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...

- 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

Photo credit: Darrell Henry
Activity Design

• “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

Photo credit: David Mogk
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?
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

Photo credit: Dave Mogk
Designing Effective Field Learning Experiences
http://serc.carleton.edu/NAGTWorkshops/field/design.html