



## 2008 AAAS/Subaru Essay Writing Competition for K-12 Educators, Finalist Essay



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Most students come in surprised to learn that science is amazing. Consequently, if kids learn “nothing” all year but leave my class loving science, I’m satisfied. It may seem heresy to say so, but as a middle-school educator, I am not specifically seeking to train a future generation of scientists. I consider it far more important to inspire lifelong science literacy of a very specific sort.

I teach toward developing an informed citizenry whose members can effectively weigh difficult science issues. “It’s going to be your future,” I keep telling them. “It’s going to take a lot of science to sustain a world with 10 billion people.” If they don’t love science early on, they’re not going to pay attention as they age. If we as educators aren’t opening their eyes to science when they’re still “wow-able,” what are the prospects for science decisions in a future democracy? Can inadequately informed decisions be called genuinely democratic?

I ask these questions, I note, as a native Kansan unwilling to teach science in my home state, where—ironically in a contemporary, agricultural economy—a rather sophist politic has come to sorry juncture with a certain scientific naiveté.

Recognizing these difficulties, I come back to my classroom and grab a hunk of friable crimson chalk. After rolling it in my hand for awhile, nonchalantly, I brush something out of my eye, maybe rub my nose, later lick a finger to turn a page. Shocked noises come from students who have never seen a teacher’s face covered with red chalk dust. Neither, I might add, had the principal, who during this lesson last fall put her head in for the first time all year, then looked genuinely alarmed: “Is it catching?”

### **The Joy of Germs: "Is It Catching?"**

I adore teaching disease and epidemiology, because the topic so readily serves up shock and awe, the stock-in-trade for 12 year olds. It grabs them, and if it grabs 'em, I've done my job.

The informal start to the unit comes sometime early in the school year, whenever I first notice kids chewing on pencils, biting their nails, or (I deeply regret to say) ever so stealthily sneaking a finger up that nose.

I run screaming from the room. No kidding, I really do. And my students start loving science that day, or so they keep saying. To me, this is nothing odd. As I've told more than one class, I think it's tough to make science seem dull. There's just so much about it that's pure fascination.

To my students, this joy in science comes as rather a surprise. Hearing me say that I think it takes hard work to make the subject boring, a student raised her hand. “Then Mr. X sure must've been working hard last year,” she said.

It breaks my heart.



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Exactly my point. Children may conceptually understand how invisible germs are transferred from one organism to another via a common surface, but it takes imagination and energy to make the lesson visible.

So we paint our hands electric blue, covering them in tempera paint, then donning taped-over lab goggles and washing until we think the paint is gone. It takes a lot more washing, a lot more soap, and a lot more scrubbing to really get clean.

And we gasp large gasps together as I read *The Hot Zone* out loud and linger over the more (shall we say) dramatic passages. We watch *Secrets of the Dead*, on the 1918 influenza epidemic, learning how scientists recently dug into the frozen tundra seeking DNA from that pathogen. We look at how treatment for the flu changed along with understanding of the pathogen, and at a very simple level, we learn that “flu” is a respiratory illness, not the gastrointestinal bug for which most people use the term.

And just about the time it seems we might be working too hard, maybe getting just a tiny bit bored, we fan out across the building to lurk all day in the bathrooms, counting the number of students who walk out without washing their hands. If you are 12 or 13, trust me, it is hard to imagine a better day than this.

So what does this tell us? What do we think the hand-washing rate means for the illness rate in our school? How can we link our observations to form a hypothesis? And while we’re at it, what is public health, anyway?

I wish I’d saved some of last year’s “public service campaign” posters, so alarming were they, so

attention-grabbing. The kids decided where to hang them: over bathroom mirrors, inside stalls, on building doors so you couldn’t come in without seeing them. One of these years—maybe this one—we’ll take the issue to a broader public, trying to determine why no time for pre-lunch hand washing is built into the school day. (I can gauge my students’ understanding of disease transmission by just how disgusted they are at the idea of dirty hands at lunch, and by how many bottles of hand sanitizer start showing up in lunch bags.)

Always, always, we come back to our own clean hands, though we may travel some distance before we do. For example, we run through a fabulous web-based epidemiology exercise called EXCITE: Epidemiology in the Classroom (<http://www.cdc.gov/excite/classroom/incex.htm>), developed by the Centers for Disease Control (whose classroom materials I consider the very best available for 7-12 students today). In it, students “track” the spread of an illness at a fictional middle school. The website lets my real students compare the activities of the fictional students, seeking common factors that led to the outbreak of the fictional disease. It’s an excellent lesson in the use of the scientific method, helping students sort data from anecdote.

Equally important, the CDC site allows me to employ technology to prepare my students for “solving” historical mysteries about how disease is spread. On the site, they are led through an excellent model; through this experience, they are drawn into the nature of the epidemiologic endeavor itself.

Another great web-based activity, Conducting a Scientific Investigation



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(<http://science.education.nih.gov/supplements/nih6/inquiry/guide/lesson3-a.htm>), from the National Institutes of Health, provides students with a role-playing activity where student teams develop testable questions and investigate a possible health problem in the local school district.

This engagement prepares us to move with equal fascination back through time. We act out the mystery that Ignaz Semmelweis faced, trying to figure out both what he discovered (clean hands) and why his colleagues were so reluctant to believe him. We read the young-adult novel *Fever 1793*, historical fiction about the yellow fever epidemic in Philadelphia, a book whose virtues include both its graphic detail (a favorite of this age cohort) and its historicity: because people of the era did not know what caused the disease, neither do the novel's readers, and this becomes another mystery for us to unravel.

*Fever 1793* bumps us into both online data searches and mathematical modeling. We move into exponential equations for the first time as we graph the spread of the yellow fever epidemics through recent history. We then seek to develop equations that show how disease might spread in our school depending on transmission rates; again, this brings us back to the data from our hand-washing study so we can see if our public-service campaign has had an effect.

All this might seem tough going, in and of itself, but by now these kids own this material. The hand-

washing study is far more than numbers on a textbook page. It's "their" study, "our" data—and when you own something, you really, really care.

By the time we're finished with the unit, this ownership has leveraged the acquisition of a far more extensive knowledge. My students know the difference between a virus and a bacterium, understand the dangers of antibiotic resistance, and can reel off a list of dangerous new zoonoses and define that word. They have designed an experimental protocol for establishing the likelihood of disease transmission among students at our school, known the difference between a population study and a sample study, explained the relationship between sample size and validity, and can tell you how to contain the spread of diseases that range from Lhasa fever to the common cold. Speaking of which, they can tell you the difference between a coronavirus, a rhinovirus, and an adenovirus—in broad terms, anyway. But guess what? I don't care. Because I'm not aiming for them to learn all this stuff, though heaven bless them when they do. I want them to have the pleasure of loving science, and somewhere along this journey, somewhere in the middle of getting their hands dirty up to their elbows, they have been amazed.

The amazement of science is ultimately what matters for all of us. We've got the rest of our lives to keep learning more details.