



Leader Discussion Guide for *Cosmos: A SpaceTime Odyssey*

Episode 2: "Some of the Things Molecules Do"

The creators of *Cosmos: A SpaceTime Odyssey* state that their aim is to promote scientific literacy. Because we know that many who watch the program may find the blurring of observational, experimental science with historical, origins science confusing, in this study guide for episode two, we emphasize the distinction between what we observe in biology and speculations about how those things came to be.

1. **Explain how natural selection and selective breeding can lead to new species of animals and plants.**

ANSWER: Natural selection is the process by which organisms that have characteristics that best equip them to survive are more likely to survive, reproduce, and pass on their characteristics to their offspring. This ultimately produces a population with characteristics similar to those that were naturally selected. Similarly, people can choose to breed plants or animals that have the characteristics they most value in order to produce populations containing lots of the desirable characteristics. Natural and artificial selection can lead to the production of new species. Neither artificial nor natural selection produces new "kinds" of plants or animals but only variations within the original kinds.

For further study:

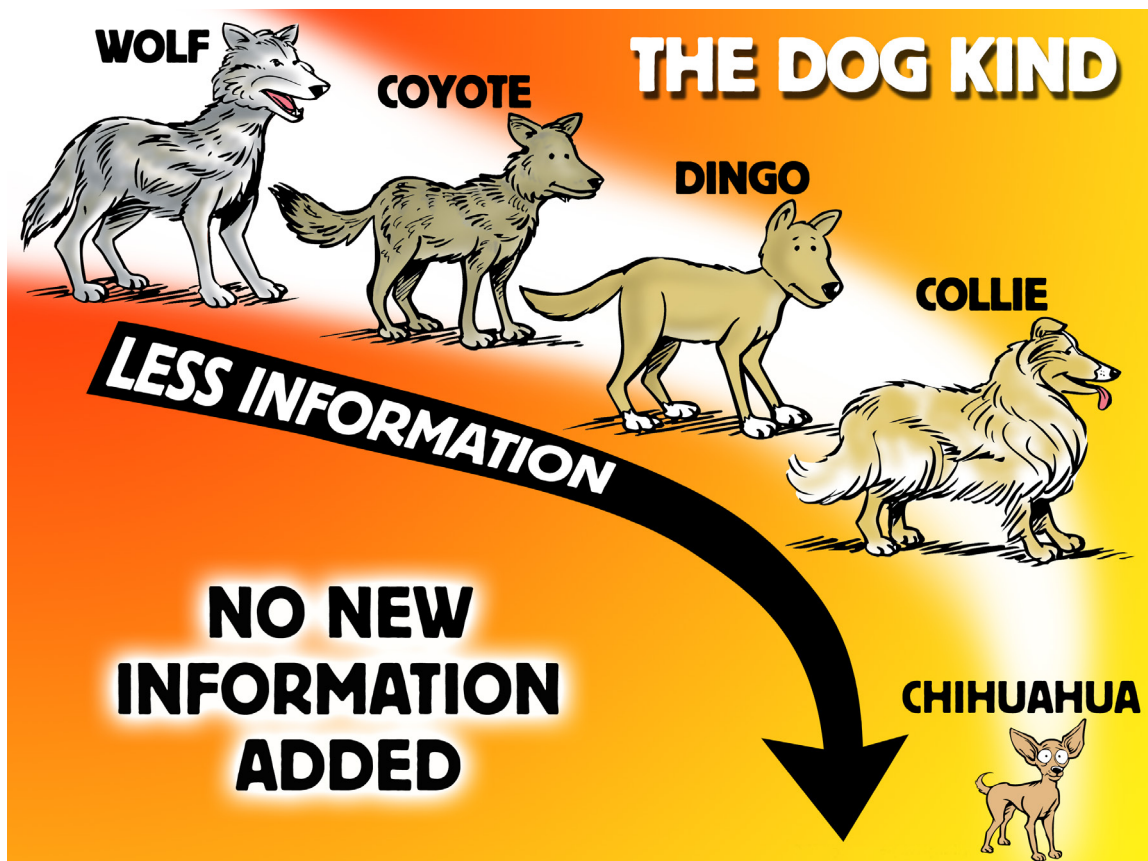
<http://www.answersingenesis.org/articles/nab/is-natural-selection-evolution>

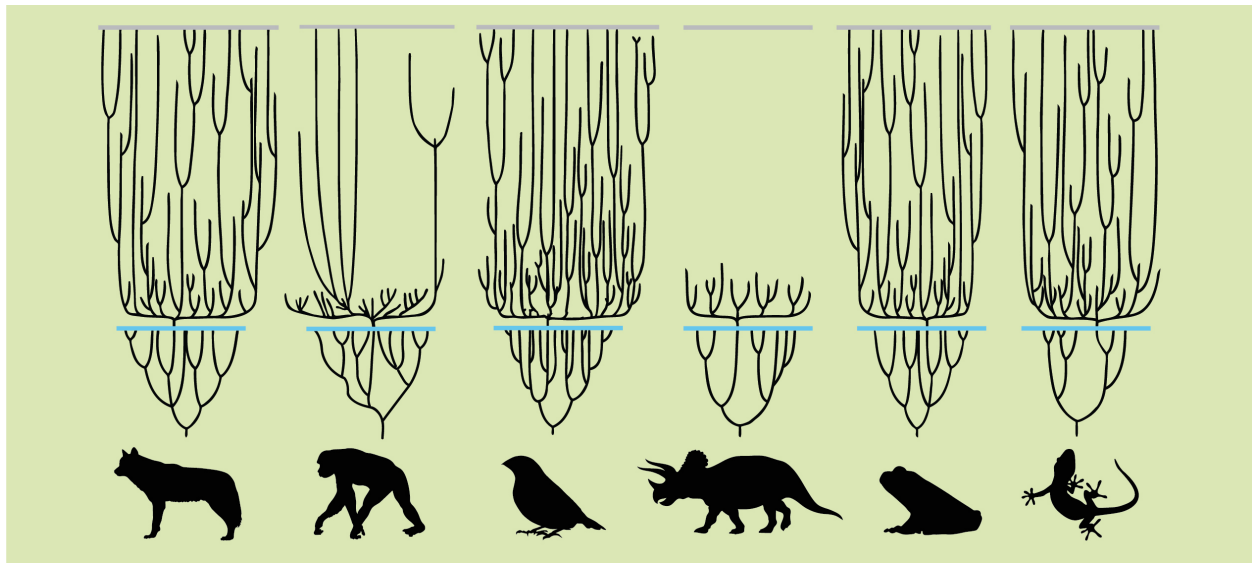
2. What is a “species”? Do species change?

ANSWER: Oddly enough, scientists have some difficulty defining *species*. In modern terminology, *species* generally refers to a group of organisms with very similar characteristics and the ability to freely breed with each other and produce fertile offspring. When organisms of two different species interbreed, they produce a hybrid that may or may not be fertile. As environmental conditions change and populations with various genetically determined characteristics become isolated from one another, new species can emerge. However, new species are always of the same “created kind” as the parent species. Thus, tigers, lions, and domestic cats are all species within the cat kind.

For further study:

<http://www.answersingenesis.org/articles/2009/03/16/fixity-of-species>





3. What is a “created kind”?

The Bible refers to “kinds” of plants and animals in the creation account in Genesis 1. God created plants and animals and designed them to reproduce “according to their kinds.” Consistent with this, biological observation shows us that all organisms—whether bacteria, plants, or animals—reproduce and vary only within their created kinds. There are over thirty species of cats, and they vary greatly, but all are of the same “cat” kind.

For further study:

<http://www.answersingenesis.org/articles/nab3/what-are-kinds-in-genesis>

4. What is the difference between speciation and molecules-to-man evolution?

ANSWER: *Speciation* is the emergence of new species. This may happen quickly in response to certain environmental conditions. For instance, when organisms with particular genetically determined characteristics are isolated on an island and only able to breed with each other, new species can form. In not-too-many generations, the characteristics that best fit the animals to survive in that environment may dominate the population. The new population may be so different from the original population that they will not freely interbreed with members of the original population and can be considered a new species. Speciation always produces an organism of the same kind as the original animals. Species do not evolve into species of a different “created kind.”

For further study:

<http://www.answersingenesis.org/articles/ee/natural-selection-vs-evolution>



5. What are genes? Where are they found?

ANSWER: Genes are units of instructions that direct how a living organism is made and how its cells function. They are coded into the organism's DNA. Many genes are written on each chromosome and provide the instructions for assembling proteins that are needed by the organism to function.

6. What is the "alphabet" used to "write" instructions in DNA?

ANSWER: DNA contains the instructions to build proteins. Proteins are made of strings of amino acids. The "alphabet" and "words" in the genes tell the cell which amino acids to string together to make the needed proteins.

In the genetic alphabet, each small combination of *nucleotides* stands for a particular amino acid. These nucleotide combinations are thus used to write instructions in each cell's massive DNA code that tells it how to make more living cells and how to function. There are four nucleotide bases in living organisms. The arrangement of these bases forms the alphabet of life. Three nucleotide combinations match each amino acid. Amino acids are the building blocks of proteins. Thus, a string of nucleotides in a section of DNA tells a cell what amino acids to put together to build a particular protein.

All living things on earth use the same genetic alphabet to write these instructions. Evolutionists claim living things could only use the same alphabet if they all evolved from a common ancestor, which itself evolved from non-living matter.

God designed all living things to use the same "alphabet." God created all kinds of living things to function in the same world, to subsist on the same raw materials

from the environment, and to interact with each other. It makes sense that He would create a system to make the biochemistry of all living things on earth consistent and compatible. Otherwise, how could ecosystems ever be established? How could anything find biochemically compatible food to eat? God designed all the living things in His Creation to function within His Creation.

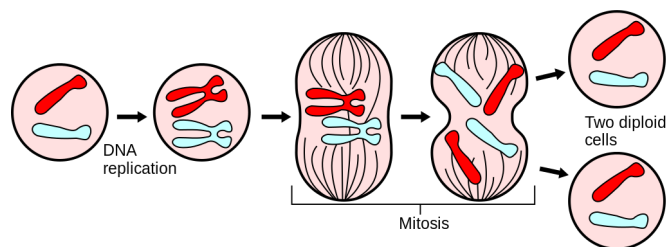
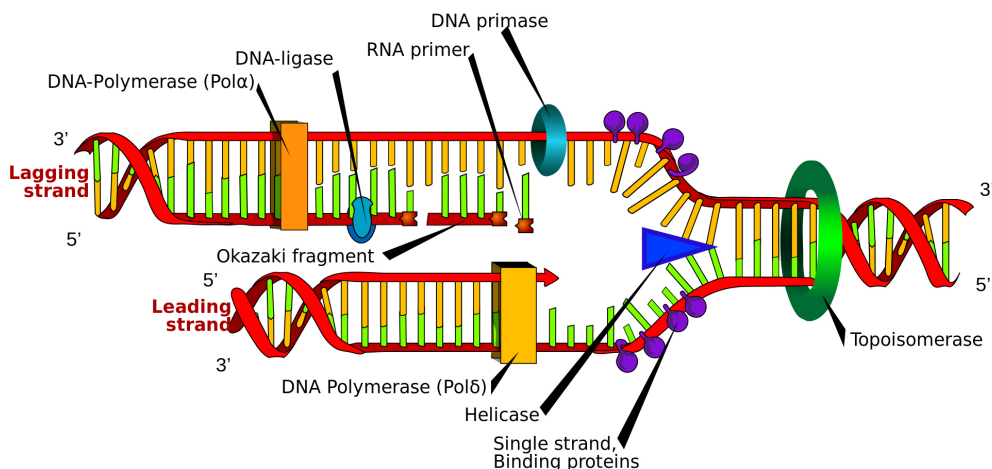
For further study:

<http://www.answersingenesis.org/articles/am/v3/n3/common-designer7>.

7. How are the instructions for building new cells passed on to new generations of cells?

ANSWER: The instructions—a blueprint for each organism—are contained in that organism's cells. They are written in the DNA of its chromosomes, and a copy is in each cell's nucleus. DNA consists of a two-stranded double helix in which nucleotide bases are attached to corresponding bases on the opposite strand. These strands detach from one another, and complementary nucleotides are lined up and strung together to build new two-stranded double helix copies of the DNA. Once the DNA in a cell has been thus duplicated—or *replicated*—the cell can divide, giving one complete set of DNA blueprints to each daughter cell.

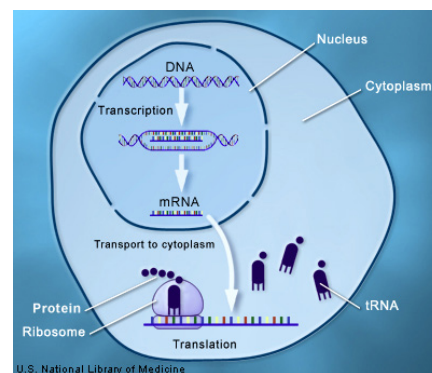
To replicate, the double helix of DNA unzips and new strands of DNA are built on the template of the old. This process is governed by a number of enzymes (polymerases, ligases, etc.) that specifically coordinate and control each step of the process.



Once the DNA in a cell has been replicated, the cell divides, as shown in this typical animal cell. Each daughter cell receives a complete set of chromosomes. In the germ cells (sperm, eggs) used for reproduction, the process (meiosis) is somewhat more complicated, but the process of DNA replication is essentially the same. Meiosis ensures that the germ cells that combine to produce offspring contain a shuffled mixture of the genes from each parent's genome.

8. **How are the instructions for how a living cell makes important molecules read and carried out?**

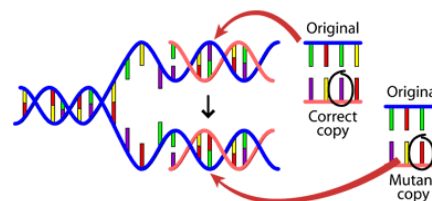
ANSWER: A portion of the DNA double helix containing the genes with the needed information unzips its complementary strands. Nucleotide bases complementary to the nucleotides in the genes are strung together to make a piece of messenger RNA. That messenger RNA is then taken to ribosome in the cell where the amino acids “listed” in the message are brought together and assembled to build the protein as directed.



The sequence of nucleotides in a gene is copied (transcribed) onto a piece of messenger RNA. In the cytoplasm of the cell, a ribosome translates the message by making a protein, stringing together the amino acids “listed” on the messenger RNA.

9. **What is a mutation?**

ANSWER: Mutations are changes in a cell’s genome (genetic material in an organism). They can occur when an error happens during the copying (replicating) of DNA. Unless the error gets caught and corrected by the cell’s proofreading mechanisms, the mutation is passed on to subsequent copies of the cell (daughter cells).



Mutations are changes in the DNA that result from errors when DNA is copied (replicated). In this typical mutation, one nucleotide is substituted for another. The resulting “spelling error” may cause lots of problems, no problems, or produce a variation in some characteristics of the organism. The instructions in the genetic code may be altered or destroyed by mutations, but even the accumulation of lots of mutations is unable to create instructions to build new, more complex kinds of organisms.

Image Credit: University of California Museum of Paleontology’s Understanding Evolution (<http://evolution.berkeley.edu>)

10. **Are mutations the raw material for molecules-to-man evolution?**

ANSWER: Mutations may be harmless but many times they result in damage to the daughter cells. In some cases, a mutation may provide an advantage for the daughter cells or an entire organism in certain environments. While this sort of change may be an advantage, it does not result in the production of a new kind of organism, only a variation that is better suited to a particular environment. Mutations do not provide the information needed to build a new kind of organism. Not even lots and lots of mutations can supply the raw material for molecules-to-man evolution.

For further study:

<http://www.answersingenesis.org/articles/nab2/mutations-engine-of-evolution>

WRAPPING UP LIFE

11. Name the characteristics of living things.

ANSWER: Living things are composed of a cell or cells. Living things use energy from the environment, respond and adapt to the environment, grow, and reproduce.

12. When living things reproduce, are their offspring identical to the parent organisms?

ANSWER: When living things reproduce, their offspring may vary, not being identical to their parent organisms, but that variation is always limited: offspring are always the same kind of organism as the parent.

13. Which of the following are actual scientific observations and which are world-view-based interpretations?

- A. Gravity causes dropped objects to fall toward the ground.
- B. Living things are composed of a cell or cells.
- C. Protein molecules are built of amino acids.
- D. The genes in DNA direct the construction of protein molecules.
- E. Plants use photosynthesis to convert the sun's energy to sugar.
- F. All cells metabolize glucose (sugar) for energy.
- G. All cells need similar enzymes to metabolize glucose, a simple sugar.
- H. All living things write their genetic information using the same "language."
- I. The genes that direct building of glucose-metabolizing enzymes are found in all living things, although many of their other genes differ.
- J. All life evolved from a common single-celled ancestor.
- K. "Science reveals that all life on earth is one."
- L. One kind of organism, after its offspring collects enough mutations, sometimes evolves into a completely different kind of organism over time.
- M. The protozoans that cause malaria may vary, but they never change into organisms that cause a completely different kind of disease.

N. Living things only come from other living things. Cells only come from other cells.

O. “The theory of evolution like the theory of gravity is a scientific fact. Evolution really happened.”

ANSWERS: A, B, C, D, E, F, G, H, I, M, and N are all observable scientific facts. J, K, L, and O are worldview-based interpretations that are not supported by scientific observations.

For further study:

<http://www.answersingenesis.org/articles/ee/what-is-science>

REACHING BEYOND

What is the difference between a single-celled organism and a multicellular organism? Give examples of each. Why do single-celled organisms not combine themselves together to turn into a multicellular organism?

ANSWER: A single-celled organism, like a bacterium or an amoeba, is equipped to do all the things it needs to do in order to survive. Like all living things, it can use energy from its environment, it can respond to and adapt to its environment, it can grow, and it can reproduce. Even when single-celled organisms live in colonies and cooperate with each other, each cell is still able to survive and function on its own. In multicellular organisms—like oak trees, petunias, earthworms, humans, guppies, and sparrows—individual cells have specialized functions and are only able to survive as part of the whole organism.

Please see <http://www.answersingenesis.org/articles/creation-debate/review-cosmos-molecules-evolution> for further discussion and a list of resources for more information about these topics.