APPLIED //

FUNCTIONAL FABRICS

From Mining Oceans to Walking in Space

THOMAS JEFFERSON UNIVERSITY TRACES ITS ANCESTRY, in part, to the 1884 founding of the Philadelphia Textile School, the nation's first center for textile-focused education. That institution continued to be a pioneer in textile science, technology and innovation for more than 130 years. Today, that legacy is visible in an array of nationally and globally recognized textile-related academic and research programs—notably including research, analysis and development of "functional fabrics" that serve a broadening range of purposes.

Jefferson is one of the few academic institutions possessing the full scope of expertise and technical facilities needed to reduce fundamental ideas to practice. As such, it fosters work ranging from discovery research and technical analysis of new materials, to design, prototype and development of formed products. Leveraging cross-disciplinary collaborations, faculty and students pursue basic science investigations; translate and apply their findings through ideation, prototyping and clinical or industrial testing; and develop production and supply-chain processes and marketing strategies. The resulting concepts, methods and products address the needs of a wide range of audiences, from healthcare providers and patients, industrial manufacturers and consumers, to United States government agencies and world-class athletes.

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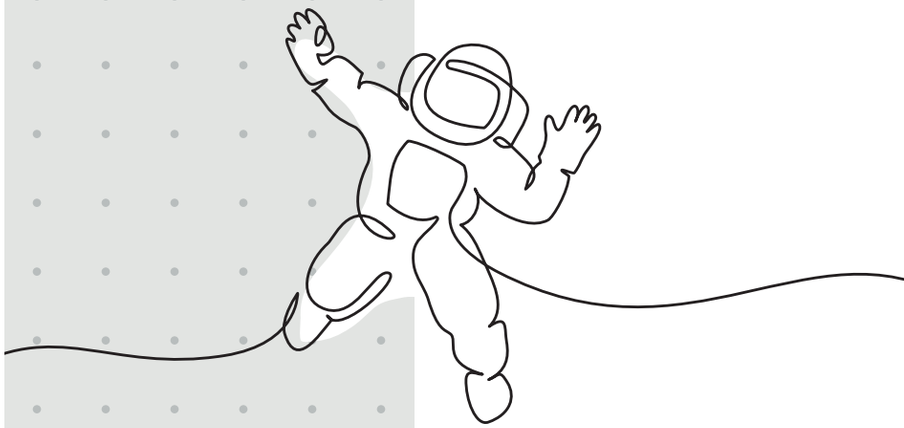

New Functional Fabrics and Garments

Since the 1970s, the University has produced high-performance material used to construct the gloves that NASA astronauts use during spacewalks. More recently, fashion design and engineering students developed creative outer-layer designs for the "Z-2 Prototype" of NASA's next-generation spacesuit. In 2017, a student team won top prize in a United States Department of Defense (DoD) challenge to redesign protective chemical-biological suits for U.S. warfighters. Their innovative concepts for materials and construction—a synthesis of original apparel design with the integration of new technologies—promised to significantly enhance comfort and improve tactility and dexterity during military action. The team has since worked with the DoD to bring their ideas and designs to reality.

Faculty and students have researched and developed new functional fabrics and garments for other kinds of high-intensity, high-stress situations. One is Olympic rowing, for which a team led by **Mark Sunderland, MS**, Robert J. Reichlin High-Performance Apparel Chair, created a seamless, single-piece uniform. Sunderland's group developed a new fabric and an innovative whole-garment knitting process, and created a uniform that fit like a virtual "second skin" for U.S. rowers in the 2016 Olympic games. He and his colleagues are now putting the finishing touches on new uniforms for the U.S. skeleton team preparing to compete in the 2022 winter games in Beijing.

New Medical Treatments

Continuing research and development of purpose-specific functional fabrics is also benefiting people with chronic disease or serious injury. Teams of clinicians, textile engineers and other technical experts are working at various stages of conceptualization, research and development of products. These include a functional vest for multiple sclerosis patients; fabric-based protective head garments for people with major head injury; polymer science-based fibers that hasten wound closure and healing; and a range of materials capable of sensing and transmitting clinically relevant biochemical or physiological changes. In the Edward P. Marram Biomedical Textile Structures Laboratory, researchers are pairing advanced textile structures with cultured stem cells to study the functionality of cell-covered textiles for medical use. One current project focuses on a potential 'cardiac patch' for treating coronary artery disease.

Novel Purposes

But functional fabrics have uses beyond garments and medical treatments. **Marcia Weiss, MFA**, associate professor of textile design, specializes in helping create new kinds of knitted and woven fabrics with novel purposes or unusual qualities—for example, fabric that conducts electricity in a way that causes it to change shape when subject to current. Weiss directs the state-of-the-art Fashion and Textiles Futures Center (FTFC), which focuses on textiles product design, engineering and function analysis, and enables student/faculty teams to partner with public and private organizations on innovative real-world projects.

"FTFC teams work on an extraordinary range of projects," explains Weiss. "We have designed fabrics that respond to heat and ice, and created novel products using completely new materials created by industry." For example, the Oak Ridge National Laboratories asked the team to help research and design a textile that would extract heavy metals from the sea, and they created a product that combined materials never before integrated together. "NASA engaged us to develop a fabric using carbon nanofibers, with layers as parallel as possible and linear strength running in one direction," says Weiss. "We created a very effective prototype, and they recently asked us to develop the next phase of the fabric."

Brian George, PhD, associate professor of engineering, is a textile engineer and materials maker whose primary research focuses on converting non-traditional materials into nonwoven fabrics for a variety of uses. He and colleagues, **Diana R. Cundell, PhD**, professor of biology, and **Alexander Messinger, MSArch, MArch, MCP**, professor emeritus, have developed new biocidal textiles that naturally kill bacteria, mold and fungi. Such materials have many potential uses, including kitchen countertops and "breathing wall" systems capable of killing bacteria in hospital rooms and physicians' offices. On a different track, Dr. George is investigating uses of waste fibers from manufacturing hats and other felt-based products. His purpose here is to explore the fibers' potential for increasing the strength of concrete and other building composites and for enhancing soil fertility for agriculture. ■