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00:00:00,000 --> 00:00:05,339

I want to thank you all for coming out  
to hear me today. I want to thank Kristen

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00:00:05,339 --> 00:00:11,969

for that very kind introduction and for  
asking me to come here and talk today. I

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00:00:11,969 --> 00:00:17,070

feel very honored to be the speaker for  
this event. I want to thank Stephanie for

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00:00:17,070 --> 00:00:22,109

setting this up and doing all that work,  
and before I go any further one big

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00:00:22,109 --> 00:00:28,230

thanks is in order as all of you know,  
probably, a few months - months ago, in a

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00:00:28,230 --> 00:00:33,360

few months, Kristen will be stepping down  
as our Dean of Liberal Arts and I for

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00:00:33,360 --> 00:00:39,210

one will very much miss her presence in  
Liberal Arts. In the time she's been here,

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00:00:39,210 --> 00:00:44,160

she's done exceptionally well at a  
difficult job that in the last year has

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00:00:44,160 --> 00:00:51,660

become superhuman difficult and I think  
I would like you to join me in thanking

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00:00:51,660 --> 00:01:02,480

her for her time here, if we could. [applause] and we  
wish you well in your future endeavors.

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00:01:02,480 --> 00:01:09,030

About this talk, so today I'm going to be  
sharing with you some of the things I

12

00:01:09,030 --> 00:01:14,310

learned in writing a book that offers a

deep history of mankind. How deep, you ask?

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00:01:14,310 --> 00:01:20,009

Well it goes back 13.8 billion years.

That means that if I spend two minutes

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00:01:20,009 --> 00:01:25,229

talking per billion years, I'll be in my

time limit here and I'll try to speed

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00:01:25,229 --> 00:01:31,200

things along and what this is this is a

true science -- science book but it happens

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00:01:31,200 --> 00:01:35,430

to be written by a philosopher, so I

bring a philosophers sensibilities to

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00:01:35,430 --> 00:01:41,070

the the enterprise and so I asked

questions that a scientist probably

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00:01:41,070 --> 00:01:46,170

wouldn't ask, and I see connections that  
a scientist might not see. So to begin

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00:01:46,170 --> 00:01:51,840

with, you are many things. So there's many  
different ways to understand you. You're

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00:01:51,840 --> 00:01:55,740

a person obviously, but you're also a  
member of a species, you're also a

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00:01:55,740 --> 00:01:59,780

collection of cells, you're a collection  
of atoms, and you're other things as well.

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00:01:59,780 --> 00:02:04,979

This is as far as I'm going to go today  
though, and each of these different

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00:02:04,979 --> 00:02:09,840

aspects of you has a history and the  
histories are in many case fascinating

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00:02:09,840 --> 00:02:20,450

histories and that's what we're going to explore today. First of all, you as a person if you did your family tree, you'd discover two

25

00:02:20,450 --> 00:02:24,680

things. The first is that it gets very big, very quick, because it grows at an

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00:02:24,680 --> 00:02:29,240

expen -- exponential growth rate. Second thing is if you tracked back sixty or

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00:02:29,240 --> 00:02:34,370

seventy thousand years, it's disputed, you would find out that all of your direct

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00:02:34,370 --> 00:02:41,360

ancestors lived in the Rift Valley of Africa and they left at that time. They

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00:02:41,360 --> 00:02:44,870

had their exit from Africa and you can see they did it at the two ends of the

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00:02:44,870 --> 00:02:49,760

Red Sea. The southern end of the Red Sea  
at that time it was an ice age so sea

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00:02:49,760 --> 00:02:55,310

level was very low, so the Water Gap  
wasn't as big as it currently is and

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00:02:55,310 --> 00:03:01,130

because there was an ice age they didn't  
do the sensible thing. The sensible thing

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00:03:01,130 --> 00:03:05,540

would be to head I don't know, to  
Paris, you know? Someplace of course Paris

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00:03:05,540 --> 00:03:09,530

didn't exist and it would have been in  
the ice so they did the other sensible

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00:03:09,530 --> 00:03:15,230

thing, given that and they headed east. So

it was quite a while before they

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00:03:15,230 --> 00:03:20,030

actually came back and went into Europe.

Now that meant that because they stayed

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00:03:20,030 --> 00:03:25,100

South they kept their dark skins, it

was only when they went into the higher

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00:03:25,100 --> 00:03:31,310

latitudes that it became evolutionarily

sensible for them to get lighter skinned

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00:03:31,310 --> 00:03:38,390

because then they could use sunlight to

make vitamin D, and that in turn means

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00:03:38,390 --> 00:03:43,760

that if you trace your ancestors back

8,000 years you will find that they were

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00:03:43,760 --> 00:03:48,350

all dark skinned individuals. So  
ethnically speaking in other words we're

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00:03:48,350 --> 00:03:59,530

all black Africans and in terms of our  
of our ancestry. Then, next question is

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00:04:00,550 --> 00:04:06,050

how we've managed to accomplish so much  
and we as a species have accomplished a

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00:04:06,050 --> 00:04:10,430

huge amount. Look around you look at the  
lights, look at the computer, look at look

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00:04:10,430 --> 00:04:14,989

at everything else. It's absolutely  
amazing and then the question is how do

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00:04:14,989 --> 00:04:18,650

we do that? And the obvious answer the  
one that people give is that we have

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00:04:18,650 --> 00:04:25,370

such big brains, but in fact our brains  
in any way you use size them, they aren't

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00:04:25,370 --> 00:04:28,610

that big.

The whales, blue whales have brains that

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00:04:28,610 --> 00:04:33,860

are six times as big as as ours and they  
haven't done squat compared to us. They

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00:04:33,860 --> 00:04:39,530

just swim around and eat krill or  
whatever it is they do and so it turns

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00:04:39,530 --> 00:04:43,970

into that interesting question of what  
is so special about us that's let us

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00:04:43,970 --> 00:04:49,370

accomplish so much? So once you get past  
the brain issue then it becomes a bunch

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00:04:49,370 --> 00:04:55,610

of things that are quite surprising. It's  
our bodies that made a huge difference,

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00:04:55,610 --> 00:04:59,570

Our bodies in conjunction with the brain.  
First of all, you have an awesome

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00:04:59,570 --> 00:05:03,500

throwing arm. You may not realize this  
but you have one of the greatest

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00:05:03,500 --> 00:05:09,290

throwing arms in the animal world. You  
can probably and looking out here at the

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00:05:09,290 --> 00:05:13,520

audience and so I better not generalize.  
Some of you can throw a baseball at 50

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00:05:13,520 --> 00:05:18,320

miles an hour. Big-league pitcher can  
throw a baseball at 100 miles an hour

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00:05:18,320 --> 00:05:24,830

with exquisite accuracy. A chimp can manage a 20 mile an hour throw and it'll

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00:05:24,830 --> 00:05:29,780

be just in a general direction, and your throwing arm turns out to have been a

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00:05:29,780 --> 00:05:33,170

very important thing in your -- in your history because it meant that you could

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00:05:33,170 --> 00:05:39,920

kill at a distance and that made a huge difference. Now I had Bob Reardon, now

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00:05:39,920 --> 00:05:46,790

retired of anthropology, read a draft of this manuscript and he -- he corrected this

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00:05:46,790 --> 00:05:50,930

the claim I made about chimps. He pointed

out that actually if you're a

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00:05:50,930 --> 00:05:58,730

researcher in a cage with a chimp, they  
can throw feces at the researcher both

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00:05:58,730 --> 00:06:03,740

at a very high rate of speed and with  
really incredible accuracy, but that

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00:06:03,740 --> 00:06:08,690

seems to be the exception. Otherwise they  
can't throw well. So you have this great

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00:06:08,690 --> 00:06:13,190

throwing arm that let you kill at a  
distance. You have superb manual

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00:06:13,190 --> 00:06:18,200

dexterity, the opposable thumb, which  
allowed you to make sharpened points for

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00:06:18,200 --> 00:06:22,550

the spears that you were throwing. Which again, increased your ability to kill at

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00:06:22,550 --> 00:06:27,980

a distance. You have the ability to walk and run in an upright --upright position.

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00:06:27,980 --> 00:06:32,720

You might say well ostriches can too, except that's not upright. Their bodies

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00:06:32,720 --> 00:06:37,520

are horizontal, and you might say okay then what about penguins? Penguins can

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00:06:37,520 --> 00:06:40,490

actually walk in an upright position, but when it comes time

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00:06:40,490 --> 00:06:44,030

to run, they fall on their belly and push with their feet. They just slide along,

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00:06:44,030 --> 00:06:48,740

and so why is it important for you to be  
able to walk and run in an upright

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00:06:48,740 --> 00:06:54,500

position? Two things. One of them is you  
can carry things when you run, right? So

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00:06:54,500 --> 00:06:58,729

you can carry your spear, you can carry  
water, you can carry things you've got

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00:06:58,729 --> 00:07:04,460

and then there's another thing. You're  
really a champion sweater in the

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00:07:04,460 --> 00:07:09,080

animal world and that may seem like  
just an annoying feature of you but it

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00:07:09,080 --> 00:07:12,949

goes much deeper than that because again  
your ancestors would have been living on

82

00:07:12,949 --> 00:07:17,330

the Savannah's of Africa would have been  
a very hot climate. So most of the

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00:07:17,330 --> 00:07:21,319

animals midday, what do they do? They take  
a nap. They do the sensible thing. They

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00:07:21,319 --> 00:07:24,979

try to get out of the Sun, and they try  
to take a nap but if you had the ability

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00:07:24,979 --> 00:07:29,599

to slap that meant you could still  
function in the midday Sun, so one of the

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00:07:29,599 --> 00:07:35,120

things you could go do is go out and  
hunt animals and normally animals would

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00:07:35,120 --> 00:07:39,800

simply run away from you and probably  
laugh as they did, but on a hot day they

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00:07:39,800 --> 00:07:44,930

would try that same gambit they would go  
off in a burst, get away from you but

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00:07:44,930 --> 00:07:49,099

because you had the ability to sweat and  
cool yourself you could just keep coming

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00:07:49,099 --> 00:07:53,419

and so you could engage in what's called  
persistence hunting. So you would keep

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00:07:53,419 --> 00:07:56,930

closing on the animal that would keep  
running, keep closing until finally the

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00:07:56,930 --> 00:08:01,009

animal would suffer heatstroke at which  
point you would come up with your spear

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00:08:01,009 --> 00:08:06,440

and kill it and there you would have you



would have lunch. So your ability to

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00:08:06,440 --> 00:08:09,740

sweat. This isn't a kind of an  
obvious thing that that would have been

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00:08:09,740 --> 00:08:15,139

one of the things that got us here today,  
but it is. You also have excellent breath

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00:08:15,139 --> 00:08:20,840

control. You know, there are other animals  
that can make human sounds, parakeets, but

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00:08:20,840 --> 00:08:24,319

they can't do it in the extended way  
that I'm doing it right now. So I take a

98

00:08:24,319 --> 00:08:28,880

single breath and I might get 20 words  
out before I take my next breath, you

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00:08:28,880 --> 00:08:33,890

know? Chimps can make the noise, that  
short thing but if you actually want to

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00:08:33,890 --> 00:08:39,409

have complex communication with other  
people, you need the breath control, right?

101

00:08:39,409 --> 00:08:46,790

That that can vary the sound, the  
intensity and why is speech important?

102

00:08:46,790 --> 00:08:50,420

Well number one, it allows for  
coordinated activities between human

103

00:08:50,420 --> 00:08:53,980

beings and so it allows for coordinated  
hunting activities

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00:08:53,980 --> 00:09:02,170

once again. Human mental evolution, so  
meat turns out to play a big role. Chimps

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00:09:02,170 --> 00:09:07,990

eat some meat. They eat meat occasionally but  
our human ancestors ate a large amount

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00:09:07,990 --> 00:09:13,060

of meat. Not-- not exclusively on meat, but  
they had a much more meat than chimps

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00:09:13,060 --> 00:09:16,930

would've and it played an important role  
in their development because meat is a

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00:09:16,930 --> 00:09:22,149

very good source of calories and of  
quality protein and so it allows for the

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00:09:22,149 --> 00:09:28,449

growth of a bigger brain. So we had  
eating meat, our ancestors meaning bigger

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00:09:28,449 --> 00:09:31,720

brains, okay? and then they use these  
bigger brains to do a bunch of things.

111

00:09:31,720 --> 00:09:36,190

One of them was to figure out how to keep fires going and how to cook meat. So

112

00:09:36,190 --> 00:09:40,600

they have cooked meat. Next step, they have an even bigger brain because

113

00:09:40,600 --> 00:09:46,449

cooking also releases the nutritional value of the meat. There's you -- you'll get

114

00:09:46,449 --> 00:09:52,570

a lot more calories and value out of eating cooked meat than raw meat. Bigger

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00:09:52,570 --> 00:09:58,420

brain led to intelligence, led to moral insights, and then led finally to the

116

00:09:58,420 --> 00:10:03,670

apex of the human experience of vegetarianism, right? Because when you

117

00:10:03,670 --> 00:10:06,730

finally get there then you put it all  
together and you realize you know I

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00:10:06,730 --> 00:10:10,060

don't really need to kill animals  
anymore. In case you're wondering, yeah

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00:10:10,060 --> 00:10:16,779

I'm a vegetarian. Okay, next your place on  
the tree of life. So the book turns out

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00:10:16,779 --> 00:10:22,029

to be full of various kinds of trees. You  
know there's family trees, there's the

121

00:10:22,029 --> 00:10:27,310

tree of life and you can look back to  
the 1800s and they had the tree of life

122

00:10:27,310 --> 00:10:31,779

and they would all show the man a man at

the top you know the top species but

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00:10:31,779 --> 00:10:36,339

there are perhaps 10 million different  
species and none of them is particularly

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00:10:36,339 --> 00:10:40,660

special and so they have these complex  
ways of trying to show you as much as

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00:10:40,660 --> 00:10:46,149

they can about the tree of life. So in  
this particular one, it's called a radial

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00:10:46,149 --> 00:10:50,350

tree of life, and it it doesn't even do  
justice to how many species there are but

127

00:10:50,350 --> 00:10:55,839

you can see your species marked as Homo  
sapiens and above it is mus -- musculus, and

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00:10:55,839 --> 00:11:01,329

then there's typho... well anyway it's  
that it's the rubber eel. There's a house

129

00:11:01,329 --> 00:11:05,079

mouse and the rubber eel and obviously  
there are a lot of animals more closely

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00:11:05,079 --> 00:11:15,279

related than we are but we're just one  
twig on this hugely bushy tree. Species

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00:11:15,279 --> 00:11:20,759

identity crisis, so me as a philosopher  
when I started looking into biology,

132

00:11:20,759 --> 00:11:25,899

which by the way I never took in high  
school so it's a real challenge for me

133

00:11:25,899 --> 00:11:30,670

had to learn, turns out that species I  
started having all sorts of questions

134

00:11:30,670 --> 00:11:35,800

about the nature of species and we normally think of species as distinct

135

00:11:35,800 --> 00:11:41,100

things but it turns out the line is really quite blurry and the old

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00:11:41,100 --> 00:11:45,670

definition that quick and easy definition that two things belong to the

137

00:11:45,670 --> 00:11:51,220

same species if they can if they can mate and have fertile offspring well it

138

00:11:51,220 --> 00:11:56,800

turns out that then all sorts of species barriers break down. For one thing, you

139

00:11:56,800 --> 00:12:02,319

are perhaps two percent neanderthal and that's because your ancestors when they



140

00:12:02,319 --> 00:12:07,889

went up into Europe finally encountered  
Neanderthals, mated with them, had

141

00:12:07,889 --> 00:12:13,540

offspring which in turn made it and so  
the jeans made it into our gene pool. The

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00:12:13,540 --> 00:12:18,490

exception to that would be there are  
exceptions so if you're a san -- SAN

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00:12:18,490 --> 00:12:23,949

tribesmen of South Africa, your ancestors  
never made it up into Europe so you're

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00:12:23,949 --> 00:12:29,170

free of Neanderthal genes. You're human  
genes, you're the real deal as far as

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00:12:29,170 --> 00:12:34,050

we're concerned. Second, when species  
transformed, they don't transform

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00:12:34,050 --> 00:12:38,800

instantaneously there's a long slow  
process. So if you tried to do our

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00:12:38,800 --> 00:12:44,769

species family tree, our parent species  
and this is argh -- all of this is arguable

148

00:12:44,769 --> 00:12:51,600

but homo heidelbergensis is often  
identified as a species we evolved from

149

00:12:51,600 --> 00:12:55,720

but of course it wasn't an overnight  
thing, you know? You didn't have these

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00:12:55,720 --> 00:13:01,360

Homo heidelbergensis parents who had a  
baby and said oh look it's Homo sapiens,

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00:13:01,360 --> 00:13:06,579

we've given birth to a new species. Would

have been a long, slow process and that

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00:13:06,579 --> 00:13:11,470

raises the possibility that in a million  
years from now if they're still

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00:13:11,470 --> 00:13:14,709

biologists they will look back at our  
species and say you know we really

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00:13:14,709 --> 00:13:20,350

weren't the proper species at all. We  
were a transitional species between two

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00:13:20,350 --> 00:13:26,960

real species.

That would put us in our place. Next, okay?

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00:13:26,960 --> 00:13:30,980

There's a cellular you. Besides you being  
a member of a species, you are a

157

00:13:30,980 --> 00:13:34,760

collection of cells and you can be  
understood in that way. You're 37

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00:13:34,760 --> 00:13:40,550

trillion cells, okay? and you can pick any  
cell you want. Pick a cell, any cell so

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00:13:40,550 --> 00:13:48,950

down there -- oops, oh no, game over --okay pick a cell. So in the  
lower left there and that's one of the

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00:13:48,950 --> 00:13:53,300

cells in your body. That cell would have  
a family tree that it could trace back.

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00:13:53,300 --> 00:13:58,190

It had a mother cell which when  
underwent fission to create two daughter

162

00:13:58,190 --> 00:14:03,020

cells. It had a mother cell, keep tracing  
back and you'll ultimately come to your

163

00:14:03,020 --> 00:14:08,180

zygote. You know at one time you were a single-celled organism. The zygote. Which

164

00:14:08,180 --> 00:14:13,100

in turn is the result of a fusion of your mother's egg cell and your father's

165

00:14:13,100 --> 00:14:18,080

sperm cell but each of them can also has a tree that can be traced back and then

166

00:14:18,080 --> 00:14:23,450

the fascinating thing is that if you keep tracing, you will go very far and 2+

167

00:14:23,450 --> 00:14:28,310

billion years ago you will encounter the organism that biologists

168

00:14:28,310 --> 00:14:33,230

refer to as Luca, L-U-C-A, the last Universal common ancestor. It'll be a

169

00:14:33,230 --> 00:14:41,600

single-celled organism and all of your cells are its descendants. Now, the

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00:14:41,600 --> 00:14:45,140

interesting thing about if we look at the cellular you it's only ten percent

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00:14:45,140 --> 00:14:51,830

human, because it turns out that you have roommates. Besides your human cells with

172

00:14:51,830 --> 00:14:56,959

their human DNA, there are for each human cell you have, there are 10 and non human

173

00:14:56,959 --> 00:15:02,839

cells living in and on you. They're living around your actual human cells.

174

00:15:02,839 --> 00:15:08,480

They're the bacteria on your skin, in your lungs, just about everywhere you want to

175

00:15:08,480 --> 00:15:12,620

talk about and then the big depository  
of them is in your gut. You have a gut

176

00:15:12,620 --> 00:15:20,810

biome. So several, a few pounds of your  
gut matter is actually these bacteria

177

00:15:20,810 --> 00:15:27,589

that live there and at first your -- your  
response is going to be ew I'm full of

178

00:15:27,589 --> 00:15:30,490

bacteria but in fact you're lucky to  
have them.

179

00:15:30,490 --> 00:15:35,930

It's a very good relationship. They help  
you digest your food, and they protect

180

00:15:35,930 --> 00:15:42,110

you from other nastier microbes. So you

acquired this at least partly at birth.

181

00:15:42,110 --> 00:15:47,569

So if you were born the usual way, on coming out of your mother, there was a

182

00:15:47,569 --> 00:15:51,860

time when you were very close to her anus. So this is getting kind of, I don't

183

00:15:51,860 --> 00:15:56,630

that we're coming up on dinner here but we won't get too far into this and as a

184

00:15:56,630 --> 00:16:05,410

result, you acquired some of her gut biome in that way and by the way, koalas

185

00:16:05,410 --> 00:16:10,610

in order to ensure that their offspring have the right microbiome to

186

00:16:10,610 --> 00:16:14,389



eat what is what do you call the leaves,  
eucalyptus? In order to do that, the

187

00:16:14,389 --> 00:16:20,209

mother will actually feed the the infant  
her own feces, I don't know how many

188

00:16:20,209 --> 00:16:23,389

times. Anybody keeping count how many  
times does feces come up in this

189

00:16:23,389 --> 00:16:29,329

conversation? So bare with me so to make sure  
that that that it has the right

190

00:16:29,329 --> 00:16:34,639

microbiome. Another thing is that when a  
woman is breastfeeding, some of the

191

00:16:34,639 --> 00:16:40,399

breast milk has complex sugars that they  
know a human being can't digest. Why

192

00:16:40,399 --> 00:16:47,180

would it be there then? The answer is  
it's to feed the microbes in her in the

193

00:16:47,180 --> 00:16:53,870

baby's gut, so those microbes can help  
the baby digest. So that's how closely we're

194

00:16:53,870 --> 00:16:59,779

interrelated with they with our our  
roommates, but it's even more dramatic

195

00:16:59,779 --> 00:17:05,449

than that, because it turns out that  
besides having microorganisms around you,

196

00:17:05,449 --> 00:17:12,350

You have them inside yourselves and we  
call them the mitochondria and they call

197

00:17:12,350 --> 00:17:15,770

them organelles, so they don't refer to  
them as cells, but if you look at the

198

00:17:15,770 --> 00:17:21,409

history of how they got there, it's a really fascinating story. They are in

199

00:17:21,409 --> 00:17:26,659

fact, ancient bacteria. They are the descendants of ancient bacteria. They're --

200

00:17:26,659 --> 00:17:32,059

they invaded your cells, maybe and there they provide you with the power that you

201

00:17:32,059 --> 00:17:37,100

have. I told you a few minutes ago that you have 37 trillion cells and you and

202

00:17:37,100 --> 00:17:41,210

they're divided into two hundred and twenty different kinds of cells. You have

203

00:17:41,210 --> 00:17:47,230

liver cells, you have brain cells and so on.

That kind of cell differentiation

204

00:17:47,230 --> 00:17:51,490

wouldn't be possible unless you had a really big genome and your genome

205

00:17:51,490 --> 00:17:55,629

wouldn't be possible if you didn't have a source with which to power the

206

00:17:55,629 --> 00:18:00,370

energy in order to keep it going and it's mitochondria that gives you that

207

00:18:00,370 --> 00:18:05,110

energy. So without them you wouldn't be the complex organism that you are and

208

00:18:05,110 --> 00:18:11,559

there's this wonderful story about how you came to have these mitochondria. Now

209

00:18:11,559 --> 00:18:15,789

there's lots of names, it's given it

a biologist would call it the

210

00:18:15,789 --> 00:18:21,879

endo-symbiotic event but I like big gulp instead. So what happened is you had

211

00:18:21,879 --> 00:18:27,399

these two microorganisms, one was a bacteria and one was in archaea and you

212

00:18:27,399 --> 00:18:29,740

know if you looked at them in a microscope you'd say will they look

213

00:18:29,740 --> 00:18:33,669

alike and they kind of behave the same way, so what's the difference? But they

214

00:18:33,669 --> 00:18:41,379

are two different branches on the tree of life and they -- they process their DNA

215

00:18:41,379 --> 00:18:45,279

in different ways. So you can think of them the way you think of a Mac computer

216

00:18:45,279 --> 00:18:49,659

and a PC. They look alike and they do similar things but they have different

217

00:18:49,659 --> 00:18:54,730

operating systems. So bacteria and archaea are two microbes that have

218

00:18:54,730 --> 00:19:02,230

different operating systems and so here's the story and this is the quick

219

00:19:02,230 --> 00:19:08,379

telling of it but somehow about two billion plus years ago, an archaean somehow

220

00:19:08,379 --> 00:19:14,019

engulfed a bacterium. They don't know what happened. Maybe the archaean was

221

00:19:14,019 --> 00:19:20,379

trying to eat the bacterium, maybe the  
bacterium invaded the archaean, maybe the

222

00:19:20,379 --> 00:19:25,450

archaeon simply grew around the bacterium  
but somehow it wound up inside and

223

00:19:25,450 --> 00:19:29,679

instead of being digested by the  
archaeon and instead of killing the

224

00:19:29,679 --> 00:19:34,480

archaeon, the two formed a long lasting  
relationship. It turned out they were

225

00:19:34,480 --> 00:19:38,619

really good for each other because the  
archaeon provided the bacteria with what

226

00:19:38,619 --> 00:19:44,259

it needed and the bacteria provided the  
archaeon with extra energy and so it's a

227

00:19:44,259 --> 00:19:49,240

relationship that's last -- that lasted  
to this day. So on average, your cells

228

00:19:49,240 --> 00:19:53,350

might have a hundred of these  
mitochondria in them. They have their own

229

00:19:53,350 --> 00:19:59,980

DNA different from your DNA  
and and you wouldn't want to be without

230

00:19:59,980 --> 00:20:03,399

them. If you lost them you'd be in deep  
trouble. You'd be dead, you'd be literally

231

00:20:03,399 --> 00:20:09,669

dead but they're all the offsprings of  
some one bacteria from all of those years

232

00:20:09,669 --> 00:20:18,970

ago and furthermore, if you look at the  
South -- the mitochondria in any other



233

00:20:18,970 --> 00:20:20,781

living plant or animal they're

234

00:20:20,781 --> 00:20:23,799

also

the descendants so talk about successful

235

00:20:23,799 --> 00:20:28,840

offspring to have created all those

descendants. Turning our attention from

236

00:20:28,840 --> 00:20:34,960

yourselves to your atoms. So you can be

viewed as a collection of atoms and the

237

00:20:34,960 --> 00:20:39,340

interesting thing is your atoms have had

a very long history. Some of them have

238

00:20:39,340 --> 00:20:46,239

been around since the Big Bang, that's a

14 billion years ago. Some of them were

239

00:20:46,239 --> 00:20:50,889

formed after that in a process we're  
going to talk about in a second here but

240

00:20:50,889 --> 00:20:55,450

you can pick any atom in you and you can  
trace its history and you'll find it it

241

00:20:55,450 --> 00:21:01,269

has had a really interesting history. So  
pick for instance one of your carbon

242

00:21:01,269 --> 00:21:06,489

atoms. Pick a random carbon atom from your  
body. Here's one way it might have become

243

00:21:06,489 --> 00:21:10,869

part of you. You might have eaten a steak  
because you haven't had your moral

244

00:21:10,869 --> 00:21:16,299

moment of moral enlightenment yet. The

steak came from a cow. The cow got it

245

00:21:16,299 --> 00:21:21,129

from grass. The grass got it from CO<sub>2</sub>  
carbon dioxide molecules in the

246

00:21:21,129 --> 00:21:27,759

atmosphere, right? and that carbon d -- that  
one carbon atom and you might at some

247

00:21:27,759 --> 00:21:32,590

point in the past gotten into the air by  
somebody burning gasoline in a car. So it

248

00:21:32,590 --> 00:21:35,289

could have been in gasoline and of  
course before that it would have had a

249

00:21:35,289 --> 00:21:43,720

very very long history. Now so some of  
your atoms go all the way back to the

250

00:21:43,720 --> 00:21:49,179

Big Bang but you have other atoms that were formed in supernova events and so

251

00:21:49,179 --> 00:21:53,159

what happens is you get a very big star that blows up and then it creates a

252

00:21:53,159 --> 00:21:59,019

cosmic debris field of all of the matter that it's created. This is the Crab

253

00:21:59,019 --> 00:22:06,220

Nebula. It isn't where we got our items from. It's very far away from us but in

254

00:22:06,220 --> 00:22:12,110

1054, Chinese astronomers actually saw the star exploding. So it's

255

00:22:12,110 --> 00:22:18,080

an interesting thing but in there, there's the makings of planets, of other

256

00:22:18,080 --> 00:22:23,500

stars, of potentially living things.

257

00:22:23,650 --> 00:22:29,140

Here's how planets are born. They're born within one of these debris fields of a

258

00:22:29,140 --> 00:22:34,130

supernova, gravity starts pulling things together, it gets flattened into

259

00:22:34,130 --> 00:22:39,800

rotating disks of matter. In the middle you have a sun forming and around the

260

00:22:39,800 --> 00:22:45,770

edge, the periphery you have planets forming, you have moons forming. So the sun

261

00:22:45,770 --> 00:22:50,600

has a family tree. So I really got into the tree game doing this. So at the very

262

00:22:50,600 --> 00:22:56,210

top there, that's the sun's parent star.

We don't know the identity because it

263

00:22:56,210 --> 00:23:00,050

hasn't been around for maybe five

billion years and they weren't keeping

264

00:23:00,050 --> 00:23:04,400

records back then but it blew up to

create the debris field that you see

265

00:23:04,400 --> 00:23:11,000

below that and that was 4.56 plus billion years ago that it blew

266

00:23:11,000 --> 00:23:18,740

up. The debris field then combined to

create, you know, the debris field pulled

267

00:23:18,740 --> 00:23:24,080

in to create our solar system and then

you have two branches below that picture.

268

00:23:24,080 --> 00:23:29,810

On the right you have uh the Sun. So  
that's how the Sun came to be, and then

269

00:23:29,810 --> 00:23:36,260

off on the left there you have the Sun  
has a brother star. It turns out there's

270

00:23:36,260 --> 00:23:40,370

another star it so what is -- what does it say,  
a hundred and ten light-years from the

271

00:23:40,370 --> 00:23:46,220

Sun. That -- that was formed in the same  
debris field from the same star that

272

00:23:46,220 --> 00:23:50,720

blew up and how do they know that?  
Because it has the same chemistry as the

273

00:23:50,720 --> 00:23:54,860

Sun. They can analyze the chemistry and  
it's almost identically the same. So the

274

00:23:54,860 --> 00:24:00,760

Sun has a brother and if you do the math  
on that there now hundred and ten

275

00:24:00,760 --> 00:24:06,470

light-years apart and they've been  
drifting for four plus billion years. So

276

00:24:06,470 --> 00:24:12,440

they've been drifting apart at 16 miles  
an hour. Not very fast, do that for four

277

00:24:12,440 --> 00:24:19,429

plus billion years though and let that  
be a lesson to you. You know? If you and a

278

00:24:19,429 --> 00:24:25,160

brother or sister drift slowly apart  
for a long enough time there comes a

279

00:24:25,160 --> 00:24:30,200

time when reunification is essentially  
impossible. Now off to the side there,



280

00:24:30,200 --> 00:24:37,250

off to the right it turns out that the  
the Sun actually has another contributor

281

00:24:37,250 --> 00:24:42,890

of matter. There was another star that  
blew up fairly near by a few million

282

00:24:42,890 --> 00:24:47,690

years ago. The exact timing isn't right  
and some of the debris from the

283

00:24:47,690 --> 00:24:53,060

explosion actually made it to our solar  
system and is included in the crust of

284

00:24:53,060 --> 00:24:59,150

our earth. It's a an element called iron  
60 and it's very hard to find in nature

285

00:24:59,150 --> 00:25:04,010

but they find it at one level of the

Earth's crust and then they assume that

286

00:25:04,010 --> 00:25:09,890

that's what happened. That means the Sun  
is a chimera. It has two, at least, stars as

287

00:25:09,890 --> 00:25:14,840

its parent stars and as long as we're  
talking about chimeras let me back up a

288

00:25:14,840 --> 00:25:18,560

little bit. So we talked about the  
cellular you. Is anybody out there a

289

00:25:18,560 --> 00:25:24,620

mother? Okay, if you're a mother, you're a  
chimera as well. You're a human chimera

290

00:25:24,620 --> 00:25:28,970

because it's an interesting thing. If you  
carry a baby in you, what happens is some

291

00:25:28,970 --> 00:25:34,130

of the baby cells will typically lodge  
in you and will thrive there and be with

292

00:25:34,130 --> 00:25:39,350

you for the rest of your life. Okay?

That's interesting, so you're a chimera

293

00:25:39,350 --> 00:25:43,910

and that can be a very endearing thing

to think about, but it can really be an

294

00:25:43,910 --> 00:25:48,680

annoying thing to think about as well,

because you know how kids are when you

295

00:25:48,680 --> 00:25:52,880

finally get them out, they leave their

stuff behind. Have you have that

296

00:25:52,880 --> 00:25:58,010

experience? Okay, you're going to have

many after lives because there are many

297

00:25:58,010 --> 00:26:01,660

you's and each one of them is going to  
have a different afterlife. As a person

298

00:26:01,660 --> 00:26:06,710

or as at least a mind, or maybe mind and a  
body, maybe you'll go to heaven. I'm

299

00:26:06,710 --> 00:26:09,950

convinced that if you go to heaven you  
aren't going to be any happier than you

300

00:26:09,950 --> 00:26:14,330

are here on Earth because it's going  
to be the same issues and so my work on

301

00:26:14,330 --> 00:26:20,420

desire convinced me of that. You're going  
to have a cellular afterlife, so if you

302

00:26:20,420 --> 00:26:24,860

have children, those are the offspring,  
those are the descendants of your own

303

00:26:24,860 --> 00:26:29,660

cells and they will come as long as your  
kids have kids have kids your cells, the

304

00:26:29,660 --> 00:26:34,370

descendants of your cells will continue  
to live. There's a woman named Henrietta

305

00:26:34,370 --> 00:26:38,400

Lacks

who died in the 1950's I want to

306

00:26:38,400 --> 00:26:43,160

say and before she died, she died of  
cancer, before she died they took

307

00:26:43,160 --> 00:26:48,690

samples of cells and have kept them  
alive ever since. So she is achieving

308

00:26:48,690 --> 00:26:55,050

what might be a kind of cellular  
immortality. Your atomic afterlife, okay,

309

00:26:55,050 --> 00:26:58,680

sort of depends on what happens to your  
body but when you go away your atoms

310

00:26:58,680 --> 00:27:01,890

aren't going to go away. They're going to  
be around for a long long time. So

311

00:27:01,890 --> 00:27:06,900

suppose you're cremated when you  
when you die, then what happens? Well

312

00:27:06,900 --> 00:27:11,790

remember your carbon atom friends? They  
get turned back into carbon dioxide. They

313

00:27:11,790 --> 00:27:16,890

go up into the atmosphere. Who knows,  
maybe an apple tree absorbs them and

314

00:27:16,890 --> 00:27:22,650

maybe an apple tree uses that carbon to

make an apple and maybe a little girl

315

00:27:22,650 --> 00:27:29,400

has that Apple as an after-school snack  
and then goes out to play hopscotch. Well

316

00:27:29,400 --> 00:27:34,770

it's your carbon atom in a new body,  
having new experiences. So that's an

317

00:27:34,770 --> 00:27:38,670

interesting thought. In the future, the  
atomic you might once again play

318

00:27:38,670 --> 00:27:45,030

hopscotch. What does it all mean? Well  
this brings us to the meaning of life

319

00:27:45,030 --> 00:27:49,230

and I made the mistake of telling people,  
various people that at the end of my

320

00:27:49,230 --> 00:27:54,600

talk today I was going to reveal the  
meaning of life. So a lot of pressure on

321

00:27:54,600 --> 00:28:02,670

me but but here goes. Now I see we're  
running short on time here, so I'm not

322

00:28:02,670 --> 00:28:07,440

going to go in it, through it, in its  
entirety, but let me give you some bottom

323

00:28:07,440 --> 00:28:12,420

line thoughts here. First of all, so this  
question of here we are in the universe

324

00:28:12,420 --> 00:28:17,220

and the question of what's it all about  
and how did this happen? Turns into two

325

00:28:17,220 --> 00:28:21,870

different why questions. First, why is  
there something rather than nothing? It

326



00:28:21,870 --> 00:28:25,890

could have been nothing, but there isn't.  
There's something and second, given that

327

00:28:25,890 --> 00:28:30,060

there is something, why this something,  
rather than some other something? Why

328

00:28:30,060 --> 00:28:36,210

these laws of physics, why these exact  
physical constants? And I thought about

329

00:28:36,210 --> 00:28:42,210

these for a long time. My conclusion is I  
don't know. I don't know the answer, but I

330

00:28:42,210 --> 00:28:47,430

suspect that they're unanswerable and it  
has to do with the the logic of why

331

00:28:47,430 --> 00:28:51,180

questions. So the interesting thing  
about why questions is they almost

332

00:28:51,180 --> 00:28:55,800

invariably give rise to new why questions. Have any of you spent any time

333

00:28:55,800 --> 00:29:02,880

with a three-year-old lately? Okay so you can go for hours and hours answering why

334

00:29:02,880 --> 00:29:07,500

questions built off the preceding why questions and that's how parents learn

335

00:29:07,500 --> 00:29:12,750

to say just because, okay? It's just because and the same thing is true when

336

00:29:12,750 --> 00:29:17,790

you ask serious why questions about the universe. They seem to generate new why

337

00:29:17,790 --> 00:29:23,610

questions. You can also ask meaningless questions about meanings, so suppose

338

00:29:23,610 --> 00:29:28,200

somebody came up to you and said what's  
the meaning of a pencil, right? It sounds

339

00:29:28,200 --> 00:29:32,910

like a question of legitimate question.  
It's grammatically correct but your

340

00:29:32,910 --> 00:29:37,800

answer should be that pencils themselves  
don't have any meaning. They don't have

341

00:29:37,800 --> 00:29:42,570

meaning, but they can be used to do  
meaningful things like perhaps write a

342

00:29:42,570 --> 00:29:47,550

sonnet. Same thing can be said of your  
life, so if you say what's the meaning of

343

00:29:47,550 --> 00:29:52,470

life? Tough question, I don't have an

answer and I don't think you should be

344

00:29:52,470 --> 00:29:55,980

spending your time trying to answer it.

Instead you should be spending your time

345

00:29:55,980 --> 00:30:02,790

seeking meaning in life. You should

write a sonnet with your life perhaps or

346

00:30:02,790 --> 00:30:09,720

maybe a limerick depending, and in

conclusion you're actually lucky to be

347

00:30:09,720 --> 00:30:15,680

here. You're here because of this series

of unexplainable events. Series of

348

00:30:15,680 --> 00:30:21,480

freakishly strange events like I told

you about the big gulp. You're here

349

00:30:21,480 --> 00:30:26,640

because your parents chose to have a  
sexual act, when they did, in the manner

350

00:30:26,640 --> 00:30:32,880

that they did, so that the egg and sperm  
that created you could unite. Make small

351

00:30:32,880 --> 00:30:39,330

changes and and you're no longer here. That's  
somebody else in your place. So I

352

00:30:39,330 --> 00:30:44,460

encourage you, if you're having a slack  
moment in the day and you're saying man

353

00:30:44,460 --> 00:30:51,450

this life, I'm not sure if it's really my  
cup of tea anymore, stop and think about

354

00:30:51,450 --> 00:30:57,270

the process of gotcha here. It's an  
absolute remarkable tale and you're just

355

00:30:57,270 --> 00:31:02,450

the latest chapter in the story.

Thank you very much, and I've been told I

356

00:31:02,450 --> 00:31:09,450

have time for questions, maybe? Yeah. So

my question addresses where do you end?

357

00:31:12,280 --> 00:31:19,190

And what I discern from your talk is vegetarianism, brothers and sisters are very

358

00:31:19,190 --> 00:31:26,240

important, appreciation of the miracle

that all the conditions required that

359

00:31:26,240 --> 00:31:30,950

had transpired for us to be who and what we are.

And embracing and embracing the mystery.

360

00:31:30,950 --> 00:31:42,620

Embracing so that it sounds like much of the book is descriptive in terms of this miracle transpiring what makes us us, and then some of the

361

00:31:42,620 --> 00:31:46,100

end was more of prescriptive,  
normative, recommendations? Or is it like

362

00:31:46,100 --> 00:31:51,860

hey,vegetarianism, brother and sister, and the  
miracle life appreciation or is it more

363

00:31:51,860 --> 00:31:57,320

prescriptive longer thing to come at the  
end that say hey, here's what you should take from this? Oh, well the book is

364

00:31:57,320 --> 00:32:01,850

eighty thousand words long and I've  
narrowed it down to a 30 minute talk, so

365

00:32:01,850 --> 00:32:05,330

there's a whole a whole bunch of stuff  
and that the amazing thing was when I

366

00:32:05,330 --> 00:32:10,250

was creating this talk how much really  
great stuff I had to throw out. So it's

367

00:32:10,250 --> 00:32:14,870

an incredible story. The story stands on  
its own two legs and I'm not sure

368

00:32:14,870 --> 00:32:22,340

scientists have succeeded in telling it  
in the full of vitality in which it can

369

00:32:22,340 --> 00:32:26,000

be told, but then the interesting thing  
is so I'm doing all this science but I'm

370

00:32:26,000 --> 00:32:29,809

hovering above it like a like a  
philosopher would and just making

371

00:32:29,809 --> 00:32:37,850

comments and making linkages and so and again, I'm pretty close. The ending you

372

00:32:37,850 --> 00:32:42,200

know that that is the conclusion I've  
drawn from this, and I've given it a fair



373

00:32:42,200 --> 00:32:48,440

amount of thought. You've got this life  
to live and you've got choices and and

374

00:32:48,440 --> 00:32:54,559

the interesting thing is the choices you  
make can have a profound impact on the

375

00:32:54,559 --> 00:32:59,210

value you take. So the vegetarian is  
aside but you know I'm also a practicing

376

00:32:59,210 --> 00:33:06,440

stoic besides vegetarian and and one of  
the big things there is ,you know, one of

377

00:33:06,440 --> 00:33:08,690

the ways to learn to love your life is  
to

378

00:33:08,690 --> 00:33:13,580

is to realize how much worse things  
could have been and then you have an

379

00:33:13,580 --> 00:33:17,270

appreciation because if you don't do  
that then you just take whatever you've

380

00:33:17,270 --> 00:33:22,460

got as your ground zero, when you say I  
want more, I want more. Which is a life of

381

00:33:22,460 --> 00:33:32,630

dissatisfaction. Does mitochondria have its own DNA, or [...] Yeah we have they now  
have lost a bunch of their DNA, they're

382

00:33:32,630 --> 00:33:36,890

down to like 13 genes but it is their  
DNA. It's different from ours and then

383

00:33:36,890 --> 00:33:40,730

because we give them so much great stuff,  
why should they do it? So they're like

384

00:33:40,730 --> 00:33:47,360

spoiled children in that respect. [unintelligible] No.

All of your mitochondrial DNA unless

385

00:33:47,360 --> 00:33:51,140

there was some kind of genetic defect,  
would have the same, although your

386

00:33:51,140 --> 00:33:55,580

mitochondria would have the same DNA, all of the nuclei of your cells what you would

387

00:33:55,580 --> 00:34:00,280

call your DNA would have the same DNA. Would that be different from [...]

388

00:34:00,970 --> 00:34:07,640

Yeah, yeah, okay, yeah. I'll say yeah, and  
you know what? You can email me if you

389

00:34:07,640 --> 00:34:13,540

prove me wrong and then I'll just make

the change, that would work fine. Yeah. The interesting thing about mitochondria DNA is that it's passed  
down from your mother,

390

00:34:15,570 --> 00:34:16,070

just because it's actually with the egg and so everybody's mitochondria that we have is

391

00:34:20,355 --> 00:34:23,600

internal linkages, and so you move that back and trace when there's first an essence

392

00:34:23,600 --> 00:34:25,600

internal linkages, and so you move that back and trace when there's first an essence [...]

393

00:34:34,849 --> 00:34:43,589

yeah and you could do the same thing  
with the the male equivalent. Yes. So I think

394

00:34:43,589 --> 00:34:47,760

it's great that somebody in the  
humanities is writing about the history of science

395

00:34:47,760 --> 00:34:56,520

for many reasons like a part of it  
really needed and interesting to see how you manage that and I guess that

396

00:34:56,520 --> 00:35:00,329

part of my question is how you know  
could you talk a little bit about your

397

00:35:00,329 --> 00:35:05,010

pressed process of basically teaching yourself some things and with you know

398

00:35:05,010 --> 00:35:10,140

totally different fields and engaging  
with it in a way that brings the methods

399

00:35:10,140 --> 00:35:17,250

and that content [...] Yeah, I don't want to  
mislead you, I've never had so much fun

400

00:35:17,250 --> 00:35:22,680

as doing the research for this because  
well I mean what you find is you have to

401

00:35:22,680 --> 00:35:26,700

go very deep so you can talk in a  
shallow manner about something. You have

402

00:35:26,700 --> 00:35:31,890

to understand that the deeper thing, so  
you know I have all my life had a deep

403

00:35:31,890 --> 00:35:39,240

interest in science and I have this  
phenomenon. I call it literary pregnancy,

404

00:35:39,240 --> 00:35:45,569

where I realize I'm getting heavy with  
book and so I noticed one of the things

405

00:35:45,569 --> 00:35:50,910

I noticed is that I was collecting  
material and then you realize you got a

406

00:35:50,910 --> 00:35:54,809

file in your computer, you realize you're  
periodically sticking things into the

407

00:35:54,809 --> 00:35:59,369

file, and then one day it dawns on you. Oh  
there's a book! there's a book, and that's

408

00:35:59,369 --> 00:36:05,190

what happened with this but I got to  
ransack science and I got -- I became a

409

00:36:05,190 --> 00:36:11,940

really very key reader daily of science news and science discoveries. It's such

410

00:36:11,940 --> 00:36:18,029

great stuff, it really is. So I'm a curious guy in both senses of the word

411

00:36:18,029 --> 00:36:23,819

and so this idea of getting to wake up and find out some new and exciting and

412

00:36:23,819 --> 00:36:29,579

so so on many occasions I mean I would be kind of angry, you know? Why did no one

413

00:36:29,579 --> 00:36:34,799

tell me this? This is such a wonderful aspect of our universe! Why did they keep

414

00:36:34,799 --> 00:36:37,859

it a secret and of course they didn't.

They've been trying to tell me all my

415

00:36:37,859 --> 00:36:40,519

life it's just

I finally became receptive and listened

416

00:36:40,519 --> 00:36:45,950

to what they were saying but I'm kind of  
going to miss the project. So this

417

00:36:45,950 --> 00:36:52,250

project has been at Oxford University  
Press but their science editor, not

418

00:36:52,250 --> 00:36:59,059

their philosophy editor for like five  
months now and they keep saying any day

419

00:36:59,059 --> 00:37:04,279

now and my own experience has led me to  
believe that that either means that it

420

00:37:04,279 --> 00:37:09,019



could happen any day now or that simply  
is their way of saying no, but we aren't

421

00:37:09,019 --> 00:37:13,609

actually going to tell you. We're going  
to burn up months of your life.

422

00:37:13,609 --> 00:37:19,970

Right? So it can go either way. So we'll  
see. What? [...] Oh it's incredible and you kind

423

00:37:19,970 --> 00:37:21,970

of wonder, but there you go. You have to make the best of it. Yes! Yes, that's true. Look out

424

00:37:29,630 --> 00:37:35,200

University of Chicago Press, yeah, I'll make  
the best of it, absolutely. Anything else?

425

00:37:35,200 --> 00:37:45,079

Well thank you very much for your  
attention. Thank you and thank you

426

00:37:45,079 --> 00:37:50,000

everybody for coming today. We really appreciate your presence. I love hearing

427

00:37:50,000 --> 00:37:54,349

all about the diversity of the research that goes on in the College of Liberal

428

00:37:54,349 --> 00:37:58,339

Arts and Sciences and I think we actually got quite a taste of what goes

429

00:37:58,339 --> 00:38:03,890

on in the departments of religion, philosophy, and classics today so thank

430

00:38:03,890 --> 00:38:06,640

you and have a great day.