

A black and white portrait of Richard Feynman. He is smiling slightly, looking towards the camera. His right hand is resting under his chin, with his index finger pointing upwards. He is wearing a dark, textured jacket or sweater over a light-colored collared shirt. The background is plain and light-colored.

Richard Feynman

A Biography

Richard Feynman: A Biography

Richard Feynman was a man of many talents. Most known for his contributions to the science community, he was also a musician, teacher, author, and renowned storyteller. His greatest accomplishments include assisting in the development of the atomic bomb during World War II and his theory of quantum electrodynamics. In addition, he was co-awarded the Nobel Prize for Physics in 1965. He is considered to be one of the most brilliant minds of his time.

Born in 1918, Feynman grew up in New York, New York to a Jewish family. From his early years, he was primed to become a scientist by his father, Melville. Under his father's guidance, Feynman began to question what was possible, which would lay the foundation for his later work in science. He had an open mind and curiosity. He was against rote learning and a believer in deeper methods of thinking through problems. His favorite subjects were math and science, and he had the classic gifted tendency to take electronics apart to see what they were made of, and to see if he could put them back together.

From his parents, Feynman was instilled with two qualities that would guide his life: the pursuit of science from his father, and a sense of humor from his mother. Additionally, while his father guided Feynman in science, it was his mother who gave him courage, and Feynman would prove to be a bold scientist, changing the world with his discoveries and not backing down when the truth needed to be told.

Feynman studied physics at MIT, graduating in 1939, and received his doctorate from Princeton in 1942. It was at Princeton that he, in conjunction with his adviser, John Archibald Wheeler, developed a new approach to quantum mechanics. It was also during his college years that he became engaged to the love of his life and high school sweetheart, Arline Greenbaum.

Just as Feynman was reaching great heights in science, his love, Arline, was diagnosed with Tuberculosis. He turned most of his attention to her; researching, hopeful he could save her. At the same time, World War II was ramping up. Feynman was asked to join a government project and initially refused, not wanting to leave Arline behind in her weakened state. Eventually

he was persuaded, and married Arline in a private office ceremony before leaving to begin what would be his work on the atomic bomb.

The next phase in Feynman's life revolved around the Manhattan Project, in which the U.S. was attempting to create the best version of the atomic bomb before Germany was able to. Many of the greatest mathematicians and scientists were recruited alongside Feynman. Feynman was hesitant to join the effort not only because he feared leaving Arline behind, but also because he did not have a great interest in the project. However, he did not want the Nazis to perfect the bomb first, so he signed on.

His work on the atomic bomb moved Feynman to Los Alamos, and he placed Arline in a nearby hospital in Albuquerque. The Manhattan Project was highly confidential, and during this period Feynman became fascinated by the secrecy. He honed his skills on safecracking, and found great pride in cracking codes. Most of the time, he was just practicing to sharpen his mind and because it delighted him. However, just after the end of the war he was able to put his skills to use and open a confidential file containing the recipe to the atomic bomb.

Feynman spent as much time as possible visiting Arline in nearby Albuquerque during this period. He spent his weeks working on the atomic bomb, and his weekends with her. In addition to his work on the atomic bomb, while Feynman was at Los Alamos he worked on calculating neutron equations for the Los Alamos "Water Boiler" to measure how close an assembly of fissile material was to criticality. He also helped engineers work on safety procedures for the storage of materials, hoping to cut down on accidents. He also did theoretical work and calculations on the planned uranium hydride bomb, which was not successful in the end.

In July of 1945, Arline passed away due to her Tuberculosis. Feynman was able to be with her when she died. Soon after her death, the war was over and Feynman was able to see his work on the atomic bomb come to fruition. Germany had already surrendered but the scientists saw their project through and detonated the bomb in the desert. Together the scientists celebrated their work and their great success.

Despite the success and celebration of the bomb, Feynman took a dark turn after his work on the atomic bomb and Arline's death. He became very pessimistic and angry, and had no inclination to work on anything so tactile

and destructive. He was disillusioned, and could only imagine what might come next after the atomic bomb. This would transition Feynman into the next phase of his scientific work, subatomic particles and diagrams.

Feynman left Los Alamos and accepted a professorship at Cornell University from 1945-1950. He returned to his previous work on quantum mechanics, which had consumed his earlier thesis at Princeton. During this time, he worked on computing the probability of a transition of a quantum from one state to some other subsequent state. He created the Feynman Diagrams, which used pictures to replace the many mathematical equations used to understand the behavior of subatomic particles.

During his time at Cornell, Feynman had highs and lows. He was regarded as a genius, but began drinking too much. He was consumed with the highs of his work, but struggled as many great minds do.

In 1950, Feynman accepted a position at CalTech (California Institute of Technology), where he remained for the rest of his career as a theoretical physicist. As Feynman continued to struggle with his personal demons, he reached out to a woman he dated briefly at Cornell, Mary Louise Bell, in hopes of raising his spirits. She moved to California to be with him, but the relationship was not meant to be. They married, but the marriage was brief and regarded as a disaster. In fact, he pleaded “Extreme Cruelty” during their divorce. He made his wife miserable with his relentless pursuit of calculus and loud drumming.

When Feynman was forty years old, he met a woman named Gweneth Howarth on a beach in England. Gweneth was only 24, and a brash au pair who claimed to have many boyfriends. Feynman was taken with her, and impulsively asked her to come back to the United States with him, if only as a business arrangement. He suggested she look after his house. It took more than a year, and in the meantime Gweneth continued to have boyfriends and frequently change her mind about the proposal, but in the end she accompanied Feynman back to the United States.

One year after Gweneth arrived in Pasadena, she and Feynman were married. They went on to have two children together, Carl and Michelle. Gweneth brought a great deal of adventure to his life and put up with Feynman’s quirks. It would be his third and final marriage, and by all appearances, he was happy at last.

The next big project to arrive in Feynman's life was the revision of the freshman physics curriculum at CalTech. Feynman was not keen to jump into this project when it was pitched to him, as it would take him away from his beloved research. He did not wish to switch his focus. However, he realized the need to pass knowledge on to future generations and eventually signed on to the project. In this effort, he worked with Professors Robert Leighton and Matthew Sands. The professors set to work transcribing lessons, which would become a set of three bound textbooks called *The Feynman Lectures on Physics*.

Today, the Feynman Lectures on Physics still remain relevant. Students and professors alike use these texts. Additionally, Feynman's lectures at Caltech became the books *Quantum Electrodynamics* (1961) and *The Theory of Fundamental Processes* (1961).

During this time, Feynman was immersed in many projects and was said to have worked at an exhausting pace at CalTech. He was dedicated to solving problems and mysteries, especially those posed to him by his students. He would not rest until he found an answer. This in addition to his research projects kept Feynman working at a pace difficult to maintain. It was also around this time, in 1965, that he was elected a Foreign Member of the Royal Society.

Feynman has a number of other scientific discoveries to his credit. In the early 1950's, he supplied a quantum-mechanical explanation for the Soviet physicist Lev D. Landau's theory of superfluidity, which is a state of matter in which the matter behaves like a fluid with zero viscosity. He also worked with physicist Murray Gell-Mann in 1958 on a theory that accounted for most of the phenomena connected to the weak force, which is the force at work in radioactive decay. This theory would lay the foundation for future principles in physics, and is considered to be a great contribution to the field.

Another great achievement by Feynman came in 1968 when he invented the theory of partons, supposed hard particles inside the nucleus of the atom. This discovery was monumental in the modern comprehension of quarks.

Aside from his work in science, Feynman was known for being eccentric. He was loud, boisterous. He was known for being confident. He was into art and music, and loved to tell stories. He was not one to sit quietly in the corner, but could be found in the center of the scene. Peers describe finding Feynman

chanting and dancing. Feynman had a passion for adventure, and then for telling anecdotes of his adventures.

One of Feynman's adventures was the pursuit of "Tuva", a lost land between Mongolia and Russia. As a youth, he had collected postage stamps for Tuva, but then it disappeared from the map. Feynman was determined to find it. He, Gweneth, and a friend named Ralph Leighton made the decision to tour Tuva and see what few had seen. They started with research, and Feynman soaked up all that he could find, though documentation on Tuva was little. His obsession with Tuva was looked at by his peers as a bit odd, but that was also par for the course for Feynman. Another obstacle Feynman, Gweneth, and Ralph had to overcome was permission to visit Tuva, as it was no longer an independent country.

Art was a passion of Feynman's, and he exhibited under the pseudonym "Ofey," to some degree of success. He had a love for both creating and viewing art. His love of music extended to the drums, particularly the bongos. He often played with the orchestra at CalTech. This ability to immerse himself so deeply in art and music often translated into his work, allowing him to see science in a way that other scientists could not. For example, the Feynman Diagrams, in which he uses pictures as equations shows how the many pieces came together for Feynman and made him far from the average scientist.

Feynman was such a great storyteller that his anecdotes evolved into a book. *Surely You're Joking, Mr. Feynman*, a volume of his stories, was published in 1985. As a man of both science and art, his stories were highly entertaining. He was able to see things through a unique lense and to make people laugh. His book became a national bestseller, and a follow-up titled *What Do You Care What Other People Think?* was published after Feynman's death. This book was much less light hearted than his first, focusing on his work with the Challenger disaster and the cover up that he witnessed.

In the last decade of his life, Feynman battled with cancer. He initially suffered from a rare form, a massive tumor in his abdomen. His tumor was removed, but he suffered damage to his internal organs. In this bout, he lost a kidney. Surgeries added time to his life and he lived many years, battling cancer off and on.

While Feynman was still battling cancer, another project landed in his lap. A

former student of his was working with the government in the wake of the 1986 Challenger. His student nominated him to join the team to investigate what went wrong. As with many of his projects, Feynman originally was disinclined. Due to his battle with cancer and the negative political nature of the project, Feynman had no desire to partake. However, his wife Gweneth was able to persuade him by reminding him that NASA needed his strong mind, and that he would see things differently than the other scientists at work. Her words worked, and he signed onto the project.

One thing the Challenger project needed was someone to speak their mind, and Feynman was just such a person. He relished the opportunity, as he frequently did. As it turned out, Feynman was a great addition to the project, as he became immersed in hidden details. Vital flight data had been hidden, and many in the organization had turned a blind eye. In his role, Feynman was an outsider and only concerned with the technicalities.

Feynman developed a theory that the explosion was caused by the inability of the rubber rings at such a temperature to expand quickly enough at launch to fully seal the joints, allowing the extremely hot exhaust gasses to leak past the joint and burn through the sizeable fuel tank filled with liquid hydrogen. A lower than usual temperature that day contributed, Feynman theorized.

Determined to test his theory, Feynman set about to recreate the situation in an experiment, using O-rings from a rocket, and a C-clamp from a local hardware store. He dropped the temperature to 32 degrees to simulate the day of the Challenger explosion, using ice water. Just as he'd theorized, the rubber remained tightly compressed.

Always the bold and daring soul, Feynman made a big plan to reveal his findings. He did not want them to be locked away with other details of the project, so he proposed that he reveal it live on TV. His experiment again worked just as planned, and history was made. This showed not only what most likely went wrong on the day the Challenger exploded, but that individuals within the organization were made to keep quiet and not speak up about the event.

In 1987, doctors discovered another tumor in Feynman, which was the beginning of his decline. He was treated surgically, but left even weaker than his previous bouts. His health continued to suffer, including the collapse of his second kidney.

Richard Feynman died on February 15, 1988, leaving behind a rich legacy of science accomplishments and the lives of many changed due to his loud and daring personality. He contributed to the study of quantum physics, and spoke his mind to get things changed. It was to his benefit.