Nobody likes soap in their eyes: Portraying a more inviting science by teaching for aesthetic understanding

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Nobody likes soap in their eyes. This is what I thought to myself as I gave my little girl a bath the other day. I lathered the shampoo in her hair, filled the cup with water, and raised it above her head to rinse when she quickly tipped her head forward. What an amazing bit of learning this was. She had found that by tipping her head the water simply ran off the top - and the soap with it!

This story illustrates a pervasive problem in science education. Too many students simply tip their heads and let science run off. Science itself doesn't give water the soapiness and sting students feel and learn to avoid. Rather, the sting is often caused by the way science is portrayed by teachers and textbooks. Too many teachers allow textbooks to frame science as neat and clean, with bold-faced words, clear definitions, staged photographs, and white lab coats. This is what Gerald Holton calls "public science."

> …the science of textbooks and journal reports - the logical, well-ordered side of science... What is hidden from nonscientists is private science…messy, disordered, exciting science in the process of being done. Public science is objective and factual; private science is subjective and emotional (in Flannery, 1991, pg. 585-586).

Holton's public science is logical, analytical, and ruthlessly objective. As a discourse, public science is cold, uninviting, and elitist. Lemke describes the same problem as the "mystique of science."

The language of classroom science sets up a pervasive and false opposition between a world of objective, authoritative, impersonal, humorless scientific fact and the ordinary, personal world of human uncertainties, judgments, values, and interests. It is the second world in which we are all comfortably (or uncomfortably) at home, and science, like all other human endeavor, is a part of that world (1990, pg. 129-130).

Both Holton and Lemke suggest that science is more human (creative, intuitive, artful) than how we typically portray it to our students. A suprisingly large literature exists on the role that aesthetics, creativity, passion, beauty, and art play in the lives and learning of scientists (Dirac, 1963; Gleick, 1992; McAllister, 1996; Poincaré, 1946; Root-Bernstein and Root-Bernstein, 1999; Tauber, 1997; Wechsler, 1978). This colorful side of science appealingly demonstrates there is room in science for students who are not highly logical-mathematical or linguistic. To suggest otherwise dehumanizes the field, alienates many children, and misinterprets the nature of

the discipline. Teaching science in ways that disrobe the "mystique of science" and portray the field in its "private" form is a vastly underutilized entry into science learning.

I have developed a set of pedagogical strategies, which invite more students into science. These strategies, collectively called teaching for *aesthetic understanding*, frame science in ways that take the "soapy sting" out of science for many students. The pedagogy and components of the analytic framework are illustrated with examples from 4th grade science students I've worked with across the last two years.

What is an aesthetic understanding?

> *The world looks so different after learning science. For example, trees are made of air, primarily. When they are burned, they go back to air, and in the flaming heat is released the flaming heat of the sun which was bound in to convert the air into tree. [A]nd in the ash is the small remnant of the part which did not come from air, that came from the solid earth, instead. These are beautiful things, and the content of science is wonderfully full of them. They are very inspiring, and they can be used to inspire others.*
>
> *...Richard Feynman*

Illustrated nicely by Feynman, **an aesthetic understanding is a rich network of conceptual knowledge combined with a deep appreciation for the beauty and power of ideas that literally transform one's experiences and perceptions of the world**. Increasingly, philosophers and educators argue that the arts and aesthetics have lessons to teach us about ourselves and our world, affect and imagination, passion and cognition (Dewey, 1934; Eisner, 1998; Garrison, 1997; Greene, 1995; Jackson, 1998). I believe we can teach science in ways that borrow from aesthetic and artistic ways of knowing, engaging more students with the beauty, power, and value of science ideas.

Teaching for aesthetic understanding is not only a way to invite more students into science, it moves those already comfortable to new levels of action, perception, and value. Aesthetic understanding accomplishes this in three ways.

Aesthetic understanding is transformative.

Feynman's quote illustrates the transformative nature of aesthetic understanding as he "sees" the event of combustion in a different and beautiful way. In an astronomy unit, a student named Robert explained, "I never realized everything was moving - the earth, the sun, the moon, the stars - everything is moving and it blows me away!" Realizing he would never view the night sky the same again, Robert added, "I never thought I'd become the kind of person who talked about and thought about such deep things." Aesthetic understanding literally transforms who we are and how we see the world.

Aesthetic understanding is unifying.

Part of aesthetic understanding is developing coherence of parts, pieces, ideas, and concepts. For example, as one learns about individual elements of the periodic table, the entire table is better understood as a series of relationships and continuities. Individual elements and relationships between elements merge in a unified and dramatic way, disclosing secrets, and allowing one to see the beauty inherent in the structure of chemistry.

Aesthetic understanding is compelling and dramatic.

Aesthetic understanding draws students into the world through intellectual interactions and explorations. It is common for my students to think about science ideas outside class, to search for examples and illustrations of ideas, and to tell others about what they've learned, relishing in the excitement and engagement of looking at the world with wider eyes.

Aesthetic understanding teaches content and it demonstrates an empowering way of perceiving and interpreting the world through science ideas. In Greene's (1995) words, students become more "wide-awake" to the world appreciating beauty and structure in new ways. This is what aesthetic understanding adds beyond more traditional learning.

How can I teach for aesthetic understanding?

A productive metaphor to guide your efforts toward teaching for aesthetic understanding is to imagine yourself as an artist. Like any artist, a teacher shapes particular materials (students, activities, curriculum…) to produce meaningful 'works' (in this case, aesthetic understanding through a different portrayal of science). What follows are three examples of how this metaphor might be used to re-focus your pedagogy.

Shaping content

Children come to experience science ideas first through the eyes of their teacher. To insure students' first experiences do not 'sting' with the soapiness of a dis-interested or un-impassioned science, ask yourself why you love your area of specialization, what ideas ignite your interests and passion, and what ideas you get most excited about teaching. Let these ideas serve as top-level organizers for your instruction. For example, I am fascinated by the idea of adaptation. It is what drew me to the study of biology and I find power and beauty in its implications. While teaching an ecology course, I highlighted adaptation as my class moved through a more traditionally organized textbook. While studying biomes, my students imagined what adaptations organisms might need to survive in different regions. While learning about ecosystems, my students studied how particular organisms were uniquely adapted to inhabit particular niches within that ecosystem.

Highlighting the idea of adaptation allowed us to move through a relatively traditional looking curriculum while focused on a powerful and important scientific idea. Adaptation allowed my students to find coherence in nature, see their world and its organisms differently, and were necessarily drawn into the world as they looked for illustrations of adaptation on their own. How is this different? Rather than leaving the concept of adaptation as something to be understood, I let adaptation and my enthusiasm for it, guide our entire unit. Adaptation became an idea to be

relished, explored, and valued. This simple re-focus put a powerful and revealing idea at the center of learning. Teachers' passions for the beauty of science ignite students' passions.

Shaping actions - yours and theirs

Teaching for aesthetic understanding forces us to be acutely aware of our affective influences as we try to invite more students into engagement with science ideas. Shaping curriculum in ways I've described above is a good first step but, inevitably, you will find yourself faced with teaching something that you do not enjoy or value. In these cases, you must continue to portray the kind of science with which students will want to engage. As students develop their own aesthetic understandings of science ideas, they may find value and beauty in ideas that you do not value. When this occurs, it is imperative that you effectively support students' attempts to see the world in different, aesthetic ways. This is not trivial. Learning science through artistic and aesthetic ways of knowing often forces us to think and talk in ways that may make us seem awkward or even foolish. Leo, a recent student of mine, found it useful to imagine himself as a molecule swimming in molten lava, trying to form crystals. I thought he was just being silly as he "swam" around the room with his eyes shut exclaiming, "It's hard to swim in molten lava. If it cools too soon, I won't form crystals!" But Leo needed to express his emerging understanding in this artistic way. After stifling a chuckle, I commended Leo for attempting to find value in his understanding of crystallization.

To shape actions, you will need to a) be aware of the messages you send to your students about the value of science ideas; b) support students' in their attempt to find value in ideas, and; c) imagine yourself as a novice learner approaching science ideas for the first time and anticipate ways to help students find value for themselves. Teaching for aesthetic understanding forces teachers to see the world through the eyes of children, and vice versa.

Shaping perception

Our brains are amazing. With just a quick opening and closing of your eyes, you can gather a great deal of information about your surroundings - color of the room, approximate number of people in it, the pattern and shape of the objects in the room. This ability to rapidly recognize and interpret our surroundings is vital to our existence. However, it also serves to blur perception. We often fail to look closely and carefully at our world. "Re-seeing" is an attempt to focus our perception on the nuance and detail of the world. Re-seeing requires that we look carefully when we might be tempted to assume we see everything. Re-seeing is also a disposition that causes us to ask questions such as, "What's really going on here? Why do things look the way they do?" And "What kinds of things do I need to know more about to really re-see this?"

I have used re-seeing with powerful results in my teaching. During the course of an astronomy unit, Edie exclaimed excitedly, "I did some re-seeing last night!" While outside she noticed the moon. "I could actually tell that it was just a shadow that made it look like a fingernail." For probably the first time in her life, Edie looked carefully at the moon and wondered why it looked as it did - she "re-saw" the moon.

Conclusion

Teaching for an aesthetic understanding requires teachers to be familiar and confident in their understanding of subject matter to reorganize curriculum in more powerful ways. It requires teachers to relinquish some control - trusting in students' curiosity as they hypothesize, speculate, and test ideas. Teaching for an aesthetic understanding with a rigid curriculum guide and a strict instructional calendar would be difficult. Rather, aesthetic understanding encourages teachers to travel at the students' pace - exploring, imagining, and wondering about important science ideas.

Certainly, teachers teaching for an aesthetic understanding have much to consider in terms of assessment practices. Aesthetic understanding is not at odds with traditional conceptual learning; in fact, I suggest that it can only serve to bolster, inspire, and solidify it. Aesthetic understanding adds to the breadth of assessment data allowing us to say more than simply, "Suzy got it and Johnny didn't." What does it mean if Suzy got an A but is uncaring about the ideas studied? What does it mean if Johnny gets a C but is alive, even passionate, with new ideas? Which child has been successful? Teaching for aesthetic understanding widens our definitions of successful learning to include attitudes, actions, and expression - qualities not typically assessed.

Research has shown student attitudes are linked to achievement as well as motivation to persist in science courses (Kahle and Meece, 1994). Teaching that appeals to aesthetics and more artistic ways of knowing may foster more positive attitudes toward science. Students can learn to "love" science while learning to "get" it as well. Additionally, aesthetic understanding may invite a different type of student into science. Traditionally, our schools reward the logical-mathematical and linguistically adept, however, these are not the strengths of all students.

Aesthetic understanding is simply a point of entry for another spectrum of students - working to dispel the "mystique of science" and demonstrating the messy, "personal" qualities of the discipline. If we are truly committed to science for all (AAAS, 1989), then we must portray science in ways more appealing to all. Removing its painful 'sting' is a good start.

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