

Leaders in Mathematical Thinking

Steven Strogatz - The Math in Six Degrees of Separation

>> The phenomenon of six degrees of separation, where we're all connected to each other on this planet through short chains of acquaintances -- someone knows someone who knows someone, you know -- that we're all just six handshakes apart or less, for a long time that was an urban myth, but except that it's true. I mean, it was an urban legend, I guess I should say. But it's actually true, and we know that it's true now, because Facebook has measured it, for one thing. I mean, we had earlier experiments that measured it, but on Facebook, you're only about four to five handshakes, or friends, Facebook friends, away from anybody else on Facebook -- which is still just the Facebook portion of the world, but that's about a quarter of the whole world, now. So it's true that part of the developing world is not on Facebook, sure, but still, a large fraction of the developed world is. And it's incredible how small the world is, and we know that now, mathematically, quantitatively. But we still don't have good intuition for it. Like, how can that be? And one of the things that I worked on with my student, Duncan Watts, years ago, was trying to find the math that could explain six degrees of separation, or this phenomenon that people call the "small world" phenomenon in social networks. And was tossed the most surprising, or really I think now in retrospect, important part of what we did is the idea that six degrees is not really about people and social networks. It's a quite universal phenomenon about all gigantic, complex networks. Whether, for instance, the neurons in your brain, the nerve cells, the brain cells, that make your brain the most powerful computing device in the universe, as far as we know. That's not because each individual neuron is so powerful. They're relatively slow, compared to a computer chip. They don't have very good memory. But the thing is that we have something like a hundred billion of those brain cells, and they're connected in some intricate way that makes them phenomenally powerful as a group. And if you ask, do they obey a six degrees of separation principle? They do. That is, we haven't mapped out the brain, but from studying simpler nervous systems of other creatures, we know that every brain cell, or every neuron, is just a few synapses, a few connections away from every other. So this also has a practical implication for people with Parkinson's, or Alzheimer's that scientists are now working on, the brain structures of people with these abnormal conditions with pathologies. And they're finding that the connectivity is different. So six degrees is now being used in neurology to help us diagnose in a very non-invasive way through functional MRI, as it's called, where we look at brain activity in different regions. What people are at risk for schizophrenia, or Parkinson's, Alzheimer's, and so on? So it's an interesting case, where a pure math question that comes out of, try and understand six degrees in a social network is having important medical implications.