Description of field geology lab submitted to Cutting Edge activity collection, *Teaching Geoscience in the Field in the 21st Century*

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Rationale:
Most of my introductory-level field trips involve students making qualitative outcrop-scale observations and rock descriptions, then using these data to come up with a paleoenvironmental interpretation for each outcrop. Further, I want students to be able to go through the process confidently with very minimal to no interaction with me. I am willing to listen to and discuss their own observations and interpretations with them, but I do not want to do any lecturing in the field. To attempt to capture students' thought processes, I observe them in real time in the field, videotape selected classes and review the tape, and read their field notebooks, which are supposed to include observations, interpretations, and labeled sketches. A few of the common problems that my colleagues and I have noticed include:

- In the field:
  - Some students get out of the vans and don't know what to do or where to start, sometimes not asking for help until we are almost ready to leave. This phenomenon is observed even when students are given verbal (in the field) and written (in their field trip guide) instructions about what to do when they get to an outcrop.
  - Some students do not have a systematic method for analyzing the outcrop, meaning that they may forget important steps.
- In the field notebooks:
  - Many field notebook entries are incomplete (perhaps because students ran out of time at the outcrop) and include insufficient detail (examples: sketches are not labeled and do not include scale, rock descriptions are limited to the color of the rock and the rock's name, interpretation is missing). This phenomenon is observed even when students are given verbal (in the field) and written (in their field trip guide) instructions on how to make a detailed field notebook entry.

In an effort to prepare students for their field trip, I developed a short lab exercise to give students practice with basic outcrop analysis *before* going on the field trip. This exercise is not a substitute for a field experience because the "outcrop" consists of a color photograph and single hand sample, but it requires students to think about what they should be observing and noting at an outcrop before visiting an actual outcrop. In addition, they may take their completed lab on the field trip and use it as a model for their field notes.

Audience:
This exercise is for students who are new/relatively new to analyzing outcrops. I have used this lab for GEOL 8L (Earth science lab) and GEOL 24 (field studies of Central California). Both of these courses are introductory courses, and the vast majority of students are non-science majors. I will be using a modified version of this lab in GEOL 1 (physical geology) this fall and GEOL 25 (field studies of Southern California) next fall.

Pre-requisite skills:
Students should have completed rock and mineral identification labs prior to doing this lab.

Contents:

- Page 1: cover page
- Page 2: pre-lab
  Students complete this assignment outside of class prior to working on the field geology lab. Briefly, the assignment involves students watching a ~5 minute tutorial on You Tube about basic outcrop analysis. Watching the tutorial and answering a few questions ensures that before coming to class, students have thought about what an outcrop is, the difference between an observation and an interpretation, and some of the steps involved in analyzing an outcrop.
- Pages 3-7: lab entitled *How to be a field geologist*
  Students complete this assignment during a lab meeting prior to going on their field trip. At this point in the semester, students have completed labs on mineral and rock identification and should be familiar with mineral and rock names and related vocabulary. At the beginning of the lab meeting, each student is given a copy of the lab.
  First, students are asked to think about which general elements to include in a field notebook entry for any outcrop (lab question 1).
  Next, each lab group is given 8 ½ x 11 color copies of a specific outcrop and a corresponding hand sample. Using the field notebook checklist that they developed in question 1, students complete a field notebook entry for the outcrop that they have been assigned (lab question 2).
  Then, each student receives an igneous rock, sedimentary rock, and metamorphic rock card. These cards, which include the required elements of a field notebook entry, are the ones that they will use on their field trip. Students compare these field notebook checklists to the checklist that they developed (lab question 3) and then complete a field notebook entry for their outcrop using the appropriate card (lab question 4).
- Pages 8-9: copies of igneous, sedimentary, and metamorphic cards
  I print these on yellow cardstock and refer to them in class as "yellow cards". These are the cards referred to in lab question 3. Card content will vary from instructor to instructor, depending on what the instructor wants included in a field notebook entry. My students take their yellow cards with them on field trips.
- Pages 10-11: two examples of color outcrop photos used in this lab.
  These are the outcrops that students analyze in lab questions 2 and 4. Hand samples representative of the outcrops (in this case, granite and shale) would be provided to students as well. You may choose to give students practice with outcrops that they will be visiting on their upcoming field trip. I always select outcrop photos with people for scale.