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March for Science Address: April 22, 2017
Columbia, SC Statehouse

Good morning, South Carolina! Thank you for joining us on this beautiful Spring Day! It is an honor and pleasure to address you today. I bring greetings from the very special school in the Pee Dee region which I am privileged to serve. The South Carolina Governor's School for Science and Mathematics.

I am a scientist, a biologist to be precise, and a plant biologist, to be more precise. Like many of us who have followed a passion for science, mine started with a simple gift from my parents, a microscope. I spent hours every week with the most powerful lens, which provided a whopping 200 times magnification, collecting pond water and observing Paramecia, Amoebas, Vorticellas, Spyrogyras, and many other critters that were much more interesting than their arcane and unpronounceable names. This wonderful tool was the start of my journey as a biologist. Some of my friends became scientists by using a similar tool, which rearranged similar lenses in a different way, called a telescope, and became astronomers. As I grew into my studies, I came upon a book which made my journey a one-way ticket, on account of its storytelling, travels to exotic locales, encounters with 500 hundred pound turtles, long necked ostriches, and exquisitely diverse finches. A certain Charles Darwin titled the book On the Origin of Species. Nothing had prepared me for the parade of life that Darwin extended as a magic carpet, but most importantly for the marvelous adventure in argument, which made the living world alive, ever changing, with older living forms transforming into new ones, and ending with an all encompassing explanation of how life on earth came to be. No wonder the good old man spent decades sitting on his observations, as his theory of natural selection did nothing less than question the meaning of humankind's place in the universe, and he was spurred to publish his findings only when he found out that another guy, Alfred Russell Wallace, had independently come to the same explanation using a completely different set of data, and was ready to publish his results. Darwin and Wallace exemplifies science at its most exalted, exciting, and real.

I share this story because it is essentially the story of many of us who have pursued lives as scientists. The details of our journeys may differ (the books that inspired us, the chemistry sets that threatened our homes with a major fire, the Mechano sets that took forever to assemble), but our passion is one and the same: uncovering, discovering, experimenting, explaining, and delighting in our individual contributions to the communal enterprise of this activity called science.

Biology and science have come a long way since my time, certainly since Darwin and Wallace's times. My little microscope birthday present has been superseded with electron scanning, confocal, fluorescence and many other tools that vastly expand our observational reach for cells, microorganisms, viruses, even nanoparticles and individual molecules. Since the discovery of the DNA double helix in 1953, molecular biology has given way to genomics, post genomics, metabolomics, epigenomics, and many other blends of biological, molecular and computational science, with an informational output

unimaginable only ten years ago. New approaches to diagnosis, treatment and cure of diseases occur at ever-faster rates and with ever-greater accuracy and efficacy, based on our deepened understanding of how genomes, cells and organisms work and co-evolve. As its essence, however, science remains the same, a peer-reviewed, independently verifiable system of observations, hypotheses and experimentation, iterating into further refinements, deeper knowledge and understanding of increasingly complex problems.

Which leads me to the paradox at the core of the March for Science. If we agree on the power of science to contribute to common good, human well being, and responsible stewardship of our planet's resources, why do we feel placed in the position of having to defend science to our community and our government? It would be impossible to do justice to the complexities of a coherent answer to this paradox in the allotted time, but let me suggest some guiding principles and opportunities.

First, acquiring knowledge, let alone understanding, is difficult! Duh, of course. Nature is complex, and does not yield its secrets willingly. This much we have learned from Francis Bacon, the philosopher and statesman who established the conceptual foundations for modern empirical and experimental science in the early 1600s. For every insight we scientists develop into how a cell works, many sleepless nights and failed experiments are left behind. (In this sense, us scientists have much in common with the entrepreneurs who populate the high tech innovation ecosystem). If knowledge is difficult to acquire, it may be even more difficult to explain. I would need a good chunk of time to explain to a layperson the principles of
optics on which a microscope works. Imagine a much longer time explaining how any of the current tools of modern biology work. And yet, it is possible. It takes scientists who are good communicators and even better teachers, to enlighten and inform the public and our elected officials. We must take on this responsibility to inspire and educate, seriously and with the same passion we apply to our experiments. This should start not in college, not in high school, but as early as kindergarten, when children have already started to ask questions and are ready to have their minds inducted into the discipline and the beauty of scientific discovery.

Second, the ever accelerating advances in data acquisition and production, coupled with a converging deluge of information, rumor, untruths and opinion (ignorant and fact-based all jumbled up) in the 24/7/365 cycle of social media, has made informed discernment and discussion in these venues nearly impossible. A democracy whose citizenry is unable to tell truth from untruth, is a democracy at risk. We must seriously consider, when it comes to complex issues, going back to the classic, time-tested way of communicating and addressing complex issues, with good old-fashioned conversation and debate, attempting understanding across wide divides, and if not achieving consensus, at least good will and respect for strong divergence on difficult subjects. This is always a good beginning.

Third, we tend to forget that, for all its explanatory power, science also has its limits, and some of them involve key existential questions. For example, biomedical science has produced many medicines that ameliorate human pain and suffering, but cannot explain

why suffering is embedded in the human condition. Scientists explain in good measure how life works, but would be hard pressed to confirm that our lives are worth living. I would suggest that a little measure of humility, recognizing both the power and the limits of what we do, and yes, our fallibility, would go a long way toward establishing a base of trust on which to build rich conversations around political, religious and scientific divides. Again, this would be another good beginning.

Lastly, we should recognize our imperfections as individuals and our strengths as communities. Like people in all walks of life, some of us are diligent and meticulous, some lazy and careless, some driven entirely by self–interest, some altruistic to a fault, some driven by fame and career advancement, some by passion for knowledge. As a community, we can and do transcend our individual frailties, and become one in pursuit of knowledge and solutions. When it comes to politicians, the same can be said. So why not again pursue the old fashioned conversation among those who can leave our petty leanings aside and pursue understanding and viable solutions, one failing at a time, one act of good faith at a time and believe in the common good? No tweets, no pundits, no Facebook, no trolling, just good, honest dialogue. That, in my view, would be a great way to truly celebrate science and its contribution to a better world, as this March for Science intended.

Charles Darwin ends his book On the Origin of Species with this marvelous phrase: "*There is grandeur in this view of life, with its several powers, having been originally breathed into a few forms or into one… from so simple a beginning endless forms most beautiful and most wonderful have been, and are being, evolved".*

There is perhaps a simile to Darwin's phrase for our still young and imperfect democracy. It is that from simple beginnings, from renewed and principled engagement among our governance groups, including scientists, the most beautiful and wonderful forms of participation – a sense of community and a commitment to solutions for the common and global good - will emerge.

Thank you.