### Student Reading - Complexity and Thresholds (modified)

By David Christian, adapted by Newsela

*\*David Christian is an American historian and scholar credited with creation of the term, “Big History.”*

Our Universe first appeared 13.8 billion years ago. The things that existed were quite simple at first. Since then, more and more complex things seem to have appeared. Human beings are one of the most complex things of all. So it’s natural that we're very curious about complex things. Learning how the Universe creates complex things can also teach us something about the way we live now.

#### **What does complexity mean?**

That’s a tough question. There’s no single answer. Empty space is much simpler than a star. A human being is in some sense more complex than an amoeba, which is made of just one cell. But what does that really mean?

Complexity is a quality, like “hot” or “cold.” Things can be more or less simple and more or less complex. Imagine a range. At one end is pure simplicity. One example is the space in between galaxies, where there's nothing but cold emptiness. At the other end of the range is something very complex like a modern city.

#### **The qualities of more complex things**

Here are three qualities that make some things more complex than others.

* **Different types of ingredients:** More complex things often have more bits and pieces. And those bits and pieces don't tend to be alike.
* **Exact arrangement:** In simpler things it doesn’t matter too much how the ingredients are arranged. Complex things, however, need their the bits and pieces arranged just right. Picture a car on the road. Now imagine that same car after it’s been taken apart in a junkyard. There's quite a difference.
* **Emergent properties:** Once the ingredients are arranged correctly, they can do things that they couldn’t do when they weren’t arranged. A car can get you around. But the parts that make up a car cannot. A car’s ability to move around is a quality that “emerges” or comes about once it’s put together right.

#### **Goldilocks Conditions**

You find complex things only where the conditions are just right for making them. It must be the right environment, with just the right ingredients, and just the right energy flows. We call these conditions “Goldilocks Conditions.” Remember the story of the three bears? Goldilocks enters their house when they are out. She tastes their porridge and finds that the father bear’s is too hot, the mother bear’s is too cold, but the baby bear’s is just right. Complexity seems to happen only where the conditions are “just right.” So whenever we see complex things appearing we can ask why the Goldilocks Conditions were “just right.”

Here’s an example. You always need energy. So if there’s no energy flowing, it’s hard to build complexity. Think of a still, calm lake that’s been dammed. Not much is happening. Then imagine opening the gates of the dam and allowing the water to flow downhill. Now you can run a power plant to make electricity. Now, more complex things can happen. But of course there mustn’t be too much energy. If there’s too much water pressure then the power plant will be destroyed. So you need just the right amount of energy — not too little, not too much.

#### **Thresholds of increasing complexity**

In the history of the Universe, “threshold moments” are moments when more complex things seemed to appear. The appearance of the first stars in a Universe that had no stars is one example of a threshold moment. The appearance of the first cities in societies that had never known cities before is another such moment.

**Source:** [The Big History Project - https://school.bighistoryproject.com/pages/console/?clientkey=54805#media/{68395B20-898A-4A60-A717-AF65BB19B0B8}](https://school.bighistoryproject.com/pages/console/?clientkey=54805#media/%7B68395B20-898A-4A60-A717-AF65BB19B0B8%7D)