Professional Development for REU Interns

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Yellowstone REU Project

- Precambrian rocks of Yellowstone National Park
- Archean tectonic and geochemical evolution of crust
- Mid-crust petrogenetic processes
- Expand knowledge of natural history of Yellowstone National Park

Photo credit: Darrell Henry
Goals of the Project

• Great Science! Great Scientists!
• Building competence and capacity.
• Initiation into the “community of practice”
A true research experience...

- Applying “core” concepts and content from the geoscience curriculum
- Meaningful and relevant to students’ professional development
- 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
Selecting the right team

• Selection criteria
  – Diversity: geographic setting, home institution, geologic interests, gender balance....

• Academic preparation: core classes completed; field experience

• Letters of recommendation: independent, self-motivated, cooperative, engaged learners

• Personal letters: excited and curious

• Other: athletes, EMT...
Preparation

• Expectation management
  – Decreasing “Novelty Space
• Advertising
• Listserv
• Closed website for posting introductions, literature, personal interests….
• Equipment – check lists
• Research goals clearly identified
• Disclaimers: physical demands, weather, bears... (affective aspects)

Photo credit: Darrell Henry and Dave Mogk
Building Team Work– The Importance of the Affective Domain

Photo credit: David Mogk and Darrell Henry
Project Design

- Full year “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
- **Analytical studies** during following semester
  - Sample preparation (cutting billets, crushing rocks)
  - 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
Professional Practice I: Field Work

- Introduction to major units
- Real-time tutorials and demonstrations
  - Field notes, measurement, sampling
  - Calibration: to make sure all students could identify rocks, measure structures accurately
- Logistics
  - Where do we need to go, how will we get there
  - 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
Professional Practice II: Research Design and implementation

- Semi-autonomous work
  - Identify key targets, sampling/mapping goals, scientific objectives, logistics

- 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
Professional Practice III: Sample Prep

- Safety!
- Cleanliness (contamination issues)
- Archiving/record keeping
- Accountability (getting the job done!)
Professional Practice IV: Analysis

- Sample preparation
- Experimental design
  - What to analyze and why, expected outcomes?
- Standardization
- Replication of analyses
- Data reduction
- Data representation
Professional Practice V: Communicating Results

- 8 integrated posters at Rocky Mountain GSA
- Student-authored abstracts
- Poster design and development
- Pre-meeting writing workshop (review data)
- Professional discourse at meeting
- Posters = sections of GSA Bulletin article
Progress Measured

- Daily reflective journals
  - Most important observations of the day
  - New questions, new plans for future work
- De-briefs after dinner
  - What each group saw, inform other groups about key observations
- Compilations
  - Structural data in spreadsheet by domain for future plotting on stereonets
  - Sample inventories—what was collected, where, for what purpose
  - Make sure that sampling was adequate to answer ALL fundamental questions
  - NPS permitting restrictions!
  - ALL DATA ARE SHARED—photos, maps, S&D, posted on project closed web-based workspace at SERC

Photo credit: David Mogk
Geologic Mastery Requires a Long Apprenticeship

- Field work must be practiced early and often

- Scaffolded to students’ level of development

- REU a great transition to profession, grad school

Photo credit: Darrell Henry and Dave Mogk
Impacts on Faculty

- Rejuvenation!
  - Great students! Great geology!
- Filled an important gap in long-term research program
- Time—Don’t Underestimate!
  - Reconnaissance planning program
  - Advertising and recruitment
  - Selection of participants
  - Web-based materials
  - LOGISTICS (travel, food, lodging, communications, safety);
    TA support is essential
  - PERMITTING; special requirements working in National Parks
  - RESPONSIBILITY—24/7 in the field

Photo credit: Darrell Henry and Dave Mogk
## What Did the Students Think: Self-Efficacy Survey

<table>
<thead>
<tr>
<th>What</th>
<th>Pre</th>
<th>Post</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify and describe igneous rocks</td>
<td>5.4</td>
<td>8.6</td>
<td>3.2</td>
</tr>
<tr>
<td>Identify and describe metamorphic rocks</td>
<td>5.0</td>
<td>7.8</td>
<td>2.8</td>
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<tr>
<td>Identify and describe sedimentary rocks</td>
<td>5.5</td>
<td>7.7</td>
<td>2.2</td>
</tr>
<tr>
<td>Identify, describe and measure structures</td>
<td>6.1</td>
<td>8.2</td>
<td>2.1</td>
</tr>
<tr>
<td>Ability to navigate in the field</td>
<td>6.4</td>
<td>8.4</td>
<td>2.0</td>
</tr>
<tr>
<td>Ability to design and implement a research project</td>
<td>4.8</td>
<td>7.4</td>
<td>2.6</td>
</tr>
</tbody>
</table>

2010 Students came to the program a little more confident, showed measurable gains.

2011 Students appeared to have gained confidence in all areas surveyed.