

Rethinking Matter and Time

Curricular Materials Prepared by
Matthew Riley
Research Assistant, Forum on Religion and Ecology at Yale

Index:

- *Journey of the Universe* Book: Chapter 10: Rethinking Matter and Time.
- *Journey of the Universe* Film: N/A.
- *Journey of the Universe* Educational Series: N/A.

Scientific Summary:

“Deterministic realism” is the name that we give to a particular worldview that understands reality to be composed of inert, mathematically predictable matter. Originating in the dramatic scientific insights of sixteenth and seventeenth century thinkers, deterministic realism can be thought of as having three core presuppositions: First, it assumes that all things in the universe are made up of tiny bits of inert matter. Second, these bits of matter are assumed to be entirely material and devoid of subjectivity. And, third, it postulates that the movement and composition of these bits of matter can be measured and predicted through mathematical laws. While this worldview has allowed us to make advances in science and technology, it is also a way of viewing the world that allows us to act in destructive ways towards the environment and other living beings.

A number of history’s great scientists fall within the tradition of deterministic realism. Galileo, one of the first scientists to think in this manner, formulated the first mathematical expressions for the motion of falling matter. Isaac Newton continued in this tradition when he used observation and mathematics to accurately predict the motion of the planets revolving around the sun. His publication of *Principia Mathematica Philosophiae Naturalis* in 1687 was a groundbreaking moment in deterministic realism. Contained within it were several of Newton’s well-known observations such as his laws of motion, his law of universal gravitation, and much of what would later be considered the foundation of classical mechanics.

It was not until the twentieth century that scientists began to rediscover that matter was more than just inert “stuff.” Whereas sixteenth and seventeenth century thinkers such as Rene Descartes and Francis Bacon viewed the world as a machine run by natural laws, twentieth century chemists such as Ilya Prigogine discovered that even chemical molecules have the capacity for intrinsic self-organizing. He discovered that trillions of molecules could organize themselves into complex patterns and that they could do so without the instructive patterns of DNA or the organizing power of the animal mind.

In addition to rethinking matter as subjective and as more than inert “stuff,” scientists are also beginning to come to new understandings of time. One way to view time differently is to view the progression of time as a measure of the creative emergence of the universe. James Hutton and Charles Lyell were the first to recognize that the Earth was part of a multi-billion year process of geological development. Another nineteenth century thinker, Charles Darwin, is

well known for his descriptions of the vast depths of evolutionary time. Later, in the twentieth century, Hubble and Einstein extended this epoch-oriented view of history to the emergence and development of the universe itself.

Discussion Questions:

1. As you rethink matter and time, reflect upon what it means to you to live in cosmological time. How is thinking like this different than your previous understanding of time? What implications does it have for your understanding of yourself and your sense of your relation to the world around you?
2. Take an image, scene, or paragraph from *The Journey of the Universe* film, book, or Educational Series that you feel conveys an important idea in regards to matter and time. Using an appropriate medium (i.e. prose, poetry, dance, painting, music, the spoken word, etc.), reformulate and express this idea in your own way. After doing so, reflect on how that helped you to better understand matter and time.
3. It might be said that the average person lives his or her life in a way that is consistent with the assumptions of deterministic realism. How might reformulating our notions of matter and time cause us to make decisions differently or to value things like rocks and trees in new and unfamiliar ways? What might some of the advantages be of thinking in such a way? What are the disadvantages?

Online Resources:

- For a better understanding of Big History, there is no better place to start than the [Big History Project](#). An immensely useful website, they provide a number of useful guidelines and resources such as [course themes](#), [timelines](#), and a [syllabus](#).
- Finding a reliable encyclopedia online can be difficult. One reputable – and free – online resource that educators might find useful is the [Stanford Encyclopedia of Philosophy](#). Entries include articles on Newton's *Principia Mathematica Philosophiae Naturalis*, differing views of [space and motion](#), and one on Einstein's theory of [General Relativity](#).
- A number of scientific authors have reached wide audiences by writing about matter, space, and time. Try this article on the [beginning of time by Stephen Hawking](#) or this [New York Times article on time by Brian Greene](#).
- The [TED](#) series can be an excellent source of information from top scientists. This talk by [David Christian](#), author of *Maps of Time*, challenges and revises how we look at the history and development of life in relation to a broader cosmic timeline.
- Interested in Ilya Prigogine? Watch this video of him talking about [complexity](#) or read a copy of his [Nobel lecture](#) given in 1977.

Print Resources:

- [Journey of the Universe Bibliography](#).
- [Science Bibliography from the Yale Forum on Religion and Ecology](#).

Select Bibliography:

- Christian, David. *Maps of Time: An Introduction to Big History*. Berkeley: University of California, 2004.
- Duncan, Todd and Craig Tyler. *Your Cosmic Context: An Introduction to Modern Cosmology*. Addison-Wesley, 2009.
- Liebes, Sidney, Elisabet Sahtouris, and Brian Swimme. *A Walk Through Time: From Star Dust to Us*. New York: John Wiley, 1998.
- Swimme, Brian and Thomas Berry. *The Universe Story*. San Francisco: Harper San Francisco, 1992.
- Toulmin, Stephen and June Goodfield. *The Discovery of Time*. Chicago: University of Chicago Press, 1977.