Name: _____ Date: _____

How Did a Patent Examiner Change Physics?

Reading level 10 (6th grade) · 1101 words

How did a patent examiner change physics? In June 1902, at age 23, Albert Einstein got the job he had waited for. It was at the patent office in Bern, Switzerland. A month later he was checking new inventions at a lectern in room 86. Three years on, in 1905, he published work that changed how scientists think about light, time and energy. This book follows how that happened, one test at a time.

Einstein had trained to teach. In 1896 he entered the Swiss Federal Polytechnic School in Zurich to become a physics and math teacher. He finished his studies but could not find a teaching job. The patent job paid 3,500 Swiss francs a year. He called it his "cobbler's trade." One account says he planned his days. Eight hours were for work, eight for science and other things, and eight for sleep, which he often used for writing.

His sense of wonder began early, by his own later account. He wrote that at four or five, his father showed him a compass. The needle's steady pointing left "a deep and lasting impression." He said he could still remember it, "or at least believe I can remember." On his 74th birthday, reporters asked if it really shaped his work. He said he thought so. But he added, "man has little insight into what goes on within him."

In 1905 Einstein was 26. A historian at France's CNRS says he signed four articles in a journal called Annalen der Physik that year, plus his thesis. One was about light made of packets. One was about the random jiggling of tiny bits in a liquid, called Brownian motion. One was special relativity. The last led to the equation $E = mc^2$. He wrote all of them while he worked a full-time job at the patent office.

Special relativity grew from a puzzle he said he hit on at sixteen. If he chased a beam of light at its own speed, he thought, he would see it as a field standing still. His paper of June 30, 1905, started from two rules. The laws of physics are the same for anyone moving at a steady speed. And light in empty space always moves at one speed, whatever moves the lamp. That speed is 299,792,458 meters per second. Today the meter itself is defined with it.

The paper reached a strange result. Say a clock is carried from point A to point B. When it arrives, it lags behind a matching clock that stayed at B. Moving changes how a clock keeps time. At the speed of a car or a plane, the gap is far too small to notice without very exact clocks. That is why nobody had seen it, and why testing it would take decades.

On September 27, 1905, Einstein dated a short paper. Its title asked whether the inertia of a body depends on its energy-content. His answer was yes. "The mass of a body is a measure of its energy-content," he wrote. If a body gives off energy as radiation, its mass drops by that energy divided by c squared. He even wrote that radium salts might be a way to test the idea.

One of the 1905 papers was bolder than the rest. John Rigden, writing in Physics World, argues that only the March paper on light was truly revolutionary. It said light can act as packets with set amounts of energy. These are called quanta. This helps explain the photoelectric effect. Light frees electrons from metal only above a certain frequency. Wave theory said brightness should matter most. Most physicists turned the idea down at first.

In 1922 Einstein received the 1921 Nobel Prize in Physics. The prize named his discovery of the law of the photoelectric effect. It did not name relativity. Robert Millikan's tests in 1916 had matched Einstein's law. Then, in 1923, Arthur Compton showed that these light packets carry motion, so they act like particles. Today they are called photons. The prize came years after the idea, and not everyone agreed with the light-packet idea at the start.

A new idea about gravity came next. In 1907, Einstein later said, he had "the happiest thought of my life." A person falling from a roof, he wrote, has, at least in the space right around them, no gravitational field during the fall. He left the patent office in autumn 1909 for a post in Zurich. Then he worked in Prague in 1911, Zurich again in 1912, and Berlin in 1914. On November 25, 1915, he presented general relativity. In it, gravity is the curving of space and time.

General relativity made a test possible. Starlight passing the Sun should bend by 1.75 arcseconds. That is twice what Newton's theory gave. An arcsecond is 1/3,600 of a degree. Stars close to the Sun can only be seen in a total eclipse. On May 29, 1919, two British teams went to look. Arthur Eddington went to Principe, an island off West Africa. Andrew Crommelin and Charles Davidson went to Sobral, a city in Brazil. Both lay along the path of the eclipse.

They compared eclipse photos on glass plates with night photos of the same stars. The night photos were taken months earlier or later. Sobral had mostly clear sky. At Principe, thick cloud left only two good plates. Both teams found bending that fit Einstein's number better than Newton's. The results were announced in London on November 6, 1919. After the press reported them on November 7, Einstein was famous around the world. It was a big step for a man who, in 1902, had just started at a patent desk.

The test still runs every day, inside GPS. Its satellites orbit about 20,200 kilometers up and carry atomic clocks. NIST says special relativity slows them by 7 microseconds a day. Weaker gravity speeds them up by 45. The net is 38 microseconds a day faster than clocks on Earth. Without constant fixes, NIST says, the signals would quickly be useless. GPS was not built to test Einstein. Still, NIST calls it the longest-running test of his theories.

In 1933 Einstein moved to the United States to work at the Institute for Advanced Study in Princeton, New Jersey. He became a US citizen in 1940. He died in Princeton on April 18, 1955. Clock tests did not stop. NIST said in February 2026 that two more are under way. One compares clocks on a Colorado mountain with clocks on the ground. The other uses clocks launched to the International Space Station in April 2025.

Questions

1. What did the 1921 Nobel Prize in Physics name as Einstein's discovery?

A. The theory of general relativity
B. The speed of light
C. The law of the photoelectric effect

2. Why did astronomers use a total eclipse for the 1919 test?

A. Stars near the Sun can be photographed
B. The Sun gives off less gravity
C. Clocks run faster in the dark

3. In "a clock that lags behind," what does lags mean?

A. Runs ahead
B. Falls behind
C. Stands still

4. How many microseconds a day faster do GPS clocks run than Earth clocks, by NIST's count?

A. 7
B. 45
C. 38

5. Why was Einstein's 1905 clock result hard to test at first?

A. Nobody had read the paper
B. The gap is too small at everyday speeds
C. Clocks did not exist yet

Words to know

patent: invention paper
quanta: energy packets
frequency: waves per second
eclipse: Sun blocked
satellites: orbiting machines

Answer key: How Did a Patent Examiner Change Physics?

1. C. The law of the photoelectric effect
2. A. Stars near the Sun can be photographed
3. B. Falls behind
4. C. 38
5. B. The gap is too small at everyday speeds