

0:00 Life is fundamentally different from dead stuff—or is it?  
0:04 Physicist Erwin Schrödinger defined life this way:  
**0:07 Living things avoid decay into disorder and equilibrium.**  
0:13 What does this mean?  
0:14 Let's pretend that your download folder is the universe.  
0:17 It started orderly and got more and more chaotic over time.  
0:21 By investing energy, you can create order and clean it up.  
0:25 This is what living things do.  
0:27 But what is life?  
0:36 Every living thing on this planet is made of cells.  
0:39 Basically, a cell is a protein-based robot too small to feel or experience anything.  
0:45 It has the properties we just assign to life:  
0:48 it has a wall that separates it from the surroundings, creating order;  
0:51 it regulates itself and maintains a constant state;  
0:55 it eats stuff to stay alive;  
0:58 it grows and develops;  
1:00 it reacts to the environment;  
1:01 and it's subject to evolution;  
1:04 and it makes more of itself.  
1:06 But of all the stuff that makes up a cell, no part is alive.  
1:10 Stuff reacts chemically with other stuff, forming reactions  
1:15 that start other reactions which start other reactions.  
1:18 In a single cell, every second several million chemical reactions take place,  
1:23 forming a complex orchestra.  
1:25 A cell can build several thousand types of protein:  
1:28 some very simple, some complex micromachines.  
1:32 Imagine driving a car at 100 km/h while constantly rebuilding every single  
1:37 part of it with stuff you collect from the street.  
1:40 That is what cells do.  
1:43 But no part of the cell is alive; everything is dead matter  
1:46 moved by the laws of the universe.  
1:49 So is life the aggregate of all these reaction processes that are taking place?  
1:55 Eventually, every living thing will die.  
1:58 The goal of the whole process is to prevent this by producing new entities;  
2:03 and by this, we mean DNA.  
2:06 Life is, in a way, just a lot of stuff that carries genetic information around.  
2:10 Every living thing is subject to evolution,  
2:12 and the DNA that develops the best living thing around it will stay in the game.  
2:18 So, is DNA life, then?  
2:20 If you take DNA out of its hull, it certainly is a very complex molecule,  
2:25 but it can't do anything by itself.  
2:28 This is where viruses make everything more complicated.  
2:32 They are basically strings of RNA or DNA in a small hull  
2:36 and need cells to do something.  
2:38 We're not sure if they count as living or dead.  
2:41 And still, there are 225,000,000 m<sup>3</sup> of viruses on Earth.  
2:47 They don't seem to care what we think of them.  
2:49 There are even viruses that invade dead cells and reanimate them  
2:53 so they can be a host for them, which blurs the line even more.  
2:58 Or mitochondria.  
2:59 They are the power plants of most complex cells and  
3:03 were previously free living bacteria that entered a partnership with bigger cells.  
3:08 They still have their own DNA and can multiply on their own, but

3:12 they are not alive anymore; they are dead.  
3:16 So they traded their own life for the survival of their DNA,  
3:20 which means living things can evolve into dead things as long as it's beneficial  
3:25 to their genetic code.  
3:27 So, maybe life is information that manages to ensure its continued existence.  
3:33 But what about AI (artificial intelligence)?  
3:37 By our most common definitions, we are very close to creating artificial life  
3:42 in computers.  
3:43 It's just a question of time before the technology we build gets there.  
3:47 And this is not science fiction, either;  
3:49 there are a lot of smart people actively working on this.  
3:53 You could already argue that computer viruses are alive.  
3:56 Hm, okay. So what is life, then?  
4:00 Things, processes, DNA, information?  
4:04 This got confusing very fast.  
4:08 One thing is for sure:  
4:09 the idea that life is fundamentally different from non-living things  
4:13 because they contain some non-physical element  
4:15 or are governed by different principles than inanimate objects  
4:19 turned out to be wrong.  
4:21 Before Charles Darwin, humans drew a line between themselves and the rest  
4:26 of living things; there was something magical about us that made us special.  
4:31 Once we had to accept we are like every living being, a product of evolution,  
4:35 we drew a different line.  
4:38 But the more we learn about what computers can do and how life works,  
4:41 the closer we get to creating the first machine that fits our description of life,  
4:46 the more our image of ourselves is in danger again.  
4:49 And this will happen sooner or later.  
4:52 And here's another question for you:  
4:54 if everything in the universe is made of the same stuff,  
4:57 does this mean everything in the universe is dead  
5:00 or that everything in the universe is alive?  
5:03 That it's just a question of complexity?  
5:06 Does this mean we can never die  
5:08 because we were never alive in the first place?  
5:11 Is life and death an irrelevant question and we haven't noticed it yet?  
5:15 Is it possible we are much more part of the universe around us than we thought?  
5:20 Don't look at us; we don't have any answers for you.  
5:22 Just questions for you to think about.  
5:25 After all, it's thinking about questions like this that makes us feel alive  
5:29 and gives us some comfort.  
5:54 Subtitles by the Amara.org community