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# COMPLEXITY & THE FUTURE

13.7 billion years ago

5 billion years ago

1 billion years ago

1 million years ago



BIG HISTORY PROJECT

# COMPLEXITY & THE FUTURE

A HISTORIAN CONTEMPLATES  
COMPLEXITY, FRAGILITY, AND  
SUSTAINABILITY

By David Christian

After carefully considering the past, the study of big history inevitably leads to the future — a future that may see increasing complexity on Earth and an ultimate trend toward simplicity in the Universe.

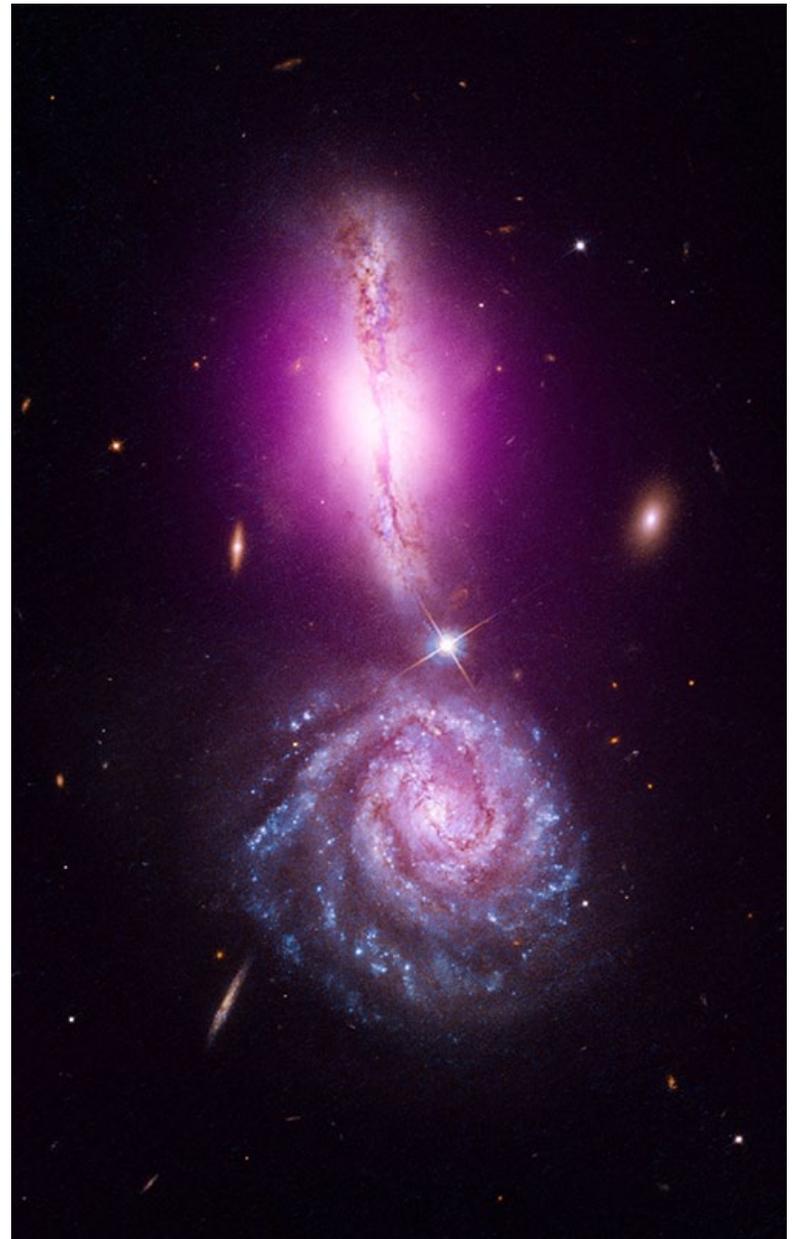
## What's next?

Well, we've covered almost 14 billion years but we're still not quite done. So what's next? Oh, yes, the future! Of course, the future's probably going to be a lot longer than the past. In fact, the latest estimates suggest that the Universe will continue to exist in some form more or less forever, so the period you've covered in this course will look like just the appetizer.

Historians don't normally talk about the future for the very good reason that, unlike the past, it is unpredictable. However, in a big history course you can't really avoid it. After all, we've been looking at huge trends: the expansion of the Universe, increasing complexity, the movements of tectonic plates, expanded human energy consumption, and global warming among them. Trends as large as these don't stop on a dime. They're more like an oil tanker cruising at top speed with a full tank; try to stop it by slamming the engines into reverse and it will sail on for several kilometers before it comes to a halt. So it's useful, for predictive purposes, that they will continue into the future; they can help us learn a few things about what's coming next. Besides, the near future — specifically the next 100 years or so — really matters! This will be the time that you, your children, and your grandchildren will be living in. And what the future is like will depend in part on what we do now. So in a sense, this is the point when you and your generation will start taking over the story of big history.

## The deep future

The easiest trends to predict are the simplest and the most prominent. At the greatest scale, we know the Universe is expanding and we believe it is trending toward simplicity. In the late 1990s, astronomers found that the rate of expansion of the Universe seems to be increasing as the Universe gets larger. So it looks as if the Universe will get larger and larger. This means that eventually the Universe could also start getting simpler and simpler as it gets harder and harder to build complex things. Tens or hundreds of billions of years in the future, the gaps between clusters of galaxies will increase



Will Andromeda and the Milky Way collide like the two spiral galaxies shown here?

until each cluster will seem to be alone. By then, stars will slowly be shutting down as they run out of hydrogen, and the lights will start turning off.

Some stars will glow like embers for hundreds of billions of years, but slowly and inexorably, each cluster of galaxies will turn into a vast, mostly empty cosmic graveyard, whose surviving bits and pieces will be pulled together into vast black holes until eventually even these will decay as the Universe gets emptier and emptier. But that's incredibly far in the future. Meanwhile, it seems that we live in a young Universe that still has plenty of energy to build increasingly complex things.

How about the Solar System? In 3–4 billion years our galaxy will begin a slow collision with its closest large neighbor, Andromeda. At about the same time, our Sun will run out of hydrogen, swell up into a red giant like Betelgeuse, gobble up the inner, rocky planets (including Earth), and then collapse and die. It is not large enough to explode in a supernova, but in its final years it will create some carbon and maybe also some oxygen and nitrogen.

As for our Earth, in just a few tens or hundreds of millions of years, plate tectonics will rearrange the continents: the Pacific will narrow, bringing Australia closer to the Americas, and the Atlantic will expand to form the largest of the oceans.

Will humans still be around? That depends what you mean by "humans." In just a century or two we may already be able to genetically engineer ourselves in ways that might look really strange and alien to our generation. Perhaps, by then, some of our descendants will also be living, with their robots, on the Moon or on Mars or on some of the moons of Jupiter or Saturn. It will probably take many centuries before they can settle planets around other star systems, though in just the last few years we have learned that they will have a large choice of possible planets to settle.

## The near future

But the future that matters most to us is the near future, the next hundred years or so. And here, unfortunately, prediction is much more difficult. The pace of change has accelerated so fast that things can sometimes seem out of control. There are quite a few worrisome trends that could threaten the future of our children and grandchildren: the increasing consumption of ever-scarcer resources (such as water, farmland, and fossil fuels); growing rates of extinction of other species; the progressively destructive power of weapons; the acidification of the oceans; and the rapid escalation of greenhouse gas emissions. If we cannot bring these changes under control, future generations will face serious challenges that may drastically reduce their standards of living and could even threaten their existence. So you could argue that we live in bleak and dangerous times.

On the other hand, it is not hard to list many positive trends: levels of interpersonal violence are lower than ever in human history; the chances of a child living a long and healthy life are greater than ever before, as are the chances of getting a good education; more and more governments are elected and include their people in the decision-making process. So, if you wanted to, you could argue that we live in the best possible period of human history.

Will our descendants enjoy lives that are richer, more fulfilled, healthier, and in general better than those of today? Or will human societies collapse under the strain of depleted resources, brutal conflicts, and environmental damage?

The answer will depend, in part, on choices made by your generation. And there is one very good reason to be optimistic about our chances: our increasing ability to learn collectively. We've seen that the power of collective learning seems to have accelerated throughout human history. And we've seen how its capacity to generate new technologies, new ideas, and new solutions depends on the size of human societies, on their diversity, and on their connectedness. Today's global society is larger than any earlier society; it contains a colossal variety of skills and knowledge; and it's connected globally through the Internet, an intricate transportation network, worldwide



media, and international corporations and institutions. Even a century ago, the global connectedness of our world would have seemed unimaginable; the idea of the Internet would have been pure science fiction!

So it's certainly true that we face big problems. But we also have good reasons to think that our astonishing capacity for collective learning will help us to overcome most of our problems and ensure that our descendants will live at least as well as us and perhaps even better. Surely the combined efforts of more than seven billion humans can overcome the challenges we face as a species.

Threshold 8 gave us the explosion of new technologies that made us the most powerful species on Earth and allowed us to consume more and more of the Earth's resources. Threshold 8 gave us the "Anthropocene." What will the next major threshold of increasing complexity be? Will it involve us humans using collective learning to build a world in which we live more sustainably with the biosphere? One very good trend we can see right now is a slowing of the rate of human population growth. For several centuries, human numbers have increased faster than ever before, but in the late 20th century it became clear that those rates are slowing, and they are slowing quite fast. Many demographers expect that human numbers will settle at about nine to 10 billion in the next 100 years and then, perhaps, begin to fall. Is that a first hint of a more sustainable future?

And now, over to you! When your great-grandchildren study big history in a hundred years, what would you like them to be saying about the achievements of your generation? What do you think the future holds?

## Image credits

The Rho Ophiuchi star-forming region,  
NASA/JPL-Caltech/Harvard-Smithsonian CfA

Hong Kong, China, at night  
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Colliding galaxies, called VV 340, in the Boötes constellation,  
X-ray NASA/CXC/IfA/D. Sanders et al; Optical NASA/STScI/NRAO/A.  
Evans et al

The “Blue Marble,”  
NASA Goddard Space Flight Center