</td>
</tr>
<tr>
<td></td>
<td>Fall</td>
<td>2 days Ped/Con Workshops</td>
</tr>
<tr>
<td>Year 3</td>
<td>Spring</td>
<td>2 days Ped/Con Workshops Presentation at State Meeting Sci. Lmg, Inq. &amp; Assmnt. Course</td>
</tr>
<tr>
<td></td>
<td>Summer</td>
<td>Sci. Leaders NPS Internship (3 wks)</td>
</tr>
<tr>
<td></td>
<td>Fall</td>
<td>Action Research Course Presentation at National Meeting</td>
</tr>
</tbody>
</table>
Two Weeks-

**Upstate**
- Great Sand Bay
- Horseshoe Harbor
- Quincy Mine
- Keweenaw Stamp Sands
- Houghton EarthCaches

**Downstate**
- Flooding
- Glacial Geology
- Energy
- Water Supply
- Michigan Geology
Earth Systems Institute I

- Morning ‘Class’
- Field work - all day
- Guest Experts - institutional change
- Daily Assignments
- Journal Exercises
Earth Systems Institute I

MiTEP ESI-I June-July 2012

Welcome Google Earth and GPS Maps Day 1 Great Sand Bay Day 2 Horseshoe Harbor
Day 3 Quincy Mine & Huron Creek Day 4 Keweenaw Stamp Sands Houghton EarthCaches
Day 5 Glaciers Day 6 Woods Lake Day 7 Core and the subsurface Day 7 Grand Ledge
Day 8 Eskers Day 9 Soils and Glacial landforms Day 10 Kalamazoo River

Week 1
June 24-29, 2012 Houghton
Week 2
July 9-13, 2012 Kalamazoo & Jackson

Textbook:
Michigan Geography and Geology 2006 ed by R.
Schaetzl Custom
Publishing, New York

Lecture Movies
Keweenaw Geology
Jacobsville Redbeds
Geopoesy
Michigan Basin
Google Earth & GPS

Course Philosophy
This class is to introduce Earth Science content to science teachers, with help at presenting this material in inquiry runs to students.
It is aimed to emphasize the development of the participants’ problem-solving skills and will employ inquiry based techniques. An important part of the class will use tools that research scientists use and to teach participants to do scientific research. The style of the class is observational, geographical, descriptive, analytical and interpretive. It is aimed to repeatedly apply a sequence of logical questions that can be tested, so that hypotheses can be rejected or refined.
Overall the subject matter is how the earth works. We aim to engage participants in understanding, interpreting, applying.

http://www.geo.mtu.edu/~raman/Silver/MiTEP_ESI-I/Welcome.html

Dr. Bill Rose
Dr. Heather Petcovic
Earth Systems Institute I
Teacher Content Knowledge

MOSART- Misconceptions-Oriented Standards-Based Assessment Resources for Teachers
Big Ideas - Earth Science Literacy

- used as a daily theme through ESSI summer course
- tied closely to student misconceptions

Big Idea 1. Earth scientists use repeatable observations and testable ideas to understand and explain our planet.
Big Idea 2. Earth is 4.6 billion years old.
Big Idea 3. Earth is a complex system of interacting rock, water, air, and life.
Big Idea 4. Earth is continuously changing.
Big Idea 5. Earth is the water planet.
Big Idea 6. Life evolves on a dynamic Earth and continuously modifies Earth.
Big Idea 7. Humans depend on Earth for resources.
Big Idea 8. Natural hazards pose risks to humans.
Big Idea 9. Humans significantly alter the Earth.
Earth Systems Institute I

EarthCache Product

- GPS & Navigation Skills
- Recognize geologic features & processes that create them

- Authentic experience in scientific inquiry & pedagogical practices

- Builds awareness of geoheritage sites within the community

mitep.mtu.edu

Credit: Emily Gochis, MTU
Pedagogy-Content Days

- Per Cohort
  - 4 days per year

- Facilitators
- Guest Speakers
- Teacher Leaders

- Introduction to Inquiry
- Content Lessons
- MSTA Lessons Preparation
- Leadership Opportunities
- NGSS Components
- PLC Discussion
Strategies Used:
- Gallery Walks
- Cookbook Labs
- 7E Lesson Cycle
- Google Earth
- RAFT and John Collins Writing
“Teachers have to develop these skills on their own.”

“No training on how to make it inquiry based!”

“Unsure of how to structure lessons, lack of confidence in ability to do this.”

“No training on how to make it inquiry based!”

“Classroom materials are not inquiry based.”

“Too many content objectives, not enough time in classroom!”

“Because inquiry takes way too much time.”
**Pedagogy-Content Days**

### Table 2-6. Essential Features of Classroom Inquiry and Their Variations

<table>
<thead>
<tr>
<th>Essential Feature</th>
<th>Variations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Learner engages in scientifically oriented questions</td>
<td>Learner poses a question</td>
</tr>
<tr>
<td>2. Learner gives priority to evidence in responding to questions</td>
<td>Learner determines what constitutes evidence and collects it</td>
</tr>
<tr>
<td>3. Learner formulates explanations from evidence</td>
<td>Learner formulates explanation after summarizing evidence</td>
</tr>
<tr>
<td>4. Learner connects explanations to scientific knowledge</td>
<td>Learner independently examines other resources and forms the links to explanations</td>
</tr>
<tr>
<td>5. Learner communicates and justifies explanations</td>
<td>Learner forms reasonable and logical argument to communicate explanations</td>
</tr>
</tbody>
</table>

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Inquiry and the National Science Education Standards. Copyright 2000 by the National Academies of Sciences. Courtesy of the National Academy Press, Washington, D.C.
Pedagogy-Content Days

Breaking into Inquiry
Scaffolding supports beginning efforts to implement inquiry in the classroom

Charles Eick, Lee Meadows, and Rebecca Balkcom

Rethinking Laboratories
Tools for converting cookbook labs into inquiry

By Mark J. Volkmann and Sandra K. Abell

Simplifying Inquiry Instruction
9/15/2005 - Randy L. Bell, Lara Smetana, and Ian Binns

Inquiry instruction is a hallmark of the current science education reform efforts. Science teachers know that inquiry is important, yet most teachers lack a practical framework of inquiry to inform their instruction.

Defining inquiry and assessing how much inquiry is supported by a particular activity or lab can be difficult and confusing. This article presents a simplified explanation of inquiry and provides a rubric that will enable science teachers to determine whether an activity is inquiry based and, if so, to assess the level of inquiry it supports. Additionally, the framework presented will allow teachers to easily adjust the level of inquiry in an activity and increase the amount of inquiry in their science instruction.

What is inquiry?
The National Science Education Standards characterize inquiry instruction as involving students in a form of active learning that encourages investigation, data analysis, and critical thinking.
Pedagogy-Content Days: Cookbook Labs

GROUP ACTIVITY:
ANALYZING & MODIFYING TEXTBOOK LABS FOR INQUKY

- You will work in groups of 3 to analyze & modify a lab from the JPS & KPS Earth Science text books.
  - Microclimates (The Air Around You) KPS 7th
  - For the Birds (Weather & Climate) JPS 7th
  - Water Cycle - What Comes up... (Water on Earth) JPS 8th
  - From the Depths (Water on Earth) JPS 8th
  - Modeling Mantle Convection Currents (Inside Earth) KPS 8th
  - A Mouthful of Minerals (Inside Earth) KPS 8th
  - The Greenhouse Effect (Ecology) KPS 8th

1- Read the lab with your group & check for the essential features of inquiry.
2- Decide as a group where does the your class of “students” fall on the inquiry continuum. Then make changes to the lab to raise the inquiry level to the needs of your classroom.
3- You will have 2 minutes to summarize the lab & the changes that you’ve made.

Evaluate, Analyze, Modify
Pedagogy-Content Days: Cookbook Labs

**Step One:**
Starting with the inquiry analysis tool as a guide, you'll decide how much the textbook activity reflects an inquiry orientation.

By using the tool, the aspects of the lab that do and do not support inquiry are identified.

**Inquiry Analysis Tool**

<table>
<thead>
<tr>
<th>Does the material:</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Engage learner in scientifically oriented questions?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Do questions guide labs?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Do students generate, refine, and focus questions for investigation?</td>
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<td></td>
</tr>
<tr>
<td>* Are questions relevant to students?</td>
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<td></td>
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<tr>
<td>2. Ask learners to give priority evidence?</td>
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<td></td>
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<tr>
<td>* Do students use their senses and instruments to collect data?</td>
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<tr>
<td>* Are recipe-like procedures presented as the only way to address the objectives?</td>
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<tr>
<td>* Do students have opportunities to decide what data to collect or how to collect it?</td>
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<tr>
<td>3. Encourage learners to formulate explanations from evidence?</td>
<td></td>
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<tr>
<td>* Are students encouraged to provide preliminary explanations?</td>
<td></td>
<td></td>
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<tr>
<td>* Do students generate explanations from evidence?</td>
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<td></td>
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<tr>
<td>* Are students asked to explain their reasoning?</td>
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<tr>
<td>4. Compel learners to evaluate their explanations in light of others' explanations?</td>
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<tr>
<td>* Do students compare explanations based on how well they align with evidence?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Are students asked to revise their explanations in light of new evidence?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Expect learners to communicate and justify their proposed explanations?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Do students have opportunities to discuss their ideas?</td>
<td></td>
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<tr>
<td>* Do students have opportunities to present their ideas in drawing, writing, or thinking?</td>
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<tr>
<td>6. Does the lab include all 5 essential features of inquiry?</td>
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<tr>
<td>7. Based on your analysis, where does the investigation fall on the inquiry continuum?</td>
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</tbody>
</table>

**Step Two:**
1. Decide as a group on level of inquiry is appropriate for your “students.”

Next, using the adaptation principles revise the textbook activities to incorporate the essential features of inquiry.

**Adaptation Principles:**

- 10 possible actions used to address the lack of inquiry associated with any lab activity.
- These actions help students engage with scientifically oriented questions, focus attention on evidence, construct explanations from evidence, and justify and communicate explanations.
- The number of principles chosen is dependent on what is learned from the inquiry analysis tool and where your students are on the inquiry continuum.
**GROUP ACTIVITY:**

**SHARE YOUR RESULTS**

**Two minutes to:**

1. Summarize your activity.
2. Where does the original investigation fall on the inquiry continuum? Why?
3. Were all of the 5 essential features included in the textbook version?
4. What did your group do to modify the textbook version?
5. Where does the modified investigation fall on the inquiry continuum? Why?
6. What skills do the “students” need to effectively participate in the modified inquiry activity?
INDIVIDUAL/SMALL GROUP ACTIVITY:

ANALYZE & MODIFYING EXISTING LESSON PLANS FOR INQUIRY

1. Analyze the lesson plan for the 5 essential features of inquiry & the current levels on the continuum.

2. Modify the lesson plan based on the level of inquiry your classroom needs & to include any missing essential features.

3. Turn in a copy of the original lesson plan (either electronically or hard copy to be scanned by us later)

4. Your analysis of the original lesson plan (typed or carbon copy)

5. The modifications you’ve made with a short explanation of how they have increased level of inquiry in the lesson and/or added any missing essential features
Pedagogy-Content Days: Science Stations

Expanding the 5E Model

A proposed 7E model emphasizes “transfer of learning” and the importance of eliciting prior understanding.

Arthur Eisenkraft

Sometimes a current model must be amended to maintain its vitality, innovation, insights, and knowledge have become a highly successful framework.

Science Stations—7E Model

Does the lesson show evidence of the inclusion of the 7E model?

- Elicit:
  - Engage:
    - Explore:
      - Explain:
        - Elaborate:
          - Evaluate:
            - Extend:

Science Stations – 7E Model

Think about:

a.) How could you ‘elicit’ students prior to the beginning of activity?

b.) How could you ‘extend’ the activity to connect to the students’ lives?

c.) What level of inquiry was used in the activity & how could the lesson be “bumped” to the next level?

The Science Teacher. Published by the National Science Teachers Association.
Duck, Duck, DATA!
A Classroom Activity for *Ducks In The Flow - Where Life Begins*

**Big Idea:** Seawater contains many dissolved substances (greater mass per unit volume, or density, than that of a fluid, weight of an object, and buoyancy is critical to a direct influence on the way seawater and objects float).

**Key Concepts:**
- An object can both sink and float depending on its relative density to the surrounding fluid.
- There are two main factors that make ocean water more or less dense: the temperature and the salinity.
- Less dense water floats on top of more dense water.
- Generate hypotheses and make predictions.

**Students explore the unique properties of greenhouse gases, which allow these gases to influence the surface temperature of a planet.**

**Main Lesson Concept:**
Carbon dioxide and water vapor are greenhouse gases that absorb energy radiated from Earth’s surface and release some of it back towards the Earth, increasing the surface temperature.

Available at mitep.mtu.edu
Pedagogy-Content Days: Google Earth

Why Teach With Google Earth?

Google Earth:
- presents a great deal of information in a geographic context
- is easy to install and use
- is an excellent venue for inquiry-based activities
- is appropriate for educational use in a wide range of subject areas
- is an effective tool integrating the study of multiple disciplines
- is a great research tool
- has a large active user community with a public discussion forum
- is pre-loaded with a wide variety useful data
- enables users to create and display their own data
- can be launched easily to explore an issue that arises during an informal discussion
- can work with abundant third-party data that is available on the web
- is available for free download

http://serc.carleton.edu/NAGTWorkshops/teaching_methods/google_earth/why.html
Pedagogy-Content Days: Google Earth

How to Teach With Google Earth?

Google Earth can be used:

- to support hands-on inquiry by students in computer classrooms.
- as a basis for homework assignments.
- for dynamic presentations during class lectures.
- for inquiry during class presentations.
- to create imagery and maps for PowerPoint, Word, and other presentation tools.
- as a data discovery, organization, and distribution tool for research projects.
- to enrich discussion of an issue that arises spontaneously during an informal classroom discussion.

Google Earth offers the means to display geographic data from a wide variety of sources together in a geospatial context. This data includes imagery for the entire globe at varying resolutions that contains a great deal of interpretable visual information. Students can use it to find their homes, schools, and other locations that are familiar to them. They can make inferences by comparing familiar places to other locations. In addition, students can learn about the world through rich layers of mappable data offered by Google’s server and a great deal of third-party content. They can also create and display their own data.

http://serc.carleton.edu/NAGTWorkshops/teaching_methods/google_earth/how.html
Pedagogy-Content Days: Google Earth

- addresses
- coordinates
- “fly-ins”
- measuring tools
- tracks
- pinpointed locations
- historical timelines
CREATING & PLAYING EARTH SCIENCE TOURS

- State the Tour Objective:
  - What Earth Science lesson will someone learn by watching your tour?
- Visits at least 3 different placemarks
- Explains the importance of each location
- Uses at least one other technique/skill that you learned today
- Asks an inquiry style question that leads to discussion after the tour
  
- Share-Out
A Model of Inquiry for Teaching Earth Science

Eric H. Pyle
James Madison University

Abstract

Teachers and administrators have heard recent calls for more inquiry instruction at roughly the same time more emphasis has been placed on testing in science. While these two factors justify an examination of inquiry practices, they also justify a refinement in teaching approaches to ensure that core, models of inquiry-science teaching attempt to engage processes of science knowledge construction, emulating the processes that have directed science teachers toward generic or
Lesson Study

- Develop teacher Leaders who reflect on their practice.

Outcomes:

1. Teacher reflection on practice within the context of a collaborative environment;
2. Improvement of student learning;
3. Creation of a framework for sustained collaborative relationships among teachers;
4. Nurturing a culture of collaboration among teachers;
5. Development of teacher leadership.
Lesson Study

The Lesson Study Process:
1. Form a Group.
2. Establish the Research Theme.
3. Choose a Subject Area.
4. Plan the Research Lesson.
5. Teach and Observe the Research Lesson.
6. Debrief the Research Lesson.
7. Teach and Observe the Research Lesson.
8. Debrief the Research Lesson.
9. Reflect and Revise the Research Lesson.
10. Write Report and Present Findings to MiTEP teachers.
Lesson Study

“This year I am all project-based. It is insane. This was a direct outcome of the lesson study, where we made an interactive discovery lesson and recorded each other.”
Concurrently with...

- How the Earth Works (online class)
  - Earth Science Content

- "Scientists-on-Call"
  - Access to content experts

- Internal Grants
  - Classroom material
Earth Systems Institute II

Dr. Bill Rose

Dr. Steve Mattox

http://www.geo.mtu.edu/~raman/Silver/MITEP_ESI-2/Welcome.html
Earth Systems Institute II

Earth Science Lessons
7E Model
MSTA Practice Presentations

- Individual Practice Presentations
  - Use the checklist to analyze the presentation.
    - Key items that should be included.
  - Comment accordingly.
  - The more feedback, the better!
# MSTA Lesson Preparation

**Presenter**

Does the presentation include the following:
- grade level/standards indicator?
- goals/objectives/intended outcomes?
- background topics necessary for key geoscience concepts?
- final purpose?

Does the lesson show evidence of the inclusion of the 7E model?

**MSTA Presentation Guidelines**

<table>
<thead>
<tr>
<th>Comments</th>
<th>Comments</th>
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</table>

**Are essential features of inquiry included? On what level?**

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>1. Engages in scientifically oriented questions</td>
<td>Poses a question</td>
<td>Selects among questions, poses new questions</td>
<td>Sharpening/clarifies questions provided by teacher or other source</td>
<td>Engages in question provided by teacher, materials or other source</td>
</tr>
<tr>
<td>2. Gives priority to evidence in responding to questions</td>
<td>Determines what constituents evidence and examines it</td>
<td>Directed to collect certain data</td>
<td>Given data and asked to analyze</td>
<td>Given data and told how to analyze</td>
</tr>
<tr>
<td>3. Formulates explanations to scientific knowledge</td>
<td>Formulates explanations after summarizing evidence</td>
<td>Formulates explanations after summarizing evidence</td>
<td>Given possible ways to use evidence to formulate explanations</td>
<td>Provided with evidence</td>
</tr>
<tr>
<td>4. Connects explanations to scientific knowledge</td>
<td>Examines other resources and forms links to explanations</td>
<td>Directed toward areas and sources of scientific knowledge</td>
<td>Given possible connections</td>
<td>Given steps and procedures for communication</td>
</tr>
<tr>
<td>5. Communicates and justifies explanations</td>
<td>Forms reasonable and logical arguments to communicate explanations</td>
<td>Coached in development of communication</td>
<td>Provided broad guidelines to use to sharpen communication</td>
<td></td>
</tr>
</tbody>
</table>
MSTA Share-a-thon Lessons

- Inquiry-Based
- 7E Lesson Plans
- Misconceptions
- Big Ideas
- Local and Regional Focus
- Place-based Lessons
- State and NGSS Aligned
MSTA Share-a-thon Lessons

Topics Include:
Earthquakes
Water
Wind
Space Science

Soils
Rocks
Minerals
Geologic Time
Energy
### The Million Gallon Oil Spill

**Overview of problem:** In 2010 a leak in an oil pipeline led to an estimated one million gallons of oil flowing into the Kalamazoo River. This was the largest inland oil spill in American history. Nearly one billion dollars has been spent on the clean up and multiple impacts remain in 2013. Yet, many Michigan citizens know little about this oil spill and its relationship to their lives. In this lesson students learn the purpose of an oil pipeline, the impact on the environment of an oil spill, and the challenges posed by an oil spill cleanup.

**Global Water**

Claudia Witt & Kari Luckett, Cohort 4

<table>
<thead>
<tr>
<th>Component</th>
<th>Description of lesson component</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elicit</td>
<td>Assess prior knowledge with an anticipation guide</td>
</tr>
<tr>
<td>Engage</td>
<td>Review answers to anticipation guide (All answers are true!) Youtube video: cholera for sale in New York <a href="http://www.youtube.com/watch?v=1Q9Ogotklkc">http://www.youtube.com/watch?v=1Q9Ogotklkc</a></td>
</tr>
<tr>
<td>Explain</td>
<td>Create a poster (must include two key facts from anticipation guide) See attached rubric.</td>
</tr>
<tr>
<td>Elaborate</td>
<td>Powerpoint connections to the United States, Michigan, Kalamazoo, etc. to make it more relevant to the students.</td>
</tr>
<tr>
<td>Evaluate</td>
<td>Poster</td>
</tr>
<tr>
<td>Extend</td>
<td>Ecojournal article reflection</td>
</tr>
</tbody>
</table>
MSTA Share-a-thon Lessons

Lesson Plans available at:

mitep.mtu.edu
Concurrently with...
STEM Learning Materials & Inquiry (ED5730)

This seven week module will introduce you to inquiry teaching, the national science instructional materials that can be used to support inquiry in your classroom.
Concurrently with...

Leadership Opportunities
Professional Organizations
Conferences

MSASE option through Michigan Tech
National Parks Internship

Sleeping Bear Dunes National Lakeshore

Pictured Rocks National Park

Keweenaw National Historical Park

Isle Royale National Park
National Parks Internship

Sleeping Bear Dunes National Lakeshore
- improved existing park geology brochures
- provided recommendations for Junior Ranger Programs
- development of interpretive posters geologic features
- geo-interpretative signage

Pictured Rocks National Park
- public safety announcements for trails
- explanation for earth system processes and why they may occur

Credit: Erika Vye, MTU
National Parks Internship

Keweenaw National Historical Park
- QR signage and geologic feature information
- National Natural Landmark Program at Hungarian Falls and Bare Bluff
- Stamp Sand project

Isle Royale National Park

Credit: Erika Vye, MTU
Action Research

- Collaborative Research
- Design and test new ideas
  obtain data
  interpret
  draw conclusions

“My students proved they could take more control over their own learning, I doubted they could do that.”

*graduate credit towards MSASE degree
Evaluation Data

**Student Information:**
State Tests, MOSART, Attitude, Advanced Science Courses, Graduation Rates

**Teacher Leadership:**
Leadership Survey, Leadership Portfolios

**Teacher Content Knowledge:**
MOSART, ESCI Pilot, Exit Survey

**Teaching Practices:** SAMPI, Exit Survey
What does it all mean?
“I was more mindful of inquiry and including earth science concepts in my lessons. I also made sure to use my experiences as examples.”

“I am definitely more focused on incorporating more place-based learning as much as possible.”

“I am more accountable to my desire for lab time and now devote more class time for inquiry and it has a positive influence on my grades.”
“It opened my eyes to how little I really knew about a topic I was teaching. This was a scary realization, but also motivating me at the same time. It made me want to learn more about the content and through that how best to teach it to my students.”

“The summer programs in the UP were the most influential. Being surrounded by science knowledge all week long, strengthened my knowledge of science concepts.”
“MiTEP made me reflect on my teaching practices and change some of my comfortable ruts.”

“MiTEP provided skills and opportunities to improve my teaching.”

“As a result of MiTEP, I use a lot more questioning within my classroom. I try to foster inquiry through questioning and learning occurs through group discussions. MiTEP helped me to see that providing just the right piece of information can stir the mind, and create questions for the student to explore on their own. Having students take ownership for their learning and making discoveries on their own has created and much richer learning environment.”
“MiTEP has given me the confidence and knowledge of science that makes it easy to be in a leadership position.”

“I became involved in a MiTEP leadership role. I presented at conferences, which I never would have done if it weren't for MiTEP, same with co-leading PD for teachers.”

“I dared to: speak, ask, try. Make and claim, give evidence, and reasoning. Change my way of thinking based on evidence, not just an idea. Product was presenting at conferences, challenged colleagues thinking, impassioned to further my knowledge and lead.”
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