

## A Frontier as Open as Your Mind

Thank you. Class of 2020, on behalf of all of my colleagues, I want to welcome each of you. We are excited that you are here. It is an honor to have been invited to give the convocation address. But, I have to tell you, if you want to know what a “deer in the headlights” looks like, just ask President Murray to describe the expression on my face when she first asked me. And I must confess to you: even after I accepted that invitation, I found myself vacillating between the thrill of the challenge, and anxiety from the pressure, to deliver something profound and worthy of the ages.

But then, it dawned on me—this is Convocation, not Commencement. Commencement is when we try to get in our last word as you, our students, are heading out the door. There is a lot of pressure there. But my job isn’t to send you off into the world with pearls of wisdom worthy of the ages. Instead, I’m here to give you a friendly push toward culturing your own pearls through the work you do at Whitman, and the relationships that you form here.

And so, as Convocation speaker, I get to have the first word. Here it is. Regardless of our specialty, each of your professors at Whitman wants the same thing for you. We want you to find your own path, to speak in your own voice, and to take on new challenges. To encourage you as you begin this journey, I’d like to give you a few “insider tips” based on my own experiences as a student. And, as a neurobiologist, I’m going to share some insights about how your brain changes with experience. But first, let’s consider the metaphor of “a pearl of wisdom” from a biological perspective, because I think it reveals an important dimension of the intellectual life of this place.

Pearls are prized as lustrous gems, but they begin to form when chunk of grit penetrates into the oyster and bothers it. Ironically, a very productive experience begins with a disruption, and the natural first response is self-defensive. Once that grit is in there, there is no getting rid of it. So the oyster wrestles with it. This process continues, for months and even years, and in the end it creates something that wouldn’t have otherwise existed. The pearl takes its remarkable form and color based on interplay between the physical properties of the foreign object and the physiology of oyster’s inner world.

While you are here at Whitman, you will encounter ideas, and intellectual challenges, that will push you out of your comfort zone. You will engage in hard conversations about politics, environment, race, ethnicity, inclusion. Perspectives will differ from yours. Work that would have made you proud in high school will fall short here. So, how will you respond? Now, I’m not suggesting the oyster as the new mascot for Whitman (although we are looking for one). Instead, I hope you will embrace it metaphorically and consider adopting it as your spirit animal.

The generation of the pearl occurs at the interface between the oyster and the surrounding world. You too have just crossed a border, moving beyond your b.c. (before college) era. This places you at a frontier in its most basic form. The Oxford English Dictionary defines a frontier as “a line or border separating two countries<sup>1</sup>.” At their worst, borders block exploration and prevent us from challenging dogma. But when these barriers are broken down, new frontiers open.

We are thinking a lot about frontiers here at Whitman. As President Murray noted in her installation address “Frontiers of a Liberal Education,” you are about to engage in an academic experience that has deep historical roots, but Whitman’s purpose is to make you better at exploring territory that may not yet be on anyone’s map<sup>2</sup>. The fact that President Murray is leading Whitman opens a new frontier: I’m sure that I don’t have to tell you that Kathy is our first woman President.

Working in an inclusive environment enhances the probability that we will solve the many challenges we face today. A recent paper called “Collaborating with people like me” documents the fact that scientific papers written by a culturally homogenous team have significantly lower impact than those written by teams that represented cultural diversity<sup>3</sup>. And in a New York Times Op Ed called “When Women Win,

Men Win Too,” Nicholas Kristof showed data from many different professional settings where teams that included both men and women improved productivity and chance of success<sup>4</sup>. Inclusive collaboration drives progress.

Looking back, I can see now that my work as an undergraduate carried me across a number of borders I was not even aware of at the time. When I started college, if someone would have told me that I would be spending my adult life thinking obsessively about brain development, if they had even said that I would become a scientist, or professor, no one would have been more surprised than I. That is an interest that unfolded during my liberal arts education at a small private college. I found my path as I talked with my professors in class, outside of the classroom during their office hours, and as I worked side-by-side with them in the lab.

At least some of you in the audience must feel like I felt when I sat in my college’s convocation. Excited to be sure, but anxious, even fearful. I come from a background that is now called “first generation/working class.” I didn’t really know what college was about. I certainly didn’t appreciate the difference between a liberal arts college and a technical one. I was self-conscious of lacking the cultural and financial resources of my peers. In short, I found myself at a frontier without a map. If this resonates with you—let me reassure you, you are not alone.

But the minute I set foot on campus I began making discoveries in the most unexpected places. Like all of you, I was assigned a pre-major advisor. My advisor and I had nothing in common—he was this old chain smoking Russian professor, Mirco Mitrovitch. But his background was so different than mine, it was fascinating to talk with him. And I credit him with encouraging me to take classes that I never would have considered. “You need to know how the world works—take economics!, take Russian (OK, that might have been a little self-serving on his part, but I loved learning the Cyrillic alphabet).

I’m going to throw down my first tip & challenge for you. Even if you think you have nothing in common with your advisor, they have so much to offer you. See if you can figure out what makes them tick. Did they spend this summer writing a new book, doing new experiments, analyzing how the Affordable Care Act affects the economically disadvantaged? And share with them things about yourself. One of the many reasons to come to Whitman is that you have the opportunity to develop a relationship with your professors. Connecting with them is one of the best insurance policies for success at college<sup>5</sup>.

Here’s another lesson that I learned in college. Draw your own conclusions. In a distribution course called “Sociology of the Family,” my professor declared that the purpose of public education was to tame the wild rural folk (of which I am one) so they could tow the line in industrial jobs. That bugged me. And I questioned my professor, but instead of getting a direct answer I got a tutorial on how to find and mine primary sources. It was like being a detective, and I loved it. Before long, every class that began with a textbook ended with trips to the library. Here is my next tip for you: listen carefully in the classroom—and then go to the original source. Look at the actual data. And think for yourself.

The distinction between academic disciplines was another border that melted away when I did my first independent research project in a faculty member’s lab. It was a sweet little project: trying to figure out the neural basis of fish migration. I collected little minnows, and samples of water from their home and foreign streams. I dribbled the different waters over their little minnow noses and tried to record the brain’s response.

Without even realizing it, I was getting serious training in the process of discovery. And, as I borrowed from Psychology, Biology, Chemistry and Physics to try and get those little minnow brains to talk to me, I gained first hand experience with how knowledge advances when tools from multiple fields combine. And so here is my next tip: a course catalogue segregates majors. But sometimes, your biggest discoveries will happen when you integrate across disciplines. And so, my next challenge for you: make a deliberate

effort to relate the different courses you take to one another. As you do, you will build your own intellectual scaffolding on which you can stand to reach for new places.

Neuroscience as a discipline is a relatively new field, but great minds have been studying the brain for as long as humans have existed, grappling with ideas of identity and humanity. The Ancient Egyptians did brain surgery<sup>6</sup>. And as frightening as that sounds, there is also evidence of prehistoric brain surgery too<sup>7</sup>. Galen, physician to Roman gladiators, explored many brains from skulls cracked open in the name of professional sports. His work poured the foundation for mapping brain function to brain anatomy. To this day, some parts of the brain retain the names he assigned to them<sup>8</sup>.

The first microscopic images of brain cells, called neurons, revealed cells of stunning size and complexity<sup>9</sup>. The resemblance between neurons and trees was striking. In retrospect, however, the intuitive appeal of the analogy distracted us from recognizing the remarkable modifiability of neuronal structure. Although most neurons live for our entire lifetime, they are anything but static. Today we have imaging technology that allows us to watch the connections between neurons, called synapses, over time. They wiggle and dance<sup>10</sup>. You might be wondering “so what?” Well, for you, the incoming class, this movement is a direct reflection of the potential for cells in the brain to make new connections.

My partner Chris Wallace and I met through a collaboration in graduate school, research that we continue with our students today at Whitman. At the time, the field was just starting to realize how dynamic cells of the brain could be. We hypothesized that if changes in neuronal structure were involved in learning, these changes should accumulate quickly, as an animal learned. So we studied rats, at the time where they begin to leave the nest and go into the world, about the rat equivalent of college age. We compared the brains of “couch potato rats” with a cohort I’ll call the “Whitman group.” Our couch potatoes lived alone in a spare space, while our Whitman rats lived as a group in a large environment filled with a changing assortment of objects to explore.

Even after just a few days, brain cells from our Whitman rats formed new connections compared to our couch potatoes<sup>11</sup>. The ability of the brain to change connections, or make new ones, is called “brain plasticity.” What triggers brain plasticity in our Whitman rats? Sensory stimulation, social interaction, play, exploration, and exercise.

Evidence suggests that the human brain responds to stimulating challenges in the same way. For example, a taxi driver in London studies for years, and must learn every street “A to Zed.” The licensing test is called “The Knowledge.” Research has shown that over time, a part of the brain involved in spatial learning, the hippocampus, increases in size as the driver’s scores improve on the tests<sup>12</sup>. Like London, Whitman is a complex and stimulating environment. So, take time during the semester to appreciate the fact that all the hard work you are doing is building your brain.

Furthermore, there is good news for all of us, including those of the “hope I die before I get old” generation. This brain building continues as long as we live. In that light, the brain never stops developing. Even when we look at synapses in the brains of old animals, they are still dancing<sup>13</sup>. If you consider your brain as the ultimate map of your possibilities, how you interact with the world impacts how your brain cells connect and communicate, even in old age. Think of your brain as a vampire (not a creepy vampire, just a hungry one). It craves novelty, and diverse forms of learning, so feed it.

Studies of the brain are getting a lot of press these days, and when scientific data are popularized, the reality can be distorted in the re-telling. The idea that a brain scan can be used as a lie detector, or determine whether someone is a sociopath, has spawned areas of “neurolaw” that are scientifically dubious, and politically problematic<sup>14</sup>. The evidence that computer brain games help with memory or problem solving is scant at best, and not compelling<sup>15</sup>. And no, you are never using only 10% of your brain, not even (or especially not) when you are sleeping<sup>16</sup>. Remember my earlier tip—before you launch into a new routine based on an article in the popular press, ask for the original data!

There is some good neuroscience to live by, however. Understanding what happens in the brain during learning can help you make lifestyle choices that maximize your benefit from new experiences. Research shows that studying and practicing over time, in measured intervals is the best way to learn<sup>17</sup>. With this in mind, you should structure your studying and paper writing so that your brain has time to absorb the benefits of what you did today and approach tomorrow's work fresh. Along these lines, sleep is crucial for storage of new memories<sup>18</sup>. The whole process is called memory consolidation and it is THE reason why you will always do better when you pace your learning. It is also why, what you try to stuff into your head during a marathon cramming session usually doesn't stay with you for very long. Just like the pearl, your brain assimilates knowledge, layer by layer. It takes multiple passes to build something of lasting value.

I want you to picture your brain "on Whitman" and make choices that support it as it works. Exercise increases blood flow to the brain, and that increased flow is like greasing the wheels of the cellular mechanisms that promote learning<sup>19</sup>. In addition, exercise is a powerful stress reliever, so make good use of the Baker Ferguson Rec Center, or, the Outdoor Program to get a dose of the beautiful northwest that surrounds Walla Walla. "You are what you eat" means even more when you consider that memory is encoded through the biological synthesis of new molecules<sup>20</sup>. So, you're in luck. The food at the dining halls is far superior to what they served when I was in college. Finally, be mindful of the risk of environmental toxins<sup>21</sup>. Get the right kind of water bottle so you aren't marinating your brain in plasticizing agents. And be aware that drugs and alcohol not only can have a dangerous allure but they also change the chemistry of your brain<sup>22</sup>.

I'm sure that you've all heard about left vs. right brain hemispheres. The simplest conceptualization is that the left hemisphere is "analytical" whereas the right is "artistic"<sup>23</sup>. But this view leads to a false dichotomy, and you impose your own barrier if you label yourself a "left, or right, brain thinker." These kinds of distinctions have also been used to polarize disciplines<sup>24</sup>. But in a liberal arts setting like Whitman, we are charged to investigate issues of humanity in a vigorous and balanced way. With so many tools at our disposal, and with a campus that is just the right size to walk across, we should never feel constrained by disciplinary borders.

The evolutionary biologist E.O. Wilson said "We exist in a bizarre combination of Stone Age emotions, medieval beliefs and god-like technology"<sup>25</sup>. And we have nothing but our brains to blame for that. Left to its own devices, the brain would feed its desire for novelty by spending more and more time staring at cell phones waiting for the next tweet, news flash, or Pokemon to appear. Maybe Pokemon Go is so popular because it resonates with our tribal hunter and gatherer instincts.

As for the tribal part of those Stone Age emotions, Joseph LeDoux studies the biological basis of our primal emotions, especially fear, and has noted the strong connections between our emotional and cognitive centers in the brain<sup>26</sup>. Carol Dweck's research shows that when we become fearful of failures, we begin limiting our possibilities<sup>27</sup>. And a central theme of Claude Steele's book, "Whistling Vivaldi" is the importance of learning what our unconscious biases are, and how they hold us back<sup>28</sup>. Together, the work of these three scientists highlight how our reluctance to dive into the unfamiliar, or worse, our unrecognized fears, can create insidious barriers.

What we imagine for ourselves is built from our own personal experience. Our challenge is to realize that we are shaped, and constrained, not only by those experiences, but also by our time. Remember Galen, physician to the gladiators? He imagined that the brain worked through some kind of aqueduct system. Aqueducts? An engineering triumph of the Romans. The Victorian Age of engineering allowed us to recognize that the brain was actually like a telegraph or steam-powered loom. And with the advent of computers...well, I think you can see where this is heading.

To understand anything, we build upon someone else's imposed structure. In the poem "London," William Blake called this our "mind-forg'd manacles"<sup>29</sup>. Mental handcuffs. But you don't want to be imprisoned by

pre-structured information. Training in the liberal arts allows you to diversify your academic portfolio. It will spur you to pursue the frontiers that fascinate you and cut across the intellectual borders that might otherwise restrain you.

Part of exercising imagination (let's call it creativity calisthenics) comes from being provoked by irritating failure. There are beautiful examples where the imagination of great thinkers of their time enabled a new time. In the Renaissance, for example, advances in the arts and sciences remain benchmarks of human achievement. The Santa Maria is a famous cathedral in Florence, Italy that was designed in the 1200's. It's nicknamed the "Duomo" because it has a fantastic dome. But the dome's form required an unsupported span that, at the time of its design, appeared structurally impossible. The cathedral sat unfinished for more than 100 years as the best minds tried to come up with some way to build that dome. Brunelleschi, a Renaissance goldsmith, with no formal training in architecture, finally solved the problem. He took inspiration from forgotten lessons of Roman engineering, building a massive dome with interlocking bricks, allowing it to be self-supporting as it towered to an unprecedented height<sup>30</sup>.

I believe that the greatest frontier before you, before all of us, is recognizing where established structures are useful, and when they become manacles that constrain us. What catches your imagination is where you direct your passion, it is personal, and it is original to you. It's in your DNA. To appreciate that buzz phrase to it's fullest extent, and to apply it correctly, you need a liberal arts education. This frontier is as open as your mind. The pearls you make are up to you.

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