**ichael Faraday** ([/ˈfærədeɪ, -di/](https://en.wikipedia.org/wiki/Help:IPA/English); 22 September 1791 – 25 August 1867) was an English [chemist](https://en.wikipedia.org/wiki/Chemist) and [physicist](https://en.wikipedia.org/wiki/Physicist) who contributed to the study of [electrochemistry](https://en.wikipedia.org/wiki/Electrochemistry) and [electromagnetism](https://en.wikipedia.org/wiki/Electromagnetism). His main discoveries include the principles underlying [electromagnetic induction](https://en.wikipedia.org/wiki/Electromagnetic_induction), [diamagnetism](https://en.wikipedia.org/wiki/Diamagnetism), and [electrolysis](https://en.wikipedia.org/wiki/Electrolysis). Although Faraday received little formal education, as a self-made man, he was one of the most influential scientists in history.[[1]](https://en.wikipedia.org/wiki/Michael_Faraday#cite_note-Rao-1) It was by his research on the [magnetic field](https://en.wikipedia.org/wiki/Magnetic_field) around a [conductor](https://en.wikipedia.org/wiki/Electrical_conductor) carrying a [direct current](https://en.wikipedia.org/wiki/Direct_current) that Faraday established the concept of the [electromagnetic field](https://en.wikipedia.org/wiki/Electromagnetic_field) in physics. Faraday also established that [magnetism](https://en.wikipedia.org/wiki/Magnetism) could [affect rays of light](https://en.wikipedia.org/wiki/Faraday_effect) and that there was an underlying relationship between the two phenomena.[[2]](https://en.wikipedia.org/wiki/Michael_Faraday#cite_note-EncBrit-2)[[3]](https://en.wikipedia.org/wiki/Michael_Faraday#cite_note-IEEUK-3) He similarly discovered the principles of electromagnetic induction, diamagnetism, and the [laws of electrolysis](https://en.wikipedia.org/wiki/Faraday%27s_laws_of_electrolysis). His inventions of [electromagnetic rotary devices](https://en.wikipedia.org/wiki/Electric_motor) formed the foundation of electric motor technology, and it was largely due to his efforts that electricity became practical for use in technology.[[4]](https://en.wikipedia.org/wiki/Michael_Faraday#cite_note-Field-4) The [SI](https://en.wikipedia.org/wiki/International_System_of_Units) unit of [capacitance](https://en.wikipedia.org/wiki/Capacitance), the [farad](https://en.wikipedia.org/wiki/Farad), is named after him.[[5]](https://en.wikipedia.org/wiki/Michael_Faraday#cite_note-5)

As a chemist, Faraday discovered [benzene](https://en.wikipedia.org/wiki/Benzene), investigated the [clathrate hydrate](https://en.wikipedia.org/wiki/Clathrate_hydrate) of chlorine, invented an early form of the [Bunsen burner](https://en.wikipedia.org/wiki/Bunsen_burner) and the system of [oxidation numbers](https://en.wikipedia.org/wiki/Oxidation_number), and popularised terminology such as "[anode](https://en.wikipedia.org/wiki/Anode)", "[cathode](https://en.wikipedia.org/wiki/Cathode)", "[electrode](https://en.wikipedia.org/wiki/Electrode)" and "[ion](https://en.wikipedia.org/wiki/Ion)". Faraday ultimately became the first and foremost [Fullerian Professor of Chemistry](https://en.wikipedia.org/wiki/Fullerian_Professor_of_Chemistry" \o "Fullerian Professor of Chemistry) at the [Royal Institution](https://en.wikipedia.org/wiki/Royal_Institution), a lifetime position.

Faraday was an experimentalist who conveyed his ideas in clear and simple language. His mathematical abilities did not extend as far as [trigonometry](https://en.wikipedia.org/wiki/Trigonometry) and were limited to the simplest algebra. Physicist and mathematician [James Clerk Maxwell](https://en.wikipedia.org/wiki/James_Clerk_Maxwell) took the work of Faraday and others and summarised it in a set of equations which is accepted as the basis of all modern theories of electromagnetic phenomena. On Faraday's uses of [lines of force](https://en.wikipedia.org/wiki/Lines_of_force), Maxwell wrote that they show Faraday "to have been in reality a mathematician of a very high order – one from whom the mathematicians of the future may derive valuable and fertile methods."[[6]](https://en.wikipedia.org/wiki/Michael_Faraday#cite_note-MaxwellSciPapVol1-6)

[Albert Einstein](https://en.wikipedia.org/wiki/Albert_Einstein) kept a portrait of Faraday on his study wall, alongside those of [Isaac Newton](https://en.wikipedia.org/wiki/Isaac_Newton) and James Clerk Maxwell.[[7]](https://en.wikipedia.org/wiki/Michael_Faraday#cite_note-7) Physicist [Ernest Rutherford](https://en.wikipedia.org/wiki/Ernest_Rutherford) stated, "When we consider the magnitude and extent of his discoveries and their influence on the progress of science and of industry, there is no honour too great to pay to the memory of Faraday, one of the greatest scientific discoverers of all time."[[1]](https://en.wikipedia.org/wiki/Michael_Faraday#cite_note-Rao-1)

**Biography**

[[edit](https://en.wikipedia.org/w/index.php?title=Michael_Faraday&action=edit&section=1)]

**Early life**

[[edit](https://en.wikipedia.org/w/index.php?title=Michael_Faraday&action=edit&section=2)]

Michael Faraday was born on 22 September 1791 in [Newington Butts](https://en.wikipedia.org/wiki/Newington_Butts),[[8]](https://en.wikipedia.org/wiki/Michael_Faraday#cite_note-ODNB-8) [Surrey](https://en.wikipedia.org/wiki/Surrey), which is now part of the [London Borough of Southwark](https://en.wikipedia.org/wiki/London_Borough_of_Southwark).[[9]](https://en.wikipedia.org/wiki/Michael_Faraday#cite_note-9) His family was not well off. His father, James, was a member of the [Glasite](https://en.wikipedia.org/wiki/Glasite" \o "Glasite) sect of Christianity. James Faraday moved his wife, Margaret (née Hastwell),[[10]](https://en.wikipedia.org/wiki/Michael_Faraday#cite_note-10) and two children to London during the winter of 1790 from [Outhgill](https://en.wikipedia.org/wiki/Outhgill" \o "Outhgill) in [Westmorland](https://en.wikipedia.org/wiki/Westmorland), where he had been an apprentice to the village blacksmith.[[11]](https://en.wikipedia.org/wiki/Michael_Faraday#cite_note-11) Michael was born in the autumn of the following year, the third of four children. The young Michael Faraday, having only the most basic school education, had to [educate himself](https://en.wikipedia.org/wiki/Autodidacticism).[[12]](https://en.wikipedia.org/wiki/Michael_Faraday#cite_note-12)

At the age of 14, he became an apprentice to [George Riebau](https://en.wikipedia.org/wiki/George_Riebau), a local bookbinder and bookseller in Blandford Street.[[13]](https://en.wikipedia.org/wiki/Michael_Faraday#cite_note-13) During his seven-year apprenticeship Faraday read many books, including [Isaac Watts](https://en.wikipedia.org/wiki/Isaac_Watts)'s *The Improvement of the Mind*, and he enthusiastically implemented the principles and suggestions contained therein.[[14]](https://en.wikipedia.org/wiki/Michael_Faraday#cite_note-14) During this period, Faraday held discussions with his peers in the City Philosophical Society, where he attended lectures about various scientific topics.[[15]](https://en.wikipedia.org/wiki/Michael_Faraday#cite_note-15) He also developed an interest in science, especially in electricity. Faraday was particularly inspired by the book *Conversations on Chemistry* by [Jane Marcet](https://en.wikipedia.org/wiki/Jane_Marcet).[[16]](https://en.wikipedia.org/wiki/Michael_Faraday#cite_note-16)[[17]](https://en.wikipedia.org/wiki/Michael_Faraday#cite_note-17)

**Adult life**

[[edit](https://en.wikipedia.org/w/index.php?title=Michael_Faraday&action=edit&section=3)]

[](https://en.wikipedia.org/wiki/File:Portait_of_Michael_Faraday2.png)[*Portrait of Michael Faraday*](https://en.wikipedia.org/wiki/Portrait_of_Michael_Faraday) by [Thomas Phillips](https://en.wikipedia.org/wiki/Thomas_Phillips), 1842

In 1812, at the age of 20 and at the end of his apprenticeship, Faraday attended lectures by the eminent English chemist [Humphry Davy](https://en.wikipedia.org/wiki/Humphry_Davy) of the [Royal Institution](https://en.wikipedia.org/wiki/Royal_Institution) and the [Royal Society](https://en.wikipedia.org/wiki/Royal_Society), and [John Tatum](https://en.wikipedia.org/wiki/John_Tatum_(scientist)), founder of the City Philosophical Society. Many of the tickets for these lectures were given to Faraday by [William Dance](https://en.wikipedia.org/wiki/William_Dance), who was one of the founders of the [Royal Philharmonic Society](https://en.wikipedia.org/wiki/Royal_Philharmonic_Society). Faraday subsequently sent Davy a 300-page book based on notes that he had taken during these lectures. Davy's reply was immediate, kind, and favourable. In 1813, when Davy damaged his eyesight in an accident with [nitrogen trichloride](https://en.wikipedia.org/wiki/Nitrogen_trichloride), he decided to employ Faraday as an assistant. Coincidentally one of the Royal Institution's assistants, John Payne, was sacked and Sir Humphry Davy had been asked to find a replacement; thus he appointed Faraday as Chemical Assistant at the Royal Institution on 1 March 1813.[[2]](https://en.wikipedia.org/wiki/Michael_Faraday#cite_note-EncBrit-2) Very soon, Davy entrusted Faraday with the preparation of nitrogen trichloride samples, and they both were injured in an explosion of this very sensitive substance.[[18]](https://en.wikipedia.org/wiki/Michael_Faraday#cite_note-18)

Faraday married Sarah Barnard (1800–1879) on 12 June 1821.[[19]](https://en.wikipedia.org/wiki/Michael_Faraday#cite_note-19) They met through their families at the [Sandemanian](https://en.wikipedia.org/wiki/Sandemanian" \o "Sandemanian) church, and he confessed his faith to the Sandemanian congregation the month after they were married. They had no children.[[8]](https://en.wikipedia.org/wiki/Michael_Faraday#cite_note-ODNB-8) Faraday was a devout Christian; his Sandemanian denomination was an offshoot of the [Church of Scotland](https://en.wikipedia.org/wiki/Church_of_Scotland). Well after his marriage, he served as [deacon](https://en.wikipedia.org/wiki/Deacon) and for two terms as an [elder](https://en.wikipedia.org/wiki/Elder_(Christianity)) in the meeting house of his youth. His church was located at Paul's Alley in the [Barbican](https://en.wikipedia.org/wiki/Barbican_Estate). This meeting house relocated in 1862 to [Barnsbury](https://en.wikipedia.org/wiki/Barnsbury" \o "Barnsbury) Grove, [Islington](https://en.wikipedia.org/wiki/London_Borough_of_Islington); this North London location was where Faraday served the final two years of his second term as elder prior to his resignation from that post.[[20]](https://en.wikipedia.org/wiki/Michael_Faraday#cite_note-20)[[21]](https://en.wikipedia.org/wiki/Michael_Faraday#cite_note-21) Biographers have noted that "a strong sense of the unity of God and nature pervaded Faraday's life and work."[[22]](https://en.wikipedia.org/wiki/Michael_Faraday#cite_note-22)

**Later life**

[[edit](https://en.wikipedia.org/w/index.php?title=Michael_Faraday&action=edit&section=4)]

[](https://en.wikipedia.org/wiki/File:Three_Fellows_of_the_Royal_Society_offering_the_presidency_o_Wellcome_L0022806.jpg)Three Fellows of the [Royal Society](https://en.wikipedia.org/wiki/Royal_Society) offering the presidency to Faraday (right) in 1857

In June 1832, the [University of Oxford](https://en.wikipedia.org/wiki/University_of_Oxford) granted Faraday an honorary [Doctor of Civil Law](https://en.wikipedia.org/wiki/Doctor_of_Civil_Law) degree. During his lifetime, he was offered a [knighthood](https://en.wikipedia.org/wiki/Orders,_decorations,_and_medals_of_the_United_Kingdom) in recognition for his services to science, which he [turned down](https://en.wikipedia.org/wiki/List_of_people_who_have_declined_a_British_honour) on religious grounds, believing that it was against the word of the Bible to accumulate riches and pursue worldly reward, and stating that he preferred to remain "plain Mr Faraday to the end".[[23]](https://en.wikipedia.org/wiki/Michael_Faraday#cite_note-23) Elected a [Fellow](https://en.wikipedia.org/wiki/Fellow_of_the_Royal_Society) of the [Royal Society](https://en.wikipedia.org/wiki/Royal_Society) in 1824, he twice refused to become [President](https://en.wikipedia.org/wiki/President_of_the_Royal_Society).[[24]](https://en.wikipedia.org/wiki/Michael_Faraday#cite_note-24) He became the first [Fullerian Professor of Chemistry](https://en.wikipedia.org/wiki/Fullerian_Professor_of_Chemistry" \o "Fullerian Professor of Chemistry) at the [Royal Institution](https://en.wikipedia.org/wiki/Royal_Institution) in 1833.[[25]](https://en.wikipedia.org/wiki/Michael_Faraday#cite_note-25)

In 1832, Faraday was elected a Foreign Honorary Member of the [American Academy of Arts and Sciences](https://en.wikipedia.org/wiki/American_Academy_of_Arts_and_Sciences).[[26]](https://en.wikipedia.org/wiki/Michael_Faraday#cite_note-AAAS-26) He was elected a foreign member of the [Royal Swedish Academy of Sciences](https://en.wikipedia.org/wiki/Royal_Swedish_Academy_of_Sciences) in 1838. In 1840, he was elected to the [American Philosophical Society](https://en.wikipedia.org/wiki/American_Philosophical_Society).[[27]](https://en.wikipedia.org/wiki/Michael_Faraday#cite_note-27) He was one of eight foreign members elected to the [French Academy of Sciences](https://en.wikipedia.org/wiki/French_Academy_of_Sciences) in 1844.[[28]](https://en.wikipedia.org/wiki/Michael_Faraday#cite_note-28) In 1849 he was elected as associated member to the Royal Institute of the Netherlands, which two years later became the [Royal Netherlands Academy of Arts and Sciences](https://en.wikipedia.org/wiki/Royal_Netherlands_Academy_of_Arts_and_Sciences) and he was subsequently made foreign member.[[29]](https://en.wikipedia.org/wiki/Michael_Faraday#cite_note-29)

[](https://en.wikipedia.org/wiki/File:Faraday_House_37_Hampton_Court_Road_KT8_9BW.jpg)Faraday House in [Hampton Court](https://en.wikipedia.org/wiki/Hampton_Court) where Faraday lived between 1858 and 1867

Faraday had a [nervous breakdown](https://en.wikipedia.org/wiki/Nervous_breakdown) in 1839 but eventually returned to his investigations into electromagnetism.[[30]](https://en.wikipedia.org/wiki/Michael_Faraday#cite_note-30) In 1848, as a result of representations by the [Prince Consort](https://en.wikipedia.org/wiki/Albert,_Prince_Consort), Faraday was awarded a [grace and favour](https://en.wikipedia.org/wiki/Grace_and_favour) house in [Hampton Court](https://en.wikipedia.org/wiki/Hampton_Court) in Middlesex, free of all expenses and upkeep. This was the Master Mason's House, later called Faraday House, and now No. 37 Hampton Court Road. In 1858 Faraday retired to live there.[[31]](https://en.wikipedia.org/wiki/Michael_Faraday#cite_note-31)

[](https://en.wikipedia.org/wiki/File:Faraday_Michael_grave.jpg)Faraday's grave at [Highgate Cemetery](https://en.wikipedia.org/wiki/Highgate_Cemetery" \o "Highgate Cemetery), London

Having provided a number of various service projects for the British government, when asked by the government to advise on the production of chemical weapons for use in the [Crimean War](https://en.wikipedia.org/wiki/Crimean_War) (1853–1856), Faraday refused to participate, citing ethical reasons.[[32]](https://en.wikipedia.org/wiki/Michael_Faraday#cite_note-Croddy-32) He also refused offers to publish his lectures, believing that they would lose impact if not accompanied by the live experiments. His reply to an offer from a publisher in a letter ends with: "I have always loved science more than money & because my occupation is almost entirely personal I cannot afford to get rich."[[33]](https://en.wikipedia.org/wiki/Michael_Faraday#cite_note-33)

Faraday died at his house at [Hampton Court](https://en.wikipedia.org/wiki/Hampton_Court) on 25 August 1867, aged 75.[[34]](https://en.wikipedia.org/wiki/Michael_Faraday#cite_note-34) He had some years before turned down an offer of burial in [Westminster Abbey](https://en.wikipedia.org/wiki/Westminster_Abbey) upon his death, but he has a memorial plaque there, near [Isaac Newton](https://en.wikipedia.org/wiki/Isaac_Newton)'s tomb.[[35]](https://en.wikipedia.org/wiki/Michael_Faraday#cite_note-35) Faraday was interred in the [dissenters](https://en.wikipedia.org/wiki/Dissenter)' (non-[Anglican](https://en.wikipedia.org/wiki/Anglicanism)) section of [Highgate Cemetery](https://en.wikipedia.org/wiki/Highgate_Cemetery" \o "Highgate Cemetery).[[36]](https://en.wikipedia.org/wiki/Michael_Faraday#cite_note-36)

**Scientific achievements**