Rocks before Terms and Tables – From the Concrete to the Abstract

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Many students have difficulty learning if their instruction begins with abstract concepts, rather than concrete (preferably tangible) things that the students can observe for themselves. For example, beginning a lesson on igneous rocks with a classification diagram, laden with unfamiliar terms, typically elicits glassy stares. We have found a better way to introduce igneous rock classification, one we have successfully used for K-12 students, undergraduate majors and non-majors, and in-service teachers.

We begin a lesson on igneous rocks by giving each group of students an unsorted pile of igneous rocks of varying properties (color index, grain size, and so forth). We ask them to observe the rocks, identifying important properties (for example, color) and how these properties vary (for example, from black to nearly white). Most student groups will independently recognize the properties that geologists use, such as grain size and percentage of dark versus light grains. At this point, we have a short discussion, where the entire class compiles a list of the properties that the various groups have identified. We might list these properties on the board or simply discuss them, adding any important ones students miss, such as whether a rock is composed of crystals or clasts.

Next, we ask students to use these properties to develop a classification system. They can do this by arranging the rocks in a matrix on their lab tables, in which the rows and columns represent selected properties. In our experience, students nearly always arrange the rocks by color and by grain size, sometimes placing pyroclastic rocks off to one side in a separate pile. By the time they have arranged all the rocks, the students will have recognized and isolated the main properties of igneous rocks, and will have, *on their own*, decided which of these are the most important.

After the groups have directly observed the rocks and developed a classification system, they now may feel ready to use technical terms to apply to the various fields of the system (for example, "What is a general name for the light-colored, coarse-grained rocks in this corner?"). It is only at this point that we introduce petrologic terms and draw a classification diagram on the board. In this pedagogical sequence, when a term such as "granite" is introduced, the student already knows what this type of rock looks like.

There are two possible ways in this approach to discuss the genesis of igneous rocks. An instructor could discuss the implications of texture and composition at the very end, after students know the different igneous rocks and how they relate in a classification scheme based on observable properties. Alternatively, the significance of each property could be addressed as each is listed in the class discussion, before the students classify the rocks. We prefer the first approach because it does not interrupt the flow from observation to classification, and it delays introducing abstract concepts, such as how color index relates to silica content, until after the students have as much familiarity with the rocks as possible.

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