Richard Feynman's Pedagogy

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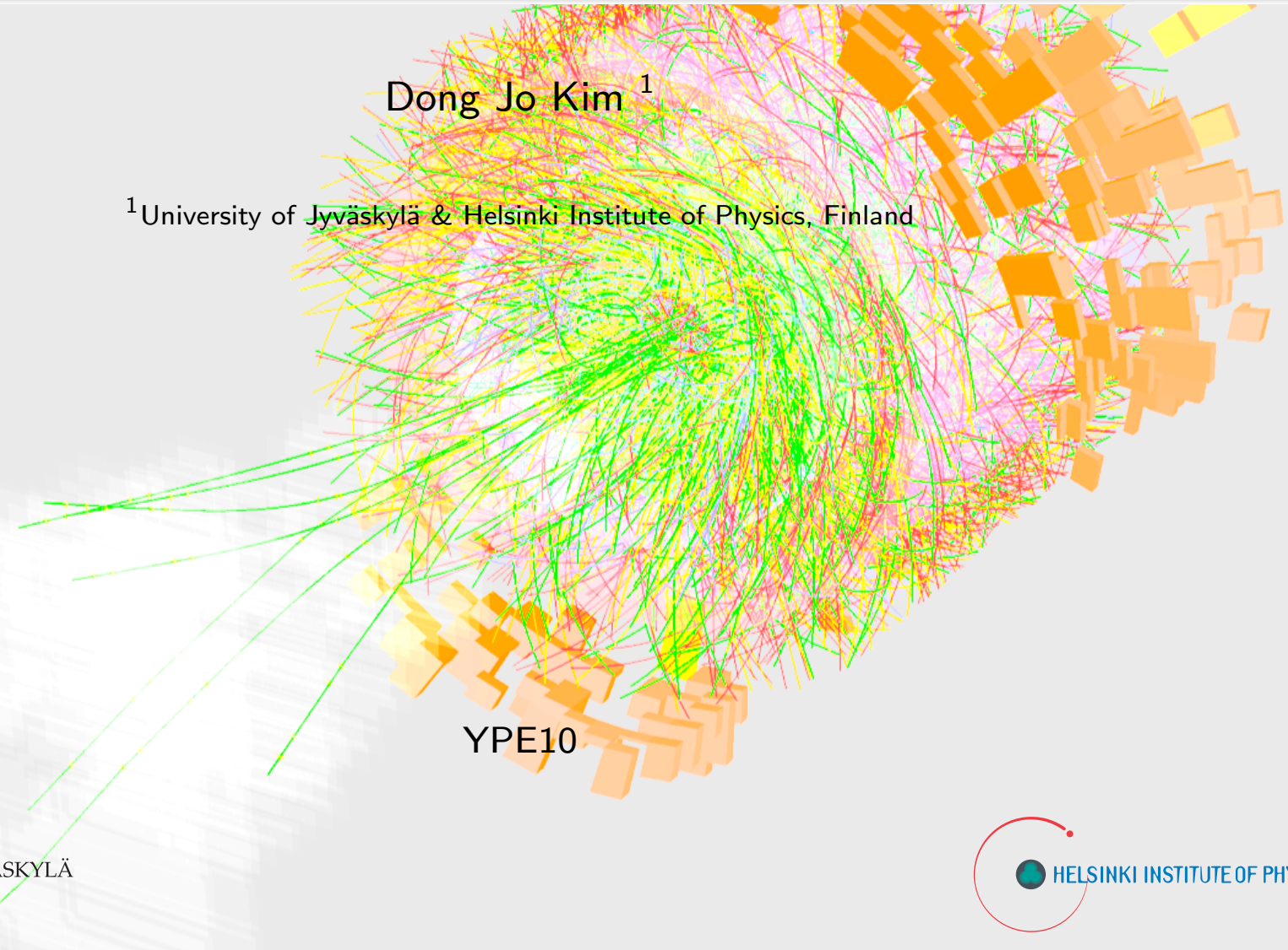

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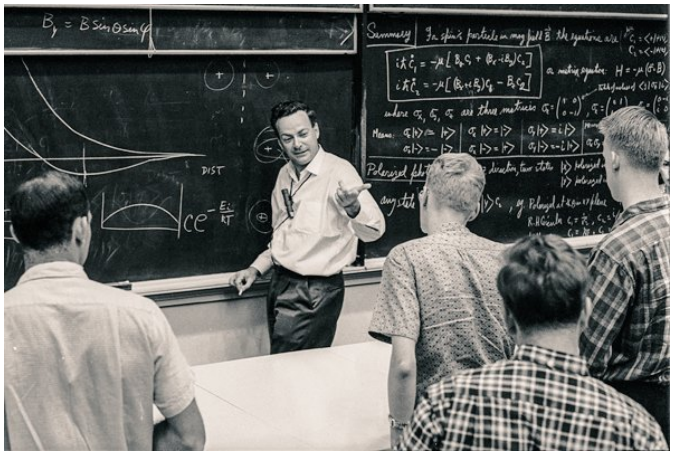
Feynman's life (May 11, 1918 – February 15, 1988)

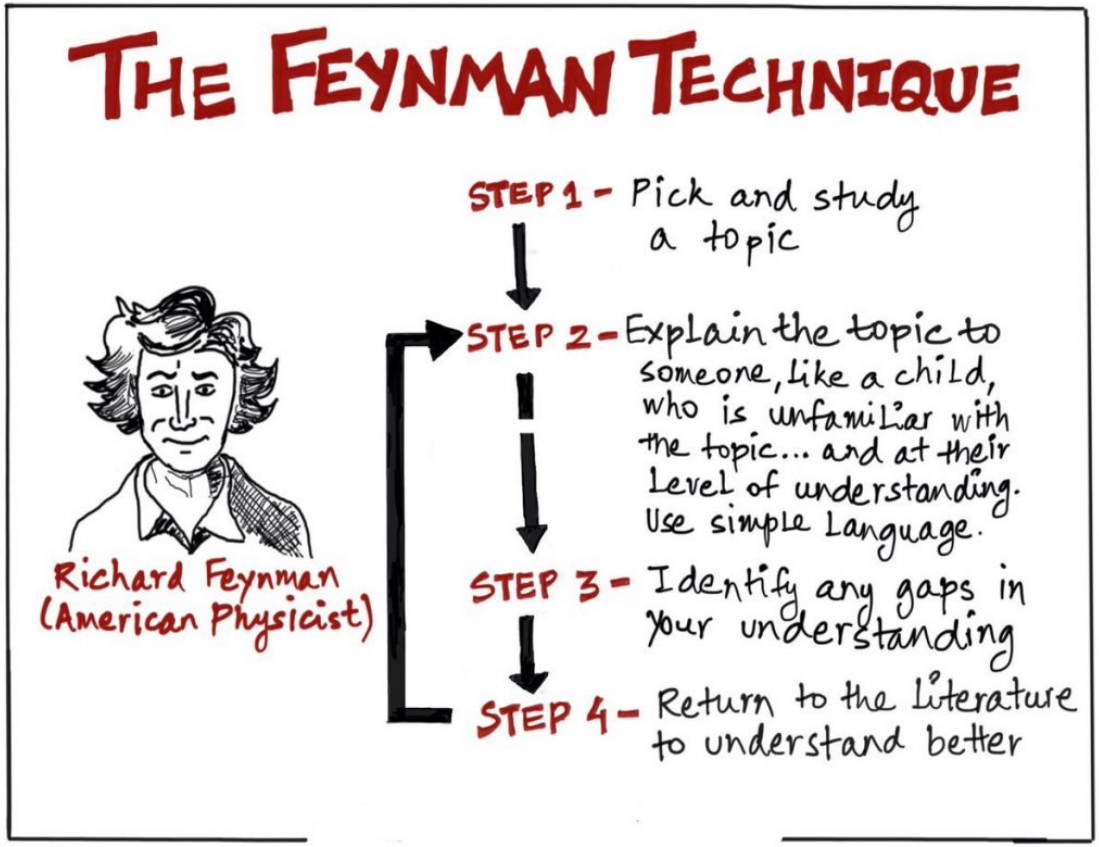


- Nobel Prize in Physics (1965)) "for their fundamental work in quantum electrodynamics, with deep-ploughing consequences for the physics of elementary particles"
- "The Great Explainer" (2009) by III LeVine Harry

Feynman's main achievements

- He pioneered an entire field: quantum electrodynamics (QED).
- In the 1940s, his invention of the Feynman Diagram helped bring much-needed visual clarification to the enigmatic behavior of subatomic particles.
- His work helping scientists understand the interaction of light and matter earned him a share of a Nobel Prize in 1965.
- His work has directly influenced the fields of nanotechnology, quantum computing, and particle physics.
- In 1986, his research and explanations were critical in helping to understand the cause of the space shuttle Challenger disaster.

Feynman's technique



- Increase the ability to teach
- Intelligent and informative deduction
- Increasing the efficiency of critical thinking
- Use knowledge in real life
- realization of true sense etc. See the details at https://strategyumwelt.com/frameworks/feynman-technique.

- The Feynman Technique is laid out clearly in James Gleick's 1993 biography, "Genius: The Life and Science of Richard Feynman."

Why It's Important?

In "Feynman's Lost Lecture: The Motion of Planets Around the Sun," David Goodstein writes that Feynman prided himself on being able to explain the most complex ideas in the simplest terms.
Goodstein once asked Feynman to explain why "spin one-half particles obey Fermi-Dirac." Feynman replied that he'd prepare a freshman lecture on it, but then he came back a few days later empty handed. "I couldn't reduce it to freshman level," he admitted to Goodstein. "That means we don't really understand it." That is to say, if Feynman couldn't explain something in simple terms, there was a problem with the information, not with Feynman's teaching ability.

In his 1974 Caltech commencement address, Richard Feynman made the following statement; "The first principle is that you must not fool yourself, and you are the easiest person to fool."

Feynman diagram, pictorial method

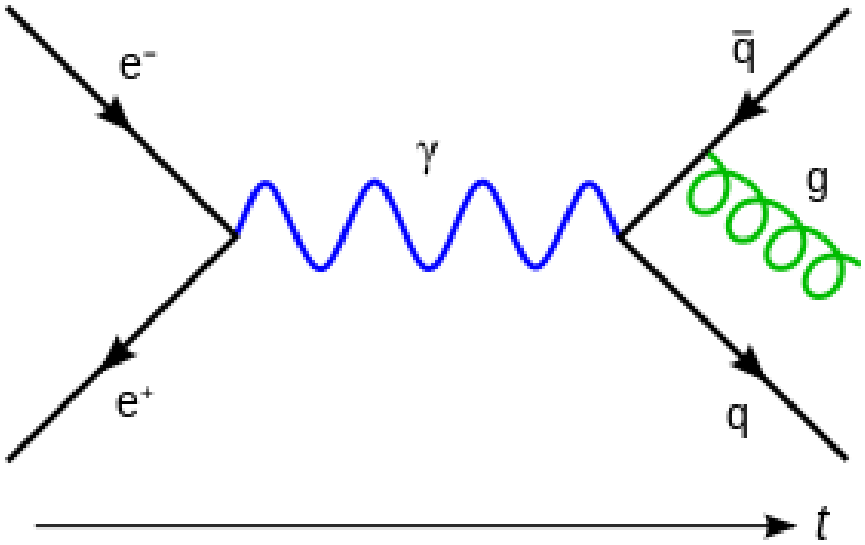
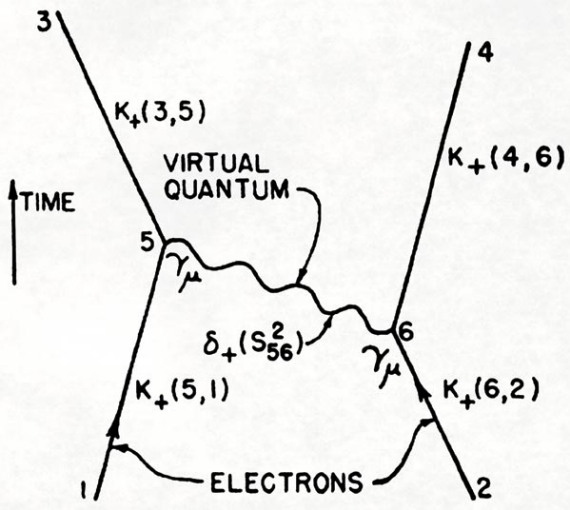


Figure: an electron and a positron annihilate, producing a photon (represented by the blue sine wave) that becomes a quark-antiquark pair, after which the antiquark radiates a gluon (represented by the green helix)

Spin 1/2	Quarks and Leptons		
Spin 1	γ, $W^{\pm}$, Z		
	g		
Spin 1/2	Particle		Incoming
			Outgoing
	Antiparticle		Incoming
			Outgoing
Spin 1	Particle		Incoming
			Outgoing
Spin 1/2	Particle/antiparticle		Each propagator gives a factor of $\frac{1}{q^2-m^2}$
Spin 1	γ, $W^{\pm}$, Z		
	g		

- Feynman devised a pictorial method to evaluate probability of interaction between fundamental particles.
- Besides furnishing an intuitive picture of the process being considered, this type of diagram prescribes precisely how to calculate the variable involved.

Drawing on passions



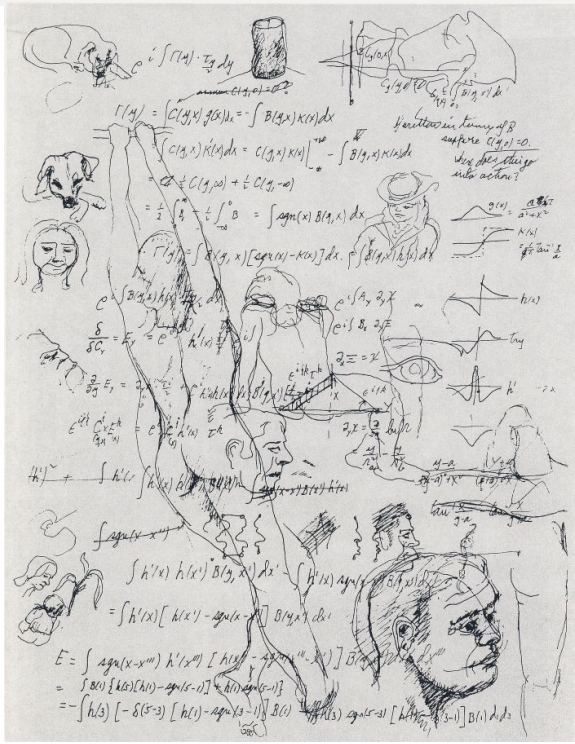


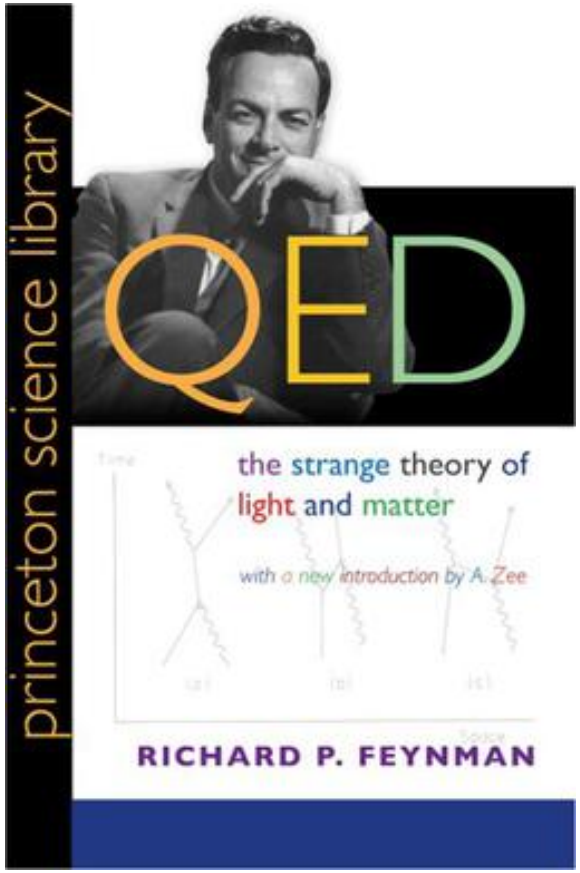
Figure: (Left) Feynman, R. P.: 1949 The Space-Time Approach to Quantum Electrodynamics, Physical Review 76, 769-89). (Right) Equations and Sketches (1985)

"I wanted very much to learn to draw, for a reason that I kept to myself: I wanted to convey an emotion I have about the beauty of the world. It's difficult to describe because it's an emotion. It's a feeling of awe – of scientific awe – which I felt could be communicated through a drawing to someone who had also had that emotion. I could remind him, for a moment, of this feeling about the glories of the universe." – Feynman discussing the intersection of art and science.

Feynman's speeches

- "Fall in love with some activity, and do it! Nobody ever figures out what life is all about, and it doesn't matter. Explore the world. Nearly everything is really interesting if you go into it deeply enough. Work as hard and as much as you want to on the things you like to do the best. Don't think about what you want to be, but what you want to do. Keep up some kind of a minimum with other things so that society doesn't stop you from doing anything at all."

QED: The Strange Theory of Light and Matter



It is unusual for a popular science book in the level of mathematical detail it goes into. "People are always asking for the latest developments in the unification of this theory with that theory, and they don't give us a chance to tell them anything about what we know pretty well. They always want to know the things we don't know."– Richard Feynman Feynman QED lectures in New Zealand - Vega Science Trust streaming video.

The Feynman Lectures on Physics

- The lectures were presented before undergraduate students at the California Institute of Technology (Caltech), during 1961–1963. The book's co-authors are Feynman, Robert B. Leighton, and Matthew Sands.
- The most popular physics book ever written. More than 1.5 million English-language copies have been sold; probably even more copies have been sold in a dozen foreign-language editions.
- A 2013 review in Nature described the book as having "simplicity, beauty, unity ... presented with enthusiasm and insight"
- Feynman opposed rote learning or unthinking memorization and other teaching methods that emphasized form over function.
- Clear thinking and clear presentation were fundamental prerequisites for his attention.
- Richard P. Feynman Prize for Excellence in Teaching

Pedagogy reflected in his speches

In April 1966, Feynman delivered an address to the National Science Teachers Association, in which he suggested how students could be made to think like scientists, be open-minded, curious, and especially, to doubt. In the course of the lecture, he gave a definition of science, which he said came about by several stages. The evolution of intelligent life on planet Earth–creatures such as cats that play and learn from experience. The evolution of humans, who came to use language to pass knowledge from one individual to the next, so that the knowledge was not lost when an individual died. Unfortunately, incorrect knowledge could be passed down as well as correct knowledge, so another step was needed. Galileo and others started doubting the truth of what was passed down and to investigate ab initio, from experience, what the true situation was?this was science. – Cargo Cult Science

In 1964, he served on the California State Curriculum Commission, which was responsible for approving textbooks to be used by schools in California. He was not impressed with what he found. —New Textbooks for the "New" Mathematics