

Graduation Address
Georgia Institute of Technology Fall Commencement
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History teaches us that one of the great drivers of scientific and cultural advancement and innovation is exploration. Today, we are at the cusp of a new age of exploration, one that will take robotic pathfinders and pioneering astronauts to the Moon, Mars and beyond. Going beyond the bonds of Earth is a quest that will require the talents and skills of many of you who are graduating today, and not just those involved in the disciplines of mathematics, science, and engineering.

Indeed, for those of you whose career path will involve the space program, I'm confident that over the course of your career you will have opportunities to tackle some of the most rewarding challenges one could imagine. We are undertaking a sustainable, long-term, multi-generational program that will enable human beings to see and do things that have never been seen and done before. If I were graduating from Georgia Tech today, I would want to work in the space business because that is where some of the most exciting action will be in the coming decades.

Before I discuss how space exploration will influence your future, I'd like to take a minute to applaud your success. You have earned a degree at one of our nation's finest centers of academic excellence, and you have every right to be proud of that accomplishment. For the rest of your life, you will look back at your time at Georgia Tech, and increasingly you will come to understand how these few years shaped the course of the rest of your life. Graduation is a huge milestone.

But it is only one of many milestones to come, and with this honor comes responsibility. One of those responsibilities is to step up to the leadership opportunities that will come your way, and to take advantage of the opportunities you will have to participate in enterprises that will spark American innovation. And to be sure, one great engine of innovation in the future will be the U.S. space program.

A generation ago, on the eve of the first robotic spacecraft landing on Mars, NASA convened a symposium on exploration which featured the late James Michener, the author of

such works as *The Bridges at Toko Ri*, *South Pacific*, *Centennial*, and, yes, *Space*. In his remarks at that symposium, Michener said, “When one deals with exploration, one has got to be aware that in every generation one field of exploration ends. As that epoch ends, we start something new. We are always at the end of something, always at the beginning of something else. This is true not only of societies, not only of total culture, but also of individuals. If we have no accomplishment, if we never know success, we lead embittered lives. But if we stop with one success and do not recognize that it stands merely as a threshold to something greater, more complex, more infinite, then I think we do only half our job.” So, there you have it from one of our most reflective American authors. Congratulations. Now get to work!

More seriously, Michener’s theme also applies to the fate of nations, and to the decisions nations make when they reach significant thresholds in their evolution. For many years America has been the world leader in the exploration and utilization of space. Our nation’s determination to be first on the Moon resulted in some of the iconic images of the 20th Century. One of these was of Georgia Tech graduate John Young, photographed leaping in front of the lunar module *Orion* while saluting the American flag during the Apollo 16 mission to the Descartes Highlands on the Moon.

But, as they say, that was then and this is now. Following Michener’s line of thought, we as a society simply cannot rest on past accomplishments. The true space age, in which humans will explore and develop worlds beyond our own, is just getting underway, and many nations are making long-term plans to assert their own influence upon this new frontier.

I firmly believe that in this century, just as was the case for the great seafaring nations of the past, a vital component of world leadership will be leadership in the exploration and development of the space frontier. World leadership involves many things. It implies the strength to defend ourselves and our allies when liberty is threatened. It requires the foresight to invest in the cutting edge of science and technology. It means establishing world technical standards – as we have done in the computing and aviation industries – not through coercion but because we have developed a capability that others must have. And, leadership means having the ability and determination to build coalitions and partnerships to do those things that fulfill the dreams of mankind. And those dreams have always included the desire to see what lies beyond the limits of the world known to any given generation.

Nearly two years ago President Bush gave us his answer to the question of whether our country should be involved in this great quest. His answer: America will lead. The President said, “We have undertaken space travel because the desire to explore and understand is part of our character. And that quest has brought tangible benefits that improve our lives in countless ways.”

With the Vision for Space Exploration, the President has given our country another opportunity to further the pioneering tradition the American people hold dear in our hearts. But the Vision for Space Exploration also recognizes the importance of international cooperation with many of the countries represented in your student body. The President said, “We’ll invite other nations to share the challenges and opportunities of this new era of discovery. The vision I outline today is a journey, not a race, and I call on other nations to join us on this journey, in a spirit of cooperation and friendship.” For those of you who come from other nations – and I understand that there are over 110 countries represented in your graduating classes – I welcome your interest in furthering this effort.

It is not a stretch to assert that everyone in this hall will have their careers and lives profoundly influenced by space in the 21st Century. Those of you involved with public policy may have roles in shaping our space program and scientific research priorities. The architecture students among you may help us design permanent outposts and research stations on the Moon and Mars. An endeavor of this complexity will certainly tap the skills and energies of those trained in management. And to be certain, the space program will always draw upon the best technical talent Georgia Tech has to offer.

Indeed, we already are. Former astronaut Scott Horowitz, who earned a masters and doctorate in aerospace engineering at Georgia Tech, leads our Exploration Systems Mission Directorate, the group developing the spacecraft, launch vehicles and related systems we will need to explore beyond Earth orbit. And last summer, I asked long-time colleague Doug Stanley, of Georgia Tech’s Aerospace Engineering Faculty, to lead a comprehensive study to define our exploration systems architecture. He tapped the skills and talents of your fellow students working in the Aerospace Systems Design Laboratory under the guidance of Professor Alan Wilhite, assessing the technologies we will need to implement our exploration vision. So, as you can see, some of you are already realizing opportunities and career possibilities through the Vision for Space Exploration.

Throughout NASA's history, our agency has shown the ability to implement large-scale engineering projects, and to conduct our systems engineering work in ways not previously thought possible. But what we have ahead of us represents a challenge significantly greater than when we first went to the Moon. With that challenge we will need bright young computer programmers, engineers and scientists who can make their mark on the space program.

We will need to learn how to assemble in low Earth orbit the 500-metric ton spacecraft that will take a crew on a multi-year voyage to Mars. In this regard, we have learned a tremendous amount from the ongoing international partnership to assemble and operate the International Space Station, orbiting 250 miles over our heads. But for voyages to Mars and beyond we will need to develop a new kind of expertise based more upon what was learned centuries ago from great journeys of exploration than upon what we have experienced in the first half-century of space flight.

We will never venture very far from home if we are forced to bring all of the required propellant and other supplies with us from the start. So we must learn to use local resources to reprovision our ships far from home. That is why we will challenge our engineers to develop rocket engines that can be fueled, for example, by a lox/methane mix, constituents that can be found in Mars' atmosphere. The requirement to live off the land will be crucial to our future in space, just as it was to Lewis and Clark and the Corps of Discovery as they made their way from St. Joseph, Missouri, to the West Coast and back from 1803 to 1806.

We must think expansively about how our astronauts in the new worlds of the 21st Century can grow food, construct shelters, supply power, and maintain their health on their own. These are challenges that will require expertise in systems engineering and all branches of discipline engineering, nanotechnology, biotechnology, and human factors, to name only a few. Really, we will find that all human knowledge and skill will be needed to advance space exploration. And in the doing of it, we are going to find that there are many things we don't yet know, and which we must learn! Every discipline will play a role, and every discipline will be challenged to expand the frontiers of its body of knowledge in order to contribute to this grand vision. I know that there are some of you in the audience who are like me and simply can't wait to get started.

Let me leave you with remarks that President John F. Kennedy made during a visit to an aerospace medical facility in San Antonio, Texas, on November 21st, 1963 – the day before he

was assassinated in Dallas. This was a story of which Kennedy was fond, originally told by the Irish writer Frank O'Connor, and I think it defines what our space exploration vision, and your future, is all about. Said President Kennedy, "O'Connor wrote how as a boy he and his friends would make their way across the countryside. When they came to an orchard wall that seemed to high and too doubtful to try and too difficult to permit their voyage to continue, they took off their hats and tossed them over the wall – and then they had no choice but to follow them." Kennedy concluded, "This nation has tossed its cap over the wall of space, and we have no choice but to follow it. Whatever the difficulties, they will be overcome. Whatever the hazards, they must be guarded against. With the help of all those who labor in the space endeavor, with the help and support of all Americans, we will climb this wall with safety and with speed – and we shall then explore the wonders on the other side."

And that's exactly what our space program will allow us to do in the decades ahead. American will lead in space and provide unique opportunities for every interested person to take on great challenges and participate in an amazing journey.

Soon, all of you will have the opportunity to toss your graduation caps in the air. Like Frank O'Connor and his friends, I hope you toss your caps up as high as possible over the wall separating you from your scholastic life and your life to come, and that in whatever direction you set forth you have a great adventure exploring the wonders on the other side. Thank you, and congratulations to the Class of 2005.