

I'm a Scientist - Script

VO - Voiceover (SC)

SC - Stephen Curry

JR - Jenny Rohn

AJ - Amar Joshi

TH - Tim Hunt

MP - Marcia Philbin

BB - Bernadette Byrne

LP - Laurence Pearl

Some file numbers/ time-stamps included

VO (black screen; title): When you think of scientists, what are the images that come to mind?

VO (Fade in, shots of statues): Maybe you think of the great scientists... like Newton...or Faraday... or Darwin... who dominate the history books because of their genius.

VO (SC at the bench in a white coat): Or maybe you think of people in white coats, doing mysterious things in a laboratory?

Stephen (SC): We see these images so often on TV that it can difficult to escape from them. They tend to give the impression that scientists are somehow different from everyone else..

SC (moving away from the bench): Well, I don't think they are... *(walks out of the lab)*.

SC (arrives in corridor): ...if you strip away the white coat *(trick shot - coat disappears - quick cross-fade)*

SC (in corridor): ...and talk to them, you soon find that the people who do science are actually a lot more ordinary than you might imagine.

VO: In this this film, I've talked to six different scientists... I've taken them away from their lab to get to know them and find out what they're really like.

VO: I started by asking them what they like to do when they're not doing science.

JR II5_0862 - 2:40:20 I really like to write. I've been writing all my life

JR II5_0862 - 3:07:15 I've published two novels. I like to write novels about scientists because there aren't that many scientists in novels and I think that's a disgrace because scientists are really interesting people.

MP II5_1030 - 7:01:09 I like to keep fit. I mean last night I went belly dancing (laughs).

AJ II5_0984 - 5:20 Something that I like that not many other people do is baking. Um... It's good to experiment outside the lab and it's always going to have a good outcome.

BB II5_0938 - 2:54:16 (Laughs) I like reading. I read a lot of books.

LP II5_0971- 7:35:24 Um I do like juggling. I've not really progressed as a juggler - I can do 3 clubs but not much better than that.

TH II5_1055 - 8:46:29 I've always liked taking photographs, so I keep a photographic diary. I carry a little camera. Let's see, I've got my little camera here.

[*cross-fade - holding camera*] There we go. See, now there we've got it. [laughs]

Photo of SC appears on camera shutter 'click'

TH II5_1055 [9:37] but I am a pretty nerdy scientist, actually, if you really want to know the honest truth.

SC: Yes please. The honest truth is exactly what we're after. So let's talk about science. When did these scientists first get interested?

JR II5_0859 - 28:00 I've always wanted to be a scientist since I was tiny.

AJ II5_0980 - 36:06 I was probably about 10, 11 or 12 when I thought about how cool science was.

TH II5_1052 - 44:18 Um... I can't remember exactly how old I was but I think I was in upper 3A (laughs), which probably would make me about 11

JR II5_0859 - 38:12 I was a real geek and in fact I was quite unpopular because I was the girl who was always sitting in the front row raising my hand and answering the questions. Didn't endear me to my classmates needless to say but I love science and I've always loved science.

BB II5_0935 - 0:00:28.14 - I think I was definitely in primary school. But it wasn't... Now I'm a biological scientist. Um... but then it was more physical sciences that I think I was interested in. I think I that was a sort of space travel thing and seeing shuttles going up into space that really captured my imagination.

LP II5_0970 - 57:25 So up until the age of about 6 I wanted to be a space fireman.

SC (*Looks up from reading 'Science'*): A what?

LP: a space fireman. My friend Colin and I were convinced that there would be a need... we were children of the space-age which is a lot of the motivation for being a scientist

anyway and we thought there would be a real need for space firemen until it was pointed out to us that in space fires are pretty much going to go out of their own accord.

(Last part of audio played over Space-fireman animation)

MP II5_1028 - 1:06:25 I was motivated by two things. I was motivated by a program called Star Trek and in Star Trek they had this lieutenant Uhura who was a communications officer and when I was growing up there was very... there were hardly any black females in that kind of role on TV who I could identify with. Usually the roles were either working in the kitchen or perhaps being a nurse or it was usually um... a role that wasn't considered... that was considered more traditional for black females and Lieutenant Uhura she kind of broke that mould and she was really inspiring.

AJ II5_0980 - 1:55:03 Science was cool. I looked forward to biology and chemistry lessons and physics. You got to do things rather than just sit watching the blackboard or whiteboard or whatever and it was active rather than being very formal and lectured at. Um... so it was... I enjoyed doing the experiments at GCSE levels - mixing things and getting the results.

JR II5_0859 - 58:18 I was obsessed by science from a very early age and I loved **school**. I was a bit weird. (Laughs).

TH II5_1052 - 59:10 I always liked science very much and was much better at science than classics and we spent much, much more time doing classics at the school where I was at than anything... Latin and Greek occupied all the morning in my memory. It was really tedious. But we had one science lesson a week.

MP II5_1028 - 1:53:16 But also there was my father - he asked me one day, what do you want to be when you grow up and I said a number of things and he said, "Well, why don't you aim for something higher? Be a doctor or be a scientist or... but just aim for something higher". Because he knew I had the ability and he believed in me. And I thought "Yeah - you're right - I am going to aim higher".

LP II5_0970 - 1:21:05 And, and then I sort of over the next I guess 3 or 4 years as I started to grow up and became more and more interested in science there was a time in the early sixties when you know science was everywhere. People were landing on the moon. My father worked for a company that sold chemicals, he would come home, he was a salesman, he would come home with the back of his car full of boxes of test-tubes and things like this. That science was something quite interesting was always rattling around in my head.

TH II5_1052 - 3:24:26 I was really an extremely untalented physicist, largely because my maths was very weak, still is very weak. Um... but the chemistry I enjoyed tremendously - I especially loved identifying chemicals, you know, distilling things and blowing things up, smelling things, you know, the beautiful colours and the reactions between them. It was just... all terrific really...

SC *(In front of blackboard)*: For some, there was an inspirational teacher...

BB II5_0935 - 0:45:17 I had some amazing biology teachers when I was at secondary

school and they really sort of changed my perspective on biology and that's really what started me on the path to where I am today.

TH II5_1052 - 2:09:00 Well I loved science when I was at school. Right from the word go. I mean, Gert Sommerhof who was the, the... teacher was a particularly inspiring person because I think he sort of understood what little boys like. You know smells, explosions, cute tricks, um, making electric circuits. He... I wasn't involved with this but

MP II5_1029 - 33:16 I had one teacher, Mr... Dr Bracebridge, I always remember him, he had a metal hand, he lost his hand during the war, and he became a chemistry teacher. And he was the one teacher that encouraged me. He said, right, I had sparks of genius (laughs) now and again and properly channeled, right, I could do something with them. And he really encouraged me, right, to follow my dream when other teachers didn't. And so that really helped.

BB II5_0935 - 2:07.10 And it was a guy called David Ensell when I was at the University of Liverpool who taught neuroendocrinology and he discussed about molecules and how they interacted with cells and the *amazing* effects they can have on the body and I thought this is for me, this is what I wanted to do.

VO (*Camera pans over gallery of photos - including Nobel Laureates*): Whatever their sources of inspiration, they all now work as scientists. They must be pretty smart - have any of them got a Nobel prize?

LP II5_0971- 8:05:04 No I don't personally have a Nobel prize. I did once get advice from

JR II5_0861 - 7:11:10 Laughs. No. When I was younger I thought I would (a) get a Nobel prize, and (b) cure cancer. No, I don't and I probably never will.

AJ II5_0984 - 42:00 No.

MP II5_1030 - 8:47:29 I don't have a Nobel prize, I'm afraid. Love to but I don't (laughs)

BB II5_0938 - 0:03:21.13 Um... no. (Laughs) Will I *ever* have a Nobel prize? I think not. But I enjoy what I do and every day is a new challenge as a scientist. So I don't feel disappointed that I'm not going to be a Nobel prize winner.

TH II5_1056 - 13:00 I do have a Nobel Prize, yes, one third of the share of the 2001 Nobel Prize in Physiology or Medicine.

LP (*Image of TH shrinks to reveal Laurence Pearl*) **II5_0971- 8:05:04** I did once get advice from somebody I know reasonably well who has got a Nobel prize, a man called Tim Hunt who did lean over to me over a cup of coffee one day and say "Laurence if you're going to get a prize, get a Nobel prize, they really treat you well!"

SC (*In front of Nobel Prize certificate*): Only one Nobel prize? But don't you need to be a genius to be a scientist?

MP II5_1030 - 8:57:29 No I'm not a genius. I'm just somebody who know what she likes to do and when she's interested in something I just work hard at it and I remain focused and determined and committed and I keep trying,. That's the key thing - I keep trying.

BB II5_0938 - 3:39:11 - Um - no I'm definitely not a genius. No. Um... I think I'm a person who works hard and who's interested in what she does. But no I'm not a genius.

AJ II5_0984 - 1:04:00 No. Definitely not a genius. The amount of mistakes I make in the lab. (laughs)

JR II5_0861 - 7:24:28 I think when you're young you think you can do everything and when you get older you realise it's just enough to do something.

LP II5_0971- 8:30:24 No, I don't think I'm a genius. I think occasionally I have little flashes of genius. Every now and then I do please myself very much that I've been able to put together a bunch of facts that haven't quite made sense to a other people or to me for quite a long time and then go "Ah! Got it!" And that's very, very pleasing. So I'm not a genius but I have little flashes about every 10 years.

VO (*Shot of TH typing at his desk*): What does the Nobel prize-winner think - is he a genius?

TH II5_1056 - 2:17:25 No, no, no, I'm no genius. No, absolutely not. In fact, my wife calls me "The People's Laureate," because she says if I can win a Nobel Prize, anybody can! [laughs]

VO (*shots of AJ working in the lab*): OK, then. So what does it take to be a good scientist?

JR II5_0861 - 5:37:10 I think a good scientist has to be incredibly curious but also very strong because it takes a lot of hard work to become a scientist.

BB II5_0938 - 1:40:00 somebody who's always questioning, not just the science but themselves as well.

AJ II5_0983 - 7:07 you have to ask questions but also ask the right question.

SC (*In front of computer screen*): So curiosity is obviously important. Is there anything else?

LP II5_0971- 2:50:13 A sort of... bloody-minded refusal to fail. 90% of what you do doesn't work. I try and get this through to my research students when they come bushy-

tailed from their first degree wanting, expecting to discover something. I say you're going to go into a laboratory every day for 3 to 4 years and nothing you do will work.

MP II5_1030 - 4:04:09. You must be someone who's prepared to just keep trying and... I mean you will get disheartened but its being able to pick yourself up from a set-back and move forward.

JR II5_0861 - 5:37:10 it takes a lot of hard work to become a scientist. And something they maybe don't tell you in your science class is that a lot of science, most of science is failure.

LP II5_0971- 3:18:11 Except every now and then one Friday morning you will look down a microscope and something will have worked and then it'll all take off. And then it'll be exciting and that moment will justify all the slog of the previous year or 2 years or 3 years or indeed working life.

JR II5_0861 - 6:17:11 So you have to be really, really stubborn and say to yourself I really want to know the answer. I want to know why it's true and I want to work really hard to find out. And I don't mind if I fail because I'm going to fail a 100 times and then that success is really sweet when you actually do discover something. It's the greatest feeling in the world.

TH II5_1054 - 12:58:29 So all my life, if I have been successful it's because I've made so many mistakes. If you learn from your mistakes, the more mistakes you make the better, because the more you learn. You try to avoid making the same mistake twice. That's a good lesson then actually. But if you never make mistakes, you'll never learn anything.

(Long shot of LP looking at his phone)

LP II5_0971- 4:17:28 You need to be imaginative, ver, very imaginative. You've got to be able to think not just in straight lines. You have to be good at thinking in straight lines but you also have to be able to take things that don't look as though they really do go together and understand where they go together.

JR II5_0862 -1:34:23 Um... I don't think you necessarily have to be brilliant, I think you just have to be creative...

MP II5_1030 - 4:32:24 And perhaps think laterally. And you have to be prepared to go down a different route to the one that you thought you were going down and accept what actually maybe that's not right, maybe this way's a better way and you need to have that flexibility.

AJ II5_0983 - 19:29. It experimental work by nature. No-one's done it before, so you come across problems that you have to fix and if no-one's done the work your doing before, you have to forge new ground.

LP II5_0971- 4:46:20 And I guess... you've got to have a passion for it. Because nothing you do ever works - statistically - and because it's... you are asking questions to which nobody will know the answer. Often there's nobody else you can ask to help you.

BB II5_0938 - 1:46:15... if you are using a specific technique that's not right for the job then what technique can you use? And if there isn't one available, can you develop it? Somebody that's constantly questioning everything that they do and how they do it.

TH II5_1055 - 3:55:14 It takes absolutely all sorts. I don't think there's any generalization you can make, actually, because there are so many different aspects to it. Sometimes you need somebody who will just grind away and grind away with great accuracy. Other times, you need somebody who makes imaginative flights of fancy. There's just no rhyme or reason.

VO (*Stephen in lecture theatre - with himself behind: trick shot*): Well that's good news. You don't have to be a genius to be a good scientist though it does take curiosity, imagination and hard work. But is it fun?

JR II5_0862 - 46:07 No, I don't think so. In fact I'm really bad at some aspects of science. I'm a terrible mathematician - I can barely subtract in my head and all my life I've scored very poorly on maths tests, believe it or not. I barely got into the program that gave me a PhD because my maths scores were too low.

LP II5_0970 - 6:03:22 I mean there is a thing that I get to do from time to time repetitiously which is very exciting still excites me. I got to do it again this week for the first time in a while which is to suddenly realise that I'm the first person who's understood something.

JR II5_0861 - 1:24:00 Well, after I did my postdoc in London... I went on to Amsterdam - I was working in the Netherlands and I worked in a very small biotech company....
(*Cross-fade*)

...they had this really amazing chicken virus that had this really amazing protein that just sort of caused cancer cells to commit suicide but when you put it on healthy cells it didn't do anything. It looked like a sort of magic bullet.

BB II5_0936 - 0:24:21 And that then led me to my PhD. I moved up to the North-East of Scotland, to the University of Aberdeen to do that. And I worked with a guy called Professor Paul Fowler. And I have to say that that 3 years of my PhD was the best 3 years of my life.

MP II5_1029 - 3:15:09 - Yeah, I absolutely loved it and I had a very good supervisor. My colleagues were - we had a great team. But also is the fact that I had this freedom to develop my interests and to study an area and make it my own.

JR II5_0861 - 2:15:08 It was really interesting - I worked on that for a number of years and we worked out the pathways behind the specificity - the reason that it killed cancer cells and not normal cells and patented it, so I was an inventor on a patent and then the idea was taken up by a big German pharmaceutical company and the last I heard this thing had gone into clinical trials so they were testing it in humans so for me, although it's a very strange, quirky project I'm very, very proud of that work.

BB II5_0936 - 0:38:27 I *absolutely loved* it. There was nothing like that buzz of being in the laboratory and getting something to work. And even when things didn't work, you still enjoyed the interaction with people, saying why didn't it work, how can I get it to work? Um... And it really was an amazing, amazing experience.

AJ II5_0982 - 2:45:11 I've manipulated a gene, put it into a bacterial cell, purified and

enriched that protein from the bacteria. Then I've managed to crystallise that, which is quite a large molecule - it's not like salt - it's about 10,000 times the size of salt. And then shot that with X-rays.

TH II5_1054 - 6:50:07 I started out trying to understand the control of hemoglobin synthesis. So hemoglobin, as you know, is the protein that carries oxygen. It's bright red in color because it has four protein chains and four heme groups, and the iron in the heme is what carries the oxygen.

OK, so I was really intrigued by findings showing that if you deprived these red cells of iron, they didn't make any hemoglobin. Now they could have made... Of course, they couldn't make hemoglobin because they didn't have iron, but they could have made the globin, the protein bit, and then put the heme in later. But they didn't. They actually shut off the protein synthesis.

Richard Jackson, a very dear colleague and I worked on this for, I don't know, a total of about 10 years, I suppose, before we cracked it.

AJ II5_0982 - 3:03:05 . And then, from that worked backwards to get a model of the protein at atomic resolution - knowing where all the atoms are. So when I step back it's a long process going from gene manipulation, all the way to getting a structure, that's quite exciting when you finally get that structure.

TH II5_1054 - [7:56] Working that out was incredibly satisfying because it went through all kinds of highs and lows. We had to follow a very tortuous path beforehand to work out a lot of things before we got to the point where we could really ask the real questions, as it turned out.

We didn't know that when we started. So it was a long and winding road. And then one day, we just suddenly, tada! You get the answer.

LP II5_0970 -3:11:12 being a scientist is actually quite a treat because it allows you to carry on being that slightly childish — in the best sense of the word — that childish state of asking why. Why is the sky blue? Why does the wood catch fire? Why are the flowers coming out in spring. The kind of stuff that all sounds a bit childish and a little bit silly but actually is immensely profound. And being allowed to carry on asking those questions - and actually getting paid for it seemed to me a fabulous route through life. Still does.

VO (*Stephen typing 'science' into Google*): But scientists seem to have found out an awful lot about the world already. Are there any more discoveries to be made to make? Isn't science more or less all done?

AJ II5_0982 - 3:55:01 The total opposite. The total opposite of that... science... every experiment I do, every result I get, I get 3 more questions at least, from that experiment

BB II5_0938 - 0:17.08 - I think there are many, many things that still need to be done.

TH II5_1055 - 21:28 No, I don't think the science is finished at all. [laughs] There are lots of things, which we don't know.

JR II5_0861 - 4:03:20 It's this mystery that always goes on. You think you've got it all sorted and then you ask a question. Maybe you regret having asked it because you thought it was all finished and then 'oh no!

BB II5_0938 - 0:50:27 - in my field in particular, we still have very little idea of how these proteins that exist within membranes actually work. And this isn't just important from a biological point of view. These proteins that exist within the membrane, eh.. they are the targets for many, many drugs and so because we don't know how they work, and what they actually look like, our ability to design specific drugs to act through these molecules is very, very limited.

MP II5_1030 - 29:06 I think there's so many things that still need to be looked at. I think the biggest challenge for this generation is that of energy generation. Energy, I think, is going to be one of the key areas where we're going to see a lot of development.

TH II5_1055 - 1:06:09 In biology, you could say on the one hand, we have been fantastically successful and we know an awful lot. But on the other hand, we really don't understand how the brain works, actually.

JR II5_0861 - 4:19:02 You know I want to pick up a glass - how on earth does my hand just do that? What is the brain doing?

TH II5_1055 - 1:16:21 I mean, even a simple little creature like a nematode worm, a millimeter long, when it swims and it wiggles, the wiring of those electric nervous circuits is not at all well understood, I understand.

MP II5_1030 - 3:31:27 Science is not dead, it's only beginning. I think we're only touching the surface.

LP II5_0971- 23:12 we're just scratching.. not even the surface. We're scratching through the dust on top of surface. I mean there are layers of complexity and organization in cells that we really don't understand.

AJ II5_0982 - 4:13:08 I have to choose the most exciting or the most promising question and follow that up. There are lots of questions that are unanswered that I just haven't got the resources to follow up.

LP II5_0971- 1:02:20 And then every time you think you know at least the molecules that are in there suddenly out of the blue a whole new piece of biology gets discovered. In the last 10 years or so we suddenly discovered a thing called small interfering RNAs. When I say we I mean a lot of other people - not me — that nobody had expected were there and suddenly they're everywhere and there's a whole layer of cell regulation that somehow we had just not noticed for 20 or 30 years. I mean it just strikes me as extraordinary. There'll be another one in the next 20 years.

TH II5_1056 - 5:35:00 And I think there are still some profoundly important questions that we don't really understand the answer to at all, in terms particularly of our own bodies. I'm sort of obsessed with how things stay the same. Homeostasis is terribly, terribly important. I mean, if you think about your nose, that's my favorite example. You know, the nose neither grows nor shrinks.

Of course, sometimes you drink too much and it becomes inflamed, I suppose, but on the whole it stays pretty much the same once you're a certain age. So that's pretty amazing,

actually. How does the nose know how big it's supposed to be, regardless of whether you had just eaten an enormous meal or whether you are starving? It's truly remarkable.

JR II5_0861 - 4:42:12 we don't really know anything. And to think that it's all sorted is completely naïve and that's great because otherwise we'd be out of a job. So there's lots and lots left to do.

It's this mystery that always goes on. You think you've got it all sorted and then you ask a question. Maybe you regret having asked it because you thought it was all finished and then 'oh no!

Fade to Black

VO (*Shot of interior of Natural History Museum - children running around*): So clearly, there's still plenty of work for the scientists of the future...

SC (*standing in front of Darwin statue*): No doubt some of them will win prizes and be commemorated in statues like Darwin here, and so go down in history. But as I hope this film has shown, many of the scientists of the future will be pretty ordinary people like me, and you.

Credits (interspersed with favourite cheeses)

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Stephen Curry

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