

Life's Emergence

Curricular Materials Prepared by
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Index:

- *Journey of the Universe Book*: Chapter 5: Life's Emergence.
- *Journey of the Universe Film*: Scene 5: The Emergence of Life
- *Journey of the Universe Conversations*: Disc 2 – Program 5: Life's Emergence.

Scientific Summary:

The first simple cells to emerge on planet Earth came into being approximately three and a half to four billion years ago when the Earth was still in a state of great upheaval and creativity. It is from these earliest cells, and from their ancestors, that all forms of life on earth descended. After roughly two billion years, these simple life forms evolved into more complex cells with nuclei and differentiated organelles.

Living cells today exist in a great diversity, but we can generally classify living cells into two groups: eukaryotes and prokaryotes. Cells with nuclei are referred to as eukaryotes. Complex multi-cellular creatures such as humans, the tomato plant, or the red-tailed hawk have eukaryotic cells. Those cells without nuclei, such as bacteria, are called prokaryotes. Though usually unicellular and invisible to the human eye, prokaryotes make up the bulk of life on planet earth.

Although they are very simple in comparison to multi-cellular creatures living on Earth today such as the crow or the Asian elephant, even the simplest of cells have a sense of awareness regarding their surroundings. This awareness allows them to interact with their environment and to make intelligent choices as to how to respond to it. All cells and all unicellular organisms have a cell membrane that surrounds them like a skin. Embedded within each membrane is a series of proteins, two of which are called receptor proteins and channel proteins. When the cell membrane comes into contact with something, say a bit of mineral or water, the receptor protein reacts. If it is something desirable to the cell, for example something it can use as food, then the cell membrane will attach itself to the material that it wants to ingest. Next, a channel protein causes a brief opening on the surface of the membrane in order to allow that material to pass through the membrane into the interior of the cell. More often than not, however, the receptor cells do not come into contact with desirable material and thus the cell stays closed. What is critical to note here is that the cell is making a discernment; it is choosing what to ingest and what to block out.

Photosynthesis is another key component of life on Earth. It allows a great transformation and transportation of energy to occur, and is also yet another way in which life as we know it is linked directly to the Sun. Plants, and some other organisms such as some forms of bacteria, contain within them organelles (i.e. small specialized organs) called chloroplasts. Within each chloroplast is a biomolecule called chlorophyll.

While chlorophyll molecules give many plants their green color, they also begin a conversion process whereby sunlight is used to transition electrons to a higher energy state. When struck by photons (small units of light), chlorophyll sets off a chemical cascade that eventually results in the creation of powerhouse molecules in the cell. These powerhouse molecules are what enable the plant to grow and develop, even to live. By the power of photosynthesis, every plant on Earth is suffused with energy coming directly from a nearby star, our Sun.

Discussion Questions:

1. How does thinking about unicellular organisms as possessing discernment change the way in which you perceive the world? What practical implications, if any, does this have for your daily life, for thinking about your place in the larger story of the universe, or for the way in which speak and think?
2. “To commune,” write Swimme and Tucker in the *Journey of the Universe* book, “may be one of the deepest tendencies in the universe” (51). What questions does this statement awaken within you? Explain how you interpret this statement in terms of your own life and experience.
3. The *Journey of the Universe* book describes the evolution and creation of life on Earth as being “nested” in the larger processes that preceded and accompanied it. Beginning with the great flaring forth, trace the formation of the human back through the formation of the various parts of the cosmos. How does this change your perceptions of the purpose, role, and story of the human?
4. In the *Journey of the Universe Conversations*, Ursula Goodenough talks about bacteria as a “self.” Do you find that this concept enriches your preconceptions and ideas about what it means to be a “self?” How does your conception of “self” rely on how you conceive of “awareness?”
5. The *Journey of the Universe* book talks about the way in which the Earth has adapted itself in such a way so that life can flourish. Why is the power to adapt so important, not just for living organisms, but for more complex structures such as planets? How does the concept of adaptation change and become more complex when considered in the context of community, rather than as an individual act?

Online Resources:

- Go to the Yale Forum on Religion and Ecology’s website for a [comprehensive list](#) of links to scientific organizations and educational resources. Highlights from this extensive list include: [NASA’s Earth Science](#) website, the [National Science Foundation](#) website, the [Union of Concerned Scientists](#), the [Ecological Society of America](#) website, and the [National Oceanic and Atmospheric Administration](#) website.
- For information on biodiversity and species preservation, visit the World Wildlife Fund’s (WWF) [biodiversity](#) page and the [United Nations Environment Programme \(UNEP\) World Conservation Monitoring Centre \(WCMC\)](#).

- Visit the [American Museum of Natural History's website](#) for a wide variety of useful links.
- The TED series can be an excellent source of information from top scientists. [This talk by evolutionary biologist, E.O. Wilson](#), for example, brings a deep knowledge of life's diversity into conversation with religion.
- The PBS website has an extensive [education page](#) on evolution.

Print Resources:

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

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