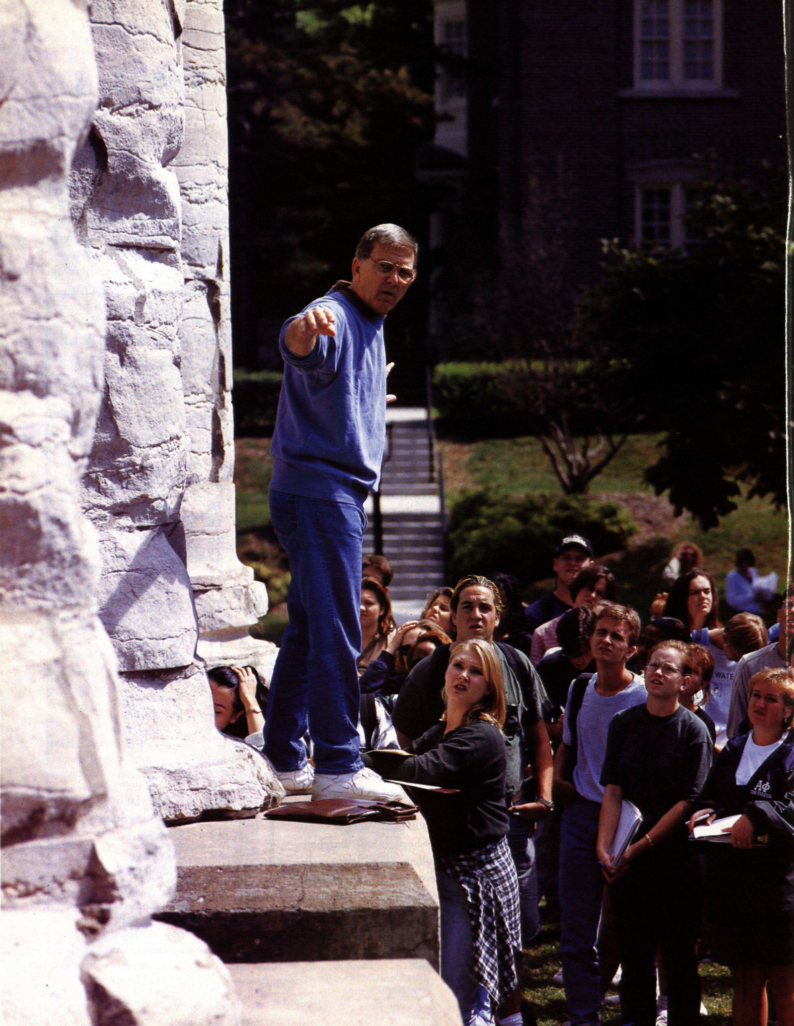
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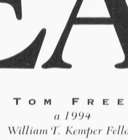
How I Teach

BY TOM FREEMAN
a 1994
William T. Kemper Fellow
for Excellence in Teaching

I didn't plan to be a teacher. In fact, as a child growing up in Hot Springs, Ark., I never even planned to go to college. These days, I surround myself with college students. And I love it. When a student comes to my office for help, I first record his or her name and then rather incidentally inquire about hometown, academic major, whether or not the folks took my course, etc. Then in my auditorium section of Principles of Geology, while explaining how southward-flowing glaciers displaced the course of the ancestral Missouri River west of DeWitt, I might contrast the older valley near Cindy's home in St. Charles with the younger valley near Amy's home in Kansas City. And, while describing features that collectively mark the beginning of the Ordovician Period of geologic time, I can ask specific students: When did the Renaissance begin? Was it with the work of Italian artist Giotto?—calling on Rob, an art



major, to supply the year 1350. Or, did it begin with the introduction of the printing press in Europe?—calling on Chuck, a journalism major, to supply the year 1414. My point is that the beginning of the Ordovician Period and the beginning of the Renaissance are analogous in that both are subjective and are a bit blurred by transitional events.

Geology Professor Tom Freeman puts teaching on a pedestal. This rock professor quotes an ancient poet: "The mind is not a vessel to be filled, but a fire to be lighted." —Plutarch

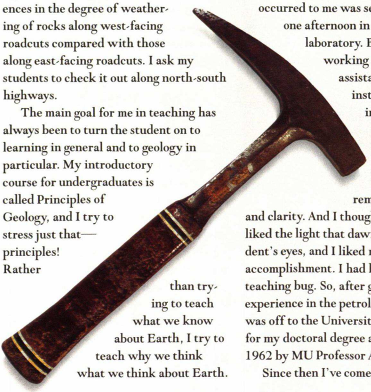
I work very hard at getting students involved in my classes, partly because teaching is more than merely conveying information. Effective teaching is inextricably linked to learning. Sure, learning is usually assumed, but it shouldn't be. Truly effective learning requires a kindling of the spirit and the development of excitement about learning, an excitement that's sparked as students learn to reason and to solve problems for themselves. At the undergraduate level I try to teach the student, rather than the subject matter—taking my cue from Plutarch (A.D. 46-120) who said: "The mind is not a vessel to be filled, but a fire to be lighted." In teaching geology, I have found that a fire can best be lighted not by teaching about Earth in the abstract, but in tangible ways—ways that draw upon students' life experiences and upon experiences they are likely to have.

All Mizzou students experience the Columns, and they come in handy when studying the weathering effects of freezing and thawing. We visit them to see how their south sides are clearly more rubbly (weathered) than are their north sides. Why is this? We eventually conclude that on clear winter days the sunny south sides commonly thaw, while the shaded north sides remain frozen. Hence, more frequent freezing and thawing on the south sides, so more weathering.

Then we go into our critical mode. I ask if the 1892 fire that destroyed Academic Hall on the south side of the Columns could have weakened the sides of the Columns closer to the fire, thereby accounting for greater deterioration. (Hold that thought!) Then we review the fact that afternoon sun is a bit warmer than morning sun, so we look for some degree of asymmetry on the more weathered south sides. That is, are the southwest sides a bit more weathered than are the southeast sides—which would support the contention that more frequent freezing and thawing accounts for the differential weathering.

The answer: Not noticeably.

So perhaps the fire is to blame after all. But I hasten to add that the effects of differential frequency of freezing and thawing can in fact be seen by differences in the degree of weathering of rocks along west-facing roadcuts compared with those along east-facing roadcuts. I ask my students to check it out along north-south highways.

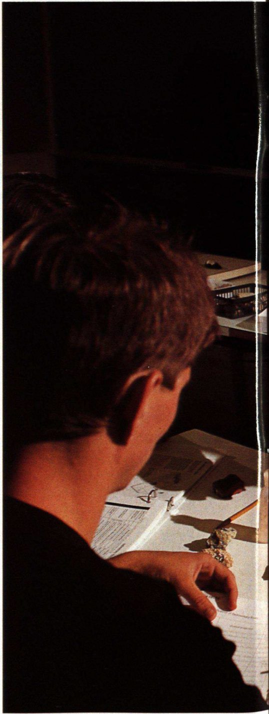


The main goal for me in teaching has always been to turn the student on to learning in general and to geology in particular. My introductory course for undergraduates is called Principles of Geology, and I try to stress just that—principles! Rather than trying to teach what we know about Earth, I try to teach why we think what we think about Earth. And I try to convince students that they should think critically about the subject of every course they take.

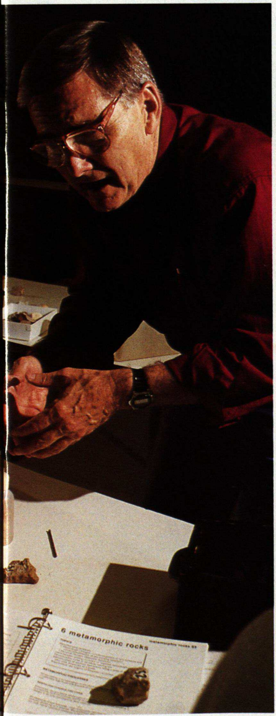
It took me quite a while—well into my college career—to become a critical thinker. No one from either side of my family tree had ever gone to college—though legend had it that my great-grandfather taught penmanship at the University of Arkansas—so no one expected me to go, least of all myself. Besides that, family finances were poor and student loans were non-existent. But in April of my junior year at what has recently become known as "Bill Clinton's High School," a couple of friends talked me into joining the Marine Corps Reserve. That was what the more macho guys did after scouting. I left for the Korean War three months later. On returning to the States, I enrolled at the University of Arkansas through the G.I. Bill. Seeing as how I was one year short of a high-school diploma and more than a bit rusty after a two-year hiatus from school work, college was very difficult for a couple of years. In fact, I darn near dropped out late in my sophomore year to join the wheat harvest.

The first time that a career in teaching occurred to me was several years later one afternoon in structural geology laboratory. By then I was working as a teaching assistant. While instructing a student in a sticky graphic problem, I got lucky and all the lines came together with remarkable efficiency and clarity. And I thought, this is fun! I liked the light that dawned in the student's eyes, and I liked my feeling of accomplishment. I had been bitten by the teaching bug. So, after gaining a bit of experience in the petroleum industry, I was off to the University of Texas-Austin for my doctoral degree and was hired in 1962 by MU Professor A.G. Unklesbay.

Since then I've come to believe there are three qualities that are important for effective teaching: sensitivity to student needs, knowledge of the subject matter and communication skills. The priority we should give to each depends on the



After class, Tom Freeman generates questions about that day's material. These become questions-for-the-week, which provide a study focus for novice note takers.



level of the student. Surely knowledge of the subject matter is essential at the graduate level, but the other two qualities are critical in teaching undergraduates. And it's the task of teachers to recognize what is needed and to shape their approach to fill that need. At a research institution such as MU, teachers should also be conversant in modern research.

Freshmen generally have less background in science and are less motivated than upperclass students, so I apply a number of strategies to mitigate these realities. I cover those fundamentals of natural science that are essential for understanding how Earth works—density (as a function of composition, state, pressure), gravity and magnetics. And, I try to get the students to really think about these fundamentals. For example, I commonly describe a problem at the end of a lecture, asking students to bring the solution to our next meeting. (No, these answers are not in their textbook. Independent thinking is required.) After explaining, say, the principle of conservation of angular momentum and how it applies to our understanding of the origin of our planets, I ask: If one drops an object from a tower, will the object strike the ground east of the tower, directly at its base, or west of the tower? (Relay your answer to me: (314) 882-6673, geosctom@showme.missouri.edu. Operators are not standing by, but I would love to hear from you.)

In my small honors section, I provide students with hands-on manipulation of animated Planet Earth geology programs on my "mobile Mac" computer. I believe that the use of technology in the classroom should truly be need-driven, not merely for its gee-whiz value. After all, students who have been playing video games since they were pups aren't that impressed by lights and sounds anyway. I advocate using a computer only in cases where it—like nothing else—can elucidate a principle.

The explanation of most geologic principles benefits from illustration. Some are best animated if the student is to truly grasp them. So the staff of our new Digital Media Center and I are developing an animated history of a "superimposed stream" like that at Johnson Shut-Ins State Park in southeast Missouri. With luck, my students will be able to fully grasp this phenomenon for the first time.

While tracing the southern limit of Pleistocene glaciation in our part of the world, I take my class outside to examine the huge—as in the size of an automobile—diorite boulder that was unearthed when workers dug the foundation for our Geology Building in 1963. I enlist the help of students who have visited Missouri's Elephant Rocks State Park to establish the fact that granite is indigenous to Missouri, but its cousin diorite is foreign to our state. So, where did the diorite come from? Canada. So how did it get here? It hitched a ride on a glacier!

As I mentioned earlier, teachers at a research university should be conversant in modern research, ideally being able to cite their own work as examples. I've told undergraduates about my research in the western North Atlantic. We drilled through 130 meters of black shale of the Late Cretaceous Age that is believed to contain more organic carbon than the total of North American coal reserves. I explain to my students that inasmuch as the ultimate source of that stored carbon was carbon dioxide in the atmosphere, there should have been a "greenhouse effect" in reverse, with resultant cooling of Earth's surface on a scale that might have accounted for the extinction of the dinosaurs—an alternative to the catastrophic asteroid-impact theory.

In working with students, my goal is to instill a zest for learning that will serve them all their lives. I'm forever seeking more effective ways to challenge the superior student, encourage the average student, and lift the stumbling student.