

## **Ask A Genius 31 - Informational Cosmology 7**

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**Scott: In informational cosmology, what is the bias towards complexity, towards information, towards order – negentropy?**

Rick: I think one of the biggest discoveries in physics was the discovery of entropy, which is the measure of order or disorder within a system and entropy being the tendency of things to move from order to disorder.

However, understandings of entropy can be a little wobbly. That can happen when you talk about negentropy, which is the increase in disorder in a system. Negentropy is even more wobbly than entropy. I am not sure how pinned down beyond the definition people's understanding is. I am sure for most people it is not even a word.

In an even more general sense, we are talking about the increase in order in a system, which strikes scientifically minded people as wrong because they have the idea of increasing entropy or disorder pounded into their head that a cup of coffee can't heat up for no reason. That it has to be lukewarm or the temperature of the room.

That the universe will keep expanding, keep cooling down, and stars will run out of energy and the universe will have a lukewarm death. So, the idea that order can increase, even though we

live on a planet where order has increased to create us, life, and everything else on the planet, it strikes people as weird.

Entropy applies to closed systems, in systems in which order can increase involves open systems in which you can shed waste heat that sheds noise. If you can get rid of the waste heat, you can have nice stuff like us.

Entropy is such a powerful idea that it has been extended to the entire universe and even though entropic characteristics of the universe are somewhat contradictory. The universe seems to have some very unentropic characteristics. It, according to the Big Bang, exploded from a point or expanded from a point, but even at that young, chaotic age had to have gone from being a big hot mess to being a very ordered place.

Things mostly don't crash into each other like galaxies in which life arises, at least like ours. There are arguments to be made that you can set up a universe-scale system, or systems, that can be unentropic as long as you're able to get rid of excess energy.

In fact, the universe has ways of getting rid of excess energy. That is the loss of energy via photons as they traverse billions of light years. Photons turn red as they traverse the gradient of space.

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