

EARLHAM COLLEGE

**Baccalaureate Address
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Conformational Change

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Anicka, thank you for that lovely introduction, and, everybody, thank you for this invitation. This is a *singular* honor. When I told my father, who has lived almost his whole life in academia, about your invitation, his first response was: “What an honor!” His second response, about five seconds later, was: “Can I come?” He recognized immediately how important this is to me. I’m glad there’s room here for one more parent.

Thank you all for the new pair of glasses. I don’t mean these actual glasses. I mean the lenses through which I’ve been seeing the world for the past two months. Basically everything I’ve read, every song I’ve listened to, every story on NPR, or every little thought that’s popped into my head, I’ve examined as potential for this talk. “Is that an idea that’s informative or amusing enough?” “Is **that** inspirational story good enough to include?” I wish I could share with you some of the stories and ideas that didn’t make the cut.

This is an interesting way to look at the world, and I recommend it to you. Imagine you’ve been invited to share hopefully meaningful words with a few of your friends who you probably won’t see for a long time, as I have been. What would you say to them? It’s mind-expanding to have this kind of intentionality about events, thoughts, and other people’s ideas. It’s an interesting prism to refract the world through. Even the ideas that don’t make the cut take on new significance. Try it sometime. Don’t just listen to the words, even if they’re only in your mind; ask yourself if they would be good enough for **this**.

Here’s my brief biography: I was born in Wisconsin but I did most of my growing up in Connecticut. I majored in physics at a liberal arts college. My transcript looks pretty good but not great. After college, thanks to a lucky break that I owe to my father, I got a job as a technician in a biophysics lab. Those two “gap” years put me on my career path to this high point today. I took a brief detour to work on my uncle’s cottage in Maine, where I also worked on a lobster boat out of South Harpswell. That was a great experience, but I knew that I wasn’t built for lobstering. So I went to grad school, and then landed a job at the University of North Carolina at Chapel Hill, where my wife and I raised our two children and where my academic work was research and discovery, publications and grants, and teaching of medical and graduate students. It was a good run, but after two decades I was ready for a change. So, in 2008 and 2009, when my son was looking at colleges, as you did, I thought I would, too. Earlham was the one college willing to change my life. What?

Did you think that “Colleges that Change Lives” do so only for people in their teens and twenties? Look around you — or look around me, anyway — it changes the lives of people of all ages, every year. I feel incredibly lucky, not only that Earlham accepted me, but also that my wife Lyn was willing to let me pull up her roots, at least partially, along with my own. So you and I are now seniors together, except that you’re graduating and I’m not.

I graduated from college 36 years ago. I don’t remember a single thing about the commencement speech. What I do remember is the argument I had with my friends afterwards. Because I had lucked into that technician job, the message I heard was “It’s good to have a plan.” But my two best friends, who didn’t yet have plans lined up, heard “It’s good to **not** have a plan so you can figure out what you’re really called to do.” These friends have gone on to stellar careers, so both messages have been correct.

This reminds me of a lesson from neuroscience: Emotion affects memory. We remember facts and events that have emotional content better. Your parents or grandparents may remember details about November 22, 1963 better than other dates from that era. You probably remember details about September 11, 2001. This enhanced memory has to do with the interaction of the stress neurotransmitter norepinephrine and a form of cellular learning called long-term potentiation in a part of the brain called the hippocampus. Long term potentiation in the hippocampus is an important step in the formation of memory, and norepinephrine, associated with stress, enhances it. Don’t worry, I’m not going to test you on this. The point I want to make is this: Stress, up to a point, enhances memory. This explains why we professors give you exams; we know the stress of an exam helps you learn and remember.

But, just as stress — not too much and not for too long — enhances learning, so can pleasure. Dopamine, a neurotransmitter associated with rewarding events, also enhances long-term potentiation. You may remember a special childhood holiday or birthday. I remember like yesterday the sunshine on my face and the buildings on either side of me as I walked down the street to the hospital where my daughter was born, over 27 years ago. Being a new parent must have activated both the stress pathways and the reward pathways, which is why I remember that simple walk so clearly. So I don’t remember what the commencement speaker said 36 years ago, but I remember the argument afterwards because of the dopamine and norepinephrine associated with it. So here’s today’s take-home item #1: It’s good to have a plan, and it’s good to give yourself room to form your plans. Go have an enjoyable argument with your friends and family about it, so you’ll remember.

Here’s take-home item #2: We are very proud of you. We love to talk about your accomplishments. We are amazed by your achievements in classrooms and laboratories, Goddard Auditorium, Wilkinson Theater, on display in art galleries, on athletic fields, and all over the world. Behind closed doors we pump our fists when you succeed. When asked “What’s the best part of Earlham?” we say “the students” and we mean it, even after it starts to sound like a cliché.

We also admire your resilience. The way you handle adversity. The way you picked yourself up from devastating loss, opened yourself up to sorrow, and carried on. This year has been difficult. You’ve faced more death in two years than most Americans your age. I feel the need to say their

names out loud so we can remember their faces and their lives: Mark Christianson, Pema Norbu, Daniel Kupchik, Samantha Malenchak, Tracey Heymann, Lenore Edwards, Kushan Chirantha Thelikada Palliya. I read an article recently about resilience. Research now says that resilience is a process that we go through, not a characteristic that we have or don't have. We're proud of how you've gone through the process of grieving and recovering.

A few weeks ago I heard an interview of Emmylou Harris, the singer-songwriter. She was talking about Gram Parsons, who died of a drug overdose when he was 26. She said something that I wish was true. She said, "People in their twenties think they'll live forever and they think all their friends will live forever." You, more than most of your peers, in this country at least, know that's not true. We're proud of the way you as individuals and as a community have faced reality.

I also I heard a quote recently from Fred Rogers — you know, Mister Rogers. He said, "When I was a boy and I would see scary things in the news, my mother would say to me, 'Look for the helpers. You will always find people who are helping.'" We're proud of the way you've done this. You've looked for help. You've been the helpers.

T.S. Eliot wrote: "No poet, no artist of any art, has his complete meaning alone. His significance, his appreciation is the appreciation of his relation to the dead poets and artists. You cannot value him alone; you must set him, for contrast and comparison, among the dead." Of course, what Eliot said about poets and artists is also true for scientists. And, really, it's true for all human beings: Our lives make sense and have value in relation to the people who have lived with us and before us.

Here's take-home item #3: You have choices to make about what to be aware of, and making those choices can be hard work. The world is full of dualities and illusions. Think of the vase/face illusion — is it two faces in profile, staring at each other? Or is it a vase? It's both. Be aware of the choices you can make to see the faces and the vase.

Think of structure and function. Many of you will remember the phrase "Structure determines function" from "Cells, Genes and Inheritance." Maybe you remember it because of the emotional content we loaded it up with: It's associated with your exams, so just reminding you of that course could be activating your norepinephrine neurons. But we also gave you a reward for that phrase, so maybe it's activating your dopaminergic neurons, too. Even those of you who didn't take CGI could ask "In my field, does structure determine function?"

For me, a molecular neurobiologist, "structure determines function" is a natural statement of the way of things. The structure of DNA shows us how it stores genetic information — its function. The structure of a neuron, with a long filament that extends all the way from a fingertip to the brain, informs us about its function to carry information.

But to my friend Brent Smith, an evolutionary biologist, function determines structure. The selective pressures on an organism guide the evolution of its body, its structure. So the function of a bird's beak, like whether it needs to crack seeds or nuts or insects to eat, applies selective pressure and determines the beak's structure as the species evolves in subsequent generations.

So structure determines function **and** function determines structure. It's a face **and** a vase. It's good to have a plan **and** it's good to let yourself find the plan.

Another example is Maya Lin's sculpture at the Vietnam Veterans Memorial in Washington, DC. The names of dead Americans are carved into a sheet of polished black rock that extends for a long way. You see the names, thousands of them. But when you step close you also see your face reflected behind the names, and you see the reflections of other people around you. You can focus on the names of the dead and the faces of the living. You can't focus on them both at the same time, but they're both right there. You have to choose which to focus on.

Sometimes it's not so easy. You may have to work at it. You may make mistakes and see only one way for a while. Let me tell you about a mistake I made until just a few weeks ago, related to the Earlham College Mission Statement. This is a beautiful synopsis of Earlham, and it attracted me to Earlham four years ago. It includes, among other things, "pursuit of truth, wherever that pursuit leads; letting the evidence lead that search; rigorous integrity in dealing with the facts."

If you're like me, you tend to focus on words like "truth" and "pursuit," "evidence" and "integrity," and even "facts," no matter how slippery they may be. Those are big, meaningful words. As a scientist I know I obsess about "evidence." I've focused on that word for a long time.

But another important word in that piece of the Mission Statement, a word that I only saw clearly as I was preparing for today, a word you might not focus on, is "letting." Not pursuing, but letting evidence guide the search, letting a moment show you the way, letting your mind see the names carved in and the faces reflected back, letting yourself consider the possibility that you might be wrong, that you might be seeing only one side. Of course you also must also act, you can't only "let." You must take action for yourself and your family, for your friends and your community, for the world. But while acting it's important to let yourself consider other actions.

Finally, let's circle back to the title of this talk, "Conformational Change." For many of you, who have heard me say these words before, I hope you smiled when you read them. That was my intent anyway — dopamine, not norepinephrine. It turns out that just sitting here, looking around, listening to me, feeling your clothes on your skin, breathing in and breathing out, thinking your thoughts, billions of molecules that make you up, your body and your mind, are undergoing nanoscopic changes in their structure, changes in their "conformation." You're changing as you sit here. Your synapses — the connections between the neurons in your brain — are changing, expanding and shrinking, connecting and disconnecting. The norepinephrine and the dopamine of this moment are making sure that some of your synapses are different now than they were a few minutes ago, and they could stay different for the rest of your life.

The point is this: You are undergoing conformational change. Right now. You, the whole you, have gone through incredible conformational changes, and you will continue to do so. We're proud of the ones we've contributed to. We're looking forward to hearing about the ones yet to come. Let yourself see them, and then please tell us about them. Please be careful out there. And please remember, we wish you joy, peace, love, and understanding.