



Albert Einstein **Physicist, 1879 – 1955**

Albert Einstein is widely regarded as the father of modern physics. Not only a famous scientist who left an unforgettable mark on the world, he has also become an icon of popular culture whose name and image are synonymous with genius and intellect. He was awarded the 1921 Nobel Prize in Physics for his work in theoretical physics, and his discovery of the law of the photoelectric effect, which was an essential step in the development of quantum theory.

A famous story is told of Einstein being awakened to the idea of the invisible forces of nature at the age of five, when his father gave him a compass and told him that magnetic forces made it always point northward. From that moment on, Einstein directed his curiosity and intellect towards understanding the physical world around him.

Einstein is most famous for his discovery is the theory of relativity, $E=MC^2$. His theory of relativity replaced Isaac Newton's laws by defining the relation of mass and energy as a consequence of space and time, instead of permanently fixed. Although he first introduced his theory in a brief, three-page paper in 1905, it was so far ahead of its time that it couldn't be proven until more advanced technology was developed years later.

Albert Einstein was born in Ulm, in Germany on 14 March 1879. His father Hermann Einstein was a salesman and engineer. In 1880, the family moved to Munich, where his father and his uncle ran a company that manufactured electrical equipment.

The Einsteins were Jews, although non-observant. Albert's first school was a Catholic elementary school. Some say that Einstein had early speech difficulties and was a poor student, but others, including the Albert Einstein Archives disagree, and he is said to have done well at his first school.

Einstein was an intelligent, curious child who received an open-minded upbringing and education from his family. Relatives and other mentors introduced him to important texts in science, mathematics and philosophy, including Immanuel Kant's philosophy and Euclid's Elements. His interests in geometry, classical music (Albert played piano and violin), science and mathematics were encouraged and accompanied him throughout his life.

Einstein was unhappy in school, but this was due to the strict teaching methods employed in the German school system at that time. The school system stressed rote-learning and discouraged curiosity and thinking creatively and outside the box, which is what Einstein excelled at. Thanks to his family's encouragement, though, Einstein's intellect and interests grew and developed. He taught himself Euclidean geometry and calculus by the time he was

fourteen. By the age of sixteen he was writing his first research science paper, and developing his first ideas of light and relativity.

In 1896 he enrolled in the four year mathematics and physics teaching diploma program at the Polytechnic in Zurich. After completing the program, Einstein was unable to find a teaching position, so he took a job in Bern, at the Federal Office for Intellectual Property, the patent office, where he examined patent applications for electromagnetic devices. Much of his work at the patent office had to do with transmitting electric signals and electrical-mechanical synchronization of time, two things that also play an important role in the thought experiments that eventually led him to his revolutionary ideas about relativity and the connection between space and time.

1905 is known as Einstein's annus mirabilis, or "miracle year". On 30 April 1905, he finished his thesis, and was awarded a PhD by the University of Zurich. In the same year, he published four famous papers, on the photoelectric effect, Brownian motion, special relativity, and the equivalence of matter and energy, which put him on the road to academic fame.

Within three years, he had become a leading scientist. He began teaching as a lecturer at the University of Bern. The next year, he quit the patent office and began teaching physics at the University of Zurich. He later taught in Prague, and then in Germany.

Early in his career, Einstein came to believe that Newtonian mechanics was no longer enough to reconcile the laws of classical mechanics with the laws of electromagnetics. This is what inspired him to develop his special theory of relativity. But he did not stop there. He came to understand that the principle of relativity could be applied to gravitational fields. By 1916 he had developed his theory of gravitation, and published a paper on the general theory of relativity. He also worked on problems of statistical mechanics and quantum theory. He later explained particle theory and molecular motion. He laid the foundation for the photon theory of light with his research into the thermal properties of light. In 1917, Einstein modeled the structure of the entire universe using the general theory of relativity.

In 1921, Einstein was awarded the Nobel Prize in Physics in recognition of his scientific brilliance. Because relativity was still controversial, the prize was officially awarded for his explanation of the photoelectric effect.

In 1933, the Nazis came to power in Germany under Adolf Hitler. While in the United States visiting universities that year, Einstein learned that the Nazis had barred Jews from holding any official positions, including teaching at universities. There were Nazi book burnings, and Einstein's books were among those burned. Einstein learned that his name was on a death list. Given these developments, Einstein decided to immigrate to the United States.

He was given a position at the Institute for Advanced Study at Princeton, New Jersey, where he remained until he died in 1955. He worked unsuccessfully on a unified field theory and to

refute the accepted interpretation of quantum physics. He became friends with the famous Austrian mathematician and philosopher Kurt Gödel, who was also at the Institute, and took long walks with him discussing their work.

In the summer of 1939, shortly before the start of World War II in Europe, Einstein was among a group of scientists who signed a letter to President Franklin D. Roosevelt, warning him that Nazi Germany might be developing an atomic bomb. The letter advised the U.S. government to become involved with nuclear science research. Einstein and other refugee scientists felt they had a duty to warn Americans that if German scientists won the race to build an atomic bomb, Hitler would be willing to use it.

It is thought that the letter is what led the U.S. to consider developing its own atomic bomb program. President Roosevelt didn't want to take the chance of Hitler being the first to have atomic bombs. The U.S. entered the "race" to develop the bomb, and started what was called the Manhattan Project. The U.S. was the only country to develop an atomic bomb during World War II.

Although Einstein was in favor of stopping Nazi Germany, he later said in 1954 that he considered signing the letter to President Roosevelt to be the one great mistake of his life, because it contributed to the development of those weapons of mass destruction, atomic bombs.

Einstein appreciated much about American society. He thought the concept of "meritocracy" in American culture gave it advantages over cultures in Europe. He valued freedom of speech and freedom of thought highly, as well as the relative lack of social barriers. He thought this encouraged people to be more creative, something that he had sorely missed during his early years in school.

Other aspects of American culture were less dear to Einstein. He called racism America's "worst disease." He was a member of the National Association for the Advancement of Colored People NAACP and campaigned for the civil rights of African Americans. He said the only remedies for racism were "enlightenment and education."

Albert Einstein died on 18 April 1955 of internal bleeding caused by a ruptured aortic aneurism. He had continued working even in Princeton Hospital, where he was taken. But he refused surgery, saying he was opposed to prolonging life artificially. He died at the age of 76, working to the very end.

Choose the best answer for the questions on this page

1. When was Albert Einstein born?
 - a. 1859
 - b. 1879
 - c. 1925
 - d. 1955

2. What first piqued Einstein's interest in the invisible forces of nature?
 - a. Lightning
 - b. A radio
 - c. A compass
 - d. Classical music

3. How old was Einstein when he began developing his ideas of light and relativity?
 - a. 5
 - b. 16
 - c. 21
 - d. 50

4. For what famous equation is Einstein remembered?
 - a. $a^2 + b^2 = c^2$
 - b. $A = \pi r^2$
 - c. A = base times height
 - d. $E=mc^2$

5. When did Einstein receive the Nobel Prize?
 - a. 1905
 - b. 1921
 - c. 1933
 - d. 1955

6. When did Einstein die?
 - a. 1905
 - b. 1921
 - c. 1933
 - d. 1955

Use complete sentences to answer the questions below.

1. Describe an experience or situation in your life that is somehow similar to Albert Einstein becoming interested in physics after his father gave him a compass.

2. From the way it is used in the article what do you think is the meaning of *meritocracy*?

3. Explain why Einstein decided to immigrate to the United States.

4. Imagine Einstein shortly before publishing his theory of relativity, which undermined Newtonian laws of physics and revolutionized the science. Describe how you think he felt.

5. What do you understand differently after reading about Albert Einstein? How will you use this information in the future?

Answers to ALBERT EINSTEIN**Multiple-choice questions**

1. b
2. c
3. b
4. d
5. b
6. d

Short-answer questions

1. Answers will vary. Accept logical, realistic answers.
2. *Meritocracy* = A system in which advancement is based on personal ability or achievement.
3. Answers will vary. Accept logical, realistic answers. (Hitler and Nazis came to power in Germany, burned his books, put price on his head, placed a work ban for Jews.)
4. Answers will vary. Accept logical, realistic answers.
5. Answers will vary. Accept logical, realistic answers.