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The History and Impact of a College-Level Field-Based Course on Learner and Community Development

David M. Harwood  
*University of Nebraska-Lincoln, dharwood1@unl.edu*

Leilani Arthurs  
*University of Nebraska-Lincoln, larthurs2@unl.edu*

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Abstract for DBER Group Discussion on 2012-11-15

Presenter, Department(s):
David Harwood and Leilani Arthurs
Earth & Atmospheric Sciences

Title:
The History and Impact of a College-Level Field-Based Course on Learner and Community Development

Abstract:
Providing students with inquiry-based learning experiences was a key recommendation made in the National Academies' 2007 report, Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future, and this presentation is about a model for providing such experiences to college-level students through a field-based geology course. GEOL 160 – Fundamentals of Geosciences in the Field was developed 10 years ago for undergraduate students preparing to be K-12 science teachers. The goals of the course are to enhance undergraduate pre-service science teachers’ (i) knowledge of geoscience and the nature of science, (ii) attitudes about science, and (iii) understanding of inquiry-based learning. The three-week summer course takes students through Nebraska, Wyoming, and South Dakota. To do this, the course is designed around national and NE science standards and the instructional approach models best teaching practices, which students can then implement in their future classrooms. The impact this course had on student attitudes and learning as well as on developing a community of learners within and beyond the course itself will be shared through various media.

A central theme of the course is the value of scientific habits-of-mind where curiosity drives the pursuit of knowledge and is necessary to solving geological problems. GEOL 160 – Fundamentals of Geosciences in the Field and GEOS 898 - Methods of Geoscience Field Instruction offer pre- and in-service K-12 teachers a ‘mental boot-camp’ experience where frustration fuels the desire to find information and explore possible explanations to solve geological questions with which they are confronted. Witnesses to this process include a science writer, a formal evaluator for the NSF award to study this approach, a colleague, and scores of former participants who recruit their peers for the next course.

In designing the course, the primary instructor hypothesized that the course would have a positive influence on how its participants would teach in the future. What he did not expect is how deeply this course would impact his own teaching. Witnessing the transformation of course participants, the high level of their sustained engagement, and real-science interactions in peer-teaching and discussion/debates, improved his confidence in implementing inquiry-based instruction. Based on his experiences with this course, he now also uses an inquiry-based approach to teaching his other campus-based and online courses.

Operational costs to run this course have been provided by EAS (dept. and alumni), NMSS, NSF, AAPG Foundation, and an endowment with the NU Foundation established by a retired school teacher. We are now exploring the feasibility and utility of using this course as a vehicle to promote networking and community building among educators in rural ESUs and local school districts.
The History and Impact of a College-Level Field-Based Course on Learner and Community Development

David Harwood and Leilani Arthurs
Dept. of Earth & Atmospheric Sciences (EAS)

GEOL 160 – Geoscience Fundamentals in the Field
GEOS 898 – Methods of Geoscience Field Instruction

Acknowledgements to: Richard Levy, Kyle Thompson, David Watkins & Norm Smith, Jim Lewis and NMSSSI, NSF, AAPG Foundation, Marlys Christiensen, EAS Alumni Advisory Board, prior course participants
Participate in an Exciting and Engaging Field-Based Teaching Model to Enhance Earth Science Education

Sharpen your inquiry tools

David Harwood & Kyle Thompson
GEOS 898  NMSSI
2013  June 9th – June 23rd
Wyoming, South Dakota, Nebraska
Providing students with inquiry-based learning experiences was a key recommendation made in the National Academies' 2007 report, Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future.

The goals of the course are to enhance undergraduate pre-service science teachers’ and in-service educators’

(i) Knowledge of geoscience and the nature of science
(ii) Attitudes about science, and
(iii) Understanding of inquiry-based learning.

A central theme of the course is the value of scientific habits-of-mind where curiosity drives the pursuit of knowledge and is necessary to solving geological problems.
How do we measure our success?

Student reflections and Field Book entries

Several are attached here....
Picture a sine wave oscillating between your internal space and your surroundings. A vibration with such symmetry and rhythm it sings to you. This powerful wave penetrates deep into your Self and Nature. Your own thoughts and instincts guide you; they are balanced by stimuli, environment. There are times when you draw on deep self reflection. There are times when you stand dumbfounded, utterly in awe of the space around you. And there are times when your mind is humming like a humming bird seeking out nectar. You hum and buzz and whistle, sipping on Mother Nature’s finest fuel, understanding. Self propelled you deftly navigate space and time.

Geology through Inquiry lets us in on Mother Nature’s secrets in such a way that holding the most humble stone in your hand can have your mind’s eye beholding your Self and all life astride the Earth and her dynamism. It is all connected. In life and science perhaps, it takes experience of great amplitude on the side of both introspection and Mother Earth’s devastating reality to have some sense of the complex whole. Some where in between is human Culture of which Science is a part.

Finding questions in nature is natural. Inquiry is the most natural way to learn about-to be exposed to nature. This type of learning resonates so, it is felt. It becomes part of the muscle memory of the mind and not merely a superficial attachment. Theory learned in this way lends itself best to praxis, putting what we have learned to use. I offer no empirical evidence to support this last statement only the logic that would suggest that active learning would make you critically more prepared to apply theory to action. You are empowered. I felt empowered. I want to empower others.

There are problems with being a humming bird, when you are really a human amongst other humans. It is hard to turn off the faucet. When your mind is open wide to the world around you, you can’t close the aperture when your mind is spewing unfermented thoughts in to the ears of your comrades. I felt a real sense of selfishness in this regard, my processes could not be compromised by inhibition or embarrassment for the sake of others. What a rewarding gift that would be to give to someone else, the gift of the freedom to explore the universe without fear of mess. My advise to someone taking an Inquiry-based class is to embrace the process because the highs of understanding of Nature are well worth the lows of doubt and confusion. And one is much more lasting than the other.
1. So, what do I know now about inquiry that I didn’t know before? Well the obvious answer is a whole lot, but that’s not very specific. I used to see inquiry as a formula lab, where you gave the students the directions, and they were all supposed to come up with the same answer following the same path. That was how it was taught to me at university, and that’s how the district told me to teach it to meet the inquiry standard.

I know now that with true inquiry there is no one path, there are many paths that lead to the answer. It is not some cookie-cutter lab and we’re not all following the same list of ten steps. It is looking at the same object and answering different questions, looking harder, making observations, asking more questions, discussing, asking even more questions, coming up with the “best answer” based on the information at hand, and still asking questions.

It is not a quick process, it takes time. Questions have to sit, simmer, and stew. They have to sit funny, in a place where there is no easy answer. There is a certain frustration level that needs to be caused by having an unanswered question hang. I know that my patience level was tested by not having the answer presented to me. But that frustration caused me to ask more questions to get to the information that was needed to know to help answer the questions at hand. If I was that way, how much more so will my students be itching for the answer now? It is something that is sobering to think about. How can I encourage kiddos to do inquiry while still keeping them from checking out?

2. Things I learned about how I learn, well I learned (or relearned) that I am not the most patient person in the world, and like my students, sometimes check out when the answer or at least progress towards an answer is readily at hand. But also learned that I don’t hate the inquiry process. I actually think that I will remember the things I learned during this class better than I remember all the things I learned in my geology classes in college not because of what I learned because of how I learned it.

So, taking that step further – how am I going to apply this to my classroom? I am going to try and get my kids outside, and making “real world” observations. (Or at least practice making in the field observations.) I want to get my students starting to think of science from an “out of the classroom” frame of reference. I think that once they get it into their head that science isn’t just a class, but it is very much a part of their everyday life, they will be more willing to struggle through the not knowing and try to build up their understanding using the inquiry method.

Also, by trying to build an “out of the classroom” perspective with my students, I think they might be more willing to work together well, and help each other build up what they know. It was when we started working as groups and bouncing ideas off of one another that naturally the things that were way off base were thrown out and the things that made sense were considered further and refined. If by using the inquiry method, I can get my students started using that kind of language and working together to build the collective idea rather than working by themselves to create a single idea, I think that I will be doing my job as a teacher to help the future work together for the betterment of society.

Craziness starts with an idea fostered in isolation; if people are trained to bounce ideas off of their peers and colleagues then a lot of the strange untruths that people buy into may start to disappear. How cool would it be to be a part in that change because of how I trained my students?

But this means I would have to be willing to give up control of my classroom, and I can be a bit of a control freak there. In order for students to have the freedom to work together and collaborate, I am going to have to get over parts of myself, and what my perceived role at the teacher is. So, not only will allowing my students to collaborate be a change in how they are used to learning, giving that much control to my students will be a change in how I am used to teaching. The question becomes – will it be worth it in the long run?

3. Geology is big, and it is very easy to get hung up on one part of the picture. I mean, I knew that in theory, but I didn’t have any real practical experience with that before this trip. At the beginning I was so stuck on what I thought I knew that I was digging for anything that sounded right. By the end I was more willing to just throw out questions that I had rather than B.S. answers. I think this is huge. Living in environments where we feel it is so important to be “right” rather than reflecting on the information in front of us, asking questions, and admitting that maybe we just don’t know.

This applies to us as people, as learners, and as teachers. It is better to ask questions than it is to be stuck on being right.
Two- and four-year colleges and universities should reexamine and redesign introductory college-level courses in science and mathematics to better accommodate the needs of practicing and future teacher educators. National Research Council, 2000

To ensure that our education majors have a challenging, content-rich and customized geoscience experience – may only get one chance!

Provide every student with skills, knowledge, and curiosity needed to “think like a geoscientist” – Manduca et al., 2003

RATIONALE
1. Integrated geology field and science teaching methods course
2. Two weeks during 5 week summer session at UNL
3. Demonstrates an inquiry-based teaching approach
4. Learn like a ‘kid’ again

A ‘mental boot-camp’ experience where frustration fuels the desire to find information and explore possible explanations to solve geological questions with which they are confronted.
“This is truly the best course I have ever taken. I have learned more in these three weeks (about geology, myself, others, life, etc.) than I ever have or could have in one year.”

— Student, class of 2007
LEARNER CENTERED

The Learning Cycle

- Engage
- Explore
- Explain
- Extend
- Evaluate

The Learning Cycle
“The National Science Education Standards present a vision of a scientifically literate populace.”

“The Standards rest on the premise that science is an active process. Learning science is something that students do, not something that is done to them.”

NRC, 1996
A good video describes the course and presents student perspectives - [http://www.andrill.org/oldsite/geo/video](http://www.andrill.org/oldsite/geo/video)
LEARNER CENTERED - FIELD NOTE BOOKS
http://scimath.unl.edu/nmssi/2013/

FIELDBOOKS – flip through two participant’s fieldbooks at this site

14 Days of Adventure
"I will never look at a rock the same way again."
"I’m inspired to continually bring up opportunities for wonder in my students."
"I felt like I was on ‘Survivor’ - and I was succeeding."

Teachers who embark on the NMSSI’s 14-day inquiry-based field course, GEOS 898: Methods in Geoscience Field Instruction, come away with a one-of-a-kind experience. This immersion adventure travels through Nebraska, Wyoming and South Dakota in June, and aims to demonstrate effective teaching methods that can integrate geoscience into K-12 learning environments. View these PDFs to read first-hand accounts from one science teacher and one math teacher’s fieldbooks. Don’t miss the opportunity to enroll in GEOS 898 for Summer 2013. Registration opens in March 2013. Syllabus Video

Fieldbook of a Science Teacher  Fieldbook of a Math Teacher
Projects (continued).

Block Diagram of Nebraska Geology

GEOS 898: METHODS IN GEOSCIENCE FIELD INSTRUCTION

4-week field trip during which we will study a variety of geological features and concepts listed on the map below.
<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Topics - [Principles and Concepts]</th>
<th>Activity</th>
<th>Readings</th>
<th>Guiding Question(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saturday</td>
<td>UNL</td>
<td>Introductions</td>
<td>Introduction of participants and instructors</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Rock Introduction</td>
<td>Visit examples of rocks in downtown Lincoln and on UNL Campus</td>
<td>R: 4.1, 4.2; Ch. 5, 5.1; 5.2; 6.6, 8.7</td>
<td>What are the unique characteristics of the rock examples? How are they different from other examples seen today?</td>
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<tr>
<td></td>
<td></td>
<td>Field books, sample boxes and syllabus</td>
<td>Review expectations and practice; distribute tools and reference materials</td>
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<td></td>
<td></td>
<td>Field orientation</td>
<td>Examine maps, virtual field trip video</td>
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<tr>
<td></td>
<td></td>
<td>Introduction to science process skills: Developing tools; GeoSTAT exam</td>
<td>Creation of grain size cards and exploration of grain shape, shape and roundness; Pre-testing</td>
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<tr>
<td></td>
<td></td>
<td>Logistical expectations.</td>
<td>Team integration, field duty assignments, daily schedule.</td>
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<tr>
<td>Sunday</td>
<td>Plate River</td>
<td>Sedimentology/Modern environments - fluvial systems (actualism); Rates of deposition [geologic time]</td>
<td>Examine the Plate River System route; measure stream velocity; collect sediment samples and examine grain size; shape, and composition; examine sedimentary structures; mud dump vs. gravel dump (vertical settling rate and horizontal distance travelled); river processes; Track elevation change on I-80 west using GPS, as we approach the Rocky Ms.</td>
<td>L: Ch. 1, Ch. 8; R: Intro pages and sections 1.2, 1.5, 1.6; Ch. 7, 7.1, 7.2, 7.10; Ch. 16, 16.1, 16.2</td>
<td>What 'modern' processes created the landscape that you see here? What processes do you see occurring in and around the river? What features do you see that indicate that water levels have been higher than today? Where do the sediments come from?</td>
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<tr>
<td></td>
<td></td>
<td>Soils in Plate River floodplain</td>
<td>Observe and describe a soil profile</td>
<td></td>
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<tr>
<td></td>
<td>Ogallia dry</td>
<td>Sedimentology/Modern environments - fluvial systems (actualism)</td>
<td>Observe the features of a dry river bed</td>
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<tr>
<td></td>
<td>river bed</td>
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<td></td>
<td>Lake Ogallia</td>
<td>Camp - camping skills</td>
<td>Set up tents, organize kitchen routine</td>
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<tr>
<td>Monday</td>
<td>Lake</td>
<td>Sedimentology/Modern environments - wind dominated systems</td>
<td>Collect sediment samples and compare and contrast with river sand.</td>
<td>L: Ch. 3;</td>
<td>How do the sediment samples from a wind dominated environment differ from those of a river environment?</td>
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<td></td>
<td>McConaughy</td>
<td></td>
<td></td>
<td>R: 7.3, 7.4, 7.5; 13.2</td>
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<td></td>
<td>Spillway</td>
<td>Stratigraphy [lateral continuity, superposition, original horizontality, erosion, facies, geologic time]; Sedimentology/Paleoenvironments.</td>
<td>Draw stratigraphic section; construct a hypothesis to explain surficial and stratal relationships; propose a sequence of events.</td>
<td>R: 7.7</td>
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<td>Ash Hollow</td>
<td></td>
<td>Propose sequence of events; compare sequence here to that at the spillway; consider time missing in a rock section.</td>
<td>R: 7.10; 9.4</td>
<td>What can we infer about relationships between rock layers? How were they laid down? How have they changed through time? How widespread are rock units deposited by wind, rivers, in the ocean? What is the sequence of events that formed Courthouse Rock?</td>
</tr>
<tr>
<td></td>
<td>Courthouse Rock and Jail Rock</td>
<td>Focus on sedimentary structures; compare results with data collected at modern sites; collect samples of sedimentary rock and label etc.</td>
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<tr>
<td></td>
<td>Wildcat Hills</td>
<td>Camp at Wildcat Hills State Rec. Area</td>
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</tbody>
</table>
Rock boxes and building a classification scheme
1. Transfer content knowledge into K-12 environment

2. Develop inquiry-based lesson plans

3. Develop virtual field trip

4. Build a network of colleagues

5. Establish connections between UNL and local schools
Building community and networking
ESU and school districts
the teaching assistants
JOIN US – for an adventure of DISCOVERY - June 9th to June 23rd

Are you ready to make the leap?

NO ADDITIONAL COST FOR A FANTASTIC FIELD EXPERIENCE!

3 GRADUATE CREDITS  DISCOVER THE HISTORY OF THE ROCKY Mts.
SHARPEN YOUR INQUIRY SKILLS  EXPLORE LIKE A KID AGAIN!
FINANCIAL SCHOLARSHIPS AVAILABLE FOR TUITION SUPPORT
Nebraska Math & Science Summer Institutes

NMSSI's Goal
The goal of the Nebraska Math and Science Summer Institutes is to offer Nebraska teachers of math and science intellectually rich graduate coursework that will enhance their ability to offer their students challenging courses and curricula.

This NMSSI course is designed with teachers' budgets in mind.

Registration begins March 2013