Mission Statement

Inspired by our land-grant identity and guided by our motto, *Ut Prosim* (That I May Serve), Virginia Tech is an inclusive community of knowledge, discovery, and creativity dedicated to improving the quality of life and the human condition within the Commonwealth of Virginia and throughout the world.

Professor Timothy E. Long: Summary of Accomplishments

An Integrated Approach to Discovery: Striving to be a 21st Century Explorer

"Professor Tim Long is a giant of science, teaching, and administration at Virginia Tech, and within the national and international scientific landscapes. His accomplishments, summed in these three areas, are literally off the charts. He is an international superstar in novel macromolecular polymeric structures, and the processes by which these can be turned into state-of-the-art technologies in a variety of fields." - Dr. Michael Hochella, Virginia Tech University Distinguished Professor Emeritus

Discovery has served as the focus for Dr. Long's academic career as a faculty member in the Department of Chemistry at Virginia Tech as evidenced by more than $50 million in funding and more than 50 patents for his work in macromolecular science and engineering. However, broader impact insists that discovery not *only* occurs in the research laboratory, but also in the classroom with translation of discoveries to local, regional, and global communities.

Discovery in the classroom has led to the design of a novel laboratory curriculum in the well-established Academy of Integrated Science in the College of Science. The curriculum integrates global technological challenges of the 21st century in an unprecedented laboratory learning experience. This gateway to science serves as a means for students to pursue a degree in nanoscience, which SCHEV approved in 2014. Recently, Dr. Long pioneered a polymer capstone course for chemistry majors leading to a degree in polymer science in the Chemistry Department.

Discovery in the research laboratory has led to Dr. Long's visible metrics of scholarship. These metrics include over 260 scholarly publications in peer-reviewed journals since 1999, >60 invention disclosures and patents, university-wide recognition with a 2010 Virginia Tech Alumni Award for Research Excellence, statewide recognition as a 2015 Virginia Outstanding Scientist, national and international awards of scholarly distinction from his premier professional society (e.g., Fellow of the American Chemical Society), and invited lectures at leading national and internationals forums of science. Dr. Long's research program averages 20 publications in high-impact journals each year with an h-index near 55, a strong indication of his sustained commitment to *both* student excellence and societal impact.

Discovery in the Commonwealth of Virginia has led to the discovery and clinical application of hydrogels for gynecological cancer therapies in collaboration between Dr. Long and Dr. Showalter at the University of Virginia. The University of Virginia brings a leading medical school and associated nationally recognized hospital and clinical settings, and Virginia Tech brings an internationally recognized macromolecular science and engineering program. Connecting these two programs emerged from a grass roots effort to improve the clinical experience of cervical cancer brachytherapy. Dr. Long's research group developed a hydrogel strategy that utilizes safe materials for the body and upon the incorporation of concepts of "click chemistry" converted the initial proposal into a patented, viable concept. Dr. Long and Dr. Showalter initially received funding for the project through a 4-VA grant, a state program designed to nurture partnerships across Virginia. Dr. Long and Dr. Showalter now have received funding from other sources, including the National Institutes of Health, and a recent Phase II Small Business Technology Transfer (STTR) from the National Cancer Institute for clinical studies.

Discovery with engagement to society has led to Dr. Long's research goal of seamlessly integrating fundamental research and training in novel macromolecular structure and polymerization processes to address global grand challenges with enabling technologies. Dr. Long is now recognized as an international leader in novel materials for 3D printing and a leader in the design and fabrication of multiphase membranes for electro-active devices in energy generation (sensors), energy storage (batteries), and water purification (membranes). To this end,

Dr. Long organized the largest international scientific forum in the history of Virginia Tech in the summer of 2012 and has secured the largest percentage of corporate funding for the Macromolecules Innovation Institute. Further, service to the global community begins with encouraging students' appreciation for the international perspectives of science and integrating novel pedagogy on the importance of service to culturally diverse communities. During the 2014 winter session, Dr. Long led the education abroad experience in Europe for the College of Science. In 2016, Dr. Long was granted a prestigious NSF Research Experiences for Undergraduates (REU) award and over 60% of the project participants were women; furthermore, many of the participants were from universities without access to tier-one research facilities. Dr. Long integrates a spirit of *intellectual entrepreneurship* with undergraduate and graduate learning outcomes and societal engagement for both regional and international impact.

Teaching

"Taking Professor Long's Polymer Capstone Lab course and being in his research group have truly been one of the best experiences during my undergraduate years at Virginia Tech. He is an incredible mentor who has encouraged me as well as others to believe in ourselves and to learn more about polymer chemistry." - Ms. Mai Nguyen, Previous Undergraduate Student and Undergraduate Researcher, Research Scientist at Luna Corporation

Student-centric instruction dictates that the latest exciting discoveries in science today must be in tomorrow's class plan. Dr. Long has demonstrated a keen passion for teaching students at all levels, ranging from first-year students in the Introduction to Nanoscience course, second-year non-chemistry majors in Organic Chemistry, fourth-year students in an inaugural Green Chemistry course and Polymer Chemistry Laboratory Capstone, and graduate students in his current Macromolecular Science and Engineering course. In 2013, Dr. Long returned to his first love: teaching organic chemistry during the fall semester to a large class of non-majors in their second year. His teaching evaluation was outstanding with a score of 5.5 out of 6.0. His strategy of starting each class with *Molecules of the Day* allows him to showcase the relevance of organic chemistry in the lives of all students, from students majoring in weed science and poultry science to students majoring in chemical engineering and biochemistry. His goal is to continually evolve as a teacher of science. Moreover, undergraduate research is a critical element of Dr. Long's teaching plan, and he has included five undergraduates *on average per semester* in his research group (totaling over 100 undergraduate researchers). Thus, Dr. Long not only balances discovery and learning, but also truly integrates the two for more meaningful impact on students and the university.

Dr. Long has demonstrated a longstanding commitment to teaching and learning, starting with the formation of short courses during his industrial career at Kodak where he strived to integrate fundamental principles with customer-centric needs. Dr. Long's passion for connecting education and industry has remained with him to this day at Virginia Tech, where he currently leads short courses for industrial scientists visiting Southwest Virginia three times per year (since 2003). Dr. Long has instructed nearly *1000 visiting industrial researchers* on the Virginia Tech campus. More recently, he has conducted short courses at leading U.S. companies, such as 3M Company, Solvay, Shell, Proctor & Gamble, and ExxonMobil, focused on the fundamentals of their technology to their employees.

Participation in short courses with industrial scientists provides Dr. Long with a keen awareness of the personal and professional skills necessary for the success of future graduates. His most enjoyable teaching moments arise when he takes a critical question society faces and integrates it into the classroom. This approach to teaching is highlighted by his design of the laboratory experience for the Academy of Integrated Science for the College of Science. He designed laboratory modules to lead students through authentic research rather than completing

compartmentalized sets of measurements. In reality, research involves perseverance in compiling and integrating disparate results and effectively formulating a hypothesis based on multiple weeks of exploration. This concept now forms the basis of a four-semester laboratory setting where experiments integrate chemistry, biology, physics, statistics, and mathematics into a single experience.

Understanding phenomena at the nanometer dimension has catalyzed rapidly emerging technologies across the globe, ranging from alternate energy and health care alternatives to water desalination. In response to the growing need for students to understand this rapidly developing field, Dr. Long co-developed a new course: Introduction to Nanoscience (NANO 1015). In collaboration with the Department of Physics and the Department of Geosciences, Dr. Long designed and delivered the first ever NANO 1015 course at Virginia Tech, and the class enrollment has doubled each year since its inception. The course focuses on the nanometer dimension, which is 10^{-9} of a meter and 1000^{th} the thickness of the human hair. He established the course mantra, *in order to think BIG, you need to think small*, and this theme was extended to the establishment of a summer camp, titled *NanoCamp*, to attract regional high school students to nanoscience. Dr. Long was a major contributor to the nanoscience B.S. degree, which now attracts students to Virginia Tech who might not have considered applying and answers a pressing need for future national imperatives. He also co-developed the NANO 3015 Synthesis and Characterization of Nanomaterials course offered at Virginia Tech for the first time in fall 2013. This course further exemplifies Dr. Long's philosophy of integrating science in the classroom with discovery in the laboratory.

Discovery

"Tim has had a profoundly important impact in the field and his current research directions will be of immense value for years to come. I have had the pleasure to follow his remarkable accomplishments in other diverse areas such as drug delivery with biopolymer-based therapeutics and tissue regeneration biotechnology and additive manufacturing. Frankly, it is remarkable to see just how diverse his interests are in the general field of polymer chemistry, and his ability to cross interdisciplinary boundaries with commanding performance."
- Dr. Robert B. Moore, Professor in the Department of Chemistry, Virginia Tech

Dr. Long's impact as a scientist has been recognized at Virginia Tech and beyond. He received the prestigious Virginia Tech Alumni Award for Excellence in Research in 2010 (the top research award at the university) and was named a Virginia Outstanding Scientist in 2015. These two distinctions from his peers are personally regarded as the most significant recognitions of his academic career. Dr. Long has also received national awards, most notably the American Chemical Society (ACS) Collaborative Research Award, ACS Mark Scholar Award, and Adhesion Society Dahlquist Award. Most recently, in 2018, he received the Thermoplastic Elastomer Award from the ACS Rubber Division. His first national award, the ACS Collaborative Research Award, was an award that represents his dedication to interdisciplinary "teamed science." This research award recognized the innovation of a new water purification membrane technology in partnership with Kraton Polymers, Inc. This discovery, commercialized as Nexar®, represents a new direction in water purification and energy generation. The technology grew from a fundamental realization that water requires a molecular environment where mobility is tuned at the nanoscale. This invention has impacted diverse technologies, ranging from the latest breathable exercise garments to water capture during household air conditioning. Dr. Long firmly believes that water will be the next petroleum and that discovery is needed to address water scarcity.

In addition to water scarcity, the United States National Academy of Sciences has identified biomaterials and bio-inspired materials as a "new and rapidly developing" subfield of science with the "goal of creating new materials of technical importance" (National Research

Council, 2007). The increasing demand for transformative biomaterial solutions has catalyzed interdisciplinary materials research programs world-wide and technological innovation in Dr. Long's research group. Recent research efforts with 3D printed pharmaceuticals will minimize side effects while maximizing medicinal efficacy and patient compliance. However, fundamental studies on biomaterials-based delivery systems are severely lacking. In support of biomaterials discovery, Dr. Long constructed the first fully functional cell culture facility in the Department of Chemistry, allowing his students to rapidly investigate the toxicity of synthetic polymers.

The introduction of positive and negative charge allows for intermolecular interactions with biomolecules, but the identical charged polymers also offer opportunities in energy and water purification. The common principle involves charged molecules forming nanostructures and providing water solubility. Dr. Long's focus on this area has led to his participation as an affiliated faculty member in the Virginia Tech Institute for Critical Technology and Applied Science (ICTAS). In 2014, he became an affiliated faculty member in the School of Biomedical Engineering and Science. Dr. Long is also a member of the faculty of Health Sciences associated with the Virginia Tech Carilion Research Institute in Roanoke.

With NIH funding and partnership with the University of Virginia, his current research focuses on the design, performance, and clinical impact of biomaterials for gynecological cancer treatment. Dr. Long's research developed, what he coined, a "smart" gel that moves and forms fast in parts of the body isolating a tumor. Addition of water softens the gel for easy removal. The idea is for a physician to insert this gel into a patient before radiation treatment, rather than packing the area with gauze, which is the current standard method that can be painful and often requires anesthesia. Current research is focused on refining the gel and utilizing it in clinical studies to help women. This partnership clearly shows the power of two universities working together for the good of the public.

Campus leadership involves gathering faculty to construct team proposals for large center-style grants. Dr. Long's ability to garner over $50M in research grants over the past 20 years has provided him with the interpersonal communication skills to excite faculty around an emerging theme and to identify faculty who solve the complex problems of the 21st century. Dr. Long has led two $6M grants (over five years) with the Army Research Office, including faculty from the College of Science and the College of Engineering. He has maintained over $2M of research funding in 2018 and 2019. In addition, Dr. Long's success as an NSF Integrative Graduate Education and Research Training (IGERT) co-principal investigator with Food Science and Technology in the College of Agriculture and Life Science led to longstanding faculty partnerships in food packaging and the interaction of polymers with biological systems. He led an NSF Research Experiences for Undergraduates (REU) program at the nexus of food-energy-water systems. In 2017, Dr. Long received his first NIH award as a STTR Phase I dealing with polymeric gels for gynecological cancer therapies. In 2019, the project received a Phase II Small Business Technology Transfer (STTR) from the National Cancer Institute.

Dr. Long's number of **peer-reviewed publications exceeds 260**, with a typical average of 20 papers *per year*. His philosophy of publishing as discoveries occur excites students as the first authors, and being *the first* to describe a discovery is a rewarding motivation. Dr. Long has also recently returned to his commitment to intellectual property, a once critical prerequisite for success in his industrial career. Now, Dr. Long has added invention reports to his portfolio of scholarly outputs, again driven, to a great extent, by the students. In 2017, a patent dealing with a new family of 3D printable engineering polymers was licensed from Solvay Inc. in Atlanta. The cervical hydrogel patent between the University of Virginia and Virginia Tech has allowed for further product development and clinical trials.

In 2014, Dr. Long also published his second paper in *Science*, arguably the most prestigious journal for scientific discovery. He continues to publish in the leading journals, and he serves on eight editorial boards, including *Macromolecules, Advanced Materials,* and *Biomacromolecules*, which have the highest impact factors of all ACS polymer science journals. Dr. Long has been

invited to serve on editorial boards for international journals, and in 2018, he was invited to serve as Editor-in-Chief of the journal *Polymer International* based in London. His invitation to lead the International Union of Pure and Applied Chemistry (IUPAC) Macromolecular Congress in 2012 at Virginia Tech serves as a testament to Dr. Long's international leadership in his field. His global reputation has resulted in increased research funding from leading international industries, including Toray Industries in Japan and BASF Corporation in Germany.

Knowledge Integration

"I believe that Professor Long is one of the leading polymer scientists in the world. One of his distinguishing characteristics as a scientist that makes his work so significant is his ability to solve problems by working at the interfaces of different disciplines." - Dr. Joseph DeSimone, UNC Chapel Hill, National Academy Member: Institute of Medicine, Science, and Engineering, and CEO Carbon 3D Printing

Dr. Long's dedication to knowledge integration across disciples is highlighted in many of his accomplishments as both a teacher and researcher. Dr. Long has received two Multidisciplinary University Research Initiative awards, which integrate knowledge across disciplines and provided Dr. Long with $12M for his work. Dr. Long was also the principal investigator for the formation of a Materials Center of Excellence (MCOE) for the Army Research Laboratories, providing $6M over five years for the integration of computational science and materials science for the discovery of next generation high performance materials. One of the most significant examples of Dr. Long's knowledge integration was his NSF Integrative Graduate Education and Research Training (IGERT) award in collaboration with the Virginia Tech Graduate School. His program created a new graduate certificate, which recognizes a new cadre of students at the interface of materials and life sciences. The program, Macromolecular Interfaces with Life Sciences (MILES), included service to the Science Museum of Southwest Virginia in Roanoke.

The old adage *change is the only constant* now requires revision to *a rapid pace of change is the only constant*. As a researcher, Dr. Long has long worked across disciplines and has now re-focused his interdisciplinary discovery at the interface of materials chemistry and mechanical engineering for accelerating the pace of innovation in manufacturing. Breakthroughs in materials science and engineering will rapidly emerge from interdisciplinary teams who effectively integrate the predictive power of computational modeling and data analytics with a more *rational design strategy* for advanced materials. With funding from a 2018 NSF award, Dr. Long together with mechanical engineers will innovate new concepts in 3D printing, effectively painting membranes and devices in 3-dimensions**.** Furthermore, national imperatives demand an accelerated pace of membrane discovery to address immediate needs, including a reduction in water consumption and global availability of drinking water, energy generation and storage, and next generation therapies to maintain global leadership in healthcare. According to Dr. Long, new membranes for *on-site* purification of produced and flow backwater must now address environmental hurdles.

Dr. Long currently serves as the Director of the Macromolecules Innovation Institute (MII). During his five years as director, Dr. Long has led the research center to reach its highest number of Ph.D. students (53) and a 10% growth in research expenditures with more than 30% funding coming from industrial partners. Only a handful of universities in the U.S. offer this degree opportunity, and the program, which ranks in the top ten internationally, has positioned students of the Commonwealth for success.

Service

"I have known Tim for nearly 15 years as a collaborator, advisee and colleague. To say that Tim has been instrumental in shaping my career in academia is an understatement. His guidance over the years has been beyond valuable. Tim has been influential in helping me develop my academic career." - Dr. Kevin Miller, Associate Professor of Chemistry, Murray State University

For Dr. Long, service involves translating science to improve the quality and quantity of the lives of his fellow citizens. Service in science seeks to excite others with the latest discoveries and helps people understand how discoveries improve the world. Dr. Long cites a generally poor public perception of science as a catalyst for sharing his message across the Commonwealth and the world. For example, Dr. Long served as chair for the 44th IUPAC World Polymer Congress MACRO2012. Virginia Tech hosted the international event in Blacksburg in June 2012 and attracted more than 1,400 attendees from 52 countries with 60% international attendees. The conference theme, *Enabling Technologies for a Safe, Sustainable, and Healthy World*, addressed many emerging technologies and interdisciplinary topics. These topics transcend traditional department and college infrastructure at many universities to provide an interdisciplinary experience of science and engineering. Dr. Long believes there is an over-arching need for these technological solutions to also adhere to the principles of earth sustainability. Recent advances in ionic liquids and agricultural based feed stocks exemplify design parameters, extending performance, and decreasing dependence on petroleum-based monomers while minimizing the carbon footprint. This prestigious event was bestowed to the university from Dr. Long's successful proposal to the IUPAC. A leading U.S. university only hosts this conference every 15 years, and Virginia Tech serves as a benchmark for success.

Service at the undergraduate level also requires innovation, and Dr. Long created a winter session course beyond his expected teaching. The course took students to leading institutions in Western Europe and nurtured an understanding of the role of science in culturally diverse communities. Virginia Tech students, as ambassadors for the university and the Commonwealth, provided a critical service element to the larger international community by participating in museum engagement and understanding the role of discovery in diverse communities. This course provided students with meaningful and critical learning experiences, particularly because existing industrial employers seek future scientific leaders with an international perspective. Future entrepreneurs in science will need cultural awareness of various global regions with a regional scientific perspective. The course was the first example of education abroad during winter session for the College of Science.

Dr. Long currently reviews proposals for the National Science Foundation, the Department of Defense, and the Petroleum Research Foundation. From 2011-2018, Dr. Long served on the scientific advisory board of the ACS Petroleum Research Fund. In this capacity, he selected proposals for funding, extending $2M of research support yearly. He currently serves as the President of the Adhesion Society and was the former Chair of the ACS Division of Polymer Chemistry. Service also includes mentorship of new faculty, welcoming them to the university and catalyzing their potential impact on the Commonwealth. During the past five years, Dr. Long served as a mentor to many faculty members, including faculty in chemistry, physics, mechanical engineering, and chemical engineering. Dr. Long is proud that his mentorship, consistent with his teaching and discovery, transcends traditional colleges and departments at the university and extends to other institutions in the Commonwealth. In addition, Dr. Long has served in many capacities within the department and university at Virginia Tech, including his service as committee member (i.e., personal committee, dean search committee, faculty search committees); leader in the Departments of Chemistry, Engineering and Physics; Fellow for the Institute for Creativity, Arts, and Technology (ICAT) Catalyst Faculty Retreat; and Stakeholder of the Materials Strategic Growth Area and for the Solar Decathlon Dubai Project.

Timothy E. Long: Personal Statement

Opening a child's chemistry set on a covered sink in the basement of our family laundry room provided countless magical moments. Mixing two liquids to generate a mysterious gas or fingerprinting a patient family member ignited a passion for answers to seemingly complex questions. The laundry room also served as a place of solitude for a boy sharing a small Cape Cod home with three older siblings, two working parents, and family dog, all only minutes away from one of the most famous chemical industries in the world: Eastman Kodak Company. Science fair projects as an elementary school student were intense due to the neighboring industrial giant, and my award-winning eighth grade exhibit on optical illusions served to transform my perception of the magic of science to fundamental tenets of science. Unfortunately, this image from a Norman Rockwell painting would suddenly fade as my parents divorced in the summer prior to high school, and the chemistry set would now become a constant traveling companion and a means of escape into the wonders of science.

My childhood chemistry set unfortunately could not answer the complex question of divorce at a time when this was a rare occurrence. However, the chemistry set provided solace during difficult times in the basement of a very small rental apartment, which was just around the corner from our former family home. This high school boy immersed himself in chemistry and math as an intellectual escape and a unique challenge during the forever volatile teenage years. The chemistry set has moved many times over the past 35 years, but I remained dedicated to my childhood passion. Now the chemistry set resides in a typical moving box in the basement of my Blacksburg home, serving as a reminder of the wonderment of science and the tranquility of discovery for a future generation. Virginia Tech transformed my childhood chemistry set to a new chemistry set of 20 international scientists with nearly 10,000 square feet of state-of-the-art instrumentation, requiring over $50M of research dollars during the past 20 years. However, the instructions on this new chemistry set remain the same: *Use this chemistry set to discover the wonders of science and transform the world around you!* It is these simple instructions that solidify my personal philosophies of discovery, learning, and societal engagement. Research discoveries improve the quality and quantity of our lives, transform the classroom with an unpredictable syllabus, and entice the next generation with the thrill of science. Below are several personal realizations that I have made during my progression as a teacher and scholar.

Never underestimate the impact of teachers on the life decisions of students! Mrs. Klein, my high school chemistry teacher, loved chemistry at a time when women generally did not pursue a career in science. She was a pioneer! Her quirky personality was infectious, and reminded high school students to pursue their dreams despite the daunting forces of adolescent peer pressure. High school chemistry was a challenging subject, a subject frequently maligned from the other students, and unpleasant odors often escaped the chemistry laboratory during the destructive distillation of wood experiment. Conquering chemistry required perseverance and hard work, acquired traits that have served me well in many aspects of my personal and professional life. Exciting students in both the classroom and laboratory, allowing students to enjoy the wonders of science in an inviting atmosphere, and embracing diversity in all forms for the advancement of science are cornerstones that were shaped in Mrs. Klein's classroom.

Undergraduate research brings the science classroom to life! St. Bonaventure University provided me with a liberal arts education that nurtured an appreciation of the connectivity of philosophy, theology, and the arts with physical sciences and engineering. Dr. Diehl taught Organic Chemistry, arguably the most challenging class for a chemistry or biology major, and for the first time, a course that demanded me to understand fundamental concepts and extend them to unforeseen challenges. You cannot memorize chemistry! This experience culminated in an undergraduate research experience in polymer science, a topic not often available at a small liberal arts college. However, I was fortunate that Dr. Diehl visited Virginia Tech to attend a short course in polymer chemistry, and he returned to campus with a new curriculum and an excitement for polymers. I decided to pursue undergraduate research under his direction, possibly the single

most important decision of my academic career. Dr. Diehl allowed me to visit his industrial partner, and I quickly realized the relevance of polymers in everyday life. Despite my high GPA as an undergraduate chemistry major, I was never able to secure a summer internship at Kodak in my hometown, a dream that still lingered. Obtaining an internship often involved being a child of a current employee or "knowing someone" at the company. I quickly realized that opportunities involve more than excellent GPAs; opportunities require awareness and a professional network. Two lessons were learned. Therefore, undergraduate research remains as an integral component of my educational philosophy, and establishing industrial networks with effective interpersonal communication skills provides internship possibilities for our students.

The scientific world is a relatively small world! Dr. Diehl's experience at Virginia Tech compelled me to attend graduate school at Virginia Tech, and Professor McGrath, a University Distinguished Professor, captured the spirit of interdisciplinary thinking in 1983 when interdisciplinary thinking was not commonplace. The short course model served to engage teachers from around the country, and I directly benefited from a strong societal engagement program. This realization was further confirmed when I experienced the internationality of science, inviting students from around the world to tackle complex scientific questions. Interdisciplinary approaches were required to solve the grand challenges of the 1980s. NASA was propelling astronauts into space, the Cold War demanded innovation, and petroleum companies were fueling the plastics revolution. Thus, graduate school solidified for me the importance of diversity in all forms, including intellectual diversity, team diversity, and cultural diversity. Diversity is the critical reactant that is stirred into the reaction pot of science to form the products of 21st century science.

Interdisciplinary thinking is no longer a paradigm: it is an expectation! I ultimately accomplished my dream of employment at Kodak; however, the 1990s adhered to the adage that "change is the only constant." The pressures of Wall Street led to the demise of corporate research laboratories, and the allure of Kodak quickly disappeared. Only my life journey could prepare me for my return to Virginia Tech, armed with a passion to change the world, a thirst for collaborative research in an interdisciplinary setting, a love for teaching science, and an excitement to establish an international network that allows our science and our students to understand that today's challenges are global challenges. My decision to return to academia was driven by my desire to be a teacher; however, I arrived at a top-ten research institution in polymer science. I quickly transformed traditional classroom teaching to discovery-based teaching, and a prestigious NSF Integrative Graduate Education and Research Traineeship (IGERT) program profoundly influenced my career. The classroom of the future is not a room with four walls and a white board; the classroom of the future is a collaborative environment where creative thinking and discovery are homogeneously combined. This realization prompted me to design the Integrated Science laboratories for the College of Science, where for the first time, chemistry, biology, physics, mathematics, and statistics were integrated for students to understand the connectivity of scientific disciplines. Moreover, my industrial experience constantly reminded me of the importance of sustainability and the environment.

A chemistry professor must be more than just a researcher! My journey from the solace of a childhood chemistry set to an industrial scientist and now a science professor at Virginia Tech has led me to this conclusion. An outstanding faculty member must integrate education with discovery, discovery with engagement, and engagement with education. A researcher is a teacher, a community partner, and an inventor. Maintaining a finely tuned equilibrium of learning, discovery, and engagement ensures my impact on the lives of our students and the Commonwealth, effectively accomplishing our university motto, *Ut Prosim* (That I May Serve).

A chemistry set in the hands of a child may be the only STEM catalyst that we need!

Timothy E. Long: Abbreviated Vita

Education:
1987 Ph.D., Chemistry, Virginia Tech, Blacksburg, VA
1983 B.S., Chemistry, St. Bonaventure University, Olean, NY

Professional Experience:
2014 Director, Macromolecules Innovation Institute (MII), Virginia Tech, Blacksburg, VA
2011 Associate Dean of Research and International Outreach, College of Science, Virginia Tech, Blacksburg, VA
2009 Associate Director of Interdisciplinary Research and Education, Fralin Life Science Institute, Virginia Tech, Blacksburg, VA
2003 Professor of Chemistry, Dept. of Chemistry, Virginia Tech, Blacksburg, VA
2001 Associate Professor of Chemistry, Dept. of Chemistry, Virginia Tech, Blacksburg, VA
1998 Assistant Professor of Chemistry, Dept. of Chemistry, Virginia Tech, Blacksburg, VA
1994 Principal Research Scientist, Eastman Chemical Company, Kingsport, TN
1993 Senior Research Chemist, Eastman Chemical Company, Kingsport, TN
1990 Senior Research Scientist, Eastman Kodak Company, Rochester, NY
1987 Advanced Research Scientist, Eastman Kodak Company, Rochester, NY

Research Funding Achievement:
Virginia Tech, Department of Chemistry, 1998-present, generated ~$50 million research funding

Courses Taught: Organic Chemistry, Introduction to Nanoscience, Academy of Integrated Science Laboratory, International Perspectives on the Nanoscience of Macromolecules, Green Chemistry, Organic Chemistry of Polymers, Synthetic Reactions of Macromolecules, Polymer Chemistry Laboratory and Capstone, Macromolecular Science and Engineering Fundamentals

Extension Short Courses Taught at Virginia Tech:
Principles of Polymers, ACS, 1999-present, offered three times per year, team-taught
Adhesion Science MII, Virginia Tech, 2015, offered one time per year, team-taught
Adhesive Principles, Adhesive & Sealant Council, 2000-present, offered one time per year

Honors and Awards (Selected):
2018 Thermoplastic Elastomer Award from the ACS Rubber Division
2018 Appointed the Editor-in-Chief of *Polymer International*, a Wiley Journal
2017 John C. Schug Faculty Research Award, Department of Chemistry, Virginia Tech
2016 Inducted into the AAAS Fellows Program
2015 Virginia Outstanding Scientist Award
2011 American Chemical Society (ACS), Division of Polymer Chemistry, Mark Scholar Award
2011 Pressure Sensitive Tape Council (PTSC) Carl Dahlquist Award
2010 Virginia Tech Alumni Award for Research Excellence (AARE)
2009 Elected ACS Fellow (inaugural class)
2003 Council of Virginia Tech Certificate of Appreciation for Teaching Excellence
2003 Faculty Research Award, Department of Chemistry, Virginia Tech

Graduate Students/Postdoctoral Fellows Advised:
Completed: Ph.D. = 45; M.S. = 6; Postdoctoral Fellows = 15; Visiting Scholars = 22
Present: Ph.D. = 9; Postdoctoral Fellows = 1; Visiting Scholars = 1

Scientific Community Service (Selected):

- Proposal and Panel Review (NSF, ACS, Petroleum Research Fund, Army Research Office, Dreyfus Foundation, Cotrell Scholars, and others)
- Manuscript Review (Review 20-30 manuscripts annually)
- Member Editorial Boards (7), past Chair of the ACS Polymer Division, and current President of the Adhesion Society
- Member of numerous University, College of Science and Departmental Committees

Professional Affiliations:

- Member of ACS Divisions of Organic Chemistry, Polymeric Materials Science and Engineering, and Polymer Chemistry
- Member of the American Association for the Advancement of Science (AAAS)

International Collaborations:

- Served as an invited research professor at Waseda University in Japan, 2018
- Established an international collaboration initiative with San Sebastian, Spain, and a corresponding student-exchange program, 2016-2018
- Chaired the 2012 IUPAC World Polymer Congress at Virginia Tech

Selected Journal Articles (out of approximately 260 peer-reviewed articles):

- Schultz, A. R.; Lambert, P. M.; Chartrain, N. A.; Ruohoniemi, D. M.; Zhang, Z.; Jangu, C.; Zhang, M.; Williams, C. B.; Long, T. E., 3D Printing Phosphonium Ionic Liquid Networks with Mask Projection Microstereolithography. *ACS Macro Letters* **2014**, *3*(11)*,* 1205-1209.
- Hegde, M.; Meenakshisundaram, V.; Chartrain, N.; Sekhar, S.; Tafti, D.; Williams C. B.; Long T. E., 3D Printing All-Aromatic Polyimides using Mask-Projection Stereolithography: Processing the Nonprocessable. *Adv. Mater.* **2017**, *29*(31), 1701240.
- Hemp, S.T.; Zhang, M.; Tamami, M.; Long, T. E., Phosphonium Ionenes From Well-Defined Step-Growth Polymerization: Thermal and Melt Rheological Properties. *Polymer Chemistry* **2013**, *4*(12)*,* 3582-3590.
- Allen, M. H., Jr.; Wang, S.; Hemp, S. T.; Chen, Y.; Madsen, L. A.; Winey, K. I.; Long, T.E., Hydroxyalkyl-Containing Imidazolium Homopolymers: Correlation of Structure with Conductivity. *Macromolecules* **2013**, *46*(8)*,* 3037-3045.
- McKee, M. G.; Layman, J. M.; Cashion, M. P.; Long, T. E., Phospholipid Nonwoven Electrospun Membranes. *Science* (Washington, DC) **2006**, *311*(5759)*,* 353-355.

Selected Books, Book Chapters & Reviews (out of 22):

- Unal, S.; Ozturk, G.; Long, T. E., *Synthesis of Hyperbranched Polymers via Polymerization of Functionally Symmetric Monomer Pairs, in Hyperbranched Polymers: Synthesis, Properties, and Applications*, D. Yan, C. Gao, and H. Frey, Eds., 2011. Wiley, New York, N.Y.
- Mather, Brian D.; Viswanathan, Kalpana; Miller, Kevin M.; Long, Timothy E. Michael Addition Reactions In Macromolecular Design For Emerging Technologies. *Progress in Polymer Science* 2006, *31*(5), 487-531.
- McKee, Matthew G.; Unal, Serkan; Wilkes, Garth L.; Long, Timothy E., Branched polyesters: recent advances in synthesis and performance. *Progress in Polymer Science* 2005, *30*(5), 507- 539.
- Rogers, Martin E.; Long, Timothy E. (Eds), *Synthetic Methods in Step-Growth Polymers*. John Wiley & Sons, Inc., Hoboken, N. J. 2003.
- Puskas, J. E.; Long, T. E.; Storey, R. F (Eds.). *In Situ Spectroscopy of Monomer and Polymer Synthesis*. 2003, Kluwer Academic/Plenum Publishers, New York, N.Y.

Timothy E. Long: Excerpts from Letters of Support

"Dr. Timothy Long represents an interdisciplinary innovator who seamlessly connects undergraduate education and graduate training with research innovation that transcends conventional collegiate boundaries. I enthusiastically endorse Dr. Long's SCHEV Outstanding Faculty Award nomination based on his record of scholarly accomplishments, including more than 250 peer-reviewed publications during the past 20 years (with 36 publications in 2018 alone), over $50M in research funding from diverse federal and corporate partners, and his presence on local television, webinars on social media, and interviews on national public radio. His efforts to launch the integrated science curriculum in the College of Science have led to several successful academic innovations, including a B.S. degree in nanoscience, a nanoscience summer camp in the College of Science, the first winter-semester abroad course for the college, and enhanced laboratory learning opportunities. He currently leads the Macromolecules Innovation Institute, a model interdisciplinary research institute on our campus with a global reputation which offers an innovative interdisciplinary graduate degree program in partnership with the Graduate School. I am particularly aware of his recent partnership with the University of Virginia, which received funding from the NIH to develop new treatments for cervical cancer, and his interviews on local television showcasing the importance of partnering our leading institutions across the commonwealth for tackling some of the most impactful challenges of our times. Dr. Long consistently strives for excellence and provides an exemplary model for current and future faculty." **Dr. Cyril Clarke**, **Executive Vice President and Provost, Virginia Tech**

"Professor Tim Long shines in every dimension of faculty life, as teacher, as scholar, and as administrator… A world-class researcher holding more than 50 patents and with well over 250 scholarly publications, Tim is especially notable for his continual success with fundamental advances in polymer science, and with translating these advances into useful products and technologies. Indeed, his success at the scientific/corporate interface is a model for faculty in the 21st century. As a teacher, Tim is an exceptional mentor who will soon have passed the 50 mark of graduate students earning degrees under his direction. His commitment to bringing his deep scientific expertise to issues in undergraduate education are perhaps best exemplified by his work as co-developer of our innovative Integrated Science Curriculum (CoS ISC), and of our pioneering BS in Nanoscience… Tim has created experiences for VT students that can be had nowhere else. Tim's high rate of productivity is even more impressive in light of the administrative positions he has held as Associate Dean and now Director of the Macromolecules Innovation Institute. Add to this that Tim has brought warmth and passion to all of these activities… I cannot be more pleased to nominate Tim Long for a Virginia Outstanding Faculty Award." **Dr. Sally Morton, Dean, College of Science, Virginia Tech**

"Tim Long excels in all areas expected of a SCHEV Outstanding Faculty Award recipient... Tim is the undisputed leader of polymer research and education at Virginia Tech. With respect to graduate and undergraduate education, Tim has been an exceptional leader with accomplishments that include the creation of the NSF funded interdisciplinary MILES integrated graduate education with faculty from Chemistry, Veterinary Medicine and Food Science, as a co-developer of the CoS ISC, and developer of a new polymer capstone laboratory in the Department of Chemistry. Tim's passion for interdisciplinary education is a natural extension of his extraordinary research. Tim's extensive industrial experience has allowed him to bridge the gap between applied and fundamental research in a fashion that is second to none…his accomplishments reflect a unique ability of Tim to partner with industry and find novel solutions to real world problems while still performing cutting edge research. Moreover, Tim's service to

the department, university and community is nearly unbelievable given his other accomplishments. For a Department Chair, Tim is the dream faculty member." **Drs. James C. Tanko (Past Chair) and Alan R. Esker (Current Chair), Professors, Department of Chemistry, Virginia Tech**

"Professor Tim Long is a giant of science, teaching, and administration at Virginia Tech, and within the national and international scientific landscapes. His accomplishments, summed in these three areas, are literally off the charts. He is an international superstar in novel macromolecular polymeric structures, and the processes by which these can be turned into state-of-the-art technologies in a variety of fields. In teaching, whether to freshman or advanced graduate students, and at all levels in between, he is magic in terms of his inspiration and insight. And I have no idea how he, on top of all this, can administrate, but at the level of this university and within the infrastructure of international scientific societies, he is the perfect organizer and leader. All of Virginia Tech would not stand nearly as tall without Tim Long." **Dr. Michael F. Hochella, University Distinguished Professor Emeritus, Department of Geosciences, Virginia Tech; 2016 SCHEV Outstanding Faculty Award Recipient**

"I have known Tim for more than 20 years, through his outstanding and pioneering contributions to the field of functionalized polymers, his tireless efforts in promoting polymer chemistry education around the world, his profound service to our university system and the American Chemical Society (ACS), and as a most highly regarded colleague in the Dept. of Chemistry at Virginia Tech. … Tim is an icon for excellence in teaching, research and service. Tim motivates excellence in all of his students, and our field is certainly indebted to his efforts in preparing the next generation of scholars and leaders. His scholarly productivity and contributions to knowledge are truly remarkable, and his service to our university, the Commonwealth of Virginia, and the international community of scientists and engineers is inspiring… Tim has had a profoundly important impact in the field and his current research directions will be of immense value for years to come... With respect to education excellence and public outreach/service, Tim should be recognized as a super role model… Tim's service to the community starts at the local level where he is a mentor to numerous young scientists, and continues through to the state and national scene where he has served the field in many capacities of the ACS. Tim's profound leadership put VT on the international map of excellence and prominence in Polymer Chemistry." **Dr. Robert B. Moore, Professor, Department of Chemistry, Virginia Tech**

"I have had the privilege of working with Dr. Timothy E. Long throughout his 20 years at Virginia Tech… I have never met anyone with the creativity and insight that Tim demonstrates. It is a joy to work with Tim in developing ideas from his original vision into basic and translational research with high-level impacts… Tim inspired me and others to think outside of the box and recognize how we were shifting the paradigm for graduate training… Tim has a way of connecting with people, in his writing and his conversations, that inspires and engages… Some of Tim's most appealing characteristics are his humble attitude, team partnering, and willingness to serve… Tim could readily claim his excellence among the talented pool of academic colleagues. Instead, Tim is inviting, collegial, championing the team over self." **Susan E. Duncan, Ph.D., R.D.; Associate Director, Virginia Agricultural Experiment Station; Professor, Department of Food Science & Technology; Co-Director, Water INTERface; Virginia Tech**

"I have been deeply impressed for many years with both Dr. Long's discovery of many scientific concepts and their practical applications and his distinguished service in academic community, through my research activities in chemistry and chemical industrial sector and collaborations between US and Japan chemistry-related communities… Dr. Long's creative and cutting-edge research is recognized globally and is beginning to have far-reaching impacts on neighboring

fields… Dr. Long is very persistent in exploring new fields in designing, synthesizing, and characterizing polymeric materials, and I consider him a worldwide pioneer and leader in the field of polymer chemistry…. He always receives an excellent lecture evaluation aside from his scientific activities, which also supports my above understanding and our students' remarkable reputation on him. I consider these a picture of his commitment to excellence as a mentor to young researchers and students, even those overseas… Overall, I view Dr. Long as outstanding and one of the best scientists among the chemistry-related communities." **Dr. Hiroyuki Nishide, Professor and Past Dean, Waseda University; Past President of the Society of Polymer Science, Japan (12,000 members); Past President of the Federation of Asian Polymer Societies and of Japan Union of Chemical Science & Technology (75,000 members)**

"I've known Prof. Tim Long for more than 30 years and am thrilled he is being considered for the SCHEV Outstanding Faculty Award. In my opinion, he is a living embodiment of the multi-faceted faculty member... I've worked with Prof. Long on several projects in the past 10-15 years and have been impressed with the quality of the work and innovation level of he and his students, two of which I have hired at IBM… He is an outstanding teacher and lecturer… More recently, Tim has been instrumental in bringing IBM Research and Virginia Tech together to discuss a more multidimensional strategic relationship… In short, I know Tim well. I know him to be an outstanding researcher, extremely creative, fundamental but interested in innovation, a superb organizer and an outstanding teacher and lecturer. He is inspiring in many ways." **Dr. Robert D. Allen, Distinguished Researcher, Sr. Mgr. of Polymer Sci. & Tech., IBM Research Center; Ntl. Acad. of Eng.; SPIE Fellow; Virginia Tech Distinguished Alumni**

"I have known Professor Timothy Long for several decades... As a professor and mentor, Tim is a true advocate for the continual growth of the individual when it comes to his students. In particular, let me mention that he has many times encouraged and supported them to take on industrial internships during the course of their studies. These internships and interactions with industrial scientists are critical in expanding their horizons at a time where their professional growth is critical… Professor Long has had a long career of active service with the Division of Polymer Chemistry in the ACS. He has organized many symposia and workshops sponsored by the Division, and served as elected Chair of the Division, where his influence and ideas were critical in sustaining the wellbeing of the Division..." **Dr. Christine Landry-Coltrain, ACS, Kodak Fellow Materials Science, Kodak Research Laboratories, Eastman Kodak Co.**

"Dr. Long is willing to take chances on students, and he took a chance on me as a new graduate student. My undergraduate degree is in Materials Science and Engineering, and I did not have the in-depth knowledge of organic chemistry… Because of his willingness to take a chance, I am now able to (and have) designed my own polymer systems, synthesized monomers (polymer building blocks) and polymers. I have characterized these systems, have published two first-author research publications, and have presented the work at major national conferences... Dr. Long is unique in that he is selfless – he does what is best for the student… Dr. Long is essentially willing to give up these extra research papers in exchange for a more meaningful experience for his graduate students (at external internships). Because of his attitude towards internships and because of his vast network of connections in the field of polymer science, I was able to do an internship at Lawrence Livermore National Lab… He makes sure that each student has ample opportunity to present their work and to make the connections that they will likely use for the rest of their professional career. I cannot think of a more deserving awardee for the SCHEV Outstanding Faculty Award, and hope this makes it clear that Dr. Long is the best of the best when it comes to faculty advisors." **Dr. Justin Sirrine, 2018 PhD Graduate Student, Research Scientist at Solvay**

Timothy E. Long: Additional Documentation

Professor Timothy Long Research Group web link: http://www.tlong.chem.vt.edu

Prof. Long's passion and motivation for success as a faculty member at Virginia Tech originates from an unwavering commitment to students at all levels. His students clearly show that excellence in teaching, scholarship, knowledge integration, and service are not exclusive but rather fundamentally integrated to provide students an exceptional education. Provided below are unedited and un-excerpted comments from two of his students.

> Professor Tim Long is an exceptionally successful and intelligent faculty, who always tries his best to understand his students' needs. He was a caring instructor in the Polymer Capstone Lab course. During our class meetings, he always asked about how each individual was doing and what their career goals were. During our experiments, he gave us the freedom to work in a safe laboratory environment independently after explaining the experiments in detail. His teaching method helped us to develop our problem-solving skill and to be creative with our Capstone projects. He always encourages us to keep trying our best and learn our failures.
>
> Professor Long has also given me an incredible opportunity to work in his research group as an undergraduate researcher. It has been truly an amazing experience as I have met and learned so much from the most talented and intelligent people in polymer chemistry. Working in his group has inspired me to reach to a higher graduate-level education. He treats everyone with love and respect, but he is also a direct and straightforward person who does not "sugar-coat" things and always gives helpful constructive criticism to his students.
>
> Taking Professor Long's Polymer Capstone Lab course and being in his research group have truly been one of the best experiences during my undergraduate years at Virginia Tech. He is an incredible mentor who has encouraged me as well as others to believe in ourselves and to learn more about polymer chemistry. He is a passionate person who loves his job and is willing to go the extra mile to help an individual. **Ms. Mai Nguyen, Previous Undergraduate Student and Undergraduate Researcher, Research Scientist, Luna**

> I first met Dr. Long during recruitment weekend in 2016 where his research and work ethic inspired me. He took the time to meet with me one-on-one to probe my personal interests and how I would fit into his group if I did decide to join in the coming fall. I ultimately chose to join his group based on his drive for innovation and his compassion for teaching and mentoring. He also taught a three-credit MACR course during my first semester, which introduced the students to polymer characterization. He pushed us to write comprehensive lab reports and give oral presentations, all in effort to prepare us for our next 5 years in graduate school. After my first year of support and mentoring from Dr. Long, I knew I made the right decision in choosing his group. After many conversations, Dr. Long put me on a project that lined up with my interests and continued to push my learning and creativity to help me grow as a student. Throughout the past two years, I greatly appreciate Dr. Long constantly pushing my colleagues and I to be more creative, work harder, and critically think about our impact on the scientific community.
>
> During my time in Dr. Long's group, he has provided my colleagues and I unprecedented opportunities to not only grow as graduate students and researchers, but also grow personally. Dr. Long is an excellent educator from teaching in classes and conducting groundbreaking research to passing along his expertise to his graduate students and collaborators. **Ms. Emily Wilts, Graduate Student in Macromolecular Science and Engineering Ph.D. Program**

VIRGINIA TECH MAGAZINE SPRING 2019

AROUND THE DRILLFIELD

NEW BIOMEDICAL GEL COULD EASE PAIN IN CERVICAL CANCER TREATMENT

A unique partnership between a Virginia Tech scientist and a University of Virginia (UVA) oncologist could result in a solution to reduce discomfort during cancer treatment for women.

Tim Long, a professor of chemistry at Virginia Tech, examines a clear gel that he created in his lab to help relieve pain during cervical cancer treatment.

https://www.vtmag.vt.edu/spring19/drillfield.php

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10 NEWS
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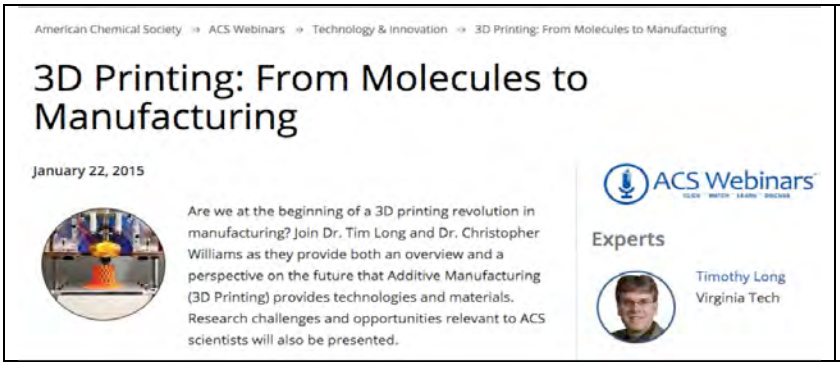
GRAHAM MEDIA GROUP

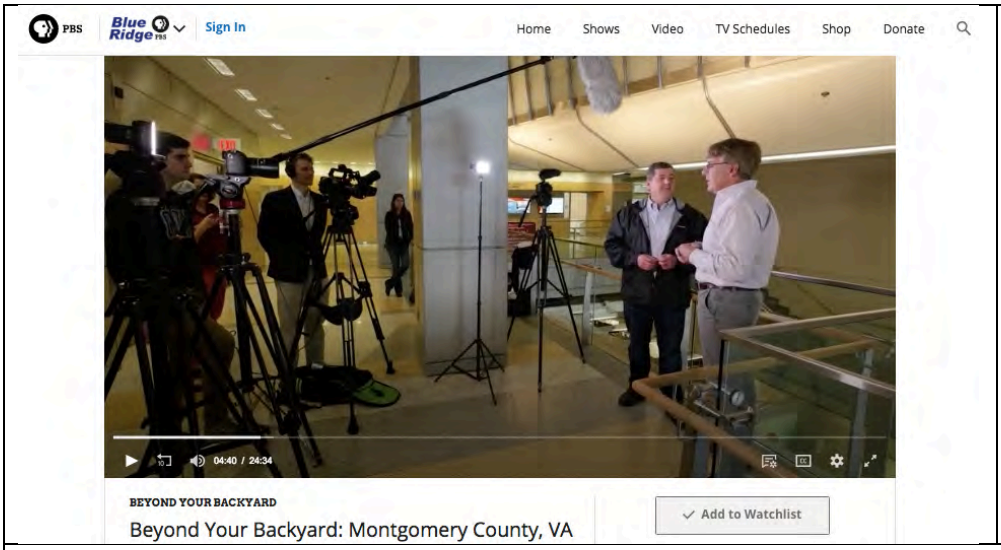
New cervical cancer treatment research happening at Virginia Tech, UVA

By Jenna Zibton, Anchor/Reporter



Free ACS member Webinar presenting “Current capabilities of 3D Printing Technologies and Materials, and Emerging research at the Intersection of Polymer Synthesis and Additive Manufacturing”

The newly established MII Center for Performance Packaging at Virginia Tech is committed to tackling the packaging industry with a systems-approach.



BEYOND YOUR BACKYARD

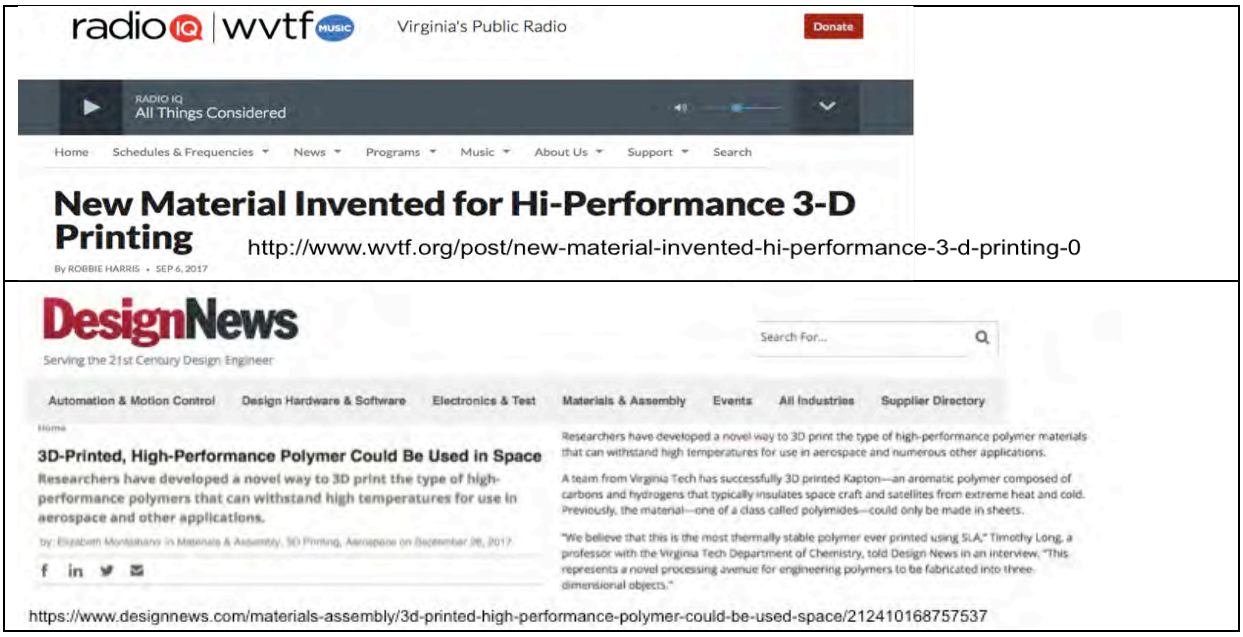
Beyond Your Backyard: Montgomery County, VA

Episode 2 | 24m 34s

In this edition of Beyond Your Backyard, Erik travels to Montgomery County, Virginia to uncover the secrets to the preparation of an excellent buffalo burger. He also learns more about the groundbreaking technology research going on Virginia Tech including self-driving vehicles. And finally, Erik explores the county indoors and out!
https://www.pbs.org/video/beyond-your-backyard-montgomery-county-va-h6lqp8/

Microplastics - Into Our Oceans: https://www.pulseplanet.com/dailyprogram/dailies.php?POP=6532 Microplastics - Solutions: https://www.pulseplanet.com/dailyprogram/dailies.php?POP=6533 Microplastics - Beneficial Uses: https://www.pulseplanet.com/dailyprogram/dailies.php?POP=6534 Microplastics - Double-Edged Sword: https://www.pulseplanet.com/dailyprogram/dailies.php?POP=6535	Interview with Jim Metzner of Pulse of the Planet. Featured on NPR - Microplastics and their effect on the ocean and environment. Aired on March 14-17, 2017.

Selected News Coverage: Virginia Tech researchers Long and Williams have created a novel way to 3-D print the type of high-temperature polymeric materials commonly used to insulate spacecraft and satellites from extreme heat and cold.



Selected Virginia Tech News Coverage:
11/26/18 New biomedical gel could ease pain in cervical cancer treatment https://vtnews.vt.edu/articles/2018/11/univrel-cancergel.html
10/18/17 Prof. Tim Long named new Editor-in-Chief of Polymer International https://chem.vt.edu/about-us/news/2017-10-18-long.html
8/29/17 VT team develops novel 3-D high-performance polymer for use in space https://vtnews.vt.edu/articles/2017/08/Engineering-3dprinted_thermal_material_science.html
3/27/15 Timothy Long selected as a Virginia Outstanding Scientist for 2015 https://vtnews.vt.edu/articles/2015/03/032715-science-scientistofyear.html
2/28/13 Fralin graduate student invents new cancer drug delivery vehicle https://vtnews.vt.edu/articles/2013/01/012813-fralin-cancerdrugdeliveryinvention.html
6/18/12 Scientific meeting at Virginia Tech will make more than $2M economic impact https://vtnews.vt.edu/articles/2012/06/061812-science-econdevelop.html
6/28/11 Chemist wins award for new approach to pressure-sensitive adhesive production https://vtnews.vt.edu/articles/2011/06/062811-research-timlongpstcaward.html
5/12/11 Chemist Timothy Long named Mark Scholar by American Chemical Society https://vtnews.vt.edu/articles/2011/05/051211-science-timothylong.html
2/21/11 Productive university, industry research partnership recognized https://vtnews.vt.edu/articles/2011/02/022111-research-longacspmse.html

Student Perception of Teaching (SPOT) Scores – Undergraduate Courses (2013-2017)

Course Name	Number	Semester	Enrollment	Credits	SPOT
Laboratory in Polymer Science	4074	Spr 2013	9	2	5.62/6
Organic Chemistry	2535	Fall 2013	122	3	5.50/6
Laboratory in Polymer Science	4074	Spr 2014	11	2	5/6
International Perspectives on the Nanoscience of Macromolecules	4984	Wtr 2014	20	3	NA
Organic Chemistry	2535	Fall 2014	129	3	5.4/6
Laboratory in Polymer Science	4074	Spr 2016	7	2	5.5/6
Laboratory in Polymer Science	4074	Spr 2017	6	2	5.3/6