Best Practices in Field Education

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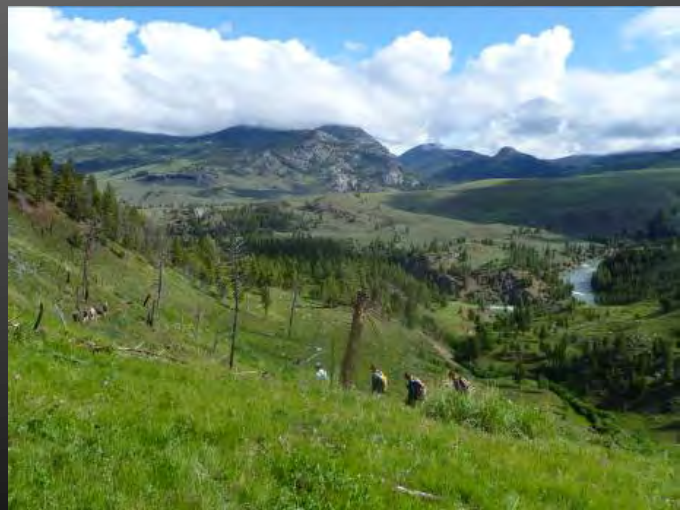
Field Learning Environment

What is unique, or at least intrinsic, to learning in the field?

- Scale is large relative to student; perception from an internal spatial viewpoint; "zoom" across scales; temporal and spatial reasoning

- Physical movement in the environment
  - Knowledge of spatial relations stored in memory, available for retrieval for later use
  - Experience can't be reproduced in artificial or virtual environments
  - Strong sensory inputs

- Experience with raw, undistilled Nature
  - Make decisions about what is important, what to exclude



Cognitive Gains from Learning in the Field

- Develop higher order thinking skills
  - Comprehension, application, analysis, synthesis evaluation; Bloom 1965
- Deep understanding through experiential learning (Kolb, 1984; Bransford et al., 1999)
- Natural phenomena in their full environmental context, connections and relations
- Interdisciplinary, using full range of content knowledge
- Emphasis on inquiry and discovery

Metacognitive Gains from Learning in the Field

Students must be:

- Self-aware of their approach
- Self-monitoring of their progress
- Self-regulating as they modify approaches when confronted with emerging problems or inconsistencies
- Capable of
  - Planning, goal-setting
  - Critical-thinking
- Conation—knowledge and affect lead to intentional, goal-oriented actions

Affective Gains from Learning in the Field

- Awe, wonder, aesthetics, curiosity
- Intra- and inter-personal impacts
- Attitudes, values, beliefs, motivations….
- Ability to work in groups, collaborative and cooperative learning
- Increased self-confidence, self-reliance
- Life-long memories; poignant experiences
- Networking, Relations (mentor-peer; peer-peer)

Engaging the Community of Practice

- A long apprenticeship is required
  - Novice-master interactions in natural setting
- Language
  - Organized skills and practices; speech and gesture
- Selection and use of appropriate tools
- Communal ethics, values, expectations
  - Efficient work habits,
  - Stimulates independent thinking,
  - Engages decision-making strategies
  - Personal work ethics
  - Collaboration communication skills

"The best geologist is the one who has seen the most rocks"
(H.H. Read, 1939)

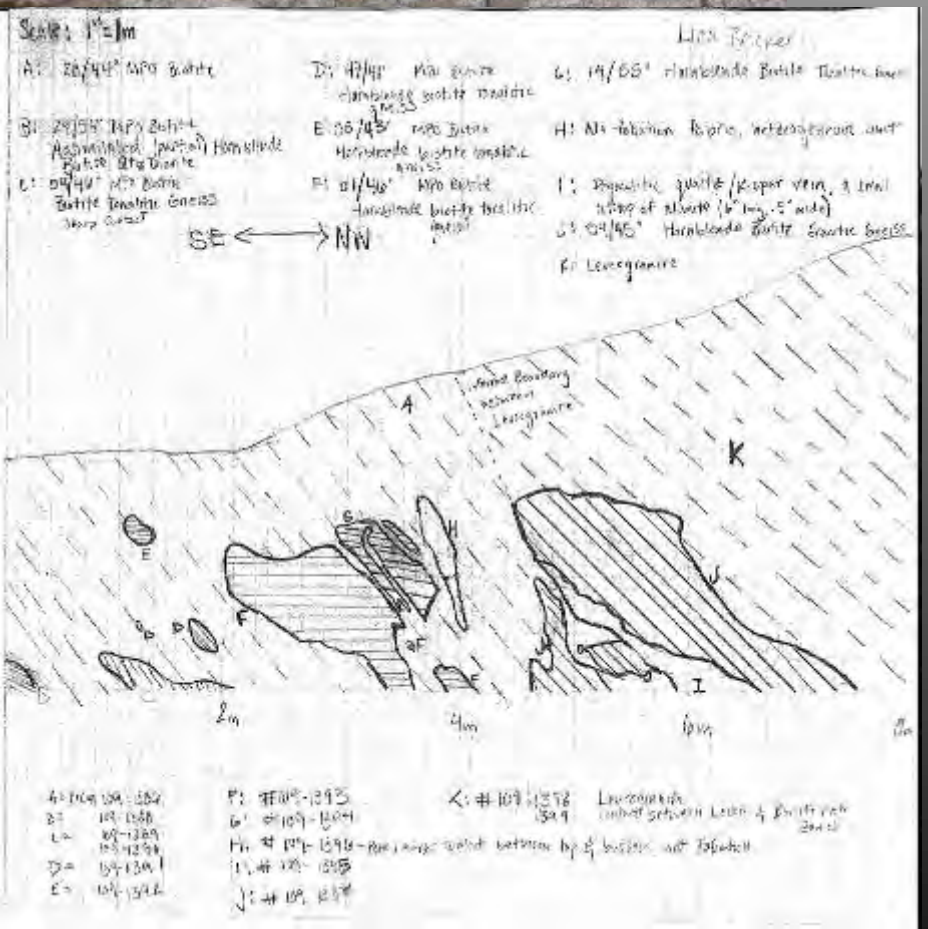
Embodiment—Brain and Body ARE Connected

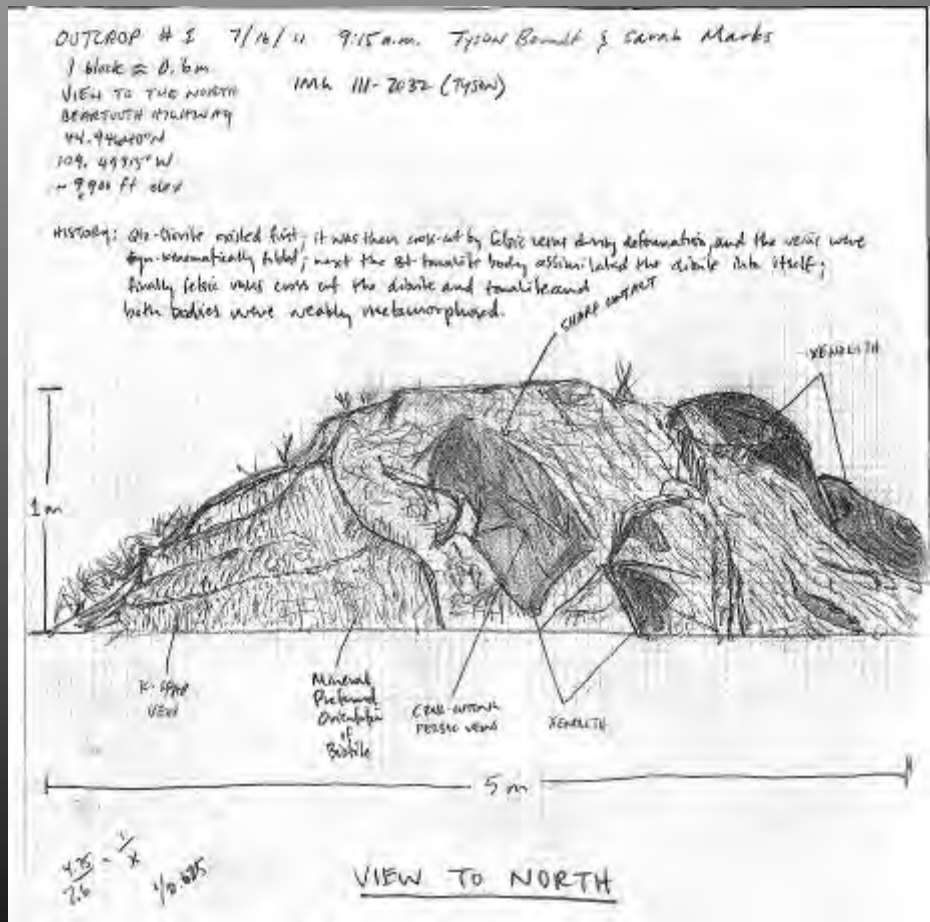
- Importance of body in human cognition
  - How to act in the world, touching, moving reveals multiple perspectives
  - "Knowing your way around"; oriented in conceptual and physical space
- Immersion in the natural environment
  - Affective experiences encode important information
- Relevant Nature is systematically observed
- Fires all the senses—a powerful affective that impacts memory, learning
- Requires broad and sustained exposure to natural variations of Earth materials, structures, processes

Inscriptions—From Nature to Culture

- Representations of natural phenomena
  - Portable, successively refined to emphasize a specific idea; but, lose the larger context, complexity
- The first inscription is most important, changing Nature into Culture (i.e. artifacts such as maps, graphs, diagrams…)
- Enhance understanding of Nature by using increasingly refined representations
- A "chain" of inscriptions, feeding back and forth from field to analysis
- Public, Portable, Permanent records

We took the opportunity to slow down and look at field relations in detail…..





Preparation is Essential

- What type of field activity? Scope and breadth
- Selection of appropriate field site/activity
- Logistics; safety
- Instructor Preparation
- Student Preparation
- Use of instruments/technology
- Contingencies

Novelty Space

- “The quality of the field trip “is determined by its structure, learning materials, teaching method, and the ability to direct learning to a concrete interaction with the environment”—Orien and Hofstein 1994
- geographic novelty
  - which refers to the students' familiarity with the field trip site,
- cognitive novelty
  - which refers to the skills and concepts the students encounter and are expected to master on the field trip, and
- psychological novelty
  - which considers the social aspects of field trips, and related issues such as personal safety and comfort.

Learning Goals

- Initiating students in the "community of practice"
- Reinforce concepts or content delivered in the classroom
- Build confidence within a student in his/her abilities
- Develop practical geologic field skills (note-taking, sketching, map making)
- Introduce students to a geologic/geographic setting
- Do a focused exploration of a given topic
- Be part of a regional overview
- Develop higher-order thinking
- Perhaps simply introduce a sense of awe and wonder for new students
- Create a positive social environment, networking, collaborative and cooperative learning

Activity Design Principles

- Butler (2009) recommends that these types of activities are particularly amenable for field instruction:
  - setting student-led tasks
  - reinforcing scientific method through hypothesis-testing
  - developing integrative skills
  - problem solving, particularly through the interpretation of incomplete data-sets and managing uncertainty
  - dealing with real-life, real-time interdisciplinary problems
  - showing the limitations of observations / measurements in problem solving
  - developing self-reliance amongst students, taking personal responsibility for safety practices.

A true research experience…

Photo credit: Darrell Henry

- Applying "core" concepts and content from the geoscience curriculum
- Meaningful and relevant to students
- Strong affective component
  - Curiosity, motivation
  - Collaborative and cooperative work
  - "Ownership" of larger project
  - Responsibility for personal contributions
  - A trusting work environment
- Excitement about making truly new discoveries

Activity Design

Photo credit: David Mogk

- "Cradle to grave" research experience
- Field work—sampling and mapping
  - Formulation of research questions
  - Planning and execution of research plan
  - Sampling, mapping as required
  - Daily data compilations; sample control
  - Sample preparation (cutting billets, crushing rocks)
- Analytical studies during following semester
  - Microprobe, XRF, LA-ICPMS, Ar-Ar,…..
- Communicating results
  - Poster at Rocky Mountain GSA
  - Writing retreat—each project will be a section of a larger research manuscript
  - Senior Thesis

Scaffolding and Sequencing

- Experiential Learning, Inquiry, Discovery
- "Zone of Proximal Development" (Vygotsky)
- Purposefully place challenges in path of students; mastery leads to next steps…
- How much will you say to the students:
  - to get them started, during the activity, after the activity
  - How much will you demonstrate?
  - How much autonomy will the students have?
  - Will you engage a dialogue about what you're doing and why?
  - How will you balance showing and finding out?

Reconnaissance: Learning by Design

- First two weeks
  - Traverse entire study area
  - Introduction to major units
    - Review what is known, what is yet to be determined
    - Field notes
    - Measurement—structural data, strat sections…
    - Sampling—identification of key samples, sample collection and selection, prep in the field
    - Calibration: to make sure all students could identify rocks, measure structures accurately
  - Logistics
    - Where do we need to go, how will we get there
    - What's the best traverse?....
    - Safety, Radios, First Aid, Check-In
    - Daily Check—objectives, location, target samples
  - Instructor "talk-throughs"
    - Metacognitive aspects –What am I doing and why?

Photo credit: David Mogk

Research Projects—The Second Half

- List key targets, sampling/ mapping goals, scientific objectives
- Each student assumed leadership to pursue research goals
  - Directed team on where to go, what to do
- Each student contributed to overall research effort
  - E.g. collecting samples for a given task if the primary leader would not likely get to that location
  - All are co-learners
  - TRUST, RESPECT

Photo credit: Darrell Henry

Formative Assessments

- Use pre- and post-activity quizzes
- Surveys (knowledge surveys, confidence logs)
- "Road checks" of field notebooks, maps,
- Make direct observations of students at work in the
- Interviews with the students in real time in the
- Videotape students in the field to record their actions
- Develop a scoring rubric to check for completeness, neatness, essential information recorded, etc.
- Reflective exercises–daily journal entries that record what was learned that day, what was interesting, important, confusing
- Concept sketches and concept maps
- Use of technology–use GPS instruments; social media used to record daily field activities; web page to showcase field results

Hard Earned Lessons

- Field work must be practiced early and often
- Field activities should be scaffolded to students' level of development
- A long apprenticeship is required to become a master field geologist

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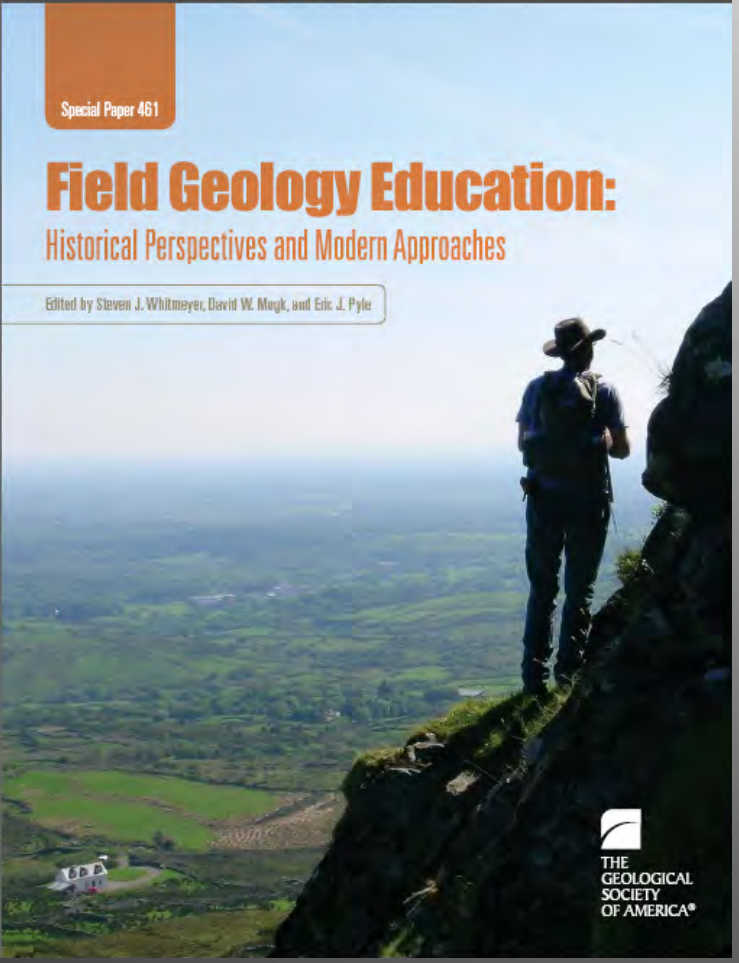

Designing Effective Field Learning Experiences

http://serc.carleton.edu/NAGTWorkshops/field/design.html