Peter J. Heaney – Teaching Philosophy Statement

Scientific discoveries are human interest stories. As an undergraduate, I roomed with four physics majors whose brains were wired differently from mine. While they assimilated abstractions through intuitive (and, to me, superhuman) powers, I found it necessary to explore the back story. Where did that discovery come from? What did people think beforehand? How did they figure it out? Consequently, I majored not in geology but in the history of science. In the nearly 40 years since my graduation, I kept reading, and occasionally publishing, articles about the history of the Earth sciences.

When I started teaching, I made my own discovery: History is The Great Explainer. I could simply present a derivation of Bragg's Law of diffraction as received wisdom from a higher agency, OR, I could discuss the competing notions of atomicity in 1912, the race to the solution by German and English scientists at the onset of World War I, the wrong turns into blind alleys that you never read about in physics textbooks, and the experiments that serendipitously yielded deep insights in minds that were prepared for them. The latter approach takes more time, but it contextualizes complex ideas for students, and it humanizes the scientific process.

Question, question, question. When I started teaching in 1991, I began with the "sage on the stage" model. My participation in pedagogy workshops soon taught me the benefits of active learning, which I came to think of as "active teaching" too. My general education course on gemology is full of hands-on exercises that let students discover interactions of light and crystals themselves. In my mineralogy class, I love to present a conundrum to the students ("Is a snowflake a mineral?") and briefly leave the room as the great debate ensues. (The question always splits the class, and the answer is "yes".) I have taught large-enrollment classes for 20 years, and creating that same intensity of student engagement is a challenge I embrace. I was an early adopter of electronic student response technology, and in the beginning, I typically asked 4 or 5 questions per lecture. As illustrated in my sample "assignment" (a reproduction of the slides for an oceanography lecture), I have evolved to where the questions drive the lesson. In addition to keeping the students continuously involved, constant querying communicates the essential nature of science, that nothing is assumed and every advance is achieved through an unceasing sequence of logical questions.

Critical thinking or critical learning as the key to JEDI? The philosopher Jacob Bronowski argued that the scientific method is routinely conducted using the "Old Testament" values of honor, justice, and integrity. These are the skills we associate with "critical thinking" in the dispassionate collection and analysis of data, and there is no disputing their essentiality to science. Excluded, however, are the "New Testament" values of love, empathy, and compassion. Bronowski – a Jew who lost family members in Auschwitz – argued that scientists who ignore the "New Testament" maxims risk betraying science on a larger scale. Scientists in Nazi Germany and Stalinist Russia succumbed to that misconception.

As a teacher of science, I believe that instilling the habit of critical thinking in my students is a necessary but not sufficient component of my job. My students also need to understand how they learn, and how others learn, to succeed when they leave Penn State. That in turn requires deep self-reflection and an even deeper consideration of their peers. I present challenging concepts through multiple strategies, and I am explicit with my students in explaining why they are seeing the same ideas presented as graphics, as stories, as equations, even as me spinning around like a presolar nebula. Different people learn differently, and the art of persuasion requires students to sense the perspectives that their peers bring to a problem. Achieving that level of affinity is the foundation for equity, diversity and inclusion as values we all should share.