

Hi Samantha
March 20, 2013

I was thrilled to receive your letter today – the timing was perfect because I will be flying off to see you in an hour or so. I did want to respond right away, however, because I loved to hear about your encounter with physics.

I was first of all, very impressed that you would go to support your friend – even though you didn't have much of a connection with physics. It not only reflects your commitment to friendship, but also your openness to adventure – however strange it might appear. I expect that you will even pick up some tidbits of physics along the way. This can't be all that bad!

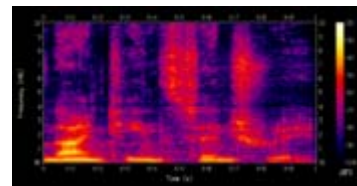
Unlike you, I enjoyed physics in high school – and in some ways even more at university. For my first two years at university I took physics as one of my main subjects since I enjoyed thinking about how mechanical things worked and exploring some of the mysteries of the world (and universe!). In those days, we hadn't heard about black holes since the observations and explanations related to them were only in their beginning stages. Einstein had contributed his ground-breaking ideas about relativity and energy – and his famous equation that you mention was well known because of the atomic bomb but many of its implications were not well understood. We still thought that time travelled only in one direction and that Pluto was a planet like the others.

I entered into physics with a high school belief about how science got done – that it was the result of many scientists working in their labs on rather clear ideas of the world. I thought that new ideas emerged from well-formulated stories about how things worked and carefully documented results from their experiments. It seemed like a world that was very foreign to my experience.

My experience of learning was much more chaotic than that. I would get intrigued by an idea, some occurrence, or somebody's challenging claims about the world and it would send me on a tizzy of reading, arguing, and fits of confusion until I either satisfied myself with some convincing explanation, or something else would draw my attention in a different direction. We couldn't 'Google' things in those days, so my favorite place would be the bookstores and libraries as I searched through all the exciting ideas. I guess, in this way, you and I are similar!

Since my experience was much more chaotic than the portrait given in high school, I wondered if I would ever 'fit in' to the structured world of science (as I thought it must be). I was delighted, therefore, when I (quite by accident) decided to attend a lecture by a world famous physicist who was visiting UBC at the time. His name was Gerhard Herzberg. He is a well know Canadian physicist who won a Nobel Prize for Chemistry in 1971 for work he had done on electronic structure.

When I went to hear him speak, his topic was about the events leading up to the discovery for which he was awarded the Nobel Prize. Much of it involved looking at spectrograms of distant planets and stars. Spectrograms are like maps of frequencies in sound, light, or atomic activities. I found an example of one on Wikipedia that represents the spectrogram of a person saying "nineteenth century". You can see it on the right.



The room was overflowing when I went to the lecture so I had to sit on the stairs (one could do it in those days without being kicked out by security). He began to tell the story about how he 'discovered' the new understanding of molecular structure that won him the Nobel Prize.

It started, he said, one day when he was feeling particularly stressed by his research, teaching, and family demands. In the middle of all these stresses he opened a letter from a graduate student in another country who was inquiring about how to interpret a spectrograph he generated by looking at a pair of stars somewhere in our galaxy. The letter included a picture of the graph along with the student's best guess at what the results meant.

In his frustration and impatience, he glanced at the graph and sent off a short letter to the student informing him that the interpretation was wrong - and offering an alternative. He then turned back to other matters and forgot all about it.

A few weeks later he received a follow-up letter from the student (that's how long it took in the days before the internet!) in which the student politely told him that he was wrong - and pointed out the evidence that he thought was convincing.

Herzberg said "At this point I got mad! Here was a graduate student telling me what was right! How impertinent!" Obviously, this had caught his attention. In order to put the student in his place, he went back to the graph and began to look for the evidence that would show the student that he was wrong.

As he worked with the graph, however, he discovered that they were BOTH wrong! Something was happening that didn't fit with either of their interpretations. It looked like a quick letter to put the student in his place was not going to be forthcoming. Now he was really hooked!

In order to figure out what was going on, Herzberg put aside his other tasks and concentrated on figuring out what the graphs meant. He conducted his own measurements and considered alternative explanations. When he did find one that was more satisfying than either of the previous ones he had laid the foundation for a new understanding of molecular chemistry that changed the way all scientists were thinking. This new insight was important enough for him to win the award.

I love this story - not for the physics or chemistry of it - but for what it reveals about the way that science (and understanding) moves ahead. He was obviously well trained and had access to many tools that allowed him to analyze molecular structure, but a key element to the breakthrough was his anger at being contradicted by an 'underling' and his persistence in trying to support an alternative claim. That was closer to my own experience than the representations of science that I was given in high school.

Since then, I have been more sensitive to the personal and social aspects of learning and scientific knowledge. It turns out that they are a lot like you have described in your lovely letter: taking advantage of opportunities that come your way, mixing with people who have different interests than your own, being open to some of the 'cool ideas' that are part of those different interests, taking advantage of the emotional responses that these activities generate - and perhaps the most critical one - exploring these new ideas with humour and inquisitiveness.

Maybe I'm making too much out of a lovely weekend and clever letter - but that's what grandparents do! It's also a fair reflection of the type of joy your letter brought me - and why I am so glad that you set up this exchange.

Love,
Bill