

## The BioInnovation Institute in Akron History of Innovation Timeline

### History of Innovation Retrospective

Polymer science and medical science have traveled in tandem for over a century, crossing paths frequently with discoveries in the former often catalyzing innovation in the latter. Louis Pasteur's validation of the "germ theory" eventually led to the innovation of latex rubber gloves and synthetic rubber barrier technologies. Edward Jenner's successful inoculation against smallpox set in motion the modern science of engineered drugs and vaccines, with polymer scientists playing an important role through the invention of polymer adjuvants to improve the immunogenicity of vaccines. This ushered in a new era of designed polymer micro bubbles for engineered drug release and highly targeted drug delivery.

After crossing paths repeatedly through the years, medical science and polymer science are now completely entwined in a relationship in which the partnership is greater than the sum of its parts. This symbiosis will only grow stronger, leading to medical innovations that until recently were thought of as science fiction.

### **1796**

British doctor Edward Jenner successfully used cowpox to inoculate against smallpox disease. In 1980, two years after the last known case of smallpox and nearly two centuries after Jenner's first successful attempt at inoculating people against smallpox, the World Health Organization declared that the disease had been eradicated after a 13-year campaign. This was the result of coordinated public health efforts by many people, but vaccination was an essential component. Vaccination has been touted as the most successful medical intervention for the prevention of disease in the 20<sup>th</sup> century.



With the discovery of adjuvants in 1925, it was established that the addition of these immunostimulators could significantly increase the effectiveness of vaccines, thus permitting less antigen to be used in each vaccine dose to achieve the desired immune response. Adjuvants began to be widely used in vaccines in the 1950s.

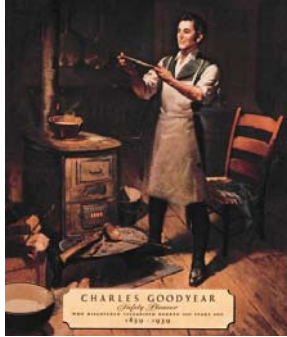
The first adjuvants were compounds such as tapioca, starch oil, saponin or even breadcrumbs, but polymer science has had a significant impact

on adjuvant design. Polymers are one of the main components of many of the primary types of adjuvants used today. Biodegradable polymer microspheres are being evaluated for targeting antigens on mucosal surfaces and for controlled release of vaccines with an aim to reduce the number of doses required for primary immunization.



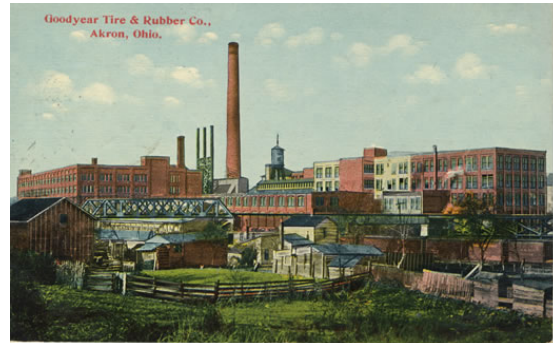
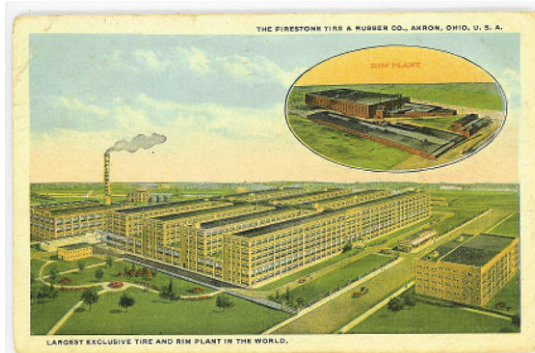
## 1839

Vulcanization of rubber was discovered. The “rubber fever” of the early 1830s had ended suddenly. Factories had sprung up to meet the demand, but the public abruptly became frustrated with the product, which froze in winter and became glue-like in summer. None of the new rubber companies survived even five years. Investors lost millions.



Charles Goodyear, a bankrupt hardware merchant from Philadelphia, was imprisoned for bad debts, so he completed his first experiments on rubber in a jail cell. After years of failed efforts, he finally discovered the secret to vulcanizing rubber: combining natural rubber with sulfur and heating it to 270 degrees, which created what we know today as the most versatile of the modern “plastics.” Vulcanized rubber is a polymeric substance that is much more durable than its natural counterpart. Neither Goodyear nor his family was ever connected with the company named in his honor. Goodyear’s only direct descendant among modern companies is United States Rubber.

Goodyear’s discovery has had immeasurable implications for healthcare. Today rubber is used in everything from hospital flooring to latex gloves, wound dressings to drug delivery devices, contact lenses to artificial lenses following cataract removal.



**1870**

Buchtel College, the precursor institution to The University of Akron, was founded by the Ohio Universalist Convention, which was strongly influenced by the efforts, energy and financial support of Akronites, particularly industrialist John R. Buchtel.



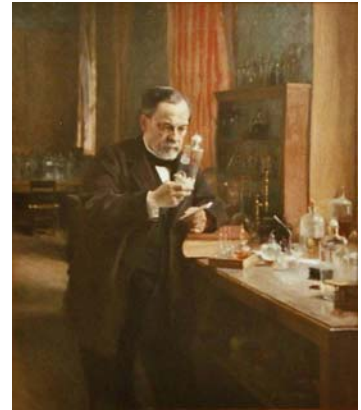
At the time, Akron was a small but steadily growing city of 10,000 along the Ohio & Erie Canal. From the outset, the college and the surrounding community were closely tied, with the college addressing the needs of the region as well as those of the Universalist Church and local entrepreneurs assisting the fledgling institution time and again.

By 1907, Buchtel College's emphasis on local rather than denominational interests led it to become a private, non-denominational school.



## 1877

Louis Pasteur's studies of anthrax confirmed the "germ theory" of disease. In the 19<sup>th</sup> century, it was not uncommon for the general public and physicians to believe that people became afflicted with disease because of their sins, curses or bad "humors." The discovery of the germ theory and of microorganisms has been hailed as the most important discovery in medicine, and possibly the most important discovery for mankind as a whole.



In the late 19<sup>th</sup> century, Pasteur's germ theory became the medical paradigm, the controlling medical idea, for the Western world. In its simplest form, the germ theory proposes that the body is sterile and that germs from the air cause disease. The germ theory fundamentally changed the habits of both the general public and healthcare professionals, prompting practices such as covering the mouth when coughing and sneezing, frequent hand washing, and ultimately the use of medical gloves.



The first mention of medical gloves was in 1889, and their important contribution to healthcare was made possible because of rubber. All surgical gloves are made from natural or synthetic rubber latex by definition. Latex exam gloves have been the choice of healthcare workers because of their durability and their flexibility, and their use has led to decreased infections of healthcare workers and a decrease in nosocomial infections in hospitals.



**1890**

Akron Children's Hospital was founded. Today the hospital cares for more than 400,000 patients each year and performs more pediatric surgeries than any other hospital in Northeast Ohio.



Children's operates a 253-bed pediatric hospital in downtown Akron, housing a regional burn center for both adults and children, a pediatric trauma center and more than 30 clinical specialty areas. Akron Children's also offers pediatric care at more than 40 locations throughout the region. In addition, more than 100 advocacy, education, outreach and research programs are provided to children and their families.

Akron Children's Hospital has earned The Gold Seal of Approval from The Joint Commission and Magnet Recognition Status from the American Nurses Credentialing Center.





## 1892

Akron City Hospital was founded, the first of Summa Health System's hospitals. The hospital was built on the site of the Bartges Mansion, which was built by Dr. S.W. Bartges in 1873 at a cost of \$36,000.



The creation of the hospital was the culmination of a dream of Boniface DeRoo, a Dutch immigrant whose will provided approximately \$10,000 for the establishment of Akron's first hospital. Akron City Hospital was founded to provide a place where the sick and injured could be treated with compassion, coupled with the best principles of medical practice.

Over the years, Akron City Hospital has gained a solid reputation in medicine. From the first accredited radiology department in the country to the first adult open heart surgery in Akron and one of the first in the country, Summa's Akron City Hospital has achieved national recognition as a provider of quality, compassionate health care.

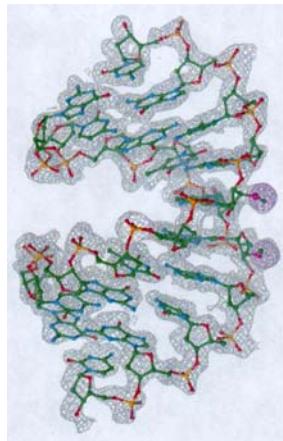
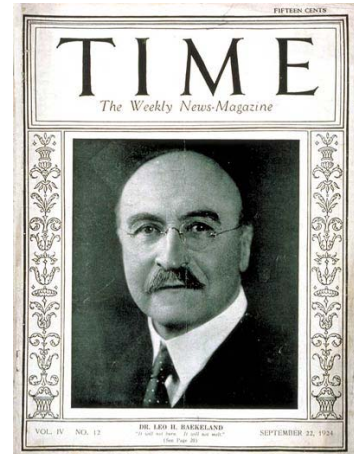


## 1907

The oldest recorded synthetic plastic was fabricated by Leo Bakeland. Bakelite's hardness and high heat resistance made it an excellent choice as an electrical insulator.

Modern life would be incomparably different without synthetic chemicals called polymers. Man-made fibers as used in clothing, carpets and curtains, plastics used in innumerable domestic and industrial applications and artificial joints, and paints and cleaning materials, are all different forms of this important discovery. What's often forgotten is that at the beginning of the 20th century, the chemistry of large molecules was unknown and their synthesis unthinkable.

Bakeland's invention would be followed a decade later by another significant milestone in polymer research, and the remaining years of the 20<sup>th</sup> century would bring many more.



## 1909

Buchtel College, which is now The University of Akron, began offering the world's first courses in rubber chemistry, prompted by the proximity of Goodyear, Firestone and Goodrich.

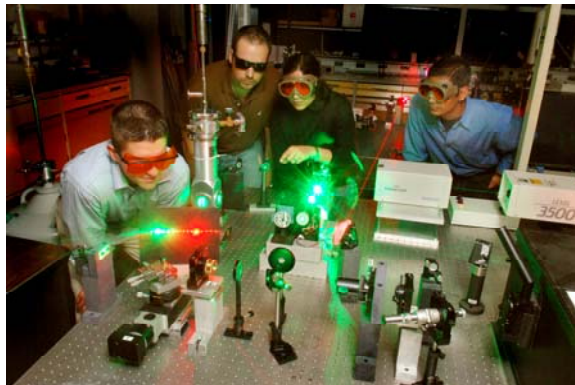


UA's tradition as a leader in polymer science and polymer engineering began with the foresight of Dr. Charles M. Knight, a faculty member at Buchtel College. As a professor and chemical consultant, he realized that young Akron rubber companies like BFGoodrich would need well-trained workers to keep growing. By 1909, Knight had set up the world's first academic rubber chemistry lab and began teaching a course in rubber chemistry the next year.



From there, the University's program gained momentum as Akron and its industry became known as the Rubber Capital of the World. In 1913, the assets of UA were transferred to the city, transforming it from a private institution into a municipal university. Seven years later, the earliest master's thesis on rubber chemistry catalogued in UA's library was completed.

By World War II, the University's program was so highly regarded that the U.S. government contracted with UA to establish the Rubber Research Laboratory to aid in the development of the synthetic rubber needed for the war effort.





## **1914**

Akron General Health System was founded as Peoples Hospital.

Akron General has grown from a single hospital to a large, fully integrated healthcare delivery system. Akron General Health System includes:

- Akron General Medical Center, a 511-bed teaching and research medical center, and Edwin Shaw Rehab, the area's largest provider of rehabilitation services
- Akron General Partners, which includes Partners Physician Group, the Akron General Health & Wellness Centers, Lodi Community Hospital, Community Health Centers and other companies
- Akron General Community Health Ventures, which includes Visiting Nurse Service and Affiliates, the largest and most comprehensive provider of home healthcare services in Ohio, and Rose Lane Health Center
- Akron General Development Foundation

Akron General serves its community with a philosophy of relentless commitment to the health and wellness of the people of Northeast Ohio. Through the efforts of nearly 6,000 employees, medical professionals and volunteers, Akron General serves the healthcare needs of more than 1.2 million people throughout Summit, Medina, Portage, Stark and Wayne Counties. The comprehensive and fully integrated system means that all of a patient's healthcare needs—from prevention to a physician visit to testing to hospital care to home healthcare—are seamlessly coordinated.



## 1920

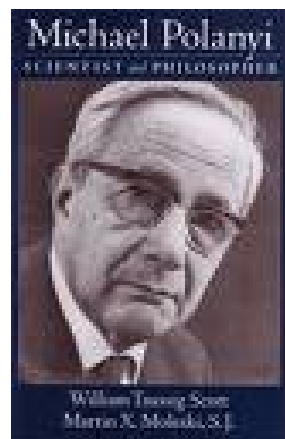
German scientist Hermann Staudinger published his classic paper, "Über Polymerization," which heralded a decade of intense research and presented the world with the development of modern polymer theory. Staudinger's proposal in the 1920s that it was possible that large molecules were made up of many thousands of atoms was ridiculed by many other scientists. The common wisdom was that the structures of such materials as rubber and Bakelite were actually many small molecules held together by an unknown force.



Staudinger stuck to his guns, and with his colleagues, he synthesized a series of organic molecules called poly(methanol)s. These compounds were long chains of repeating units, the units being -CH<sub>2</sub>O-. They are made by joining lots of methanol molecules together. The German scientists made chains of different lengths and showed that their properties changed depending on the length of the chains.

Five years later, physical chemist Michael Polanyi used X-ray crystallography to discover the chemical structure of cellulose. This discovery established the fact that polymer unit cells contain sections of long chain molecules rather than small molecular species.

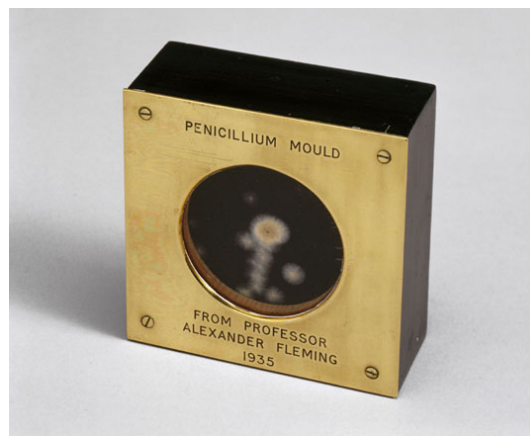
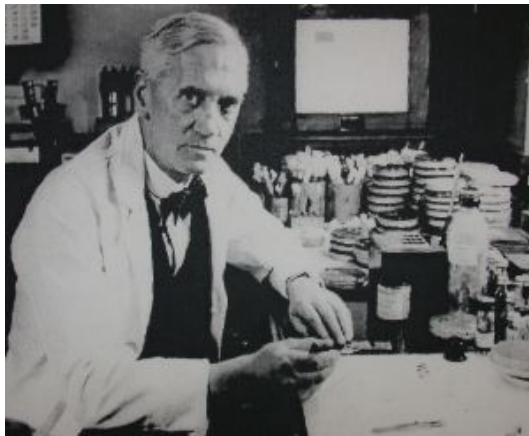
Polanyi's research into Cellulose and the following study of its derivatives and other early plastics have been used in the development of many pharmaceuticals, controlled-release medications and emulsifiers as well as the plastic of photographic film, including X-ray films, and hundreds of other medical innovations.



## **1928**

British bacteriologist Alexander Fleming discovered penicillin, the first antibiotic, while working at St. Mary's Hospital in London. He observed that colonies of the bacterium *Staphylococcus aureus* could be destroyed by the mold *Penicillium notatum*. This principle later led to medicines that could kill certain types of disease-causing bacteria inside the body. At the time, however, the importance of Fleming's discovery was not yet appreciated. Use of penicillin did not begin until the 1940s when Howard Florey and Ernst Chain isolated the active ingredient and developed a powdery form of the medicine.

In many ways, penicillin and other antibiotics are actually anti-polymers because they destroy the polymer-based cell walls of microorganisms. Ironically, the first generation of antibiotics could not be taken orally because they were destroyed in the digestive tract. The development of biodegradable plastic capsules helped solve this problem.



**1939**

Just 17 years after its founding, St. Thomas Hospital became the first hospital in the country to recognize the medical aspects of alcoholism as a disease when it began treating the patients of Robert H. Smith, MD, a co-founder of Alcoholics Anonymous. The hospital opened the nation's first alcoholism treatment ward and continues this longstanding dedication today. Sister Ignatia, a Sisters of Charity of St. Augustine nun, established the alcohol detoxification unit and became the first person to admit alcoholics to the hospital for treatment in August of that year.

Alcohol and Drug Abuse Services operate as a front runner in the diagnosis, treatment and rehabilitation of substance abuse patients.



## 1942

The University of Akron formed the Rubber Technical Institute, allowing University researchers and students to be well-prepared to contribute to the development of synthetic rubber to aid the Allied war efforts. Fourteen years later, the University established the Institute for Rubber Research, which was renamed the Institute of Polymer Science in 1964.

A newly discovered polymer called polythene had many properties that made it stand out: it was easy to form into different items, was tough and hard wearing, was impermeable to water, and was insulating to electricity. Discovered in the 1930s, it was used in the Second World War to insulate the many meters of cables needed for the vital radar equipment used by the British.

It was President Roosevelt's decision to make aggressive, focused investments in basic science during the war that launched the enduring partnership between the federal government and research universities, a partnership that has vastly enhanced America's military capabilities and security, initiated many important industries, produced countless medical advancements and spawned virtually all of the technologies that account for our modern quality of life.





## 1945

The National Academy of Sciences established the Artificial Limb Program in response to the influx of World War II veteran amputees and for the purpose of advancing scientific progress in artificial limb development.

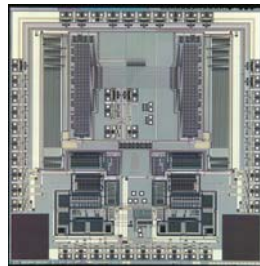


Since the program's creation, advances in areas such as materials, computer design methods and surgical techniques have helped make prosthetic limbs increasingly lifelike and functional. Collaborative efforts between Oak Ridge National Laboratory, NASA and the National Institute of Aerospace, as well as additional research funded by the U.S. Department of Defense, have developed pressure-sensitive, temperature-sensitive, water-resistant materials

for aeronautic, aerospace and robotic applications. The materials have nearly the same heat-conducting ability of human skin and are piezoelectric, generating electricity in response to pressure. They can be designed to behave as both a temperature and pressure sensor, as a flexible electrical conductor or as part of a polymer material with mechanical and thermal properties similar to those of human skin.



The functionality of prosthetic legs was enhanced in 1961 by what is perhaps the greatest achievement in materials science. Fairchild Semiconductor Corporation manufactured the first commercially available integrated circuits, or microchips, which have revolutionized medical science.



## 1950

The John S. and James L. Knight Foundation was created a decade after the establishment of the Knight Memorial Education Fund by John Shively Knight and James Landon Knight. The private, independent foundation originated with the Knight family's belief in the value of education. The brothers' father, editor-publisher Charles Landon Knight, had a tradition of helping financially strapped students pay for college. To honor his memory, the brothers established the Knight Memorial Education Fund to provide financial aid to college students from the Akron area. The fund's assets of \$9,047 were transferred in 1950 to the newly created Knight Foundation.



Today, Knight Foundation promotes journalism excellence worldwide and invests in the vitality of communities in the United States where the Knight brothers once owned newspapers. Since 1950, the foundation has made more than \$1 billion in grants, including more than \$400 million to support journalism excellence and free speech. Knight Foundation invests in ideas and projects that can lead to transformational change.



[www.knightfoundation.org](http://www.knightfoundation.org)

## 1953

Geneticists James Watson and Francis Crick deciphered the double-helix structure of DNA on Feb. 28<sup>th</sup>, prompting Crick to announce in an England pub that day that they had discovered the “secret of life.” Indeed, their finding confirmed suspicions that DNA carries life’s hereditary information.



The discovery had a major impact on genetics and biology that can be seen today in the form of prenatal screening for disease genes, genetically engineered foods, and the use of DNA testing to produce evidence in criminal court.



DNA consists of polymer chains and is considered the premier natural polymer. A great deal of current research focuses on “conducting” polymers with applications in DNA-based computer processing.



## 1958

The “total hip replacement” was born in England. A very innovative surgeon, John Charnley, was aggressively pursuing effective methods of replacing both the femoral head and acetabulum of the hip. In 1958, he addressed the eroded arthritic socket by replacing it with a Teflon implant that he hoped would allow for a smooth joint surface to articulate with the metal ball component. When the Teflon did not achieve this goal, he went on to try polyethylene, which worked incredibly well. In order to obtain fixation of this polyethylene socket as well as the femoral implant to the bone, Charnley borrowed polymethylmethacrylate, known as bone cement, from dentists. This substance was used as a strong grouting agent to firmly secure the artificial joint to the bone. By 1961, Charnley was performing the surgery regularly with good results.



Akron General's Orthopaedic & Rehab Center has a history of superior clinical results in treating damaged joints. The center's specialists lead the way in orthopaedic research and innovation and are skilled in replacements of the shoulder, hip, ankle, elbow and knee. Akron General orthopaedic surgeons performed one of the first ceramic-on-ceramic hip replacements in the country - a new type of longer-lasting hip implant now available to younger patients. The hospital's patients benefit from newer techniques, less pain and more durable implants.



## 1964

After a dramatic increase in cigarette smoking and rates of lung cancer in the 20<sup>th</sup> century, the U.S. surgeon general issued the first official warning about the health risks of smoking. This report from the surgeon general and the many that followed had a significant impact on public attitudes and policy, transforming the issue of smoking from one of individual and consumer choice to one of epidemiology, public health and risk for smokers and non-smokers alike.

**SURGEON GENERAL'S WARNING: Smoking Causes Lung Cancer, Heart Disease, Emphysema, And May Complicate Pregnancy.**



One of the most significant innovations in smoking cessation was the development of the nicotine patch, which typically consists of a plastic chamber that contains the drug and is covered by a selectively permeable membrane to control the rate at which the drug is delivered. This carrier layer can be made from a variety of plastics, including polyvinyl chloride, polystyrene, polyurethane, ethylene vinyl acetate, polyester, polyolefin and polycarbonate.



Luther L. Terry



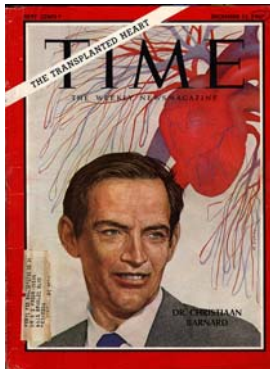
This type of drug delivery device, generically known as a transdermal patch, consists of a drug reservoir sandwiched between an occlusive back layer and a permeable adhesive layer that attaches to the skin, and has applications for a wide variety of drug delivery systems.





## 1967

Less than a decade after performing South Africa's first kidney transplant, Dr. Christiaan Barnard, a South African surgeon, performed the world's first successful human heart transplant.



The operation lasted nine hours and involved a team of 30 people, including Barnard's brother, who assisted him during the surgery. After passing this milestone in a new field of life-extending surgery, Barnard was celebrated around the world for his daring accomplishment.

Research increasingly turned to artificial organs and organ systems in the second half of the 21<sup>st</sup> century. Biocompatible plastics such as teflon, polypropylene and delrin have played a key role in the production of artificial organs, hemodialysis and implants.

Also in 1967, The University of Akron became a state university.

## 1973

The Northeastern Ohio Universities College of Medicine was founded to meet a critical need for primary care physicians in Northeast Ohio.



In the summer of 1972, the Ohio General Assembly passed a bill that provided \$50,000 to establish "a consortium of state universities in northeastern Ohio for preparation of detailed plans for medical education based insofar as practicable upon facilities of existing universities in each area and upon community hospital facilities." Those universities – The University of Akron, Kent State University and Youngstown State University – developed a plan for expanding medical education opportunities in Northeast Ohio,

including establishment of a medical school.

In August 1973, the General Assembly of the State of Ohio passed legislation to establish the Northeastern Ohio Universities College of Medicine (NEOUCOM).

In 1975, 42 students were selected for the charter class of the combined B.S./M.D. curriculum, and they began their studies at NEOUCOM's affiliated universities.



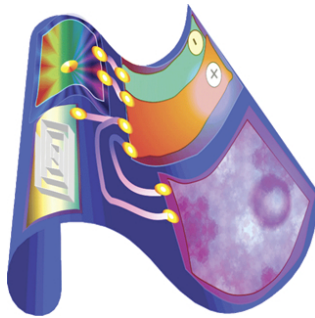
## 1974

Dr. Howard Igel and Dr. Aaron Freeman successfully grew human skin in the lab to treat burn victims, making Akron Children's Hospital the first hospital in the world to achieve this feat. The innovation launched an explosion of R&D into wound healing and skin regeneration.



One result of that R&D was the creation of Polyimide, also known as FILMSkin, more than three decades later. FILMSkin was developed by researchers from Oak Ridge National Laboratory's Nanomaterials Synthesis and Properties Group in collaboration with experts from the Superhydrophobic Materials Group and the National Institute of Aerospace in NASA's Langley Research Center. They produced a Flexible, Integrated, Lightweight, Multifunctional skin, called FILMSkin, for next-generation prosthetic hands and arms.

Their challenge was to make a revolutionary skin using superhydrophobic material with thin layers of carbon nanotubes to mimic skin's properties, allowing the prosthetic wearer to feel heat, cold and touch. FILMSkin was made to look and feel as real as human skin. It is lightweight but stretchable, allowing flexibility for movement with the prostheses, and it sheds water just like human skin, which is an important quality in protecting the electronics within.



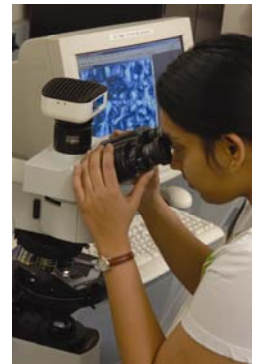
## 1976

For the first time, polymers/plastics outstripped steel as the nation's most widely used material per unit volume. We now use more plastic than steel, aluminum and copper combined.



In the 1980s, Akron and the Northeast Ohio region earned a reputation as the “Polymer Valley” of the United States. Akron’s expertise in polymers grew largely out of its history in the rubber industry. The region is home to 45 percent of Ohio’s polymer production sites as well as two of the nation’s most highly regarded polymer research centers – The University of Akron and Case Western Reserve University. UA has graduated more people in polymer engineering than any other university in the country, providing the many polymer companies in the area with a steady stream of talent.

UA’s solid polymer academic programs and research have also led to a great deal of commercialization in Northeast Ohio. Based on license rights or technology, many UA faculty members have formed companies for the purpose of developing a wide variety of polymer-based products. In 2002, several such companies were established, including TCS Polymers, which was founded by Dr. Frank Kelley, dean of UA’s College of Polymer Science and Polymer Engineering, and Barry Rosenbaum, director of technology for Omnova Solutions. The company commercializes color-changing polymer technology that they co-invented.



## 1977

Dennis Weiner, MD, mandated that orthopaedic research projects would be necessary for orthopaedic residents at Akron Children's Hospital to finish their training. As a result of this bold step, the Pediatric Orthopaedic Department at Akron Children's has been highly active in biomedical research for more than 30 years, publishing nearly 100 scientific articles, two books and more than 800 scientific presentations at various meetings.



The Pediatric Orthopaedic Department is currently involved in approximately 50 clinical and basic science projects at various stages of development. Four additional papers have been accepted for publication, including a collaborative basic science project involving Drs. Weiner, Landis, and one of Children's orthopaedic residents, Dr. Thomas Scharschmidt, on gene expression in subcapital femoral epiphysis. This landmark article will be published in *The Journal of Bone and Joint Surgery* and involves innovative, novel technology (laser capture and PCR), which is capable of isolating cells and determining what the cell is actually producing.

In addition, Children's is currently collaborating with Northeastern Ohio Universities Colleges of Medicine and Pharmacy (NEOUCOM) on four major basic science projects on clubfoot molecular biology, evaluation of the effects of pressure on the rabbit growth plate, evaluation of hypothyroidism in pigs, and investigations into the molecular biology of various skeletal dysplasias. All of these basic science research projects involve high-level technology and collaboration among partners.

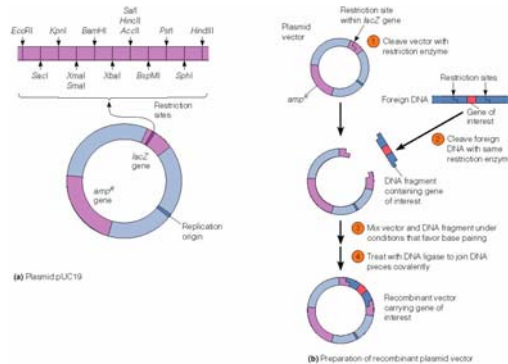




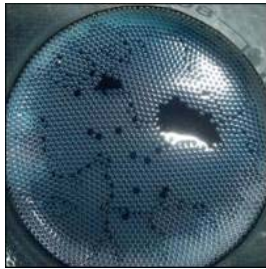
## 1982

Marking one of the biggest breakthroughs in recombinant DNA technology, the FDA approved the first drug developed with the technology: a form of human insulin.

Recombinant DNA is a form of artificial DNA created when DNA strands are combined or inserted, thus combining DNA sequences that would not normally occur together. By adding DNA to existing organisms, specific traits such as immunity can be coded or altered. The recombinant DNA technique was first engineered in 1973. Through its use, genes that are identified as important can be amplified and isolated for use in other species or applications where there may be some genetic abnormality or discrepancy, thus providing a different approach to complex biological problem solving.



Today, a tremendous amount of promising research is underway into micro bubbles, and other polymer encapsulation and delivery technologies to protect and maintain the therapeutic value of these highly complex and sensitive macro-molecules.



## 1982

Dr. Walter Hoyt, Jr., one of the “founding fathers” of the Akron City Hospital and the Summa Health System, gave his “Four-legged Stool” speech to the 1982 Fellows of the American Academy of Orthopaedic Surgeons citing patient care, education, research and quality as essential elements of medicine.

Seven years later, St. Thomas Hospital merged with Akron City Hospital to become Summa Health System. This was followed in 1993 by the merging of the medical staffs and the consolidation of the clinical services at Summa’s Akron City and St. Thomas Hospitals, forming a hospital corporation. In 1998, Summa was recognized by *U.S. News & World Report* as one of “America’s Best Hospitals,” and the health system received its first ranking for its orthopaedic services.



## 1988

The University of Akron established the world's first College of Polymer Science and Polymer Engineering, following the establishment of the Akron Polymer Engineering Center five years earlier and the Biomedical Engineering Department eight years earlier.



What began in the early part of the century as a few courses in rubber chemistry has evolved into the largest academic program of its kind. The city once known as the "Rubber Capital of the World" now is an international center of polymer research. With five endowed professorships and chairs, the college's distinguished faculty represent one of the largest concentrations of polymer expertise in the world. This wealth of knowledge draws distinguished visiting faculty and top students from around the world, and has helped establish Northeastern Ohio as "Polymer Valley."

In 1991, UA dedicated the Polymer Science Building, later to be named the Goodyear Polymer Center. Four years later, UA's polymer science program broke into the top five of national rankings by *U.S. News & World Report* for the first time, ranking second in the country.



## **2000**

*U.S. News & World Report* once again ranked The University of Akron's Polymer Science and Polymer Engineering Program second in the nation, ahead of such prestigious universities as MIT and CalTech.

In the previous year, the University accepted the largest individual donation ever directed to its research efforts. Dr. James D'Ianni, an important figure in the history and development of synthetic rubber, donated \$1.75 million to UA.

The U.S. Air Force Research Laboratory and UA established a Collaborative Center in Polymer Photonics in 2002. The \$2.7 million center began development of a new generation of electronics that transmit data at the speed of light.



**2001**

Newsweek magazine named Akron one of nine “high-tech havens,” noting that these cities “have become important players in the information age...and have built their new economies with hard work and innovation.” Akron was featured alongside such premiere cities as Barcelona, Spain, and Oakland, Calif.



The article described Akron as the center of Northeast Ohio’s “Polymer Valley” and as a city that rebounded from the collapse of the rubber industry by capitalizing on the research infrastructure that it left behind. Highlighting the city’s polymer strengths – hundreds of polymer-related companies, thousands of jobs, The University of Akron’s Goodyear Polymer Center – the article quoted the president of The Plastic Lumber Co. as saying that “polymers saved Akron.”

In a bode to the secondary benefits of economic rejuvenation, the article mentioned the popularity of baseball games in the brand-new Akron Aeros park, noting that the smell of popcorn and hot dogs had replaced the molten rubber scent that wafted through the city throughout most of the 20<sup>th</sup> century.





**2001**

Akron General Medical Center tied with the Cleveland Clinic to receive the National Research Corporation's Consumer Choice Award. The hospital has gone on to win this coveted award for seven consecutive years, repeatedly earning recognition as "Akron's Most Preferred Hospital for Overall Quality and Image."



National Research Corporation annually provides Consumer Choice Awards for the most-preferred hospitals in more than 250 U.S. markets. Winners, named in *Modern Healthcare* magazine, are selected from the nation's most comprehensive, nationwide consumer health care profile, the NRC Healthcare Market Guide. Its data is culled from consumer surveys from more than 200,000 households in the U.S. Consumer Choice Awards for hospitals. The annual awards are based on consumer preference responses.

As a major teaching hospital, Akron General Medical Center trains future physicians through 11 high-quality medical residency programs. Akron General is a teaching affiliate of the Northeastern Ohio Universities Colleges of Medicine and Pharmacy, a State of Ohio facility that serves as the Medical College of The University of Akron, Kent State University and Youngstown State University. Akron General Medical Center provides regional centers of excellence in heart and vascular, cancer, orthopaedics and emergency medicine and wellness. This highly tertiary facility is the only hospital in Northeast Ohio with designations as a Level I Trauma Center, a Stroke Center and a Chest Pain Center.

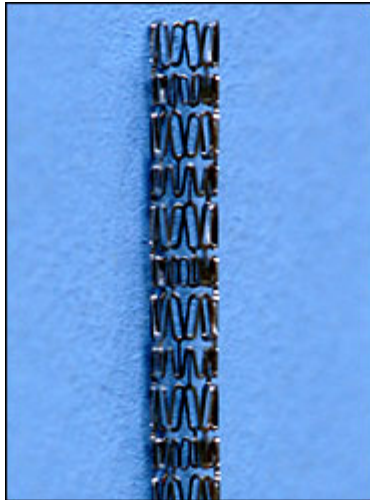


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Health for your heart



## 2004

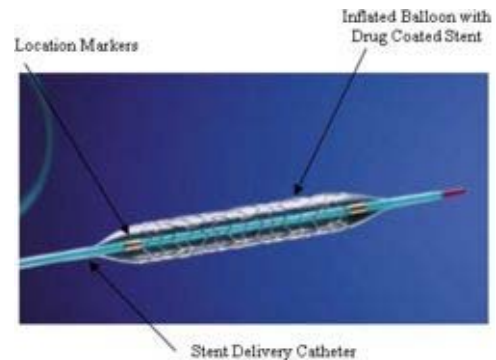
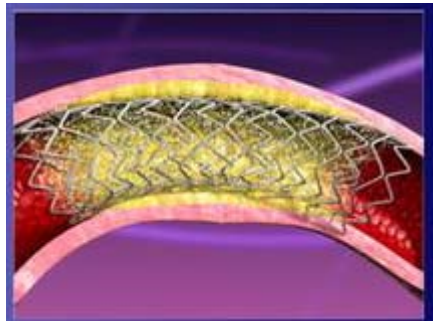
The U.S. Food and Drug Administration approved Boston Scientific Corp.'s TAXUS drug-eluting cardiovascular stent system. This technology is perhaps the most significant example of the powerful convergence of medical science and polymer science. To date, approximately 4.6 million TAXUS stents have been implanted globally, making them the world's most frequently used drug-eluting stents.



TAXUS is—all at once—a device, a drug, a drug delivery vehicle, a structural component designed to hold open coronary arteries, and an implant. The greatest innovation of the TAXUS stent is the layered polymer matrix that, taking into account intra-arterial fluid dynamics, releases the medication paclitaxel over a period of time. This controlled release prevents coronary artery tissue from relogging the stent following implantation in the coronary artery. The polymer matrix was conceived and created at The University of Akron.

The polymer component of the TAXUS stent system is one of several biocompatible polymers and was first invented by Dr. Joseph P. Kennedy, distinguished professor of polymer science at UA, and colleagues. The UA material is based on a copolymer of polystyrene and polyisobutylene, called SIBS, which features modifiable triblock morphology. The polymer can be designed to release drugs over different time spans.

Drug-releasing polymers have fundamentally changed medical devices. Their use in implantable devices is rapidly increasing with applications ranging from the treatment of brain cancer to diabetes. In 2005, it was a \$28 billion industry in the United States.



## 2005

*U.S. News & World Report* again ranked Akron General and Summa Health System among the 50 best hospitals in the country.

Summa captured top 50 finishes in three categories: respiratory disorders (28<sup>th</sup>), digestive disorders (48<sup>th</sup>) and orthopedics (49<sup>th</sup>).



Akron General ranked in the top 50 in two categories: heart (35<sup>th</sup>) and respiratory disorders (45<sup>th</sup>). The following year, the hospital improved on its ranking even further. *U.S. News & World Report* ranked Akron General as having the 30<sup>th</sup> best heart and heart surgery program in the country, the top ranking for heart care by any hospital in Summit County. The hospital maintained its ranking in the care of respiratory disorders.

Akron General's leadership in heart care is clearly demonstrated by a number of major advances:

- The designation of Akron General as having Summit County's only accredited Chest Pain Center
- The area's first hospital to develop a comprehensive heart failure clinic
- The area's only Primary Stroke Center as designated by Joint Commission
- The area's only hospital to acquire a 64-slice volume CT scanner, a revolutionary new imaging device that provides physicians with exquisitely detailed 3-dimensional scans of the heart within five beats



## 2006

Akron-area companies and academic institutions demonstrated that the tremendous research and product development in the “Polymer Valley” can translate into substantial commercial opportunities.

In January, OrthoHelix Surgical Designs, Inc., an Akron-based developer of innovative surgical instruments and implants for use in foot, hand and ankle surgery, announced several million dollars in new venture funding, a milestone in the company’s effort to become a market leader in the hand and foot orthopaedic market segment.



Later that year and two years after the FDA approval of the TAXUS stent, The University of Akron signed a technology licensing agreement with Boston Scientific that expanded its rights to a family of novel polymers developed by researchers at the university for use in medical devices.

The positive growth in local investments continued in 2007, when Ohio led a record-setting investment year for Midwest medical company startups, according to the Midwest Health Care Venture Investment Report. Akron-area companies that contributed to Ohio’s leading position included OrthoHelix and SpineMatrix Inc.

In the latest commercialization milestone, Integra LifeSciences Holdings Corporation announced in July 2008 that it will acquire Akron-based Theken Spine, LLC, Theken Disc, LLC, and Therics, LLC, for \$75 million and up to \$125 million in future payments based on the performance of the business.



## 2007

Akron Children's Hospital's two busiest departments came together to form the Center for Orthopedics and Sports Medicine in October. The 30,000 square-foot center is staffed by specialists in orthopedics, sports medicine and sports rehab and features a fully equipped physical therapy and rehabilitation center; a new radiology suite with digital X-rays; laboratory and casting services; and more.



Also in 2007, Dr. Robert Burnstine performed about 100 surgeries for congenital nystagmus at Akron Children's, versus 10 per year in previous years. Patients have traveled from all over the world for this surgery, including two from Nepal in southern Asia. Akron Children's and ORlive presented a live surgery Webcast on eye surgery for congenital nystagmus, which

resulted in a dramatic increase in volumes.



## **2008**

Business Facilities magazine ranked Ohio fourth in the nation in biotechnology strength and noted that every state in the top 10 should be considered a biotechnology leader. According to the magazine, biotechnology is the fastest-growing economic development sector in the country. The article noted that Ohio has made “impressive commitments to support the advancement of stem cell research.”

Also in 2008, the NASA Glenn Research Center announced a partnership with Akron’s Goodyear Tire and Rubber Company to improve tire technology for a new generation of tires to be used on lunar vehicles for future exploration missions. The Goodyear partnership is one of 38 partnerships awarded by NASA’s Innovative Partnerships Program (IPP), which is a NASA-wide program that funds collaborations between NASA centers and industry to develop innovative technologies in support of the four NASA Mission Directorates: Science, Exploration Systems, Aeronautics Research and Space Operations.



## **2008 Business Facilities RANKINGS REPORT**

<b>Overall Biotechnology Strength U.S.</b>
1. PENNSYLVANIA
2. CALIFORNIA
2. MASSACHUSETTS
4. OHIO
4. TEXAS
6. ILLINOIS
7. NEW JERSEY
8. NEW YORK
9. FLORIDA
10. KANSAS
10. MINNESOTA

## **2008**

Leadership from Summa Health System and the Crystal Clinic broke ground on the new Crystal Clinic Orthopaedic Center located on Summa's Akron City Hospital campus. Announced in 2007, the 231,000 square foot center will feature 96 inpatient private rooms and 12 operating rooms. It will combine the orthopaedic outpatient and inpatient surgical and medical services of the two organizations, including space for Summa's orthopaedic residency and research program and physician offices.

The Summa Cardiovascular Institute, in conjunction with Summa's Minimally Invasive Surgery Institute, performed Akron's first closed-chest, robotic mitral valve repair surgery using the da Vinci Robotic Surgical System. The benefits to the procedure, done to repair damage to the valve while keeping the patient's chest primarily intact, include reduced risk of infection, less blood loss, less pain and scarring after surgery, shorter hospital stays and a faster return to regular activities.





**May 2008**

Ohio's Third Frontier Commission awarded nearly \$8.6 million to a joint effort among Northeast Ohio hospitals and universities to transform the region into an orthopaedic research leader. The cluster will bring together researchers and physicians from The University of Akron, Northeastern Ohio Universities Colleges of Medicine and Pharmacy (NEOUCOM), Case Western Reserve University (CWRU), the Lerner Research Institute of the Cleveland Clinic, Akron General Health System, Akron Children's Hospital and Summa Health System.



The Northeast Ohio orthopaedic proposal was among 23 projects statewide vying for a piece of the grant money, offered by the state's Department of Development and the Ohio Board of Regents to increase "clusters of research excellence" across the state.



The Northeast Ohio research cluster plan is a piece of a larger development initiative to create a multi-million-dollar research facility within the city of Akron's biomedical corridor, which stretches from Akron General Medical Center, around downtown and to Summa's Akron City Hospital.

City and county officials have been working with UA, NEOUCOM and the Akron hospitals to identify possible sites for the proposed Orthopaedic Research Institute of Northeastern Ohio, known as ORINEO for short. The proposed institute could be part of a related plan to bring the five regional partners together to form an Akron Academic Health Center to boost medical research, education and job creation.



**Looking to the Future**

A major, transformational initiative is launched to build upon Akron's rich legacy in polymer science and to create a national landmark in life-saving and life-enhancing innovation.

