# George Mason University 2012 College of Science Commencement Address

Dean Chandhoke, members of the faculty, alumni, parents, and especially the graduates of the Class of 2012, I am honored to have this opportunity to address you today in the Patriot Center…

Being a federal employee perhaps it would be appropriate to say: "I am from the U.S. Government – and I am here to help you!" Since I work for the institution that defines the official time for the United States, I had better stay on time today with my presentation. I have been told that I am the only thing that stands in the way of you and your diplomas.

About a year ago, I had the privilege to visit George Mason to speak to a forensic science class. The students were interested and asked many insightful questions. I applaud the university faculty for their efforts in developing a forensic science program. I hope that your program is able to produce many successful forensic scientists now and in the future. Being a careful observer, I must say that today's audience is a little larger than the 30 students I addressed last year!

*Well, this is the moment you have all been waiting for for four years or more*. Your parents will cry – with joy, of course, because they can stop paying your college tuition. You can post photos of yourself in your cap and gown on Facebook. And most importantly, you can tweet to all of your friends what an amazing commencement speaker you have today!

I graduated from college 20 years ago. My, has the world changed over the past two decades! This afternoon I thought I might offer a Top Ten list of things that differ today from when I graduated in 1992.

Number 10. Google was not a verb – it was simply a 1 followed by 100 zeros.
Number 9. Tweeting was something that birds did – and they weren't angry birds!
Number 8. Cell phones were the size of your shoe – and were only used for making phone calls – very expensive phone calls.
Number 7. Homework assignments were turned in on paper and we looked up information in books found in libraries.
Number 6. Computers had floppy disks about the size of a slice of bread and were not networked.
Number 5. O.J. Simpson was only famous as a football player.
Number 4. Cameras had film.
Number 3. Texting wasn't even a word – much less a primary means of communication.
Number 2. Without GPS systems, women stopped at gas stations to ask for directions and men got lost!
And the number one thing that differs today from 20 years ago: The internet – the internet was still a figment of Al Gore's imagination.

Clearly, we have come a long way in the past two decades due to advances in science and technology. ***Class of 2012, where will you take us in the next 20 years?*** You have chosen science as a career and you can be part of progress over the next generation to help change the world.

In my field of forensic DNA analysis, the advances have been amazing to observe and to participate in over the past 20 years. TV programs such as *CSI* and *Law & Order* make forensic

science appear rapid and always successful in solving crimes. Unfortunately, reality is far from Hollywood's projection of instant and absolute results. *Forensic science requires, as all science does, hard work – but the thrill of discovery can bring great satisfaction*.

DNA tests used at the time of the O.J. Simpson trial almost 20 years ago took about 8 weeks to perform and required significant amounts of blood or other body fluids for identification. Forensic DNA testing today can be performed in less than 8 hours – and soon hopefully in less than an hour. These DNA tests require only a few cells such as may be left in a single fingerprint.

I have been able to play a role in these technological advancements – and have enjoyed writing several textbooks to help train up the next generation of scientists. What will you do with the education you have received here at George Mason University? What impact will your efforts have in making the world a better place?

**To inspire you and to provide a roadmap for your success – whether in science or in life, I offer three pieces of advice today. First, you *will* fail. Second, you are not alone. And third, you *must* keep learning.** Let me demonstrate…

***Step to the side of the podium and juggle for a few seconds***

*Comment: Juggling is one of many useful skills I acquired during my college years…*

**Point #1: you will fail.** Now you are probably saying to yourself, "And I thought this guy was supposed to give an inspiring speech—boy, what a pessimist!" Let me explain myself. You will fail at something you attempt to do in your life. *It is how you respond to that failure that will determine the measure of the man or woman you become*. It is in failure that we learn and gain experience.

You may fail in your first job interview. Unfortunately in the current job market, you may even fail to get a first job interview for a while. You may fail to fulfill an assignment as quickly or completely as is needed by others. You may fail to reach a goal you have set. The only way you will not experience failure is to do nothing – and then you ARE a failure!

Thomas Edison, the most successful inventor in U.S. history, explored thousands of ways to make a light bulb, enduring failure after failure before he succeeded in illuminating the world. Edison is credited with the famous saying: "Genius is one percent inspiration, ninety-nine percent perspiration".[1] That perspiration comes from hard work and sometimes failing more than succeeding. Attitude makes a difference here. Regarding his many experiments that did not work, Edison noted: "I have not failed. I've just found 10,000 ways that won't work."[2]

How do you develop that faith to go forward following a failure? When something goes wrong, do not give up. Work in science is called research or "re-search" because it is a quest that often needs to be repeated. Your experiments, an article you write, or the computer code you create may not work the first time. Do not let failure defeat you. Rather let it propel you forward with renewed innovation and commitment to succeed. Seek out and embrace your scientific problems to solve and illuminate your part of the world with your unique collection of knowledge, talents, and determination.

I have always appreciated a quote from President Calvin Coolidge: "Nothing in the world can take the place of persistence. Talent will not; nothing is more common than unsuccessful men

with talent. Genius will not; unrewarded genius is almost a proverb. Education will not; the world is full of educated derelicts. Persistence and determination alone are omnipotent. The slogan 'Press on' has solved and always will solve the problems of the human race."[3]

While in college I got the crazy idea that I wanted to qualify for and run in the Boston Marathon. Although I had run cross country and track in high school, preparing for a 26.2 mile race was a little daunting since I had never run more than about five or six miles at a time. I developed a 3-month training plan and began running six days a week. In my first marathon, I hit the "wall" at mile 24 and ended up walking the last two miles. I finished 12 minutes short of the required qualifying time for Boston.

Now I could have considered myself a failure and given up on my goal to run in the most prestigious marathon in the world. Many people would probably be happy to just finish a marathon, which I had. Instead, I was determined to try again and do whatever I had to do to reach my goal. I began more intense training. Running close to 2,000 miles over the next year, I devoted sometimes two hours a day to improve my stamina and speed. When I ran my next marathon, I finished more than 31 minutes faster – easily surpassing the qualifying time for Boston. The following April, I ran in the 96$^{th}$ Boston Marathon. Achieving this goal was a significant milestone in my life – and I often reflect on what I learned from this experience.

This persistence in spite of initial failure has benefited my scientific work as well. During my graduate research, which was performed at the FBI Academy in Quantico, Virginia not far from here, I learned how to perform the polymerase chain reaction. The polymerase chain reaction, or PCR, is a widely used process in molecular biology to replicate or create copies of specific DNA sequences.

In my early experimental work, I could not get the PCR reaction to work properly for several weeks. I performed dozens of experiments day after day changing the various components of the DNA test. I persisted in my experiments and eventually succeeded in finding and fixing the problem. These initial failures required me to break down and examine every part of the PCR process. This effort led to a detailed understanding of the process – something that has benefited me throughout my career and laid the groundwork for my expertise in DNA analysis. If everything had worked the first time, I would have missed a valuable learning experience.

The former head of NASA, Daniel Goldin, has said: "Not experiencing any failure in life is rarely a sign of perfection; rather it is a sign that your goals aren't bold enough… The real mark of your character comes from not how you react to your successes, …[but] how you react to your failures." [4]

**Point #2: you are not alone.**

While you will experience failure at times, you will also enjoy success. When you do have success in science and in life, it is often largely because of help from other people. The monuments of scientific achievements are built one brick at a time on foundations laid by those who have gone before you in your field.

Many science jobs today involve large collaborative projects. The Human Genome Project and its effort to understand the code of life involved thousands of scientists around the world – truly a community collaboration to achieve this important scientific goal.

You learn from teachers and mentors who give of their time and energy to help you succeed. Be grateful for their contributions and give them appropriate credit. You would not have come as far as you have in life right now without the love and support of good parents. Your parents have often sacrificed financially and otherwise to help you get this college education. Have you thanked them? This day of celebration is an achievement for them as well as for you graduates.

At the beginning of each of my books and at the end of every one of my scientific papers is a section entitled "Acknowledgments"[5], where those people who helped in any way on a project are listed by name. This simple listing of people's names that have helped me accomplish some aspect of my research or writing can never fully capture my gratitude for their help. Even though the assistance may be small in many instances, a bond is formed by listing those who have helped.

I chose a scientific career in large measure because of a diligent and dedicated high school biology teacher named Kermit Posten. Mr. Posten demanded excellence of his students. His lectures were fact-filled. His tests were challenging. He expected us to do our best. Perhaps you have had a teacher like this that has challenged and inspired you. Mr. Posten instilled in me a desire to learn and to love biology. I began as his student at a small high school in Maryville, Missouri. Now I am the teacher and the world is my classroom.

Five years ago I tracked down Mr. Posten. He still lives in that small Missouri town. I thanked him for inspiring my scientific career with a signed copy of my latest textbook. I will always cherish that moment when I had the opportunity to thank my teacher and mentor – one who believed in me and set me on a path of success.

I am here today because I did not give up when I initially failed with some projects. But also I am here because others have not given up on me.

Remember that nothing you do in life will be accomplished solely through your efforts. You are always building on the knowledge and experience of others. Be grateful for them. Be grateful that you are not alone.

**Point #3: you must keep learning.**

Your education does not stop today with the receipt of a diploma. Your true education BEGINS today. College teaches you how to learn. Life after college enables you to develop your learning skills and to apply them to real problems.

American physicist J. Robert Oppenheimer, who led the Manhattan Project to build the first atomic bomb, said, "It is not possible to be a scientist unless you believe that it is good to learn".[6]

I love to learn. The desire to learn from everything around me is a passion that I have had all my life. I became a scientist because I like solving puzzles. Scientific research involves solving some amazing puzzles. I enjoy the thrill of discovery. I cherish those moments when understanding comes as pieces of a challenging problem solidify into a satisfying solution.

Regardless of how many hours you put into study during your time here at George Mason, there will still be many thousands of hours of learning required over a lifetime to achieve your best in your field of endeavor. But always try to keep your continued learning in perspective.

Remember that “an expert is someone who knows more and more about less and less – until he knows absolutely everything about nothing!”[7]

In preparation for this presentation, I read a biography on George Mason[8]. One of the most interesting facts to me was that Mr. Mason was a life-long learner. Although his formal education was limited, he became proficient in matters of law and philosophy by reading books in his uncle’s library when he was a young man. Because of his preparation, George Mason was in a position to play an important role in the founding of our country. As a George Mason University graduate may you share his legacy of being a life-long learner!

I cannot emphasize enough the importance of self-education. I have never had a single class on molecular biology or statistics – yet I have written books that included both subjects. How? I have read extensively and taught myself. I concur with Thomas Jefferson who wrote to John Adams late in his life: “I cannot live without books.”[9] And THAT is my Mr. Jefferson quote, which of course is required of all UVA graduates!

Be bold if you want to change the world. Realize that if you wait to follow the crowd, then you will not be the leader. I chose forensic science as a career *before* CSI TV shows made it popular. If I had waited to come into the field later, my opportunities to make an impact may have been limited by a crowded field.

You are each unique – blessed with talents and experiences that can make a difference to those around you. Unless you have an identical twin, your DNA – your genetic blueprint – is unique. There is literally no one else in the world quite like you.

So in conclusion… Face your future failures with resilience, resolve, and determination. Show appreciation and share your successes with those who have helped you. And always, always keep learning! If you keep learning, no failure is final.

*Juggle briefly…*

The world needs great scientists but even more the world needs good people. The future is in your hands. So today I challenge you to go forth and build on what you have learned at George Mason University. Make your parents and your teachers proud. The world waits. Make a difference!

Thank you and good luck!

Sources

[1]http://en.wikiquote.org/wiki/Thomas_Edison; originally from a spoken statement uttered around 1903; it was later published in *Harper's Monthly* (September 1932)

[2]http://en.wikiquote.org/wiki/Thomas_Edison; as quoted in an ad for GPU Nuclear Corporation, in *Black Enterprise* Vol. 16, No. 11 (June 1986), p. 79. Edison commented that "many of life's failures are people who did not realize how close they were to success when they gave up" (this is presented as a statement of 1877, as quoted in *From Telegraph to Light Bulb with Thomas Edison* (2007) by Deborah Hedstrom, p. 22).

[3]http://en.wikiquote.org/wiki/Calvin_Coolidge; Calvin Coolidge was the 30th President of the United States and lived from 1872 to 1933.

[4]Daniel S. Goldin in his commencement speech "Galileo and the Search for Truth" to Massachusetts Institute of Technology graduates in 2001. Complete speech is available at http://www.humanity.org/voices/commencements/daniel-goldin-mit-speech-2001.

[5]Acknowledgments for this talk: My wife Terilynne, my parents Doug and Marsha Butler, my brothers-in-law Jeff Wright and Jason Wright, and my academic parents UVA Professor Ralph Allen and his wife Karen for input on this talk and continued support in my endeavors. I also express appreciation to the many resources available on the internet including http://www.humanity.org/voices/commencements and http://www.humanity.org/voices/commencements/writing-commencement-speeches for gathering information on other commencement speeches that were very helpful in crafting this one.

[6]Quoted in *Speeches that Changed the World*, (Smith-Davies Pub, 2006), p. 124

[7]Statement attributed to Nicholas Butler; see http://www.goodreads.com/quotes/show/181579

[8]*George Mason: Forgotten Founder* by Jeff Broadwater (The University of North Carolina Press, 2006)

[9]http://en.wikiquote.org/wiki/Thomas_Jefferson; Letter to John Adams (10 June 1815)