

December 3, 2003

To: MSU Teaching/Learning Committee

Fr: David Lageson, Professor and Department Chair

Re: Instructional Innovation Grant (2003-2004)

Project Title: *Enhanced Laboratory Learning in Tectonics & Structural Geology*

Submitted by: Dr. David R. Lageson
Professor of Geology & Department Head
Department of Earth Sciences
Traphagen Hall, Rm. 200
MSU-Bozeman
Ph: 406-994-6913
lageson@montana.edu

Collaborators: Ms. Jennie Flight, MSU Graduate Student in Geology
Ms. Falene Petrik, MSU Graduate Student in Geology

Enhanced Laboratory Learning in Tectonics & Structural Geology

Rationale: Topics in tectonics and structural geology are taught in a variety of undergraduate courses, including ESCI 111 and 112 (Physical Geology & Physical Geography, respectively – both proposed as *Natural Science Inquiry* for Core 2.0), GEOL 205 (Earthquakes & Society – proposed *CIS* course for Core 2.0), GEOL 315 (Structural Geology), and GEOL 433 (Tectonics). Although these four courses span the undergraduate curriculum, they all share a common learning difficulty or obstacle: students have incredible difficulty with spatial and temporal visualization of 3-D geologic structures and tectonic features of the Earth. In particular, students have great difficulty in mentally transferring 2-D spatial/map data into 3-D images, graphics and constructions that are so essential to understanding geologic structures (such as cross sections, stereonet diagrams, volumetric block models, layered models, rotational operations, etc.); the added component of geologic time (4th dimension) makes the task even more difficult. Spatial and temporal concepts are fundamentally important to the Earth Sciences and pose the greatest learning challenges to undergraduate students, according to numerous studies published in the *Journal of Geological Education* and the *American Geological Institute* (AGI). Despite this awareness of the problem, published laboratory manuals in structural geology all fail to address learning obstacles in 2D-3D-4D conceptualization. Therefore, we propose to attack this problem by developing a new generation of laboratory manual that will place greater emphasis on new techniques of structural visualization and computer simulation, suitable for use in the courses mentioned above. We plan to use this manual at MSU for 1-2 years, prior to seeking formal publication for wider use.

Methods and Activities: In order to be successful, we feel a new structural geology laboratory manual should incorporate the following: 1) serve as a reference text for the numerical and graphical *methodologies* used to solve various types of 2-D and 3-D problems; 2) be *methodical, organized and fluid* (current manuals are extremely inconsistent in their presentation of problem solving techniques, making the material inaccessible and frustrating for students); 3) bring *meaning* to the material through the use of local examples from Montana and surrounding areas and “mini-field trips”; and 4) incorporate new *computer-based technology for 2-D and 3-D visualization*, thus capitalizing on the computer literacy (i.e., the electronic, digital mindset) of most young undergraduate students today (something totally lacking in existing laboratory manuals). Two graduate students who have served as teaching assistants for structural geology will work directly with Dr. Lageson to create a new digital lab manual that will incorporate these four elements through interactive, visualization-intensive activities and exercises.

Anticipated Outcomes: By the end of spring semester, 2004, we plan to have a digital (PDF) draft of our new lab manual completed. During spring semester, we will test new digital visualization techniques (software from *RockWare/RockWorks* and web-based sources) in GEOL 433 (Tectonics) and determine their suitability for incorporation into the manual. After editing during the 2004 summer, the manual will be ready for use in ESCI 111 and GEOL 315 during fall semester, with on-going modifications (see below).

Assessment: Assessment will consist of on-going student, lab instructor, and professor evaluation of each segment upon its completion. Revisions will be fluid and dynamic, allowing us to digitally modify the lab exercises as problems or issues arise (not possible

with existing published manuals). After 1-2 offerings, we plan to “publish” our *MSU Structural Geology Laboratory Manual* as a CD product.

Budget for *Enhanced Laboratory Learning in Tectonics & Structural Geology*

- 1) Salary for Jennie Flight: 100 hours at \$10.00/hr - \$1,000.00
- 2) Salary for Falene Petrik: 100 hours at \$10.00/hr - \$1,000.00
- 3) Matching funds:
 - a) Earth Sciences accounts in the MSU Foundation (for “supplies and equipment” to aid in geoscience education) will be used to purchase *RockWorks 2002* software from *RockWare* for incorporation into the new structural geology lab manual: Academic (10 pack) single institution license = \$1,500.00
 - b) The Department of Earth Sciences will send Dr. Lageson to a national workshop sponsored by NAGT (National Association of Geology Teachers) on “*Teaching Structural Geology in the 21st Century*” during summer 2004. NOTE: funds requested for the Instructional Innovation Grant will NOT be used for this workshop! Our new structural geology lab manual will be showcased at this national meeting for peer review and input as part of the assessment process. Please review the following web site:
<http://serc.carleton.edu/NAGTWorkshops/structure04/index.html>

Total amount requested from the Instructional Innovation Grant pool: **\$2,000.000**