



# Heartland Science

Ohio's Legacy of Discovery & Innovation



## Medicine, Health & Science

From the Heimlich Maneuver  
to the Speed of Light

### General Anesthesia Pioneer

Ernest H. Volwiler, of Hamilton, and Donalee L. Tabern, of Bowling Green, in 1936 discovered the general anesthetic Sodium Pentothal, one of medicine's most important drugs. Used worldwide over the years, it has saved countless millions of patients from unpleasant effects that once were an unavoidable part of surgery. Sodium Pentothal also is the drug sometimes used as "Truth Serum."



General anesthetics make patients unconscious, eliminating the sensation of pain over the entire body. Local anesthetics relieve pain in one area, with the patient remaining awake. Pentothal, an intravenous anesthetic, goes right into the blood stream and works fast. It was the world's first such drug used regularly and became the model for development of a family of other "short-acting" barbiturate drugs that includes Brevital and Surital. Pentothal remains in wide use around the world today.

Although Sodium Pentothal produces rapid unconsciousness, that action lasts only a few minutes. So doctors usually use Pentothal to begin putting patients to sleep, followed by an inhaled anesthetic. That's because many patients would find it very unpleasant to breathe in a gaseous anesthetic while awake. Inhalable anesthetics like ether may cause muscle twitching, hallucinations, and other frightening effects. Pentothal makes the start, or induction, of anesthesia less stressful for patients.

When Volwiler and Tabern began research in the 1930s at Abbott Laboratories, a big pharmaceutical company, doctors used ether and chloroform as general anesthetics. Both are inhaled.

### *Fun Factoids*

#### The Truth About "Truth Serum"

CIA agents finally nab the terrorist, and desperate to discover whether more attacks are on the horizon, administer a shot of Truth Serum. He immediately blabbers, giving details of the plot and naming names of fellow terrorists.

That's the Hollywood version, and at least part of it is true. Nobody knows for sure whether intelligence agencies actually use such tactics. But "truth serum" really exists, thanks to Ohio inventors Ernest H. Volwiler and Donalee L. Tabern.

In the 1940s, psychiatrists started using Sodium Pentothal in a form of treatment called narcotherapy. It is a kind of drug-induced substitute for hypnosis, which doesn't work in many people. Narcotherapy involves giving a person a dose of Sodium Pentothal too small to cause unconsciousness, but just enough to make the individual relax completely.

In that anxiety-free state, patients are more susceptible to suggestion and psychiatrists think it's possible to uncover repressed memories and feelings that may be contributing to psychological problems.

Sodium Pentothal got the name, Truth Serum, because patients under its influence – and guided by a skillful psychiatrist – lose some inhibitions and may talk freely about topics they might never otherwise discuss. They tell the truth about such topics, but only if they want to. Narcotherapy patients, just like individuals who are hypnotized, don't lose all self-control and blabber out answers to every question. If a person wouldn't disclose damaging information when fully conscious, he probably wouldn't do it when under the effects of Truth Serum. And Sodium Pentothal is not the only drug used as Truth Serum. Some psychiatrists think that drugs like Sodium Amytal and scopolamine are good alternatives.

The two Ohio researchers wanted to find a drug that would "put patients out" quickly and comfortably before starting surgery, and also might have uses alone during brief operations. They tested more than 200 chemical compounds before settling on 5-ethyl-5-(1-methylbutyl)-2-thiobarbituric acid, or thiopental sodium. That's the drug's chemical name. Sodium Pentothal is the trade name that Abbott Laboratories decided to use in selling thiopental sodium.

Sodium Pentothal is also used as a radioprotective drug, to help prevent tissue damage in patients undergoing radiation treatment for cancer and in individuals who encounter radiation for other reasons.

In the 1940s, Tabern started Abbott Laboratories' pioneering work in developing and marketing "radiopharmaceuticals." These special radioactive drugs have important uses in medicine in diagnosing and treating certain diseases. They also are used in medical research. Thanks to his work, Abbott became the first drug company to supply radiopharmaceuticals.

#### Find out more...

- [Abbott Laboratories](http://www.abbott.com)  
(www.abbott.com)



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### Battelle

The Battelle Memorial Institute opened in Columbus in 1929. It is one of the nation's first privately endowed independent research and development laboratories. Battelle is considered a global leader in science and technology, developing and commercializing technology, solving problems for government and industry, and managing laboratories for customers. Battelle, with the national labs that it manages or co-manages, oversees 19,000 staff members and conducts \$2.9 billion in annual research and development. Battelle innovations include the development of the office copier machine (Xerox), pioneering work on compact disc technology, medical technology advancements, and fiber optic technologies.



In 1965, Battelle developed the first hot isostatic processing (HIP) vessels, used to make super-strong materials and superalloys for jet engines, nuclear power plants and other high-tech applications. The technology behind the office copier tops the list of the top 10 achievements from Battelle's first 75 years, while next-generation advancements in personal healthcare and renewable energy headline the list of projected advancements over the next 75 years.



Battelle has a strong record of laboratory management, including management or co-management of five Department of Energy (DOE) national labs and the establishment of laboratories in Europe, Asia, and elsewhere around the world. As an organization, Battelle also has a reputation of highly distinguished work in metallurgy (Battelle's original specialty), pioneering nuclear research, and the development of the technology that led to the compact disc. Battelle also occupies a strong position in the field of alternative fuels, especially fuel cells.

### Find out more...

- [Battelle](http://www.battelle.org)  
([www.battelle.org](http://www.battelle.org))
- [Battelle Innovations](http://www.battelle.org/innovations)  
([www.battelle.org/innovations](http://www.battelle.org/innovations))



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### Crile Finds Cleveland Clinic

Dr. George W. Crile, a native of Chili, led a group of four Ohio physicians who founded the Cleveland Clinic in 1921. Dr. Crile also founded the American College of Surgeons, the renowned professional organization that helps assure high quality surgical care throughout the country. They agreed to practice medicine together as a team, pooling their knowledge and resources to provide patients with better health care. It was one of the world's first group practices, an approach to delivery of health care that became increasingly popular.



The Cleveland Clinic, located in Cleveland, Ohio, is a not-for-profit multispecialty academic medical center that integrates clinical and hospital care with research and education. The Cleveland Clinic was founded in 1921 by four renowned physicians with a vision of providing outstanding patient care based upon the principles of cooperation, compassion and innovation. *U.S. News & World Report* consistently names The Cleveland Clinic as one of the nation's best hospitals in its annual "America's Best Hospitals" survey. Approximately 1,500 full-time salaried physicians at The Cleveland Clinic and Cleveland Clinic Florida represent more than 100 medical specialties and subspecialties. In 2004, patients came for treatment from every state and 100 countries.

In addition to providing patient care, the Cleveland Clinic trains new physicians in one of the world's biggest freestanding medical education programs. That role will expand in the future, with the opening of a medical school jointly created by the Clinic and Case Western Reserve University. The Cleveland Clinic Lerner College of Medicine of Case Western Reserve University will emphasize training physicians who plan to become medical researchers and doctors interested in both treating patients and doing medical research.

The combined emphasis on treatment and research was one of the guiding lights for the Clinic's founders. Through the years, the Cleveland Clinic has been a world leader in medical breakthroughs, including many that involve cardiovascular disease and cancer, the leading causes of death in the United States.

In the 1940s and 1950s, for instance, Dr. Irvine H. Page made a series of major discoveries that established high blood pressure as a major risk factor for heart attacks and stroke. Dr. George Crile Jr. in the 1950s pioneered new "conservative" surgical techniques for treating breast cancer, achieving the same results with less disfiguring therapies than the then-standard radical mastectomy. George Phalen identified carpal tunnel syndrome, a painful disorder that affects workers whose jobs involve repetitive wrist and hand movements. D. Rupert Turnbull Jr. developed the "no touch" technique to isolate diseased tissue, thus preventing the spread of cancer cells during surgery for colon cancer. It greatly reduced the death rates after colorectal surgery.

In 1956, Dr. Donald B. Effler and Dr. Laurence K. Groves pioneered open heart surgery, stopping and restarting the heart of a 17-month-old with the aid of a heart-lung machine developed by Dr. Willem A. Kolff. Cleveland Clinic cardiologist Dr. F. Mason Sones Jr. developed coronary angiography, which allows doctors to view the heart and its vessels through moving X-rays. Angiography paved the way for the development of coronary bypass surgery and other operations to treat clogged arteries. Dr. Helen Brown had a major role in establishing high blood cholesterol as a risk factor for heart disease, and developed the world's first diet to reduce cholesterol levels.

In 1963, Drs. Ralph A. Straffon, Eugene F. Poutasse, and Willem A. Kolff performed one of the world's first successful cadaver kidney transplants. Dr. Kolff also invented a pioneering artificial heart and in 1957 tested it successfully in a dog. It was the first implantation of an artificial heart in the Western World. Before moving to Cleveland, Dr. Kolff invented the kidney dialysis machine that today keeps 55,000 kidney failure patients alive in the United States.

In 1967, Dr. Rene Favaloro developed coronary bypass surgery, which today is one of the most frequently-performed operations in the United States. Dr. Floyd D. Loop in 1971 introduced the most important refinements in the techniques used for bypass surgery and pioneered ways of lowering the cost of hospitalization for cardiac surgery. The Cleveland Clinic started one of the nation's first heart transplantation programs in 1968, and today is the busiest heart transplant center in the United States.

Dr. Delos M. Cosgrove pioneered aortic valvuloplasty, a procedure that allows surgeons to repair diseased heart valves. Drs. Gene H. Barnett and Donald W. Kormos develop the sonic wand, an imaging technique that allows brain surgeons to pinpoint lesions with unprecedented ease and precision.

#### Find out more...

- [Cleveland Clinic](http://www.clevelandclinic.org)  
(www.clevelandclinic.org)
- [American College of Surgeons](http://www.facs.org)  
(www.facs.org)



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### First Dental School

Dr. John M. Harris in 1828 started the world's first dental school in Bainbridge, Ohio, and helped to establish dentistry as a health profession. It opened on February 21, 1828, and today is a dental museum. Visitors can see a variety of antique dental instruments and sets of false teeth.



Harris started out as a medical doctor in Cincinnati, and then moved to Bainbridge in the mid-1820s. In 1827, he started offering classes for those who wanted to study "preparatory to their entering a medical college." By 1828, however, his courses began to specialize in studying dentistry, a medical specialty that Harris focused on in his practice as well.

### Toothpaste Pioneer

Toothpaste can be traced back to 500 BC in China and India. Our modern toothpastes were brought into popularity in 1824, by a dentist named Peabody, who added soap to toothpaste. Then, in the 1850's, John Harris added chalk, and soon the S.S. White Company introduced a paste in a collapsible tube. But it wasn't until 1873 that toothpaste was mass-produced when Colgate introduced the first toothpaste in a jar. Fluoride was added to toothpaste in 1956, when Proctor & Gamble launched its Crest product.



### Find Out More...

- [The Dr. John Harris Dental Museum](http://www.bainbridgedentalmuseum.com)  
([www.bainbridgedentalmuseum.com](http://www.bainbridgedentalmuseum.com))
- [American Dental Association's History of Dentistry](http://www.ada.org/public/topics/history)  
([www.ada.org/public/topics/history](http://www.ada.org/public/topics/history))
- [National Museum of Dentistry](http://www.dentalmuseum.umaryland.edu)  
([www.dentalmuseum.umaryland.edu](http://www.dentalmuseum.umaryland.edu))



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### First Female MD

Dr. Elizabeth Blackwell (1821 - 1910) was born in England, and grew up in Cincinnati where she moved in 1937. She graduated from the Geneva Medical College in western New York in 1849, becoming the first woman doctor in the United States.



As a child, Blackwell was educated by tutors. After her father died, she and her family operated a private school, where Blackwell found herself more and more interested in medicine. At the time, it was unheard of for a woman to consider a medical career, but that didn't stop Blackwell. She felt strongly that women deserved to have the option of seeing a woman doctor, who might best be able to understand a woman's unique makeup.

In 1847, Blackwell started on a quest to earn a medical degree. It was difficult to find a school willing to accept her, however. She was rejected by 29 medical schools. Some schools thought her application was a joke. Others were shocked that a woman would consider applying. Her persistence won out though, when she was finally accepted into Geneva Medical College in western New York in 1847. A fellow classmate described the scene as Blackwell arrived at her first class in medical school: "A hush fell over the class as if each member had been stricken with paralysis...A death-like stillness prevailed during the lecture." Blackwell graduated first in her class.

During her career which spanned several countries, Elizabeth Blackwell published many books. Among them:

- The Religion of Health (1871)
- Counsel to Parents on the Moral Education of Their Children (1878)
- The Human Element in Sex (1884)
- Pioneer Work in Opening the Medical Profession to Women (1895)
- Essays in Medical Sociology (1902)

Blackwell also founded a hospital in New York entirely staffed by women in 1857. It ran for over thirty years, but she was drawn to England, and returned there in 1869, where she helped organize the National Health Society and founded the London School of Medicine for Women. In 1875, Blackwell was appointed professor of gynecology at the London School of Medicine for Children. While in England, Blackwell lectured extensively and was the first woman to have her name entered in the British Medical Register. One of Blackwell's best-known quotes sums up her determination, "If society will not admit of woman's free development, then society must be remodeled."

Photos, copies of her letters of admission to medical school, and more information about Elizabeth Blackwell are available at the National Institutes of Health website at [www.nlm.nih.gov/hmd/blackwell](http://www.nlm.nih.gov/hmd/blackwell).



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### First Female Dentist

In 1866, the Ohio College of Dental Surgery in Cincinnati became the first dental school in the United States to grant a degree to a woman. Lucy Beaman Hobbs Taylor (1833 - 1920) earned it after only four months of study, because she already had years of experience as a practicing dentist.



People in those days didn't expect women to have a career outside the home. Born in New York State, Hobbs was a brilliant student who wanted to study medicine. Teachers and family discouraged her, however, because that was not a common profession for a woman. In 1859, Hobbs moved to Cincinnati, studied dentistry with a veteran dentist, and worked as an apprentice for a dentist. She applied to the dental school in 1861, but was rejected because she worked in a dental office. Taylor moved to Iowa, where she opened her own dental office and became well known as an excellent dentist.

She was determined to get a dental degree, and reapplied to the Cincinnati school. They said, "yes." Taylor's persistence, and the Cincinnati school's enlightened attitude, helped to open new opportunities for women in dentistry. She later married a dentist, and they opened a successful dental office together in Lawrence, Kansas. Taylor also became an activist for women's rights.

### Find Out More...

- [American Dental Association's History of Dentistry](http://www.ada.org/public/topics/history/index.asp)  
([www.ada.org/public/topics/history/index.asp](http://www.ada.org/public/topics/history/index.asp))
- [About Dr. Lucy Hobbs Taylor](http://mywebpages.comcast.net/thorsdag/LucyHobbsTaylor.html)  
(<http://mywebpages.comcast.net/thorsdag/LucyHobbsTaylor.html>)



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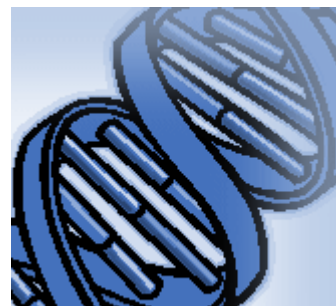


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### Genetic Engineering Landmark

The world's first functional gene transfer between mammalian species was performed in 1981 at Ohio University in Athens when researchers successfully produced rabbit genes in mice.



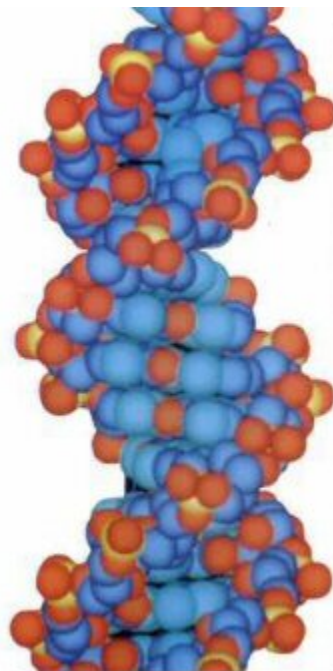
Genetics is a rapidly growing field. Strides in disease control have been achieved through international efforts such as the Human Genome Project. Over time, and with continued support of genetics research, more diseases will be understood, which will impact treatment, prevention, and the overall health of the life on earth.

### What is a Gene?

Genes are material entities that encode information essential for the construction and regulation of polypeptides, proteins and other molecules that determine the growth and functioning of the organism.

### What is Gene Transfer?

Gene transfer is achieved by inserting copies of a gene into living cells in order to synthesize the gene's product. The gene may be microinjected directly into the cell or into a virus via gene splicing. The virus is then allowed to infect a desired cell in order to integrate the new gene into the DNA of the infected cell.



### Did You Know?

- The National Human Genome Research Institute (NHGRI), a branch of the National Institutes of Health (NIH), announced the first draft of the dog genome sequence in a free public database for use by biomedical and veterinary researchers around the globe.
- In 1909, Wilhelm Johannsen coined the word "gene" to describe the Mendelian unit of heredity.
- In 1983, the first disease gene was mapped when a genetic marker for Huntington's disease was found on chromosome 4.

## Find out more...

- [National Human Genome Research Institute](http://www.genome.gov)  
([www.genome.gov](http://www.genome.gov))
- [National Human Genome Project Educational Resources](http://www.genome.gov/Education)  
([www.genome.gov/Education](http://www.genome.gov/Education))
- [History of the Human Genome Project](http://www.ornl.gov/sci/techresources/Human_Genome/project/hgp.shtml)  
([www.ornl.gov/sci/techresources/Human\\_Genome/project/hgp.shtml](http://www.ornl.gov/sci/techresources/Human_Genome/project/hgp.shtml))
- [Genetic Timeline](http://www.genome.gov/Pages/Education/GeneticTimeline.pdf)  
([www.genome.gov/Pages/Education/GeneticTimeline.pdf](http://www.genome.gov/Pages/Education/GeneticTimeline.pdf))
- [Ohio University](http://www.ohio.edu)  
([www.ohio.edu](http://www.ohio.edu))



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### First Genetics Doctorate

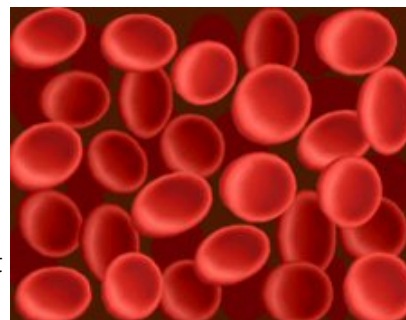
Dr. Harriet Hyman Parker was a pioneering researcher in human genetics and was the first person to get a doctorate in that field, conferred by The Ohio State University in 1936.

Dr. Parker's work on blood groups and Rh factor led her to discover that multiple blood groups are present at birth. This provided the scientific basis for safely transfusing jaundiced newborns, resolving cases of uncertain identity of infants in hospitals, and establishing legal evidence of nonpaternity.



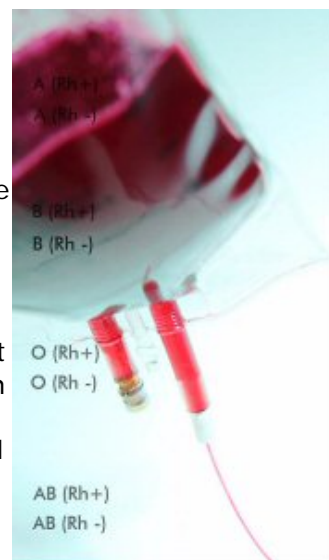
### What is the Rh Factor?

Red blood cells carry proteins on their surfaces. The Rhesus factor, or Rh, is a protein carried by some individuals. If a person's red blood cells carry Rh, they are considered to be "Rh Positive." If not, they are "Rh Negative." The Rhesus factor is named for the Rhesus monkey, in which it was first discovered.



### Rh and Pregnancy

Pregnant women are often given a blood test to determine whether their blood is Rh Positive or Negative. An Rh Negative mother who is carrying an Rh Positive baby may produce antibodies against the baby's red blood cells. While this has no impact on the first pregnancy, it can cause complications in future pregnancies as the antibodies can cross the placenta and destroy the red blood cells of a developing fetus. In 1968, this problem was addressed by the introduction of Rhogam (Rh immunoglobulin). The medication is given to women who are Rh-negative to help prevent them from generating antibodies against the red blood cells of their babies. As a result, the incidence of Rh sensitisation has fallen drastically since 1968. The procedure is not a 100% solution. About 2 out of 100 Rh-negative women will still develop antibodies before delivery.



### Find out more...

- [About Rh Factor in Pregnancy](http://pregnancy.about.com/cs/rhfactor/a/aa050601a.htm)  
(<http://pregnancy.about.com/cs/rhfactor/a/aa050601a.htm>)
- [What it Means to be Rh Negative](http://www.babycenter.com/refcap/1480.html)  
([www.babycenter.com/refcap/1480.html](http://www.babycenter.com/refcap/1480.html))



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### Heimlich Maneuver

In 1974, Dr. Henry J. Heimlich, a Cincinnati chest surgeon, developed the Heimlich Maneuver -- a simple procedure that laymen can use to save victims of choking, which is the sixth leading cause of accidental death. It costs nothing, requires no special equipment, and takes just minutes to learn. In addition to saving victims of choking, it is sometimes used to save drowning victims. The Heimlich Institute, which he founded in Cincinnati, is currently researching new treatments for AIDS and cancer. It is also working to promote peaceful solutions to international problems through the "A Caring World" program.



The Heimlich Maneuver has had an enormous public health impact, saving an estimated 30,000 lives over the years in the United States alone. In 1984, it earned Dr. Heimlich a prestigious Albert Lasker Award for Public Service. Many recipients of the Lasker Award have gone on to win a Nobel Prize.

More than 100,000 people around the world choke to death each year when food or other foreign objects accidentally lodge in the trachea or windpipe. Unless breathing is restored within 4 minutes they face irreversible brain damage and death. Bystanders may not recognize the problem because the victim can't speak and call for help. Many choking cases are mistaken for heart attacks. Choking cases that occur in public eating places are sometimes termed "café coronaries."

In 1972, Dr. Heimlich recognized the enormous toll from accidental choking, and began to study exactly how objects lodge in the windpipe and how they might be dislodged. He discovered that the usual ways of treating the emergency actually made things worse. Hitting a choking victim on the back or attempting to remove the object with the fingers usually wedged it tighter in the windpipe. Dr. Heimlich realized that air remains in the lungs even when a person's airway is completely blocked.

Research on animals convinced him that the trapped air could be used to force an object out of the windpipe. He published the idea in the Journal of Emergency Medicine so that physicians around the world could read about it and test it. The idea was simple: Any bystander could suddenly compress this air in the victim's lungs by delivering a quick, upward thrust to the diaphragm. That would pop the object out of the windpipe, just like squeezing on a water-filled balloon squirts water out the opening. The report created a sensation, as people used it to save lives. First-aid personnel, emergency medical technicians, medical professionals, and people in everyday life use the Heimlich Maneuver in choking and other medical emergencies.

Dr. Heimlich also has pioneered other medical advances. In the 1950s, he developed and used an operation to replace the esophagus, which carries food from the mouth to the stomach. Sometimes regarded as the first total organ replacement in history, it is used today to repair certain birth defects of the esophagus. In 1964, he developed a valve device for draining blood and air out of the chest cavity in patients with gunshot injuries. It was first used in the Vietnam War, cost about \$1, and saved the lives of thousands of American and Vietnamese soldiers shot in the chest. Today more than 250,000 Heimlich valves are used worldwide each year to treat patients with chest wounds, or following surgery.

### **Saving A Life With the Heimlich Maneuver**

A choking victim cannot speak or breathe and needs help immediately. To perform the Heimlich maneuver on a conscious adult, stand behind the victim and wrap your arms around his waist. The rescuer makes a fist with one hand and places the other hand on top, positioned below the rib cage and above the waist. The rescuer then applies pressure by a series of upward and inward thrusts to force the foreign object back up the victim's trachea. It can be used to save an adult choking victim, an infant, drowning victims and in other situations. For simple instructions, [click here](#). For a course on First Aid including use of the Heimlich Maneuver for the choking adult, child, or infant, contact the American Red Cross or the American Heart Association.

### **When to Use the Heimlich Maneuver**

- The person cannot speak or cry out.
- The person's face turns blue from lack of oxygen.
- The person desperately grabs at his or her throat.
- The person has a weak cough, and labored breathing produces a high-pitched noise.
- The person does all of the above, then becomes unconscious.  
Some people may use a gesture recommended as the universal warning sign for choking. It involves placing a hand at the base of the neck.

### **The Heimlich Maneuver for Pets?**

Yes, indeed. The Heimlich Maneuver can save the life of a beloved dog or cat, if owners know when and how to use it. Find out more at [www.heimlichinstitute.org/pets.html](http://www.heimlichinstitute.org/pets.html).



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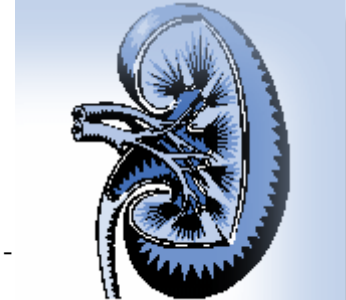


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### Artificial Kidney Machine Inventor

Dr. Willem J. Kolff invented the kidney dialysis, or artificial kidney, machine. The first membrane oxygenator for clinical use was developed based on the Kolff's artificial kidney model. He also supported the evolution of the artificial heart, an investigated intra-aortic balloon pumping and how to best preserve an organ for transplantation.



During his childhood in the Netherlands, Kolff chose zoo keeping as his career of choice. His father, a doctor and director of a tuberculosis sanitarium, continually experienced the death of his patients. The young Kolff felt that watching so many of his patients die would be too challenging. Ultimately his father won out, and Kolff pursued medicine. Some believe that it was this dread of watching patients die that led Kolff to eventually focus on artificial organ development.

In 1938, Kolff earned his medical degree from the University of Leiden in Holland. Later that year, he watched one of his own patients die of kidney disease. He was frustrated at the lack of options he had for treating the young boy, and tried to explore options for purifying his patient's blood.

Kolff began working on a process in which toxins in tainted blood move through small pores in cellophane into a fluid rinse, and then back to a patient's circulatory system. Over several years, Kolff built four different artificial kidney machines. These experiments with kidney machines met with failure as he was only allowed to try his invention on patients who were already close to death. The advent of World War II made it difficult for Kolff to gather the materials he needed to further his experiments.

Then, in 1950, Dr. Kolff joined the staff of the Cleveland Clinic Foundation. He believed that he would find more support and funds in the U.S., where the idea of an artificial kidney was more accepted. Kolff spent the bulk of his first years at the Cleveland Clinic working out improvements for his kidney machine. He was able to increase clinical use of the kidney and played a major role in starting a kidney transplant program.

Kolff also started the first Department of Artificial Organs in the world at the Cleveland Clinic. Kolff's work has had a major impact on the quality of life of people around the world. His device has saved hundreds of thousands of lives, and each day, about 55,000 people are being kept alive by dialysis.

## Did You Know?

The process of dialysis replicates the work of normal, healthy kidneys by removing waste, excess water, and salt so these do not build up to an unhealthy level in the body. In addition dialysis (and healthy kidneys) maintain safe levels of chemicals in the blood, such as potassium, sodium, and bicarbonate, and also helps maintain a healthy blood pressure.

## Find out more...

- **Willem Kolff Foundation**  
([www.willemkolffstichting.nl/en/](http://www.willemkolffstichting.nl/en/))
- **National Kidney Foundation**  
([www.kidney.org](http://www.kidney.org))
- **NKF's Kidney Learning System**  
([www.kidney.org/klis](http://www.kidney.org/klis))



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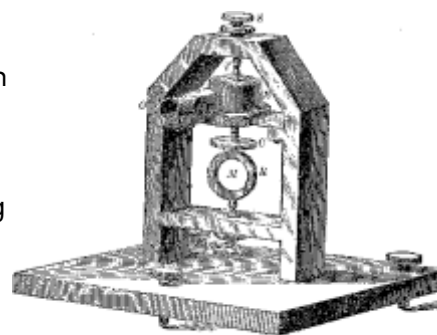
### Michelson-Morley Experiment

Albert Abraham Michelson (1852-1931) was the first American to win the Nobel Prize in physics in 1907. His experiment disproved the notion that space is filled with ether. Michelson was born in Stzelno, Poland and graduated from the U.S. Naval Academy at Annapolis (1873).



Michelson also was an instructor at the U.S. Naval Academy. In 1877, as part of a class demonstration, Michelson conducted his first velocity of light experiments. He made an important modification of a previously popular method for determining the velocity of light - he used a revolving mirror. He later served as Professor of physics at the Case School of Applied Science in Cleveland from 1883 to 1889.

While in Cleveland, Michelson built an interferometer (a device designed to split a beam of light in two and bring the two beams back together again) and collaborated with chemist Edward William Morley (1838-1923) of Western Reserve University (1869-1906) to conduct experiments that showed the speed of light was unaffected by movements of the earth through space (1887), disproving the "space ether concept" and paving the way for Albert Einstein's Theory of Relativity (1905).



Design for Revolving Mirror

The pioneering work performed by this pair has come to be known as the Michelson-Morley experiments. Michelson was also the first scientist to accurately determine the speed of light (299,792 km/sec).

Michelson served as President of the National Academy of Sciences from 1923 to 1927. Morley's later research dealt with the density and weight of gases, which resulted in his definitive chemical method of determining atomic weights.

Throughout his life, Michelson was known as a person who loved education, and who inspired others who would themselves emerge into inspiring teachers, physicists, and inventors.

### Did You Know?

- The works of Albert Abraham Michaelson are freely available in electronic form from Project Gutenberg: [Experimental Determination of the Velocity of Light](http://www.gutenberg.net/browse/BIBREC/BR11753.HTM) (www.gutenberg.net/browse/BIBREC/BR11753.HTM)

## Find out more...

- [View an animation of the Michelson-Morley Experiment](http://galileoand爱因斯坦.physics.virginia.edu/more_stuff/flashlets/mmexpt6.htm)  
([http://galileoand爱因斯坦.physics.virginia.edu/more\\_stuff/flashlets/mmexpt6.htm](http://galileoand爱因斯坦.physics.virginia.edu/more_stuff/flashlets/mmexpt6.htm))
- [Albert Abraham Michelson Biography - Adam Mickiewicz University](http://www.staff.amu.edu.pl/~zbow/ph/sci/aam.htm)  
([www.staff.amu.edu.pl/~zbow/ph/sci/aam.htm](http://www.staff.amu.edu.pl/~zbow/ph/sci/aam.htm))
- [Interferometry](http://en.wikipedia.org/wiki/Interferometer)  
(<http://en.wikipedia.org/wiki/Interferometer>)
- [U.S. Naval Academy Library Profile of Michelson](http://www.nadn.navy.mil/LibExhibits/Michelson/Michelson_career.html)  
([www.nadn.navy.mil/LibExhibits/Michelson/Michelson\\_career.html](http://www.nadn.navy.mil/LibExhibits/Michelson/Michelson_career.html))



# Heartland Science

Ohio's Legacy of Discovery & Innovation



## Medicine, Health & Science

From the Heimlich Maneuver  
to the Speed of Light

### Polio Vaccine Production

Frederick C. Robbins (1916-2003), of Case Western Reserve University School of Medicine in Cleveland, shared the 1954 Nobel Prize in Physiology or Medicine for discovering a method of growing poliovirus in a test tube. Until that discovery by Robbins and fellow laureates John F. Enders and Thomas H. Weller, poliovirus had to be studied in monkeys, which were expensive to use in research and difficult to handle. Their achievement led to development of the first effective vaccines to prevent polio. The viral disease then occurred in great epidemics, which threatened children with paralysis and death. In addition, the first effective vaccines paved the way for making vaccines given today to prevent childhood diseases including common measles and German measles. Before a vaccine was developed, German measles was a major cause of birth defects.



Scientists had been trying to make a polio vaccine since 1900. Robbins joined Enders and Weller at Children's Hospital in Boston in 1948, where researchers were trying to break through a major barrier hindering vaccine development. Scientists then thought that the poliovirus would grow only in nerve tissue in living mammals, warm-blood animals that include people. That made it seem almost impossible to develop a vaccine. Nerve tissue then could not be grown in test tubes in the ways needed to make a vaccine. By 1952, Robbins and his associates proved those beliefs wrong. They discovered how to grow poliovirus in laboratory cell culture dishes containing human embryonic skin and muscle tissue.



Jonas Salk, of the University of Pittsburgh, immediately used the discovery to develop the first polio vaccine, which became known as the "Salk vaccine." Given by injection, it used an inactivated form of poliovirus to produce immunity. The Salk vaccine went into general use in 1955. In 1957, Albert B. Sabin developed an oral vaccine that used live poliovirus with the infectious part inactivated. It went into use in 1963, and today is the main vaccine used in the United States. The vaccines quickly controlled polio in the United States. In the late 1950s, more than 2,500 cases of paralytic polio, the most serious kind, occurred each year. By 1965, there were only about 60 cases. The last naturally transmitted case of polio occurred in the United States in 1979. Health officials in 1994 declared that polio had been eradicated in North and South America. Polio, however, continues to occur in other parts of the world. The World Health Organization hopes to wipe out the disease in the near future. Its Global Polio Eradication Initiative involves government agencies as well as private groups like Rotary International and the Bill & Melinda Gates Foundation.

### Find out more...

- Centers for Disease Control National Immunization Program ([www.cdc.gov/nip](http://www.cdc.gov/nip))

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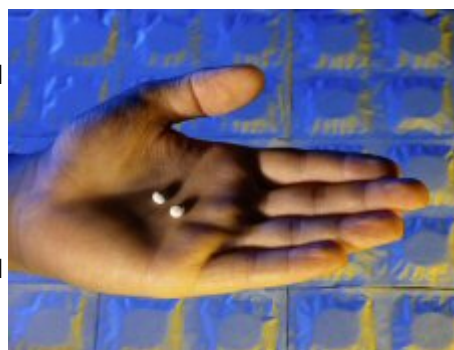
### Oral Polio Vaccine Namesake

Dr. Albert Sabin (1906-1993) in 1950 developed a polio vaccine that could be taken by mouth, rather than injection. Polio was a much-feared viral disease that could cause death and frequently left victims paralyzed in various parts of the body.



The oral live polio vaccine was developed as an alternative to the highly effective injected, killed polio vaccine previously developed by Jonas Salk. The oral vaccine remains in wide use today. Sabin isolated strains of each type of polio virus that were not strong enough to produce the disease themselves. However, these strains were capable of stimulating the production of antibodies to combat the infection. This technique led to Sabin's oral polio vaccine that won FDA approval in 1960. His work prevented an estimated 5 million cases of polio and 500,000 deaths worldwide.

Sabin began his career in biomedical research in 1926 while he was a student at New York University. He worked at the Rockefeller Institute for Medical Research briefly, and then moved to Cincinnati, Ohio in 1939. Apart from time serving in World War II, Sabin spent the next thirty years working at the University of Cincinnati College of Medicine and the Children's Hospital Research Foundation. During the war, Sabin focused on exploring the many viral diseases that impacted American troops serving abroad. As a result of this and future work, Sabin developed a vaccine for Japanese encephalitis.



In the 1960's, Sabin's oral polio vaccine was distributed to about 100 million children throughout Europe. From 1962 to 1964, the vaccine was given to about 100 million people in the U.S. It is said that in just its first two years of use, Dr. Sabin's vaccine prevented nearly 500,000 deaths and five million cases of paralytic polio.

### Did You Know?

- To honor his work, Sabin received 46 honorary degrees from universities around the world.
- Sabin also received the United States National Medal of Science in 1970 and the Presidential Medal of Freedom in 1986.

### Find out more...

- [Sabin Vaccine Institute](http://www.sabin.org) (www.sabin.org)
- [Legacy of Albert B. Sabin](http://www.sabin.org/who_legacy.htm) (www.sabin.org/who\_legacy.htm)
- [Polio Vaccines](http://www.sabin.org/vaccine_science_polio.htm) (www.sabin.org/vaccine\_science\_polio.htm)

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### Ohio Name on the Scale

Charles F. Richter (1900–1985) was born in Ohio where he lived until age 16. He developed the scale to measure earthquake intensity that bears his name. The Richter scale, invented by Richter in 1934, is used around the world. The Richter magnitude is calculated from the amplitude of the largest seismic wave recorded for the earthquake.



Richter magnitudes are based on a logarithmic scale. This means that for each single number of increase on the scale the amplitude of motion of the ground increases tenfold. Numbers for the Richter scale range from 0 to 9, but no real upper limit exists. The 1906 San Francisco earthquake was measured as 7.8 on the Richter scale. More recently, the Alaskan earthquake of 1964 was 9.2; the 1995 earthquake in Kobe, Japan, reached 6.9; and the 1999 earthquake in Izmit, Turkey, measured 7.6, and the 2004 earthquake in the Indian Ocean measured 9.0.



Originally, the Richter Scale could be applied to records from instruments that were manufactured identically. Over time, instruments were calibrated with respect to each other so magnitude could be determined from any calibrated seismograph machine.



### The Richter Scale

- Magnitude 2.5 or less is usually not felt. 900,000 are recorded annually by seismograph.
- Magnitude 2.5 to 5.4 is frequently felt, but usually results in only minor damage. 30,000 are estimated each year.
- Magnitude 5.5 to 6.0 can cause slight damage to buildings and other structures. There are an average of 500 of these per year.
- Magnitude 6.1 to 6.9 may cause heavy damage, especially in highly populated areas. There are about 100 at this level per year.
- Magnitude 7.0 to 7.9 is considered a major earthquake that can result in serious damage. 20 are usually reported a year.
- Magnitude 8.0 or greater is a formidable earthquake. One will take place every five to ten years, and its power can wipe out whatever is near the epicenter.

## Find out more...

- [An Interview with Charles F. Richter](http://gldss7.cr.usgs.gov/neis/seismology/people/int_richter.html)  
([http://gldss7.cr.usgs.gov/neis/seismology/people/int\\_richter.html](http://gldss7.cr.usgs.gov/neis/seismology/people/int_richter.html))
- [Recent Earthquake Activity in the USA](http://earthquake.usgs.gov/recenteqs/)  
(<http://earthquake.usgs.gov/recenteqs/>)
- [Recent Earthquake Activity in the World](http://earthquake.usgs.gov/recenteqsww/)  
(<http://earthquake.usgs.gov/recenteqsww/>)
- [U.S. Geological Survey Information About Past and Historical Earthquakes](http://earthquake.usgs.gov/activity/past.html)  
(<http://earthquake.usgs.gov/activity/past.html>)



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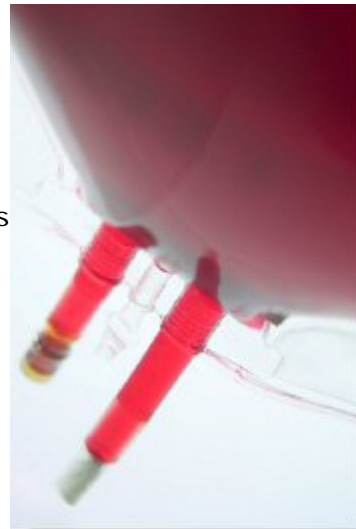
### Surgery Pioneer

Dr. George W. Crile, a native of Chili, Ohio and a virtuoso surgeon, in 1921 founded The Cleveland Clinic and the American College of Surgeons (ACS). He pioneered many surgical procedures. Today, The Cleveland Clinic ranks among the world's top medical facilities. The ACS is the leading professional organization of general surgeons.



Crile was born on November 11th, 1864 on a small farm near Chili, Ohio. He worked as an elementary school teacher to pay his way through Northwestern Ohio Normal School, which later became Ohio Northern University. He briefly served as principal of the Plainfield (Ohio) School. He became interested in pursuing a career in medicine as a result of a friendship with a local physician. Crile earned his M.D. degree with highest honors in 1888.

Crile also served as a Brigade Surgeon with the rank of Major in the Spanish American War. The military medical experience proved extremely valuable to Crile, with many resulting applications in his civilian medical career. He evaluated and treated thousands of those wounded or killed in the Spanish American war, and he put the experience to work when he returned home.



### Did You Know?

- Crile's major accomplishment, for which he was world famous, was shifting the focus of surgery from pathological anatomy -- which had become commonplace -- to physiology. So many patients who had successful operations were dying anyway. Crile determined they were dying of shock, and he introduced physiological monitoring, that is still done today, in every operating environment. (Source: Peter English, "Shock, Physiological Surgery, and George Washington Crile," Greenwood, 1980)
- In addition to being a founder of the American College of Surgeons, Crile also served the organization for 26 years.
- Over his career, Crile wrote 24 books and over 400 articles.

## About the Cleveland Clinic

The Cleveland Clinic was founded in 1921 as a not-for-profit group practice, integrating clinical and hospital care with research and physician education. The Cleveland Clinic has more than 1,300 salaried physicians on staff, representing approximately 120 specialties and subspecialties. In 2003, they provided for almost 2 million outpatient visits and almost 50,000 hospital admissions. Patients came to the Cleveland Clinic from across America and from more than 80 nations.



## About the American College of Surgeons

The American College of Surgeons is a scientific and educational association of surgeons, founded in 1913, to improve the quality of care for the surgical patient by setting high standards for surgical education and practice. Members of ACS are called "Fellows." The College has more than 64,000 Fellows, including 3,700+ Fellows in other countries, making it the largest organization of surgeons in the world. There are also presently more than 5,000 Associate Fellows. The letters FACS (Fellow, American College of Surgeons) after a surgeon's name means that the surgeon's education and training, professional qualifications, surgical competence, and ethical conduct have passed a rigorous evaluation, and have been found to be consistent with the high standards established and demanded by the ACS.

### Find out more...

- [The Cleveland Clinic](http://www.clevelandclinic.org)  
([www.clevelandclinic.org](http://www.clevelandclinic.org))
- [The American College of Surgeons](http://www.facs.org/about/corppro.html)  
([www.facs.org/about/corppro.html](http://www.facs.org/about/corppro.html))



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### Tagamet is From Ohio

Dr. Graham John Durant discovered the H<sub>2</sub> receptor class of drugs, including Tagamet®, which inhibit the production of stomach acid.

Durant was born in Newport, England in 1934. He relocated to Ohio as the founding director of the University of Toledo's Center for Drug Design and Development in 1987. It was here that his work with the H<sub>2</sub> receptor class of drugs led to the discovery of cimetidine, which inhibits the production of stomach acid. Cimetidine is known by the brand name of Tagamet. Cimetidine inhibits the action of histamine in creating gastric acid in the stomach. It is used to treat ulcers and acid reflux.



### Did You Know?

- Dr. Durant was inducted into the National Inventors Hall of Fame in 1990.
- Cimetidine was approved by the FDA in 1977 and came off patent May 17, 1994.
- In September 1993, an FDA committee declined permission to market this drug without prescription.
- The FDA changed its mind and on March 29, 1995, approved a lower strength dosage form for over the counter (OTC) use. The OTC formulation was named "Tagamet HB."



### Find out more...

- [What is Heartburn?](http://www.tagamethb.com/about-heartburn.asp)  
([www.tagamethb.com/about-heartburn.asp](http://www.tagamethb.com/about-heartburn.asp))
- [MedlinePlus: Heartburn](http://www.nlm.nih.gov/medlineplus/heartburn.html)  
([www.nlm.nih.gov/medlineplus/heartburn.html](http://www.nlm.nih.gov/medlineplus/heartburn.html))



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### Applying X-Rays in Medicine

Dayton C. Miller, a physicist at the Case School of Applied Science in Cleveland, did the first experiments using X-rays to observe fractured bones. X-rays had been discovered by Wilhelm Roentgen in 1895. But soon after, Miller perfected the techniques for exposing skeletal images on photographic plates. He decided to use cathode ray tubes built by William Crookes to make some of the first photographic images of concealed objects, including a bullet within a man's limb.



Miller earned his doctorate in astronomy at Princeton University, and then in 1890, he began his work at the Case School of Applied Science as an astronomy teacher. Later, he focused on physics and became the head of the physics department in 1893.



### What is an X-Ray?

Light has many different forms, including visible light, and others such as radio waves, microwaves, infrared, ultraviolet, gamma radiation, and X-rays. The energy of the photon indicates its form of light. For example, radio waves have low energy photons. Optical photons, which are the ones we can see, are a million times more energetic than those in a radio wave. And, the energies of X-ray photons can be hundreds to thousands of times greater than those of optical photons.

### Did You Know?

- Miller worked with George Crile, leading to use of X-rays in cancer treatment.
- Other Cleveland Clinic scientists made key advances in determining proper doses of x-rays.
- Dayton Miller collected flutes. He is said to have had flutes made by 460 European and American instrument makers, over 130 Native North and South American flutes, and a 17th/18th century jade flute example from China. Miller died in Cleveland in 1941 as he was preparing to move his entire collection of flutes, books, and related materials to the Library of Congress.

### Find out more...

- [Dayton Miller Flute Collection at the Library of Congress](http://memory.loc.gov/ammem/dcmhtml/dmhome.html) (<http://memory.loc.gov/ammem/dcmhtml/dmhome.html>)
- [How X-Rays Work](http://science.howstuffworks.com/x-ray.htm/printable) (<http://science.howstuffworks.com/x-ray.htm/printable>)

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