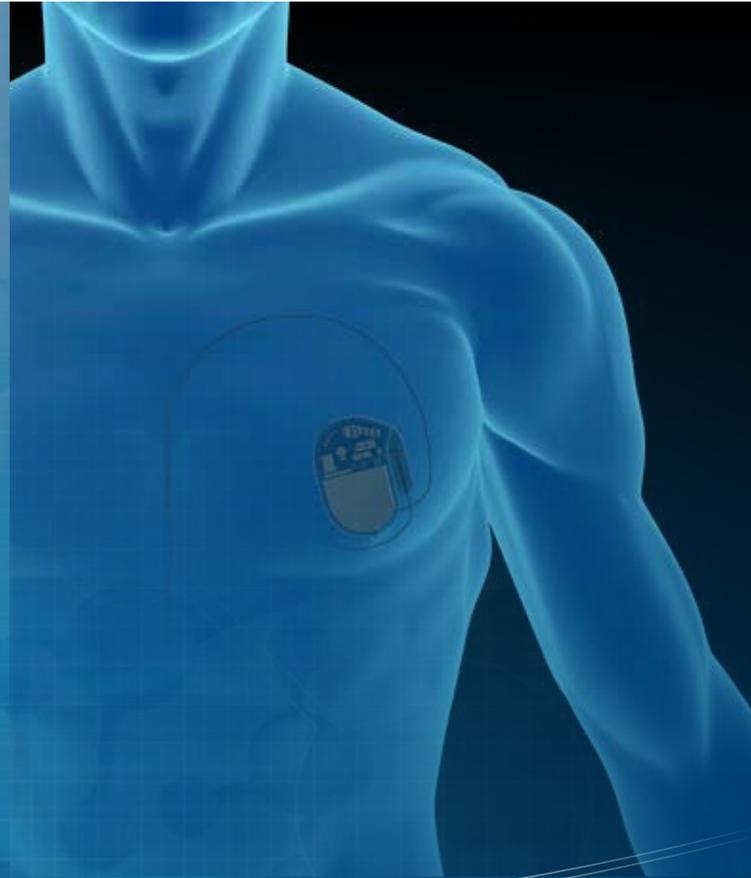


BREAKTHROUGHS

The Story of
Minnesota's
Extraordinary
Biotechnology
Industry



Big Ideas ... Brilliant Innovations ... Booming Industries



Having a brilliant idea is just the beginning.

Transforming that flash of insight and inspiration into a groundbreaking diagnostic tool or treatment requires a staggering array of scientific, research, legal, regulatory, financial and entrepreneurial expertise—all of it available at the right stages along the way.

If you're willing to ping-pong between the East and West Coasts (and pay premium prices) you can piece together parts of what you need to succeed.

Or, you can have it all in Minnesota.

Early stage, pre-clinical, pre-market, post-market. Everything it takes to turn ideas into innovations is right here.

“We're the only place that connects all the dots. It just doesn't exist anywhere else,” says Shaye Mandle, CEO and President of LifeScience Alley, the trade association that promotes Minnesota's life-science, biotechnology and health technology industries.

At auctioneer speed, he ticks off the areas of deep industry expertise Minnesota offers to companies of all sizes and at all stages:

- Basic research and discovery
- Clinical trials and product testing
- Regulatory review and approval
- Commercialization and productization
- Design, development and engineering
- Intellectual property protection
- Manufacturing, distribution and operations
- Business development and finance
- Reimbursement and market access

“Minnesota's Medical Alley is the global epicenter of health technology and care. We are home to the #1 cluster of innovation and top-ranked US hospital in the Mayo Clinic. Medical Alley is the birthplace of connected care and the modern medical device.”

— Shaye Mandle, President and CEO of the Medical Alley Association



Sector Snapshot

Minnesota has one of the strongest life-science, biotechnology and health technology clusters in the world, generating billions of dollars in revenue each year.

Made up of 1,700 companies, the cluster has an unusually broad base of talent in medical devices and equipment; drugs and pharmaceuticals; research, testing and medical labs; and agricultural feedstock and bioagriculture.

The cluster employs 48,000 people at an average annual wage of \$87,000. In addition, every bioscience job in Minnesota generates four more jobs in a wide range of support industries, bringing the total employment impact of the state's biosciences industries to more than 236,000 jobs.

Some of the world's most well-known companies have headquarters or major operations here, including Medtronic, Boston Scientific, 3M, Upsher-Smith, Hawkins Pharmaceutical, Beckman Coulter, Baxter Healthcare, Cargill, DiaSorin, Lifecore Biomedical, the National Bone Marrow Donor Program, Cellectis, BioAmber and Bio-Techne R&D Systems, to name a few.

INNOVATION FROM THE GROUND UP

With an eye toward feeding a world whose population is projected to exceed 9 billion by the year 2050, Minnesota scientists, institutions and companies are at the forefront of bioagriculture research and development.

Minnesota is one of the top-ranked states in a broad array of crop and livestock production—and the nation's third-largest exporter of agricultural goods.

With such abundant production expertise, it's no surprise the state also is a leader in applying biotechnology in many fields of agriculture to produce better seeds, greater crop yields, more nutritional value, better breeds, new animal vaccines and improved animal health.

But that's just the beginning.

We're also experts in applying biotechnology to develop new products from the crops we grow and harvest in our fields and forests.

Minnesota is a leading producer of biodiesel and ethanol. And the state is widely recognized as the epicenter of research and development in biopolymers and bioplastics—sustainable and more environmentally friendly alternatives to petroleum.

With major operations in Minnesota, companies like NatureWorks (corporate headquarters) and BioAmber (research and development) are using plant sugars instead of petrochemicals to produce everything from food packaging and films to textiles and durable goods.



A TIMELINE OF MINNESOTA'S BIOSCIENCE HISTORY

1851

Minnesota opens a university, authorized by the territorial legislature.

1864

William W. Mayo, M.D. opens medical office in Rochester, Minn., establishing the origins of Mayo Clinic.

1882

The University of Minnesota establishes a medical department.



And hundreds of up-and-coming small and mid-sized companies are hard at work, applying their genius to some of the world's most vexing problems, pioneering the next great waves of innovation, and positioning themselves as future industry leaders.

You'd expect nothing less from the place that gave birth to the world's medical device industry and that remains at the forefront of discovery in so many bioscience sectors.

A Long History of Leadership and Innovation

For more than 150 years, Mayo Clinic and the University of Minnesota have driven advancements in health care and bioscience. Their groundbreaking efforts began even before Minnesota became a state in 1858.

Working separately, together and hand-in-hand with visionary researchers and inventors, these pioneering institutions have helped give the world an astonishing number of groundbreaking discoveries and medical "firsts."

Innovative medical records systems. Cortisone. Open-heart surgery. The heart-lung machine. The mechanical heart valve. Kidney, pancreas, bone marrow, human islet, heart-lung-liver transplants. Telemedicine. Rapid anthrax tests. The list goes on.

This kind of scientific vision—with a focus on basic and applied research and the technology transfer between academia and industry that results—helped pave the way for the rise of Minnesota's incomparable medical device industry, known as Medical Alley.

As medical device breakthroughs were spun off into successful companies like Medtronic and St. Jude Medical or the medical division of 3M, the region attracted ever more medical, scientific, research, engineering and computer science expertise.

Such an exceptional concentration of talent tilled and fertilized the ground for the next crop of Minnesota-grown innovations that today flourish in most every bioscience field.

A COOL MOOOOOOOOVE

When cows are overheated in the summer, bad things can happen.

They lose their appetites. They produce less milk. Their fertility rates fall.

To combat the ill effects of heat-induced stress, Minnesota-based Cargill has developed feed ingredients that keep cows cool during periods of high heat and humidity.

During trials in Texas, Brazil and the Netherlands, the products (called I.C.E. and Cooling Pack) proved effective at the cellular level.

One U.S. dairy farm was able to maintain 70 pounds of milk production per cow each summer day instead of having it drop to 60 pounds when temperatures climbed.

A TIMELINE OF MINNESOTA'S BIOSCIENCE HISTORY

1883

Saint Mary's Hospital construction begins after Mother Alfred Moes, of the Sisters of St. Francis, offers to build and staff it—if W.W. Mayo and his sons will provide medical care.

1888

University of Minnesota founds medical school and admits 116 students.

1889

Saint Mary's Hospital opens in Rochester, Minn.

BIRTHPLACE OF AN INDUSTRY

Minnesota's inventive medical device history is on display at the National Museum of American History in Washington, D.C.

The Places of Invention exhibit chronicles the rise of Minnesota's Medical Alley and five other inventive hotspots in the United States that built innovative industries and revolutionized life in America and around the world in the process.

Sponsored by the Smithsonian's Lemelson Center for the Study of Invention and Innovation, the exhibit examines the amazing things that can happen when the right mix of inventive people, resources and inspiring surroundings come together.

"What is it about a place that inspires creative people to do new and different things? Place matters in invention," says Monica Smith, the exhibition's project director. "It's really about that moment where a group of inventive people coalesce in a place."

It's an excellent chance to learn more about the medical visionaries and technical geniuses who gave birth to a bioscience industry in Minnesota that continues to produce all kinds of marvels and breakthroughs.



Discovery continues at an unbridled pace each year in Minnesota as the University, Mayo Clinic and hundreds of companies dedicate a staggering amount of brainpower and research dollars to unraveling the mysteries behind many

of the world's most complex medical problems and to developing new and improved diagnostic tools, medications, devices and treatment protocols.



A TIMELINE OF MINNESOTA'S BIOSCIENCE HISTORY

1902

The Minnesota Mining and Manufacturing Co. (the global company known today as 3M) is founded.

1907

Dr. Henry Plummer of Mayo Clinic introduces the Dossier Medical Records System, providing patient histories easily accessed and shared by multiple doctors.

The Mayo Clinic and the University of Minnesota establish a graduate school of medicine.

Spotlight on Mayo Clinic

A single-minded devotion to unraveling the deepest mysteries of disease underlies all endeavors—and cuts across all disciplines—at Mayo. “Without research, there would be no Mayo Clinic,” says CEO and President John Noseworthy.

Patient need drives efforts at Mayo, where campuses in Minnesota, Arizona and Florida conduct basic, translational, clinical and epidemiological research.

As doctors treat patients and see opportunities for advancing patient care, they work together with Mayo scientists and research teams and Mayo Clinic Ventures.

This close integration makes it possible to quickly bring proven diagnostics and therapeutics to patients and share this knowledge with the next generation of doctors and scientists.

Research Investments at Mayo

Mayo devotes a tremendous amount of money, time and talent to research. In 2014 alone, it invested \$648 million in a wide range of studies. Of the total:

- \$276.4 million came from Mayo funding, including philanthropy and royalties
- \$371.6 million came from external sources. (Federal and state funding: \$274.9 million; industry: \$62.6 million; and other sources: \$34.1 million)

In addition to financial muscle, the brainpower Mayo applies to research is considerable. It has:

- 193 full-time scientific faculty
- 619 physicians actively involved in research
- 3,317 full-time research personnel

Research facilities at Mayo include 29 core laboratories that occupy 347,926 square feet (32,323 square meters) of lab space.

And Mayo researchers are remarkably prolific. Currently, the institution has:

- 9,832 active Institutional Review Board-approved human research studies
- 2,672 new Institutional Review Board-approved human research studies
- 6,392 research and review articles in peer-reviewed journals
- 4,110 active grants and contracts



John Noseworthy
Mayo Clinic CEO and President

A TIMELINE OF MINNESOTA'S BIOSCIENCE HISTORY

1921

Scanlan International is founded to produce custom surgical instruments.

1933

The first prepaid multiple hospital plan is created, known as Blue Cross Blue Shield.

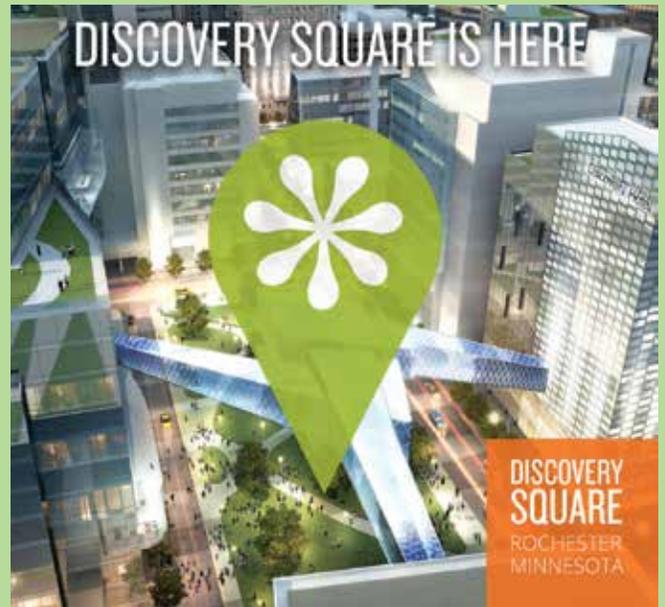
1942

Elizabeth “Sister” Kenny opens an institute offering her special method for treating polio.

MAYO ON THE GROW

An ambitious plan to turn Mayo Clinic and its hometown of Rochester, Minnesota, into an even bigger draw for medical patients, practitioners, researchers and companies is under way. The massive medical and economic development project known as Destination Medical Center (DMC) is a one-of-a-kind, \$5.6 billion private-public initiative - the largest in the history of the State of Minnesota and one of the largest in the country.

Mayo Clinic will significantly expand its campus by building out more than 2 million square feet of research, commercial, and product development space in “Discovery Square” – an urban bioscience research campus in Rochester, Minn.



DISCOVERY SQUARE:

Mayo Clinic’s medical and research model, its unique culture of collaboration and team science, and its partnership with the DMC initiative allow for the physical and cultural environments necessary for Discovery Square and the ecosystem surrounding it to become a leading destination for innovation and industry in life sciences.

Mayo Clinic is elevating its global leadership in research and innovation with the selection of Minnesota-based M.A. Mortenson Company as the strategic real estate development firm to build Discovery Square – the economic engine for DMC.

“At Mayo Clinic, we feel that we have a responsibility to bring forward discoveries that will deliver hope and better health to people around the world. There is no better way to stimulate innovation than through collaboration, which has been part of the Mayo culture for over 150 years. We’re looking forward to welcoming businesses, medical innovators and researchers from around the world to Discovery Square, each of whom will work together to accelerate advances in bioscience, research, education and technology for health and wellness.”

– John Noseworthy, M.D., president and CEO, Mayo Clinic.

A TIMELINE OF MINNESOTA’S BIOSCIENCE HISTORY

1944

The health maintenance organization (HMO) concept is introduced by Community Health Association of America in Two Harbors, Minn.

1948

3M introduces the surgical drape, the company’s first health care product.

1949

Medtronic is founded by Earl Bakken and Palmer Hermundslie as a partnership to service electronic medical equipment.

Edward C. Kendall and colleagues at Mayo Clinic are awarded the Nobel Prize for isolating cortisone.

A Focus on the Individual

Some of the most exciting research at Mayo is coming in the promising fields of individualized and regenerative medicine.

At the Center for Individualized Medicine, Mayo researchers and physicians use the latest in genomic, molecular and clinical sciences to design highly individualized treatments based on a patient's very own molecular or genomic makeup.

Using bioinformatics (a combination of computer science, biology and genetics), researchers analyze a patient's DNA to determine his or her unique disease susceptibility, provide better diagnoses, earlier interventions, more efficient drug therapies and customized treatment plans.

Some promising areas where Mayo is on the leading edge of discovery include:

- **Pharmacogenomics** – Understanding how a patient's DNA sequence influences their response to medications is key to delivering the right drug at the right dose at the right time for the most effective treatment.
- **Microbiome** – Communities of bacteria living in the human body do much more for us than we ever imagined. Mayo researchers are studying how this microbiome promotes wellness and enables disease. By studying its genetic code, researchers are looking for new ways to keep the human microbiome healthy, repair it, and use its powers to prevent and treat disease.
- **Biomarkers** – Found in tissue, blood, urine and other body fluids, these molecular substances can be used to indicate health or disease. Prostate and ovarian cancers are two examples of how the use of biomarkers can lead to individualized diagnosis and treatment.
- **Regenerative medicine** – This game-changing field has the potential to fully heal damaged tissues and organs from within, offering solutions and hope for people who have conditions that today are beyond repair.



A TIMELINE OF MINNESOTA'S BIOSCIENCE HISTORY

1952

The world's first direct-vision open-heart surgery is performed at the University of Minnesota by Dr. C. Walton Lillehei and Dr. F. John Lewis.

1955

Mayo Clinic becomes the first medical center to perform open-heart surgery using the Mayo-Gibbon Heart Lung Machine.

1957

Medtronic cofounder Earl Bakken develops the first small, wearable, external, battery-operated pacemaker at the request of University of Minnesota surgeon C. Walton Lillehei.



Mayo's Center for Regenerative Medicine takes three interrelated approaches:

- **Rejuvenation** – Boosting the body's natural ability to heal itself. Cells once thought to be no longer able to divide (including highly specialized cells of the heart, lungs and nerves) have been shown to have some ability to heal themselves. Teams within the center are studying how to enhance self-healing processes.
- **Replacement** – Using healthy cells, tissues or organs from a living or deceased donor to replace damaged ones. Researchers are finding ways to overcome the ongoing donor shortage, the need for immunosuppression and the challenges of organ rejection.
- **Regeneration** – Delivering specific types of cells or cell products to diseased tissues or organs, where they ultimately will restore tissue and organ function.

Stem cells are the key to regenerative medicine. Teams are studying a variety of stem cells (including adult and embryonic stem cells), various types of progenitor cells (such as those found in umbilical cord blood), and bioengineered cells called induced pluripotent stem cells.

Many of the regenerative therapies under development at the Center for Regenerative Medicine begin with a patient's cells. For example, a patient's skin cells may be collected, reprogrammed in a laboratory to give them certain characteristics, and delivered back to the patient to treat his or her disease.



A TIMELINE OF MINNESOTA'S BIOSCIENCE HISTORY

1957

First direct stimulation by electrodes pacemaker is developed at the University of Minnesota.

1960

First heart valves developed by Miles "Lowell" Edwards and Dr. Albert Starr. More than 175,000 Starr-Edwards valves were successfully implanted into patients between 1960 and 1998.

1961

3M forms its Medical Products Division, devoted solely to health care. Today, it's called 3M Health Care Division.

Spotlight on the University of Minnesota



A NEW DIMENSION IN MEDICINE

One of just a handful of elite labs worldwide to have a 3D bioprinter capable of building living tissues, the University of Minnesota's Visible Heart Research

Laboratory is at the forefront of one of the most intriguing areas of regenerative medicine.

With the latest technology provided by BioBots, a U.S.-based biotech startup, University researchers are exploring the mysteries and potential of biofabrication, the process of building living tissues and organs.

Angela Panoskaltis-Mortari, a professor of pediatrics and medicine at the University, plans to use the printer to produce a biocompatible piece of esophagus, which she and her colleagues hope to transplant into a pig by the end of the year.

Visionaries hope that eventually the technology could be used to create new organs for human transplant, custom-designed for a patient's exact dimensions and "living ink" made, in part, from that patient's own cells.

Until that day arrives, the bioprinter can support a wide variety of research, including printing 3D living tissue models for research and pre-clinical drug testing.

Biomaterials to biomechanics. Cancer to infectious diseases. Drug delivery and design. Neuromodulation and magnetic resonance imaging. And a whole lot more.

University of Minnesota researchers are the bright minds behind many treatments, medications and diagnostic tools used in hospitals today. And more than 4,000 full-time scientific faculty are driving the life-saving breakthroughs of the future.

The University invests heavily to advance those innovations and bring them to market.

In 2014, research funding at the University topped \$741 million, including:

- \$490.3 million from federal sources
- \$130.6 million from private sources
- \$64.7 million from state and local government
- \$55.2 million from business and industry

Last year, those research investments produced 343 invention disclosures, 138 new U.S. patents and 15 startup companies.

The University's Biomedical Discovery District is at the heart of it all, a complex of the most advanced facilities for basic and translational research found anywhere in the country. Here, ideas are born, developed and pushed forward.

Grounded in the belief that great discoveries happen when different scientific disciplines meet, the complex allows researchers from across the University to work side-by-side to find new cures and therapies for our most challenging health conditions.

A TIMELINE OF MINNESOTA'S BIOSCIENCE HISTORY

1963

The University of Minnesota performs its first kidney transplant.

1966

The Rochester Epidemiology Project is introduced, providing a medical records linkage system that has made Olmsted County one of the few places in the world where the occurrence and natural history of diseases can be accurately described.

1966

First-ever pancreas transplant in a human is performed at the University of Minnesota.

Within the multi-building complex that forms the district, researchers are working to unlock the mysteries of brain diseases like Alzheimer's, discover new immunology-based treatments and other therapeutic strategies for cancers and infectious diseases and tackle cardiac regeneration.

The new Microbiology Research facility slated to open in early 2016 has 80,000 square feet (7,432 square meters) of labs and office space for the study of infectious diseases and development of new drugs and vaccines.

The Biomedical Discovery District also is home to some of the most advanced magnetic resonance instrumentation anywhere—including the world's largest magnet for human imaging at 10.5 T.

At the Center for Magnetic Resonance Research (CMRR), these high-powered magnets are opening windows into the body's inner workings and giving researchers amazing new ways to study diseases and evaluate treatments.

Couple amazing technology with deep human expertise in imaging physics, engineering and signal processing and the potential for breakthroughs is nothing short of astounding.

The approaches and instrumentation developed at the CMRR are some of the most important tools used today to study system-level organ function and physiology in humans for basic and translational research, and are increasingly applied worldwide.

Magnetic resonance imaging is a critical tool for all kinds of leading-edge research in many disciplines at the University of Minnesota. Its use has expanded from fields that have traditionally valued neuroimaging data—such as psychology, neuroscience, psychiatry, radiology, and child development—into a whole host of other domains, including economics, political science, public health and even design.

Over the next five years, the University plans to redouble research efforts with initiatives to expand research in targeted areas, to promote research across scientific disciplines and to accelerate the transfer of knowledge to the marketplace through public and private-sector partnerships.

A History of Collaboration

A rare atmosphere of collaboration between scientists, researchers, industry and government lies at the very heart of Minnesota's biosciences success.

Nowhere is that more evident than the Minnesota Partnership for Biotechnology and Medical Genomics, a unique collaborative venture between Mayo Clinic, the University of Minnesota and state government.



A TIMELINE OF MINNESOTA'S BIOSCIENCE HISTORY

1968

The first successful non-twin bone marrow transplant takes place at the University of Minnesota.

1969

First FDA-approved artificial total hip replacement takes place at Methodist Hospital in Rochester, Minn.

1972

Cardiac Pacemakers, Inc. is founded by Manny Villafana. The company later became part of Guidant and produced the first lithium-powered pacemaker.

The partnership was born in 2003 out of recognition that by combining the unique strengths at each institution and by sharing expertise and costs, Mayo and the University could accomplish things together that neither could do alone.

Looking for ways to boost economic development in Minnesota's biosciences industries, it was state leaders who first encouraged deeper collaboration between the two institutions. The state Legislature has continued to back the joint effort with recurring funding.

"Investments we make in our biosciences industries pay us back in two very important ways," observes Kevin McKinnon, Deputy Commissioner at the Minnesota Department of Employment and Economic Development (DEED).

"First, advances in human health, plant and animal science, biofuels and the environment benefit everybody—not just here, but all over the world," says McKinnon. "Second, when big success in the lab turns into big success in the marketplace, big new companies result. That means lots of very good jobs. That means economic growth and stability. Any way you look at it, we win."

For as long as they've existed, the University and Mayo have cooperated on research and education. But in recent years the partnership has taken research and development efforts to a whole new level.

The focus is on areas that have great potential to produce new ways to diagnose and treat major diseases, improve human health, and create jobs and economic growth through research, development and commercialization.

The partnership has attracted more than \$60 million in grants from the National Institutes of Health. The goal is to draw continuing support from federal and private sources and generate revenue from breakthroughs that are brought to market.

Recently funded partnership projects bring University and Mayo experts together in some very intriguing areas, including:

- **Pharmacogenomics and Prostate Center Treatments** – Using clinical studies and lab research, experts are delving into what makes some prostate-cancer drugs ineffective for some patients.
- **A New Kind of Heart Valve** – Researchers are using engineered tissue developed at the University and stent technology developed at Mayo Clinic to create a new type of heart valve.
- **New Drugs for Multiple Myeloma** – Not all patients respond equally well to proteasome inhibitors, a new class of cancer drugs. The team is using genomic scans and clinical studies to find out why.

"Advances in human health, plant and animal science, biofuels and the environment benefit everybody—not just here, but all over the world."

– Kevin McKinnon, Deputy Commissioner of the Minnesota Department of Employment and Economic Development



A TIMELINE OF MINNESOTA'S BIOSCIENCE HISTORY

1972

The University of Minnesota establishes a PhD program in biomedical engineering, leading to a significant increase of medical device companies in Medical Alley.

1972

Mayo opens a medical school, the 110th in the United States and second in the state after the University of Minnesota.

1973

Mayo School of Health Sciences opens, with the first group of health professionals being nurse anesthetists.

- **Safer Solutions to Treat Aortic Valve Calcification** – A new drug to treat aortic valve calcification can be toxic to the liver. Without an effective drug, surgical replacement of the valves is the only option. The team is trying to uncover the chemical mechanisms underlying the reaction and find alternatives at the molecular level.
- **Fighting Brain Cancer** – This research team uses animal models to study the use of a virus to combat deadly brain cancers. The virus activates the body's own immune system to fight the tumors.
- **New Glaucoma Treatment** – A commercialization award is helping support validation studies on a drug to fight glaucoma with the goal of approval by the U.S. Food and Drug Administration for patient use.

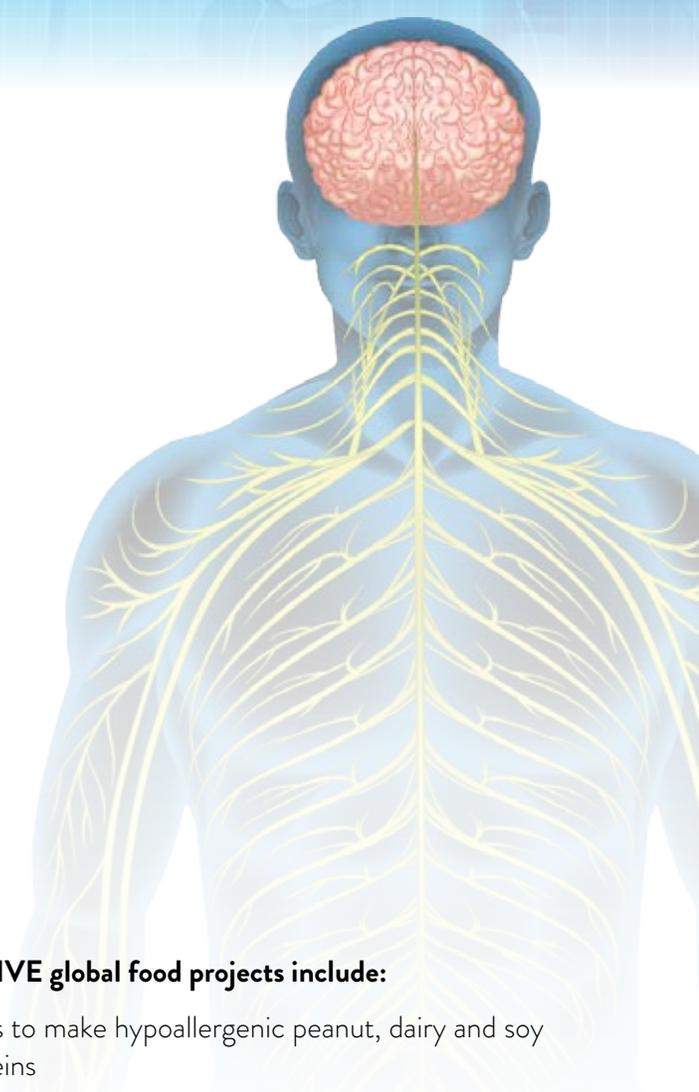
The MnDRIVE initiative is another example of how a partnership between the University and the state is helping pave the way to new breakthroughs.

Short for Discovery, Research and InnoVation Economy, this landmark initiative aims to take on real-world challenges, advance new discoveries and cultivate strategic business collaborations by pairing the University's experts with private-sector partners in the state's key and emerging industries.

An investment of \$36 million in state funding fuels research in four areas:

- Global food ventures
- Robotics, sensors and advanced manufacturing
- Discoveries and treatments for brain conditions
- Advancing industry and conserving our environment

So far, MnDRIVE has undertaken 120 projects (involving 354 researchers), hired 111 faculty members and other staff, secured 21 patents and licenses and cultivated more than 75 outside partnerships with industry leaders including Cargill, 3M and Medtronic.



MnDRIVE global food projects include:

- Ways to make hypoallergenic peanut, dairy and soy proteins
- Evaluating a new antibiotic technology to reduce salmonella in poultry using methods from genetic engineering, bioinformatics, microbiology and animal health science
- Bioresponsive food packaging that will tell you when milk is spoiling in the jug
- A new way to detect the presence and measure the concentration of salmonella contamination in ground meat and poultry, with an eye toward more effective and efficient management of outbreaks



A TIMELINE OF MINNESOTA'S BIOSCIENCE HISTORY

1976

St. Jude Medical is founded by Manny Villafana to develop and market an innovative series of bi-leaflet heart valves.

1977

Human trials of the St. Jude heart valve begin by noted surgeon Dr. Demetre Nicoloff at the University of Minnesota.

1979

Artificial blood is used for the first time at the University of Minnesota.



MAKING MICROBES WORK FOR MINNESOTA

Microorganisms are everywhere. Our mouths and digestive tracts. Our soils and waterbodies. Even in such extreme and unusual environments as acidic hot springs, the middle of the Antarctic ice sheet, and deep in the earth's crustal fluids.

At the University of Minnesota, researchers are harnessing the power of microorganisms to clean up contaminated lands and waters.

Much in the same way that humans eat sugar and breathe oxygen, certain microorganisms can make a living by “eating” and “breathing” organic and inorganic compounds. In doing so, microbes can break down pollutants.

Known as “bioremediation,” the science is already widely applied to treat municipal and industrial wastewaters, and many treatment systems involve microbial processes in some capacity. But the University is taking the idea much further.

Research supported through the MnDRIVE program includes using microorganisms to treat nitrate runoff from land, remove estrogens from our wastewater, reduce sulfate that is present as a result of certain industrial processes, and generate energy while desalting brines. Microorganisms can even be used to immobilize metals, neutralize acid and remove sulfate from water.

MnDRIVE robotics and manufacturing projects include:

- New electrodes made of carbon nanotubes and graphene used in deep brain stimulation
- Magnetic nanobots to probe malignant cells and make a new cancer therapy
- New sensors for colposcopy
- Robot companions that help patients reduce anxiety in difficult medical situations
- Soft, smart, worm-like transvascular surgical robots with integrated sensing and precision therapeutic control
- Robotic system to inspect apples for packing
- Complex 3D printing for the development of cutting-edge medical devices

MnDRIVE brain conditions projects include:

- Using deep brain stimulation to improve movement and mobility in patients with Parkinson's disease

MnDRIVE environment projects include:

- Initiatives dedicated to identifying and removing pollutants like atrazine and phosphorus from water

The University's Biotechnology Resource Center (BRC) works hand-in-hand with industry on collaborative and contract research.

With expertise in molecular biology, biochemistry, microbiology and biochemical engineering in a broad range of industrial settings, the BRC offers customized research and development services as well as limited production services in fermentation, downstream processing, protein expression and good manufacturing practice capabilities.

The center has completed hundreds of fermentation and biotechnology projects for life-

A TIMELINE OF MINNESOTA'S BIOSCIENCE HISTORY

1983

3M Health Information Systems is formed to help health care providers access, compile, code, report, store and exchange health information.

1985

FDA approves use of cardioverter defibrillators, and Cardiac Pacemakers, Inc. (Guidant) introduces the first implantable cardioverter defibrillator.

1989

Mayo Clinic pioneers telemedicine with real-time broadcasts that enable medical specialists in locations around the world to collaborate on patient care.

science companies here and around the world. And the momentum has been building.

“I have watched the interactions between the life-science industry and the University of Minnesota grow substantially over the last three years,” says BRC Director Tim Tripp. “It has been particularly exciting to see small and startup companies using the resources and expertise of the University of Minnesota to grow their business.”

Turning Breakthroughs into Business

Can there be any doubt about Minnesota’s ability to turn big ideas into big commercial successes and world-class industries?

The fact that some of the world’s most recognized companies—including several in bioscience-related fields—are headquartered or have major operations in Minnesota says a lot. So does the success that Mayo, the University of Minnesota, and hundreds of small and mid-sized companies have had in commercializing their discoveries.

The University’s Office for Technology Commercialization ranks sixth in the nation for bringing research with commercial potential to market. The office works with entrepreneurs, researchers and investors to create startup companies based on the University’s research.

“It has been particularly exciting to see small and startup companies using the resources and expertise of the University of Minnesota to grow their business.”



— Tim Tripp, Director of University of Minnesota’s Biotechnology Resource Center



Artist rendering of Discovery Square

The office also partners with companies to use University research and technology in products they develop. Such well-known companies as Medtronic, 3M, Honeywell, Boston Scientific, Rolls Royce and Adobe have licensed and successfully commercialized research and technology pioneered at the University.

At the same time, Mayo Clinic Ventures is a global leader in research and technology commercialization. It licenses Mayo’s intellectual property, teaches entrepreneurship, starts companies, runs a business accelerator and participates in a \$100 million venture and growth fund that supports economic development.

Mayo Clinic Ventures also works closely with industry. To date, the group has received more than 5,900 disclosures, filed 5,500 patents and signed 2,600 licensing agreements. An unprecedented 47 percent of disclosures are commercialized.

Discovery Square, a state-of-the-art biotechnology park being planned as part of an ambitious \$5.6 billion expansion of Mayo Clinic campus in Rochester, Minn., aims to simultaneously quicken the pace of medical innovation and economic development.



A TIMELINE OF MINNESOTA’S BIOSCIENCE HISTORY

1993

World’s first two successful single donor human islet transplants take place at the University of Minnesota.

1996

Mayo Clinic performs the first heart-lung-liver transplant in the United States.

2001

A one-hour anthrax test is developed by Mayo Clinic in collaboration with Roche Molecular Biochemicals.



ANGEL TAX CREDIT HELPS BIO FIRMS TAKE FLIGHT

Minnesota's Angel Tax Credit program gives innovative companies the capital they need to take flight and gives investors the confidence they need to finance small startups.

"You get the funds you need, you get the confidence you need, and to some degree you get the exposure you need," says Judy Lundy, president of Mill Creek Life Sciences in Rochester, Minn., which raised \$3.6 million through the program.

In just five years, the state-funded program has helped hundreds of high-tech startups attract hundreds of millions of dollars in capital investment, including a high concentration of biotechnology, medical devices and equipment, and health care companies.

The program provides a 25-percent tax credit to investors and investment funds that put money into Minnesota startups focused on high technology and new proprietary technology, products, processes or services.

Maximum credit is \$125,000 per person per year, or \$250,000 for joint filers. Unlike programs in other states, Minnesota's Angel Tax Credit is refundable, which means investors receive cash back, rather than just a credit toward state income tax liabilities.

Designed to be the "Silicon Valley of medicine," the facility will link Mayo's renowned expertise together with private companies, entrepreneurs, researchers and others. A focus on translational research means teams can more quickly turn what they learn in the lab into promising new ways to diagnose, treat and prevent disease.

Discovery Square is expected to attract premier talent and significant outside investment from individuals and companies hoping to bring treatments and technologies to market. As companies turn medical discoveries into commercial successes, Discovery Square may well turn into one of the state's most powerful engines for job growth.

Biotech Incubators and Support Services

In addition, biotechnology incubators play an important role by providing lab and office space to early-stage bioscience companies and helping bring new technologies to market.

University Enterprise Laboratories in St. Paul is a collaborative research center that is home to a mix of early-stage life science, medical and tech companies. Areas of focus include biotechnology, medical devices and medical diagnostics.

The SEED Partners in Minneapolis focus on biopharmaceuticals, bioscience and medical device technology. Its venture capital fund invests in promising projects.

Located in the Minnesota BioBusiness Center in Rochester, Minn., Mayo Clinic Business Accelerator provides collaborative space for new companies, venture capital firms and entrepreneurs.

A TIMELINE OF MINNESOTA'S BIOSCIENCE HISTORY

2001

CVRx is founded to develop the Rheos System, an implantable technology to treat high blood pressure and heart failure.

2003

Drug-eluting stents hit the market using technology developed by SurModics, Inc., a milestone in the convergence of biologics and medical devices.

The University of Minnesota and Mayo Clinic create the Minnesota Partnership for Biotechnology and Medical Genomics.

2004

Mayo Clinic and IBM, with its supercomputer, collaborate to take advantage of an explosion in new medical data to drive research and breakthroughs in medicine.



Attracting Investment

Success has an irresistible gravitational pull.

And Minnesota's long track record of innovation and commercial success in a wide variety of bioscience fields gives it undeniable power to attract entrepreneurial interest and investment.

Since 2009, life-science investment in Minnesota has topped \$1.8 billion.

In 2014, investments in Minnesota-based life science organizations reached a record high, with \$430.4 million directed to 86 companies. The capital influx continued an upward trend that has seen back-to-back investment increases of 23 percent and 38 percent over the past two years.

Medical device companies saw the lion's share of investment. That's no surprise to anyone who understands Minnesota's world-leading position in developing complex medical devices. While that leadership will certainly continue, several emerging sectors are showing tremendous potential for major long-term growth, including:

- Regenerative medicine and cell therapy
- Drug delivery
- Diagnostics
- Health IT
- Neuromodulation

Already areas of deep expertise and significant research in Minnesota, these sectors are expected to drive bioscience industry growth well into the future.

Over the last five years, for instance, Minnesota companies have generated 70 percent of all pre-market approvals for drug delivery devices. For the first quarter of this year, that number was 87.5 percent.

Substantial investments in 2014 point to growing interest in several emerging markets.

Last year, investment in pharmaceuticals and biotech rose dramatically, posting a tenfold increase over 2013. And more than twice as many pharmaceutical and biotech companies received investment. In fact, the state's bio/pharma cluster has grown 54 percent in the past 10 years.

In addition, investments in digital health companies reached \$41 million in 2014, an increase of 41 percent over the previous year. Interest is especially keen from venture capital groups on the East and West Coasts.

A Powerful Formula for Success

Some of the brightest minds on the planet. Some of the world's top research facilities. Unrivaled leadership from academia, industry and government. A predominant atmosphere of cooperation. A long and stellar track record of innovation.

From the very beginning, that potent formula has nurtured Minnesota's bioscience industries, helped them sprout, take root and grow into a scientific and economic powerhouse that is the envy of the world.

"It's an amazing legacy, but it's only the beginning," says DEED's McKinnon.

"Minnesota is the future for bioscience companies of all sizes that want to turn their big ideas into big successes. Start here. Expand here. Relocate here. It'll be the best investment you ever make."

A TIMELINE OF MINNESOTA'S BIOSCIENCE HISTORY

2004

Medtronic launches world's first digital pacemaker, which monitors the heart's upper and lower chambers and delivers the minimum electrical impulse needed to keep the heart beating.

2006

Boston Scientific and Guidant sign merger agreement to create a \$27 billion company.

2014

Mayo Clinic recognized as the top hospital in the nation on its 150th anniversary.

Cooking Up the Future of Biotechnology

Growing new human organs for transplant. Developing a non-invasive home screening test for colon cancer. Using biospheres to remove contaminants from water.

These are just a few of the groundbreaking biotech innovations being used or in development—in Minnesota and across the globe—based on research breakthroughs from the University of Minnesota and Mayo Clinic.

Innovation isn't just a buzzword in Minnesota—it's happening every day. From startups to established businesses, companies are using research from Minnesota to bring to market new biotechnology products and services that can save lives, improve health and make our communities better places to live.

Here are a dozen brief company profiles that illustrate the breadth of this remarkable work.

The Actives Factory: Startup Appears to Be Barking Up the Right Tree

Bark from birch trees contains anti-inflammatory compounds that have been shown to reduce cholesterol and blood pressure, treat infections and stimulate the immune system, according to the University of Minnesota. The Actives Factory, a University of Minnesota startup based in Two Harbors, Minn., uses patented techniques to extract and synthesize the naturally occurring chemicals in birch bark. These compounds hold promise for the development of new pharmaceuticals, cosmetics and nutritional supplements. The patented technology behind The Actives Factory was developed through the University of Minnesota's Natural Resources Research Institute and licensed through the University's Office for Technology Commercialization.



Photo courtesy of the Minnesota Department of Natural Resources

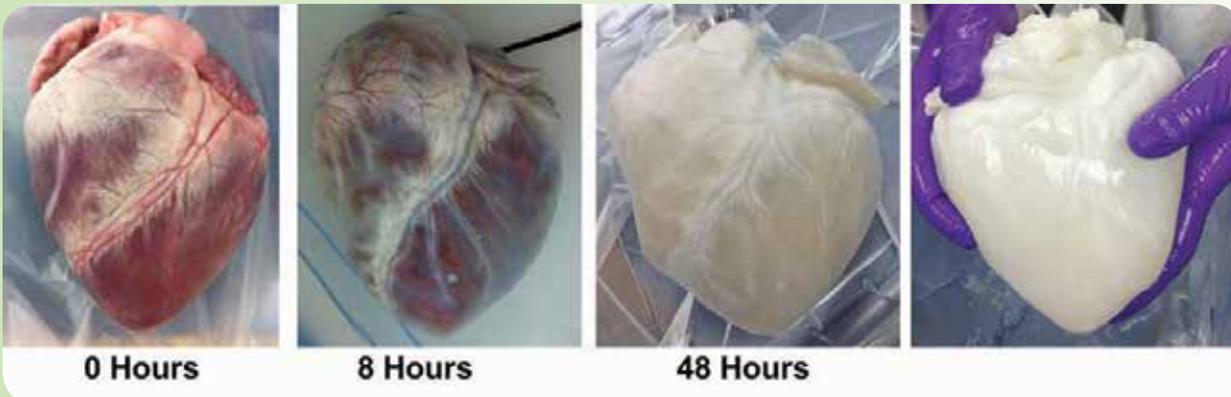


Photo courtesy of Miromatrix



Miromatrix Medical: Potential to Revolutionize Medicine

Using its proprietary perfusion decellularization/recellularization technology, Miromatrix has the capability to make fully biological human organs for transplant. This method of decellularizing and recellularizing any vascularized tissue, up to and including whole organs, is protected by a series of patents and patent applications in all major markets and originally was licensed from the University of Minnesota. Based in the Minneapolis area, Miromatrix has launched its first product (a liver-derived biological mesh) and is working independently and with partners—including Mayo Clinic—to develop a series of organ-based products.

Minnepura Technologies: Using New Technologies to Purify Water

Minnepura Technologies, Inc.—a University of Minnesota startup based in Minneapolis—has developed a patented bioencapsulation technology that provides safe, cost-effective treatment solutions to remove potentially dangerous chemicals from water. These patented biospheres target and remove troublesome contaminants from waste streams in a natural and environmentally friendly manner. Minnepura provides solutions to the oil and gas, agricultural, municipal water and pharmaceutical industries.



Photo courtesy of Minnepura Technologies

Preventice: Remote Monitoring Provides Peace-of-Mind

Minneapolis-based Preventice, a Preventice Solutions company, developed the BodyGuardian Heart monitor, a small, lightweight wireless non-intrusive body sensor. Developed in collaboration with Mayo, the BodyGuardian Heart monitor uses sophisticated algorithms that delivers continuity of patient care and continuous 24-hour near real-time remote cardiac monitoring. The monitoring system is a cutting-edge approach that allows health care providers to monitor key biometrics outside the clinical setting, while patients go about their daily lives, thus safeguarding the health and safety of individuals every day. The FDA-cleared BodyGuardian Heart monitor records and wirelessly transmits important physiological data such as ECG, heart rate, respiration rate and activity level for many common cardiac and chronic diseases. BodyGuardian Heart monitoring system creates a constant connection between patients and their care teams, potentially easing stress and worry, increasing compliance with treatment plans and improving quality of life.



Photo courtesy of Preventice Solutions

Mill Creek Life Sciences: Patented Potion for Producing Stem Cells

Using technology licensed from Mayo Clinic, Mill Creek Life Sciences in Rochester, Minn., has developed a revolutionary new medium for producing human stem cells and primary cells used in regenerative therapy. Now in clinical trials in Europe, the United States, Canada and Australia, Mill Creek's technology should make it possible one day for patients to be treated with their own stem cells for a wide variety of diseases. Mill Creek's PLTMax is a human-protein-based cell culture supplement that is animal-free and serum-free. It's available in both clinical and research grades and is intended to follow work from bench to bedside.



Photo courtesy of Exact Sciences



Exact Sciences: Aiming to Eradicate Colon Cancer

Exact Sciences, based in Madison, Wis., partnered with Mayo Clinic to create Cologuard, a noninvasive, colorectal cancer-screening test that was recently approved by the FDA and by Medicare. A 10,000-patient, multi-site study published in *The New England Journal of Medicine* showed that Cologuard had a 92 percent sensitivity for detecting colorectal cancer, with 94 percent sensitivity in detecting early stage colorectal cancer (Stages 1-2). Cologuard requires no preparation or dietary restrictions and can be done from home. The patient then mails the test to Exact Sciences Laboratory. Cologuard identifies altered DNA and/or blood in the stool, which are associated with the possibility of colon cancer or precancer.

Ambient Clinical Analytics: Using IT to Increase Patient Safety

This Rochester, Minn.-based startup uses licensed Mayo Clinic technologies to give critical care providers real-time access to vital process-of-care information and analytics at the bedside. Its three technologies include: AWARE (Ambient Warning and Response Evaluation), which reduces information overload by using analytics to filter and present relevant patient data; Mayo Clinic YES Board®, a multi-patient management tool that provides real-time situation awareness for emergency departments and hospital pediatric departments; and Syndromic surveillance, which provides "smart alerts" that identify the presence of sepsis and ventilator-induced lung injury. By allowing physicians to spend more time with patients instead of reviewing information, these tools aim to reduce overall health care costs and improve patient outcomes. The FDA recently gave clearance for Ambient's AWARE software platform as a Class 2 device.

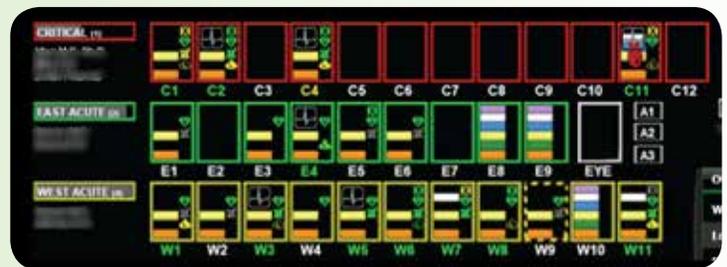




Photo courtesy of Torax Medical



Torax Medical: Treating Reflux Disease and Sphincter Disorders

Torax Medical, Inc. is a medical device company headquartered in St. Paul that develops and markets products designed to treat sphincter disorders utilizing its technology platform, Magnetic Sphincter Augmentation (MSA). Torax Medical is currently marketing the FDA-approved LINX® Reflux Management System for the treatment of Gastro-esophageal Reflux Disease (GERD) in the United States and Europe and the FENIX® Continence Restoration System for the treatment of Fecal Incontinence (FI) in Europe. The Mayo Foundation for Medical Education and Research was one of the founding investors in Torax Medical.



NeoChord, Inc.: Transforming Mitral Valve Repair

Based in Eden Prairie, Minn., NeoChord is a privately held medical technology company focused on advancing the treatment of mitral regurgitation. It has received CE marking for its DS1000 device, a single use, hand-held device designed to repair mitral regurgitation by deploying artificial chordae tendinae in the beating heart. Mitral regurgitation is a progressive disease that left untreated can result in atrial fibrillation, congestive heart failure and death. The DS1000 device uses intellectual property licensed by Mayo Clinic.



Photo courtesy of NeoChord, Inc.

FocusStart: Seeking to Reinvent the Early Stage Device Development Process

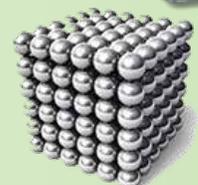
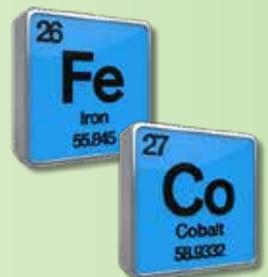
FocusStart is a Twin Cities-based medical device company with a business model designed to accelerate the development process. Currently, FocusStart is working on four innovative technologies—including an anti-coagulum cardiac ablation catheter, an orthopedic tissue tension sensor, an anti-biofilm urological catheter and a smart inhaler. FocusStart's licensing partners include Mayo Clinic and University of Minnesota. LifeScience Alley named FocusStart the 2014 New Company of the Year. In April 2015, FocusStart received a Phase II Direct SBIR Award from the National Institutes of Health to develop the company's cardiological technology.



Universal Magnetic Systems: Using Nanoparticles to Help Detect Disease



Universal Magnetic Systems LLC (UMS), of St. Paul, Minn., uses novel methods to produce high-strength magnetic nanoparticles that provide customers with a faster, more efficient and more powerful means of separating and isolating biotarget materials. Its technologies—licensed through the University of Minnesota—have applications in the *in vitro* diagnostics markets (including immunoassay, cell separation and flow cytometry). They also have future applications in biotechnology, medical diagnostics, catalysis, communications and energy production.





SPOTLIGHT

On Minnesota's Medical Alley
Companies 

Spotlight on Minnesota's Medical Alley Companies



APS



American Preclinical Services (APS) is a state-of-the-art, AAALAC and ISO17025 accredited, USDA registered and GLP compliant Contract Research Laboratory specializing in medical device and pharmaceutical testing. Conveniently located in the heart of the Minneapolis/St. Paul medical device biotech cluster, APS operates a multi-million dollar, 8 acre campus with over 70,000 total square feet of laboratory and office space.

Whether your company is a startup or an established industry leader, our experienced scientific and operational staff have the expertise to meet your preclinical research needs and timelines. By utilizing our catalogue of services, which include regulatory consulting services, ISO10993 biocompatibility testing, analytical services, interventional & surgical research, toxicology, pharmacology, pain research, physician training and bioskills, and complete pathology services, you will be able to develop and execute a full preclinical program, all under one roof.

Whether you are conducting pilot and screening evaluations, feasibility and efficacy testing or pivotal GLP safety studies of the finished product, you will have industry experts to rely on every step of the way. We strive to deliver comprehensive, yet rapid service with the understanding that, "in product development, the only constant is change". We've tailored our processes, capacity, and customer service to keep up with today's fast paced business cycles. APS will go from an initial quote to a ready-to-implement preclinical program with your time lines in full focus.

www.americanpreclinical.com

AMERICAN PRECLINICAL SERVICES

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Minneapolis, MN 55433 USA



Birchwood Labs



Originally founded in 1948 as Fuller Pharmaceutical Company, Birchwood Laboratories LLC manages both the production and distribution of a diverse product offering from its 10-acre Corporate Headquarters in Eden Prairie, Minnesota. We are a privately held medical manufacturer committed to providing healthcare professionals, their patients and retail outlets quality products for wound care and prevention, incontinence and associated skin conditions and personal care.

We are seeking distribution relationships in order to expand our global reach.

The Birchwood Medical Division's product line include:

- AER Witch Hazel Medicated Pads & Towelettes – Both pads and Towelettes are saturated with 50% Witch Hazel, an astringent that helps to shrink swollen or inflamed tissues and relieve irritation, along with 12.5% non-greasy glycerin. Together they provide a cool, soothing compress.
- Scopettes Large-Tip Applicators - Uniform and highly absorbent with 5/8-inch Rayon heads and 3/16 inch cushioned tips, Scopettes have been the leader in large-tip swabs for over 40 years. Scopettes and Scopettes Jr. are designed for proctologic and vaginal procedures, but may be used for topical and oral applications as well
- B-Sure Incontinence Care Products - For Accidental Bowel Leakage (ABL) associated with hemorrhoids, surgery, diarrhea or childbirth.
- LiquiCell Medical Technology - Ultra-thin and nearly invisible liquid-filled membranes of LiquiCell Shear provide a synthetic, external bursa that allows the body to glide or float with an object and aid in the reduction of shear and friction of the skin. These products have multiple applications from use on beds to prevent bed sores, to seating and other areas where the potential of tissue degeneration due to constant exposure may be involved.

Birchwood products are manufactured in FDA approved facility and undergo rigorous quality control.

www.birchlabs.com

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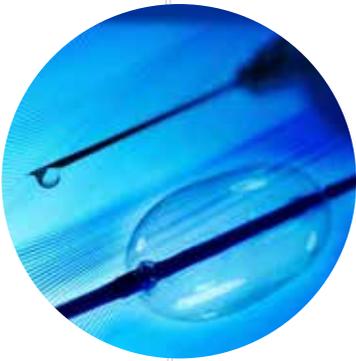
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Formacoat



FORMACOAT: “MAKING THE TOOLS OF MEDICINE RUN SMOOTHER®”

Advanced medical device coating services for lubricious, hydrophilic, hydrophobic, superhydrophilic, superhydrophobic, and non-thrombogenic coatings for demanding medical devices. Formacoat provides a ‘one-stop shop’ for a wide range of coating technologies for various applications from different coating vendors. Our wide array of coatings provides advanced capabilities for coating lumens, ID/OD’s, balloons, films, wires, foams and complex device shapes. Core device capabilities include coating catheters, introducers, guide wires and components, including balloons, tubing and wire and a variety of other medical devices, as well as other non-medical device articles for unique and challenging applications. Additional custom capabilities exist for devices and materials include reel to reel, spool to spool film, solvent casting, and foam or screen mesh applications that benefit from a medical device coating.

Incorporated in 2002, Formacoat is a privately held medical device contract manufacturing company located in Minnesota, USA. Our roots come from the diverse community of Twin Cities (Minneapolis/St. Paul) companies that have made our area a world center for the medical device and life science industries. Formacoat is ISO 13485 Certified.

Formacoat’s commercial device coating expertise provides excellent quality service and, with its many coating options, is able to offer a range of capabilities and commercial coating-service prices.

Formacoat specializes in the application of an increasingly wider array of different medical device coatings for our customers’ diverse products. The company streamlines the customer’s R&D and path to commercial production by choosing the best coating options from a variety of vendors, and accumulating knowledge and experience with the device and its medical applications. The company can coat challenging devices with complex shapes and geometries, and is developing new capabilities in microfluidics. In addition, Formacoat is able to assemble and package products.

We are specialists in providing coating-engineered application solutions utilized in sophisticated medical device design and development for scalable, dependable production. As a uniquely positioned medical device coating services contract manufacturer, Formacoat is dedicated to providing value to its customers around the world by improving the design, functionality and performance of our clients’ medical devices. We work expertly with our customers to improve medical device functionality and performance. Through broad expertise, tools and efforts, Formacoat: “Making the tools of medicine run smoother®”.

www.formacoat.com

FORMACOAT LLC

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Ilion Medical



THE SACROILIAC JOINT IS PROVING TO BE THE BIGGEST NEW OPPORTUNITY FOR SPINE SURGERY

Ilion is ideally placed within this market with a safe, revisable technique; now intended as a stand-alone product. Proper diagnosis of sacroiliac joint pain results in a frequency equivalent to 20% of back pain cases. Sacroiliac joint fusion has been recognized as an effective means to address sacroiliac joint pain (ISASS policy statement 2016).

Ilion's surgical system features the NADIA NeuroSafe™ posterior bridging approach which eliminates neurovascular risks commonly associated with Laterally-Based Techniques. Our posterior approach never crosses critical neurovascular anatomy.

Key features of the NADIA® system include:

- Superior solutions for your surgeons – Implant insertion is both intuitive and interesting. The surgery is performed with instruments that have been praised for their finesse and elegance.
- The potential to be a stand-alone product – NADIA is designed to be less dependent on bone graft and utilizes proprietary surface topography resulting from a combination of titanium plasma spray (TPS) and hydroxyapatite (HA) coating. Our surface engages the bone at both microscopic and macroscopic levels.
- Safety – Our reliable pin-guided instrumentation follows radiologic landmarks and provides for consistent, dependable placement of the implant.
- Revisability – The implant is designed in such a way that a larger size can be placed in the same location with the same familiar approach when revision is necessary.

The NADIA® Posterior Technique emphasizes bone healing, mechanical stabilization and alignment of anatomic structures. Safety is planned into every step.

Credibility for your product line – Ilion's clinical practice and research provides a unique competence in SIJ anatomy and treatment. Our expertise is reflected in a strong patent portfolio. Ilion's IP was licensed to an international manufacturer/distributor in 2009 and has seen great medical success. Ilion has participated in the training of over 300 surgeons, representing a strong installed base of users. Ilion is now a fully integrated device company selling implantable products and surgical tools.

Our latest product, NADIA®, has received regulatory approval in Europe and includes enhanced instrumentation as well as implant ongrowth and ingrowth features.

www.ilionmedical.com

ILION MEDICAL, INC

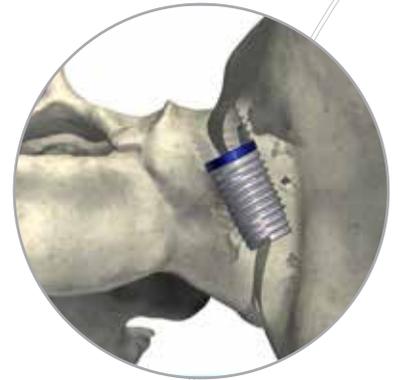
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FOREIGN LANGUAGES SPOKEN: ENGLISH, SPANISH, GERMAN





International Life Science Enterprises



**International Life
Science Enterprises
LLC**

YOUR PARTNER IN DEVELOPING AND EXECUTING YOUR GLOBAL STRATEGY

International Life-Science Enterprises (ILSE) is dedicated to the successful establishment of Life Science companies in Global Markets. Our mission is to increase the international reach of life science companies. We specialize in the introduction of life science technologies and products into the US and Canadian markets. We help our clients determine if their product(s)/technologies have viability in the market, navigate regulatory requirements, find qualified professional service providers, establish strategic relationships, organize financing, distribution and prepare winning strategies and associated tactics for marketing, distribution and sales..

We also provide an interim base of operations and resolve logistical concerns associated with establishing a U.S. market presence. Navigating the constantly changing reimbursement systems in the US is a major and primary requirement for any company introducing new technologies and/or products into the US Health Care System, we pride ourselves on been familiar with these trends. As a private life sciences strategist and consultancy, we are a true partner to our clients in every aspect of their growing a life science business. Our extensive network allows us to provide alternatives that can guide our clients to maximize their commercial potential. Our goal is to be your resource for vital, current and unbiased business information.

<http://internationallifescience.us>

INTERNATIONAL LIFE SCIENCE ENTERPRISES

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Minnetronix



Minnetronix is a medical technology and innovation company with deep expertise in electronic and electromechanical devices. Since 1996, we have partnered with companies worldwide to design, engineer and manufacture new technologies and therapies that solve unmet clinical and business needs.

DESIGN & ENGINEERING

At Minnetronix, we leverage decades of experience to solve our customers' most complex systems engineering and systems integration issues. Our software, mechanical, and electrical engineering teams develop state-of-the-art technology and products for performance, reliability, and regulatory compliance. And, our long history in electromechanical medical devices has given our teams specialized skills and abilities that we apply to each project.

Minnetronix' engineers are focused on the commercialization of software, mechanical and electronics-based medical devices, primarily Class II and Class III products. Our processes are specifically designed to meet FDA and ISO requirements for design and production controls. Minnetronix is FDA-registered with a full best-in-class quality management system in place and a track record of six consecutive FDA inspections resulting in No Action Indicated, the most favorable possible outcome.

All of the products we design and build are subject to international product safety requirements for medical devices. Our engineering team has expertise in EN 60601-1 as well as the associated collateral and particular standards. We have successfully guided many products through compliance testing and registration with safety agencies including UL, TUV, Intertek, CSA and others.

MANUFACTURING OPERATIONS

Minnetronix offers medical device manufacturing services and experience tailored to support all stages of the product lifecycle. We build products ranging from neuro-stimulation systems and RF devices to blood pump controllers and blood analyzers, surgical lasers and high energy ultrasound ablation systems. Our manufacturing assemblers and technicians are skilled and experienced in building high-complexity medical products. We have specific expertise in manufacturing devices with embedded, safety-critical medical software.

Integrated with product development, we offer complete turnkey manufacturing of finished instruments and sustaining engineering, ongoing production engineering support, and service. Our product manufacturing services are tailored to support our customers through the complete product lifecycle.

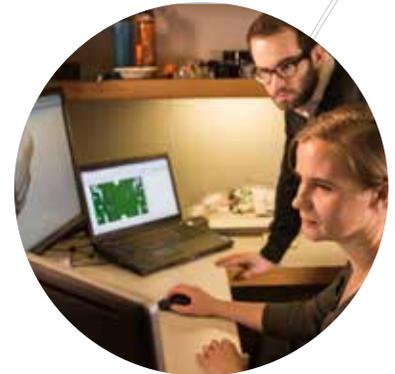
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SPOTLIGHT

On Minnesota's Medical Alley

Collaborators 



GREATER MSP

GREATER > MSP™

Minneapolis Saint Paul Regional Economic Development Partnership

MINNESOTA'S MEDICAL ALLEY

Over 900 medical device companies have headquarters or major operations here – from industry leaders such as 3M, Medtronic, Boston Scientific and St. Jude Medical to a promising pipeline of emerging companies. Minnesota's traditional strength is in cardiovascular technologies, but the state has significant presence in combination/drug delivery products, and is leading the charge in growing the neuromodulation market globally.

HOME TO MEDICAL PIONEERS

The Birthplace of the pacemaker and in-ear hearing aid, Minnesota continues to be a hotbed of innovation. It leads the nation in cumulative premarket approvals granted by the FDA – 33% of all PMAs between 1960-2014. With a talented and well-educated workforce and a robust supply chain, Minnesota is positioned to dominate the medical device industry for decades to come. INNOVATION HAPPENS FASTER HERE.

GREATER MSP (Minneapolis Saint Paul Regional Economic Development Partnership) is a non-profit organization (501c3) dedicated to providing public and private sector leadership, coordination and engagement to grow the economy of the 16-county Minneapolis Saint Paul region. With its economic development partners throughout the region, GREATER MSP is advancing a coordinated regional economic development strategy, a coordinated regional brand to promote the region's assets and a coordinated regional business retention, expansion, and recruitment program to stimulate capital investment and job creation in the region. The organization is also promoting a regional talent strategy to attract and retain talented workers.

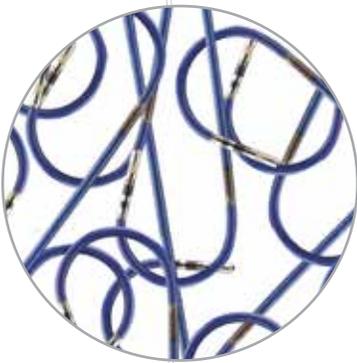
www.greatersp.org

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Mayo Clinic



With Mayo Clinic at its heart, the Destination Medical Center (DMC) initiative is the catalyst to position Rochester, Minnesota as the world's premier destination for health and wellness; attracting people, investment opportunities, and jobs to America's City for Health and supporting the economic growth of Minnesota, its life science sector, and beyond.

Destination Medical Center is a one-of-a-kind, \$5.6 billion economic development initiative in Rochester, Minnesota. It is the largest public-private partnership in state history, designed to position Minnesota as a global center for the highest quality medical care and to generate high-value jobs, new tax revenue, and businesses.

DMC will provide the public financing necessary to build the public infrastructure and other projects needed to support the vision of the 20-year development plan.

MAJOR INVESTMENTS TO FUEL THE GROWTH

- Mayo Clinic: \$3.5 billion over 20 years
- Additional Private Investments: \$2.1 billion
- State of Minnesota: \$585 million

DISCOVERY SQUARE

DMC is centered around six development sub-districts in downtown Rochester with each space is designed for innovation and collaboration. A new address for the future of bio-medical, research, education and technology innovation, Discovery Square, one of the DMC sub-districts in downtown Rochester, is a keystone to the DMC economic development strategy.

Discovery Square, and its close physical linkage to Mayo Clinic, will provide an authentic urban experience that supports a unique environment for community amenities, collaborative culture and an innovative ecosystem.

Destination Medical Center (DMC) is a strategic vision that further elevates Mayo Clinic and Minnesota globally as the preferred destination for the highest quality health care and stimulates additional, high-value economic benefits. With a robust entrepreneurial and innovation ecosystem, DMC is attracting start-up companies and supporting life science growth in Minnesota.

www.mayoclinic.org

MAYO CLINIC

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Medical Alley Association



WHAT IS MEDICAL ALLEY?

It is a region in Minnesota that was said to follow the corridor from Rochester through Duluth; but as the years have stretched, so have the borders. Minnesota's Medical Alley is home to the world's most concentrated health technology cluster made up of medical device, biopharmaceutical, diagnostic and digital health industry leaders. It is the birthplace of the modern medical device and a hot spot of innovation. It is where industry intersects with care providers, insurance companies and research organizations to improve patient access and lower costs.

SERVING OUR MEMBERS

The Medical Alley Association is a state-based member organization serving the health technology community. We work to promote Minnesota's Medical Alley by influencing policy at the state and federal levels, delivering actionable intelligence that informs decision-making and connecting members to peers, training and businesses.

The Association's membership and supporting community extends throughout the world, employing more than 300,000 Minnesotans and many more globally. Founded in 1984, the Medical Alley Association has played a leadership role in growing Minnesota's Medical Alley for 32 years.

www.medicalalley.org

MEDICAL ALLEY ASSOCIATION

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Medical Device Innovation Consortium



ABOUT THE MEDICAL DEVICE INNOVATION CONSORTIUM

The Medical Device Innovation Consortium (MDIC) is the first Public-Private Partnership collaborating on regulatory science to make patient access to new medical device technologies faster, safer, and more cost-effective.

Recognition of MDIC's commitment to regulatory science has, in part, recently been acknowledged by being awarded seed funding to establish the Coordinating Center for the Medical Device National Evaluation System for health Technology (NEST). The opportunity to leverage MDIC's regulatory science innovations with NEST pilot projects tracking medical device data and patient-reported outcomes, have the opportunity to revolutionize the ways in which real-world evidence supports medical product approvals/clearances.

Ultimately, MDIC regulatory science and NEST activities will help improve the quality of real-world evidence that health care providers and patients can use to make better informed treatment decisions and strike the right balance between assuring safety and fostering innovation and patient access.

www.mdic.org

MEDICAL DEVICE INNOVATION CONSORTIUM

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Align Resources

Accelerate Progress

Achieve Results

WORKING COOPERATIVELY to its engineer and competitive technology innovation

REDUCING TIME and resources needed for new technology development, assessment, and review

HELPING PATIENTS gain access to new medical technologies sooner

University of Minnesota – Office of University Economic Development

University Economic Development



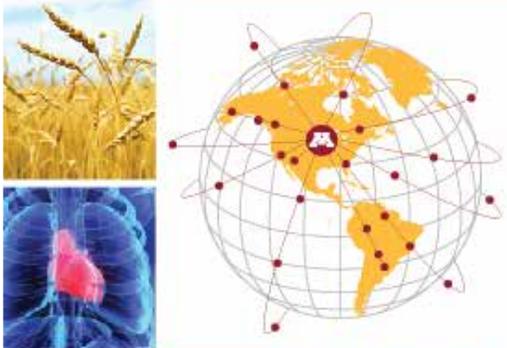
University
Economic Development

UNIVERSITY OF MINNESOTA

Driven to DiscoverSM



frontdoor.umn.edu



Strengthening ties between the University, industry and community partners

The Office of University Economic Development (UED) connects community and industry partners with the talent, training, research and resources of the University of Minnesota to position the state as an economic leader.

The office was established in 2014 in response to an increasing need for public-private partnerships to address the economic development goals of the state and the region.

As a top-10 public research institution and with comprehensive offerings spanning medicine to engineering to law to agriculture, the University of Minnesota is a powerful economic engine for the state. UED reaches out to external partners to put that engine to work to enhance Minnesota's innovation economy through educated people and cutting-edge research.

Building on the University's five campuses and more than 25 regional extension offices and research centers statewide, UED leverages the University of Minnesota's assets, resources and knowledge to encourage economic growth in order to build a vibrant innovation ecosystem that strengthens business and promotes discovery, entrepreneurship and workforce development.

To explore opportunities for collaboration with the University of Minnesota or to learn how the University Economic Development office can be of assistance to you, visit frontdoor.umn.edu.

www.frontdoor.umn.edu

UNIVERSITY OF MINNESOTA

Office of University Economic Development
University of Minnesota

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Strengthening ties
with industry and
community partners



Great Companies Choose Minnesota



Minnesota is home to 17 companies on the Fortune 500 list of largest U.S. publicly-traded firms. Several Minnesota companies, including Cargill, make the Forbes list of largest privately-held companies.

Many Minnesota-Based Companies are Recognized Worldwide.



Medtronic
When Life Depends on Medical Technology



UnitedHealth Group™

Foreign Investment in Minnesota

Leading foreign companies recognize that the state's unique competitive advantages make it a great investment.

- 706 foreign-owned companies in Minnesota employ about 101,000 people.
- About 15 percent of all foreign-owned companies operating in the United States are located in Minnesota.
- Over the past two years, foreign-owned companies have invested \$910 million in 42 projects in Minnesota and created almost 4,300 jobs.

mn.gov/deed/invest

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Courtesy of
Olympus Surgical



Courtesy of
Smiths
Medical

U.S. Government Selects Minnesota as America's Medical Manufacturing Center

In July 2015 the U.S. Commerce Department selected Minnesota's Medical Manufacturing Partnership as the center of excellence in the U.S. for medical manufacturing. This distinction allows Minnesota and its companies access to \$1 billion from federal agencies to accelerate manufacturing growth.

A federal interagency panel chose the Minnesota Medical Manufacturing Partnership because of the strength of our economic development plan, the potential for community impact, and the depths of our partnership across the public and private sectors to execute our plan.

"It's the federal government's stamp of approval on this region, being designated as the center of excellence nationally for medical technology manufacturing," said Michael Langley, CEO of Greater MSP, which is taking the lead in the Partnership.

"This designation is the US Department of Commerce saying to executives, investors, and entrepreneurs, if you are choosing a location, starting a company, or building a product, the Minnesota medical manufacturing community is the best place in the country to do it," said Shaye Mandle, CEO of the Minnesota Medical Alley trade group whose members employ more than 300,000 Minnesotans and many more globally.



Minnesota's broad coalition of partners has a deep tradition of working together and includes Mayo Clinic, the University of Minnesota, many private sector industry leaders, government, NGOs, trade groups and chambers of commerce. Specifically we are focused on strategic initiatives to enhance Minnesota's world-leading competitive edge in:

- Workforce and Training
- Supplier Networks
- Research and Innovation
- Infrastructure and Site Development:
- Trade and Investment
- Operational Efficiency and Capital Access

www.greatersp.org

MINNESOTA TRADE OFFICE

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★ MINNESOTA ★

AMERICA'S TOP STATE FOR BUSINESS

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2015



Business. Economy. Wealth. Health. Culture. Nature. Happiness.

Any way you look at us, Minnesota is the envy of the nation.

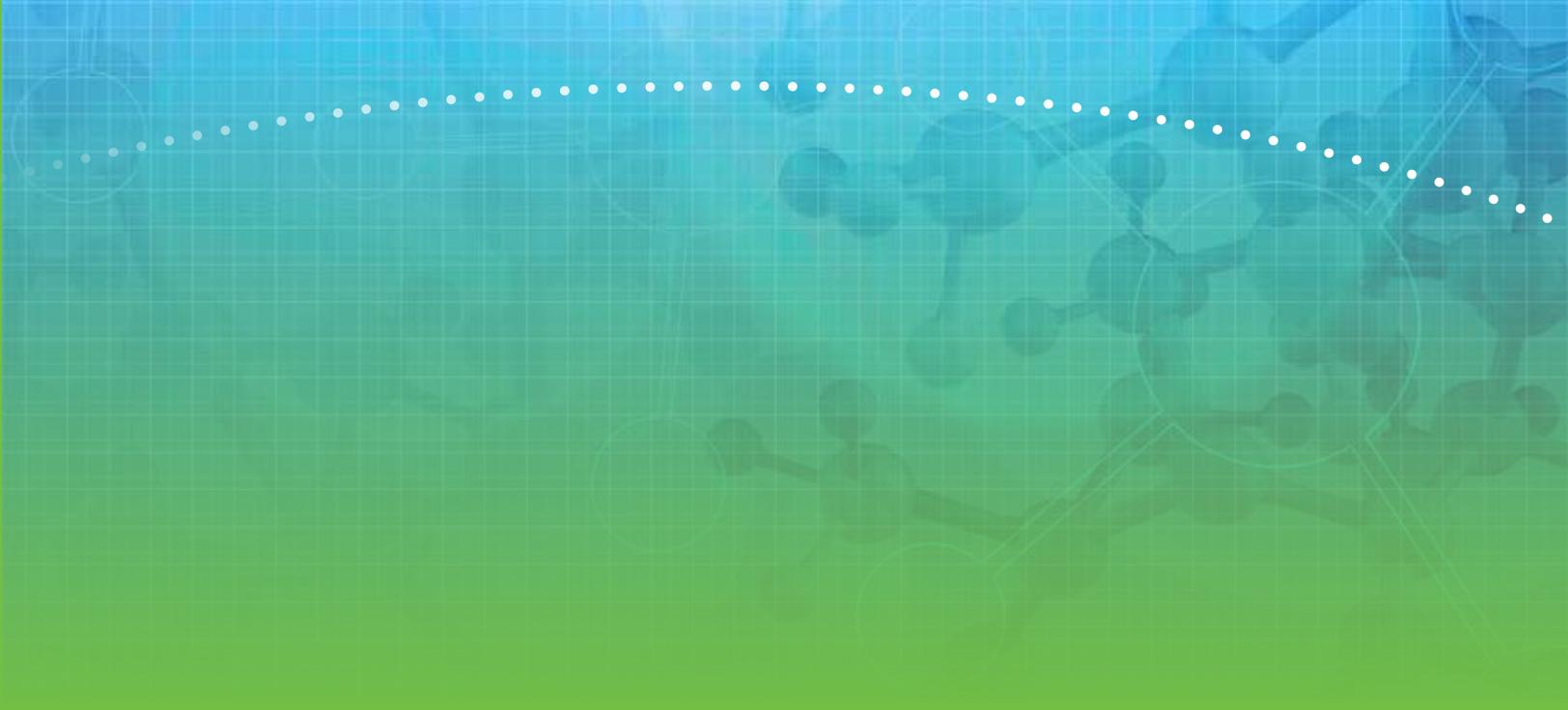
**See for yourself why CNBC named us
the 2015 America's Top State for Business.**

mn.gov/deed/business/locating-minnesota/why-minnesota



Make Minnesota Your Next Great Investment.

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Minnesota Trade Office

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