Scott H Young Book Club

Surely, You're Joking Mr Feynman

August 2017

For the month of August (2017) the Book Club book was Surely You're Joking Mr. Feynman, Adventures Of A Curious Character. This is the auto-biography of the famous Nobel Prize winning physicist, Richard Feynman.

The reason I picked this book is that very often, the things that you want to improve about yourself — you want to have more patience, more discipline, be more adventurous or more interesting — a lot of these abstract ideas are hard to internalize when you talk about them in an abstract way.

So if I said that being patient is important, you might say, yes, being patient is important. But then I put you in a concrete situation where you have the option to be patient or get frustrated. And when you are now in this concrete situation you very often don't apply this abstract principle that you just said was very important.

Very often you'll say, you know what, patience is important but right now in this situation I feel my instinct is to do X, to quit, to switch, or to do something different.

I think that's why it's so good to find these examples of people you really admire. You should identify these qualities that you would like to emulate and read their biographies to see how they handle specific situations. Next, see if their guidance for how they decided to resolve certain situations, it may be different from yours but by seeing how this person approached a concrete situation differently, I think it's a better way to internalize these qualities.

The reason I wanted to read this book is that Richard Feynman, if you haven't heard of him before, is an amazing example of someone who was very curious and very interested in how things work.

In particular he didn't accept the surface explanation of things. So he was always saying, but how does it really work? What is going on underneath?

It's such an important quality that even though I try to cultivate it myself there are many situations where I would have just taken the explanation for granted and Richard Feynman is like, maybe that's not the real explanation. What's really going on?

So he sought to have this deep understanding of things. He had intellectual breadth meaning that a lot of people who are good at just one thing try to stick to that. So if you're good at physics but not so much at drawing, you might leave art to the artist. But Feynman did the opposite. He ended up becoming a sort of professional artist where he's selling his artwork.

He was also very adventurous and bold and confident so you can see how he makes these decisions [by thinking] you know what, that would be cool, that would be fun, as opposed to playing it safe. He takes risks, too. Finally, he was always questioning authority and dogmatism which allowed for his most original and creative ideas.

It's impossible for me to summarize this book because the thing you need to get from the book isn't the summary but seeing these concrete situations and how Feynman reacted to these situations sometimes with success sometimes with comical results.

I will give one quick highlight of his life, though. He starts out as very bright and excels in school, he's a real "tinkerer" and he's always fixing things even from a young age. He does his undergraduate at MIT and later does his graduate studies at Princeton and after that he's working on the The Manhattan Project (during WWII) helping to design the atom bomb.

He becomes a professor and he works on lots of theories and this later leads to him getting the Nobel Prize in addition to having a lot of physical things named after him. Along the way he learns to pickpocket, speak Portuguese and Japanese, he becomes this sort of professional artist, he works on his theories in a strip club, and he plays the bongos a lot. This is a guy who is eclectic and eccentric on top of his important theories and discoveries.

I will just talk a little bit about some of my favourite stories from the book. Then I will talk a little bit more about this with Kalid Azad from www.betterexplained.com in greater depth. We'll talk about what we liked about the book and what we thought were the main takeaways.

One of the first stories I really like was in his later years and he finds this paper and he can't make heads or tails and at the time, it's actually his sister who says "you're saying this because you didn't discover it. Because you were not personally involved in figuring out the steps, you're saying that it doesn't make sense to you."

So he goes through, line by line, and tries to understand and he says "once I actually did that, it made sense to me."

This is a small example but it made a profound impact on me. It was the story that led me to develop what I call The Feynman Technique which is basically the idea that if you can't explain it yourself, maybe you don't really understand it. Going through things and explaining them to yourself is always a better way to understand something.

Another story that I really like is where he is doing some painting and this guy who is sort of a professional painter says "I am making yellow paint by mixing red and white paint."

Feynman says, "that can't be true. I don't know a lot about pain mixing but I do know if you mix red and white you get pink."

The guys says "no no, it's red and white to make yellow."

Feynman says "hmm, maybe there's a chemical reaction? How do I explain this?"

The guy ends up getting the white and the red and of course, it's getting pink, not yellow and the guy says, "oh ya, you know what, I add a little bit of yellow."

So Feynman says "Aha! That's how you got yellow paint, you were adding… yellow paint!"

I think this is a very interesting story aside from being amusing because he was saying how his developed understanding of the world — this idea that there must be something crazy going on— instead of considering a simpler theory that this guy isn't revealing everything to him.

I think that although it can backfire, this shows a principle of developing these deep models

of the world and deep understanding that have this explanatory breadth. So he had this physics knowledge and it led him to believe that there must be something funny going on if you mix red and white paint and get yellow.

Another idea I really like comes from when he was in Brazil teaching and it's quite amusing but he talks about lecturing the class about polarization of light. It's the idea that light as a wave can go in this direction or that direction and that makes a difference because you can have polarizers that allow light to go in this way but not that way and that kind of thing. He said he was lecturing to these students and he asked them, "who knows what polarization is?" and every single person gave the exact same textbook definition.

He said "okay great, so light will only go in this direction [hand gesture] and how could we tell with one of these films what the direction of light is?"

No one has any ideas, no knows how to solve it.

Feynman says, "do you know about polarization of light when it comes from reflections?" and again, every single person gave the exact same textbook definition.

He says, "okay, well then how would you be able to tell which way it's polarized on this polarizer just with one of these films?"

Again, no understanding and no way of explaining it.

Feynman eventually comes to see that they [the students] had learned physics entirely by definition. Memorizing these concepts and what they mean definitionally and not in the flexible way of knowing how to use them.

I know this is a common story and repeats itself but I think it respects his philosophy of learning being this deep understanding of concepts and not just regurgitating memorized expressions or formulas. Feynman believes you have to have this real, deep understanding of how ideas work.

This is something I've struggled with myself and my own learning. Richard Feynman has been a great inspiration for me in that regard.

Really this book is impossible to summarize; there's so many stories that I think you should read all of them if you want to get a chance to see what this person was like and how they may respond and think about things differently that you might.

Now, I'm going to go and have a conversation with Kalid Azad where we talk in depth about some ideas in the book and how they influenced us.

Interview:

Scott: Today I have Kalid Azad who was also our Book Club contributor two months ago for Zen & the Art of Motorcycle Maintenance. We're going to discuss Surely You're Mr. Feynman: Adventures of a Curious Character. So what did you think of the book, Kalid?

Kalid: It's one of my favourite books, I'm always thinking, What Would Feynman Do? It was a good read, I read it awhile back, and coming back to it this time for this discussion here, I was a bit more careful in terms of highlighting quotes and things. It was just a nice reminder of the attitude that genuinely curious person ideally should have.

He has a Socratic wisdom to him where he pretends not to know anything and he's always willing to question himself and others. I think his attitude towards learning is to take away the academic pedestals and the reverence of experts and sort of, work things out for himself. So he's not afraid to say he's confused and he asks people to give examples when needed. That type of attitude leads to real understanding. For me it's inspiring to see someone who has reached the highest level in his field and have that approach.

Scott: So of course we're talking about Richard Feynman who was a Nobel Prize Winning Physicist and worked on The Manhattan Project so insanely accomplished but the thing you get a feeling of when you read this book is how down to earth he is.

I think this raises an interesting question (we've talked about this in the discussion group, lots of people weighed in this with their opinions)

Clearly Richard Feynman is genius, if we're allowed to use this word for anyone we should use it for him. He won a Nobel Prize in Physics; if you're not going to use it for him than I don't know what the word exists for. So he's clearly a genius but there's a sense that not only has he always been really smart (in the beginning of the book he's fixing radios, fixing things, etc.) so it's clear he's got raw intelligence.

But also what struck me was how his attitude was towards learning everything. I think there's probably some interplay that if you're very intelligent you have robust confidence and then that confidence allows you to do things but it's also aided by the intelligence so it's a bit of a chicken and egg problem here.

But I think you [Kalid] put it right on the money that this was someone who had incredible confidence in learning and try new things and broadening his knowledge and believing that he could understand things, but he also had this real playfulness to it, this real irreverence, this real questioning of authority and dogma, and I think his curiosity was probably one of his best qualities.

What do you think is the interplay between this innate talent versus personality or versus attitude?

Kalid: I think Feynman discussed taking an IQ test and he wasn't genius level. It was high but it wasn't stratospheric. I think his success came from his willingness to admit he didn't know so I think

A man can't learn what he thinks he already understands. I think Feynman was wiling to constantly question himself. Even if his pure mental horsepower wasn't at the top — he was definitely much above average — but he was able to use his sort of "set of tricks" and be wiling to absorb new one and apply them without getting his ego involved. If he didn't know something he was curious to learn how it worked.

In my mind that attitude is probably responsible for most of his success. He was wiling to question orthodoxy where others would have been hemmed in. Even for physics, he kind of came up with his own Feynman diagrams and is own notation for things. I don't think a lot of people would have done that.

He said even for math he came up with his own symbols and notation. He thought certain types of notation was awkward so he's essentially putting it into his own terms. A lot of his success came from accepting what made him comfortable versus trying to conform himself to systems that were inefficient for him.

Scott: So you bring up what I think one of the most interesting parts about Feynman. I always try to look for these internal not quite contradictions but where someone takes two seemingly opposite qualities and blends them in a way that enhance each other.

In Feynman's case I see this end of confidence that he just has this fearlessness to try things and do new things and feel as though he will be successful.

On the other hand you have this profound humility. Again, this may be from one of his videos, it may not have been from the book, but he said something to the effect of "I know how hard it is to know a thing" so the amount of work that goes into prove even the most basis ideas in math and physics meant that he had this great humility about how things should work and what things are true. He didn't just accept things or take them for granted.

Even from his own perspective, I don't think he took his own ideas with that much conviction unless he had personally proven it himself. On the other hand you have this incredible confidence and they seem to work seamlessly together. It just shows that you can have both of those qualities.

Kalid: Confidence and humility are not opposed. I think the caricatures might be. But in Feynman's case I think it was a confidence in the process. I think he was confident that by questioning things and being humble would eventually get him to understand things better.

I think he was confident in the strategy. By then each particular incident or battle with an idea was an experiment; he wasn't personally invested in whether it came out successful because he knew he would learn something.

I think the scientific method or the scientific process and questioning what you knew… I think he had a confidence in that approach as being the right thing long term.

Scott: One of the reasons I picked this book was of course it was inspiration for this learning technique I called The Feynman Technique. I feel a little bad about naming it now. At the time, when I first called it The Feynman Technique, I had just recently read this book and I was suffused with his spirit of "understand things in your own terms" and I remember this passage from the book where he talks about dealing with this physics paper that he didn't understand and then he covers how he explained it to himself.

I seemed to recall that he explained how he got through that obstacle in a lot more detail than he actually did in the book. In the book it was a bit hand wavy to the effect of "I read it though, line by line, and then I understood it," and I took that to mean something more

elaborate of how he actually went through it and did it which ended up being the whole technique.

I don't know to what extent Feynman's methods for understanding things how must resemblance they bore with this technique that I kind of named after him. But, for me, the spirit of the technique of trying to understand things and not be convinced that you understand something that you actually don't is really apparent in every chapter of this book. What do you think about that?

Kalid: Yes, when I was reading that particular passage about physics I was reminded of you. I thought oh yes, this is probably the inspiration. It's grey but I think his sister encouraged him to break down something that he couldn't understand into simple parts.

In other parts of the book he'd be talking to mathematicians. There's a quote about how he can basically tell you if the theory is true or not as long as you start with simple examples of what the terms and definitions mean.

He basically created a mental model and then as they were explaining the theory he was modifying the model. He could say "yes this is true because the idea I have in my head still makes sense."

So I think that general approach — writing something down or thinking of an example, personally I like analogies — it's about being honest with yourself if you've truly understood something. A lot of us, we just take things at face value and we think the memorized definition is the ultimate level of understanding. But I think Feynman was very in tune with himself and he would be honest if something was confusing or not.

He wasn't afraid to say "I don't understand" and he would stop the explainer and have them give an example. I think a lot of people are shy or intimated so they just nod their heads and pretend to understand. I think Feynman was confident enough in himself to not feel foolish and ask questions.

Scott: I think this something that you brought up historically from being in Brazil about the difference in educational philosophies (memorizing versus understanding) and I've seen that a lot when talking to students often from other educational traditions.

Often, they'll talk about how they have to memorize everything and I don't know whether that's a systematic thing, meaning that, certain educational systems, they like the "repeat the definition of X" verbatim rather than did you actually understand it.

I don't know why, I've always been looking at it from the outside because in our education system in North America, I've very much felt that there is a benefit to getting understanding and it's sort of a misconception that a lot of students have that they see all these bewildering concepts and ideas and they go to memorize them because it seems to be the only inroad into this thicket of intellectual space and they don't really see that the right way to learn it is to try to understand these concepts deeply. So they just resort to memorization.

But, it may be true that in other places the way that you're tested really benefits someone who is going to memorize instead of understand. I think Feynman had some sharp words to

say about that.

Kalid: I think it's about incentives. In the chapter on Brazil he asked some students to show him how the classes are taught and basically the exams were nothing more that testing your memorization ability. So there wasn't the need for creative thought. In the book you see how the incentives of different systems shape the outcome.

So yes, in the Brazil case, the students had memorized definitions but when he asked a question about applying it to a scenario they couldn't apply it and so he realized that they had a fragile understanding.

I think unfortunately it's easier to test a memorized definitions than it is to ask a creative question. Ultimately we're concerned about true education and not just education theatre, sort to speak. If we actually want to understand something, we need to go beyond those memorizations.

Scott: Absolutely I know another example you brought up was about certain textbooks (Feynman was looking at) and it turns out he was one of the few people who was actually reading them. He felt as though the person writing them was not in a full grasp of the subject. One of the ideas this touched on was the idea of, what is an explanation supposed to do, and sometimes people think that science is about using "science-y" words. For example, I used a "science-y" word as opposed to a religious or supernatural word and therefore I've done my job explaining it.

However the goal of science is something stronger than that meaning that you're making an explanation that has something at stake. It has some predictions that could be shown to be wrong. So maybe you'd like to talk a bit about that and what you're thoughts are.

Kalid: Sure. In the textbook case Feynman was asked to review some textbooks for kids in the LA school district. He basically called them all lousy. He'd be almost screaming at the errors he saw. It wasn't just the errors but more the conceptual misunderstanding of the fundamentals.

So one of the examples was there's a kind of a picture of a spring and a kid on a bicycle and maybe, I think it was a ball moving downhill. And the question was "what makes it go?" and the answer was energy.

It's just a word, "energy", "magic", and so on. All motion is energy. Okay but everything stops because of energy, too. So it's a meaningless statement but then you think that because you're using a "scientific" word like energy, then you're learning something and understanding things.

Feynman said he would talk about this with his dad. He said that his father would ask, okay, what made it go? Well I am riding my bike. Well what made that go? Well the food that I ate. Well, where did that come from? Well, the sun. So essentially all energy is light that's been transformed. Through many processes we've transformed it into motion, heat, food, and plants.

That's a better way to talk about what's happening. I think the book just used a one word

description of "energy" without explaining anything and it's not different from the word "magic".

Feynman was concerned that the authors weren't seeing the fundamental idea and they were just repeating textbook definitions without any insight.

Scott: That's a good example and again I am blurring my lines of what I got from the book and the series of YouTube videos that you can find that cover interviews with Feynman in his classic style with interesting ideas, concepts and explaining phenomenon.

One of the ones I really like is about trees. You were talking about sunlight and all the energy coming from there and it's like, where does the tree comes from?

The intuition is that tree comes from the ground: material is drawn up from the ground. But that's not actually the case. Most of the tree comes from carbon so really the tree comes from the air.

He has some other examples of this. Another one, again I'm not 100% confident if this was in the book, but what is the thing that keeps the trains on the tracks? So I won't explain this one but most people think there's some kind of stopper so the tracks can't go too far to one side (that's an emergency measure) but that's not the main reason.

I leave it to those listening to this podcast; if they want to go check it out on YouTube they can find out what keeps the trains on the tracks.

It's these types of curiosities about everyday things. How often do you see a train and how many people actually wonder what keeps the trains on the tracks? So I really like his attitude for taking something that's ordinary and again having this humility about it. He looks at it and says maybe I don't actually know what's going on.

I think that's such a profound attitude that most people don't have. Most people, they think they know all of these things just because they never introspect and dig beyond the surface.

Kalid: I think it's really that curiosity and that questioning instinct to ask what is true and how do we know it and how can we test it. Feynman also gives the example of in one of the textbooks they were trying to explain some equation of motion.

So they said okay you have a ball rolling down a ramp and here's how far it went each time and there's some slight errors in the measurements because it's an experimental result so you see that as bit earlier or later and maybe that's because of friction.

But then Feynman said with a real ball you actually have two types of energy: you have potential energy and a physical ball that has to rotate. So some of the energy is going into rotating the ball as well as moving it. Therefore the actual results would be five sevenths of what they were. It would be a big difference from what the textbooks showed.

It was a completely made up example. They'd taken an equation of motion and plotted it out without actually doing it. If you want to use a real world example, just try it out. You'd see that the equations are really off.

So anyway that's just another example of, you know, almost the theatre of learning versus actually understanding something.

Scott: He talks about learning art and this is again something that I think is very interesting about Feynman because a lot of people have this attitude, "oh I'm a math or science person or I'm good languages or I am good at art" as though you're one type or the other.

I think that's a real pervasive myth. I haven't seen any evidence that gives it a sound scientific backing that there's this real strong difference between analytic thinkers versus creative thinkers. I think he showed that by having a willingness to learn art.

One of the things he talks about in takin the art class is how the teachers used such a different pedagogy than they do in physics. What they do in physics is they give you tons and tons of "methods" and say "do this, do this, do this and so on."

Feynman said that the art teacher was reluctant to say "do this or do that" because you don't say "make the lines heavier" because, well, maybe there was someone who did it with lines that weren't heavy and maybe he was successful.

There's no real hard and fast rules and I think he took from this insight that, you know, what would physics be like if it was taught more like art where it's more organic problem solving.

Your example about the person who made the fake experiment is perfectly right because very often how we learn math and physics is divorced from the reality of how it's actually practiced. It's practiced in this kind of like, "hmm how can we solve this and figure this out?"

I remember hearing the mathematician Terrence Tao saying that he was a bit of a prodigy. He got his PhD at some incredibly young age (I want to say fourteen years old but I don't know for sure) and he was one of the most famous and most successful living mathematicians.

He was talking about how he was good at math as a kid but it was very misleading because when you start doing math as a researcher it's so different from the math where you had to memorize concepts and theories. It's more like, here's the problem and let's just try stuff.

So you have to have an intuition about how to solve it. I think that Richard Feynman had that same kind of attitude from a very early age; this sort of problem solving attitude. I think it led him being to a good physicist but also to exploring other avenues of learning that he otherwise would not have if he had just been scholastic type trying to learn and memorize things in the academic sense.

Kalid: Yes I think it is easy for people to say "well, I don't need to try this thing that could make me feel embarrassed. I am good at this one thing, so I don't need to feel embarrassed ever again."

Feynman wasn't afraid of being silly. His whole attitude was playing pranks, being wiling to look silly and it wasn't problem for him.

One of the examples I like is that, I think he was going to Cornell and needed a place to sleep. He basically suggested "there's a pile of leaves on the street." He was willing to sleep there but his buddy wasn't. So they eventually found a couch or something. But he was able to not have any pretense or things.

That includes drawing, language, and things. He mentioned he'd even make up fake Italian sentences to yell at groundskeepers. He just had this really playful attitude. I think that allows you to make a lot of progress. I think there are people who are naturally talented but just going out and trying it gets you a lot of the way there.

Scott: So you are obviously someone who I think, you take after Feynman in many respects, you really strive for these intuitive understandings. No Nobel Prize yet but… (laughter)

Obviously you've read his biography and I think everyone should. But what would you say are your key takeaways? If someone was listening right now and asked themselves "how can I be more like Feynman in embodying his attitude towards life?" What are the top three things you'd endeavor to work on to be more like Feynman?

Kalid: Great question. I think the first takeaway is recognizing when things make sense and it's okay for things not to make sense. Something might click, great, if it doesn't, maybe you can resolve it then or maybe you can write it down later. In my head, sort of similar to you, you have the Feynman Technique and I have what I called the ADEPT (Analogy, Diagram, Example, Plain English and Technical) standard.

Those are the components I need to have to feel as though I've understood something. If I am learning something and I don't have an Analogy, Diagram, Example, and Plain English Description I basically feel it's kind of like a gap that I feel.

Everyone has their own checklist or their own requirements but you should have something where you know if something is clicking. Have a standard for yourself, it's important. I think Feynman would stop people and ask them for a plain English example if they were explaining something and he couldn't understand it. Whatever it is for you, having that standard is important.

Scott: I was going to say, for me, maybe I'll keep the list short so we don't leave everything explained, but I think if I were to say the biggest takeaway from how Feynman was doing things was to be curious and I think that sounds really simple but you can see how (in the book) he gets himself into situations and how your intuitive response, like what you'd do by reflex, is not actually what he does in the book. It might be his confidence or his charisma but I think a lot of it is his curiosity. He's genuinely interested in trying to find out about things.

I feel as though this was brought up in the bookclub discussion about this curiosity. A lot of people asked "aren't interest or curiosity just inherent qualities?"

You know, you can't just snap your fingers and be as smart as Feynman so you shouldn't be able to snap your fingers and be as curious. But, I actually disagree here. I think that curiosity is something that you cultivate and it's because a lot of the things that push us away from curiosity are these encrusted fears and aversions that we have to things from maybe negative exposures in the past. Particularly through school.

If someone shows you an equation for something and you have a mild panic attack from your days of learning algebra and it strikes you as hard because maybe you're not very good at it. Or speaking another language and you just remember trying to memorize that vocabulary so you push that off.

I think if you take it from the perspective that curiosity and interest is something you can cultivate to the extent that you want to tear down those barriers, I think there's a huge benefit and possibility.

Me describing it in these abstract terms, like be more curious!, is maybe the worst kind of self-help but I think that's why you need to read this book. Reading Surely You're Joking Mr. Feynman is showing you examples of what it means to be a curious person.

You can see this abstract idea — being interested, curious, and not letting dogma or accepting the status quo, holding you back — you can see what those jargon-y buzzwords mean in practice.

Kalid: Exactly, and I think Feynman even talks about how he had a burnout in physics where he was not interested in it or was having trouble and he basically had to return to play where he was playing with ideas that had no application.

I think even for himself it wasn't like he was curious all the time and playful all the time, he still had to put in a bit of effort and adjust his attitude and allow himself to explore things that weren't necessarily [with] application.

So you should be genuinely interested and genuinely curious but not with the purpose of being more effective. As soon as you put the goal orientation there it might taint the way you approach it. So allow yourself to have a freeform exploration even in a practical application, I think that can help cultivate it.

Scott: Well I want to thank very much Kalid Azad for joining us. For those of you who are not familiar he has an excellent website, www.betterexplained.com and he was also previously on this book club podcast talking about Zen & the Art of Motorcycle Maintenance.

Previously we were talking about, actually, quite similar themes! It's amazing how often you can end up having similar conversations even if the material is different. I highly recommend his amazing website and also our previous book club podcast. Thank you again for joining us!