

Workshop: The Origin of Life
by Dana Krempels

Conditions of the Early Earth

1. Consider the Stanley Miller apparatus. What was it meant to simulate?
2. What elements and compounds were present in the apparatus in
 - a. gaseous form
 - b. liquid form
3. What energy source(s) were provided, and what was each meant to simulate?
4. What products were found in the apparatus after it was allowed to operate for various amounts of time, and under various conditions?

5. How might each of these have contributed to the formation of early cells?

6. What element was notably absent from the earth's primordial atmosphere, and why was this absence essential to the formation of life?

Components of Life

1. What is the definition of a biological macromolecule?
2. Name two common examples of each of the following types of macromolecule:
 - a. nucleic acid
 - b. protein
 - c. carbohydrate
 - d. lipid

Controversy and Politics: Where did Life come from?

Humans have probably been debating the question of the origin of life since they huddled around campfires at night and had nothing to do but chew on bones. Although there are probably many ideas in many cultures as to the exact nature of the origin of life, only some of these ideas fall within the realm of science.

Science is based upon (1) **observable, verifiable phenomena** (affectionately known as "facts") and (2) **ideas/hypotheses that can be tested for accuracy with the scientific method**. If something cannot be physically observed/verified and/or subjected to rigorous scientific methods, then it is cannot be considered to be in the realm of science.

We will now discuss which of three fairly well-known ideas is within the realm of science, and which are best left to debate within disciplines, such as the Humanities and Social Sciences, other than the natural sciences.

A. Evolution by Means of Natural Selection

1. By now, you are familiar with Charles Darwin's observations and inferences regarding organic evolution by means of natural selection. His work is sometimes distilled into four basic **tenets** of evolution by natural selection. What are these tenets?

Tenet 1. _____

Tenet 2. _____

Tenet 3. _____

Tenet 4. _____

2. Consider each of the above tenets. Which are observable/verifiable facts? If a tenet does not describe an observable fact, then can it be tested scientifically? If so, suggest a research question and experiment that addresses this tenet.

Tenet 1. _____

Tenet 2. _____

Tenet 3. _____

Tenet 4. _____

3. Which of Darwin's tenets should be considered observable fact?
4. Which of Darwin's tenets cannot be considered observable fact?
5. Of the latter, what observable evidence exists to support the tenet?
6. What evidence exists to refute it?
7. Would you consider Darwin's tenets to be within the realm of science? DISCUSS.

B. Cosmic Ancestry? The Idea of Panspermia

1. A hypothesis popular in some circles suggests that Life originated as a result of the "seeds of life" (e.g., primitive cells, macromolecules, etc.) having been carried here on meteorites. This idea is sometimes known as "panspermia". Use your Dictionary of Word Roots and Combining Forms (Borror) to determine the meaning of "panspermia." Write it here:
2. What do you suppose the literal translation of this word refers to?
3. Pose some testable research questions (with predictions) that might help to determine whether this idea might be correct. (Even if they require technology not yet at our disposal.)

4. Is the notion of "panspermia" within the realm of science? DISCUSS.

C. Science or Pseudoscience? Scientific Creationism

In many religious traditions, including those of the three Abrahamic faiths (Judaism, Christianity and Islam), life is said to have originated at the hand of divine creator. Periodically, people in the United States who believe in the literal translation of Biblical creation gather their political forces and attempt to convince schools boards and government agencies that the concept of divine creation be taught in science classes alongside evolutionary theory as an "alternative theory" for the existence of life.

In the 1990s, a group of creationists founded the Institute of Creation Research (ICR), which purports to demonstrate that the idea of divine creation is scientifically testable. They dubbed this field "Creation Science." The "creation scientists" state that their version of the origin of life is scientific, not religious, in nature, and hence should be legal to teach in public schools. The ICR devised nine tenets of "Creation Science." But are they similar to Darwin's tenets?

Tenet 1. "The physical universe of space, time, matter and energy has not always existed, but was supernaturally created by a transcendent personal Creator who alone has existed from eternity."

1. Does this tenet describe a physically observable, verifiable fact?
2. If so, what physical evidence exists to support this idea? If so, write it here:
3. What evidence exists to refute it?
4. Can you design a testable hypothesis regarding this tenet?
5. Is this tenet within the realm of science?

Tenet 2. "The phenomenon of biological life did not develop by natural processes from inanimate systems but was specially and supernaturally created by the Creator."

1. Does this tenet describe a physically observable, verifiable fact?
2. If so, what physical evidence exists to support this idea?
3. What evidence exists to refute it?
4. Can you design a testable hypothesis regarding this tenet? If so, write it here:
5. Is this tenet within the realm of science?

Tenet 3. "Each of the major kinds of plants and animals was created functionally complete from the beginning and did not evolve from some other kind of organism. Changes in basic kinds since their first creation are limited to 'horizontal' changes (variations) within the kinds, or 'downward' changes (e.g., harmful mutations, extinctions)."

1. Does this tenet describe a physically observable, verifiable fact?
2. If so, what physical evidence exists to support this idea?
3. What evidence exists to refute it?
4. Can you design a testable hypothesis regarding this tenet? If so, write it here:
5. Is this tenet within the realm of science?

Tenet 4. "The first human beings did not evolve from an animal ancestry, but were specially created in fully human form from the start. Furthermore, the 'spiritual' nature of man (self-image, moral consciousness, abstract reasoning, language, will, religious nature, etc., is itself a supernaturally created entity distinct from mere biological life."

1. Does this tenet describe a physically observable, verifiable fact?
2. If so, what physical evidence exists to support this idea?
3. What evidence exists to refute it?
4. Can you design a testable hypothesis regarding this tenet? If so, write it here:
5. Is this tenet within the realm of science?

Tenet 5. "The record of earth history, as preserved in the earth's crust, especially in the rocks and fossil deposits, is primarily a record of catastrophic intensities of natural processes, operating largely within uniform laws, rather than one of gradualism and relatively uniform process rates. There are many scientific evidences for a relatively recent creation of the earth and universe, in addition to strong scientific evidence that most of the earth's fossiliferous sedimentary rocks were formed in an even more recent global hydraulic cataclysm."

1. Does this tenet describe a physically observable, verifiable fact?
2. If so, what physical evidence exists to support this idea?
3. What evidence exists to refute it?
4. Can you design a testable hypothesis regarding this tenet? If so, write it here:
5. Is this tenet within the realm of science?

Tenet 6. "Processes today operate within fixed natural laws and relatively uniform process rates but, since these were themselves originally created and are daily maintained by the Creator, there is always the possibility of miraculous intervention in these laws or processes by their Creator. Evidences for such intervention should be scrutinized critically, however, because there must be clear and adequate reason for any such action on the part of the Creator."

1. Does this tenet describe a physically observable, verifiable fact?
2. If so, what physical evidence exists to support this idea?
3. What evidence exists to refute it?
4. Can you design a testable hypothesis regarding this tenet? If so, write it here:
5. Is this tenet within the realm of science?

Tenet 7. The universe and life have somehow been impaired since the completion of creation, so that imperfections in structure, disease, aging, extinctions and other such phenomena are the result of 'negative' changes in properties and processes occurring in an originally-perfect created order."

1. Does this tenet describe a physically observable, verifiable fact?
2. If so, what physical evidence exists to support this idea?
3. What evidence exists to refute it?
4. Can you design a testable hypothesis regarding this tenet? If so, write it here:
5. Is this tenet within the realm of science?

Tenet 8. Since the Universe and its primary components were created perfect for their purposes in the beginning by a competent and volitional Creator, and since the Creator does now remain active in this now decaying creation, there do exist ultimate purposes and meanings in the universe. Teleological considerations, therefore, are appropriate in scientific studies whenever they are consistent with the actual data of observation, and it is to assume that the creation presently awaits the consummation of the Creator's purpose."

1. Does this tenet describe a physically observable, verifiable fact?
2. If so, what physical evidence exists to support this idea?
3. What evidence exists to refute it?
4. Can you design a testable hypothesis regarding this tenet? If so, write it here:
5. Is this tenet within the realm of science?

Tenet 9. "Although people are finite and scientific data concerning origins are always circumstantial and incomplete, the human mind (if open to the possibility of creation) is able to explore the manifestations of that Creator rationally and scientifically and to reach an intelligent decision regarding one's place in the Creator's plan."

1. Does this tenet describe a physically observable, verifiable fact?
2. If so, what physical evidence exists to support this idea?
3. What evidence exists to refute it?
4. Can you design a testable hypothesis regarding this tenet?
5. Is this tenet within the realm of science?

6. Is "Creation Science" within the realm of science? DISCUSS.
7. What are the differences between a hypothesis that is scientifically testable and one that is not? Which of the three ideas about the origin of life described here can be scientifically tested? DISCUSS.

D. Scientific creationism vs. Darwin in the Courtroom

Several times in the past, proponents of creation science have gone to court in an attempt to require that creation science be taught alongside, if not instead of, evolution by means of natural processes in public school science classes. Rather than championing any scientific strengths of the tenets of creation science, those arguing for creation science in the classroom point out "weaknesses" in the theory of evolution by natural selection.

One Creation Scientist has claimed, "A major goal of creation science is to point out the weakness of evolutionary theory, because basically there are only two alternatives for how we got here, and if naturalistic processes are incapable of the task, then special creation must be the correct answer."

1. Do you agree with the statement above? Discuss it objectively and dispassionately.
2. In their efforts to gain credibility for creation science, its proponents often claim that "evolution by natural selection is only a theory and hasn't been proven." Discuss this assertion. Is it accurate? Can one prove a scientific hypothesis or theory? In science, what are the precise definitions of
hypothesis –

theory –

law -

E. Intelligent Design: The New "Creation Science"

Most recently, persons interested in discrediting the Darwinian view of evolution have proposed a new idea, "Intelligent Design." Its major claims can be found in this excellent overview from *Natural History* magazine:

<http://www.actionbioscience.org/evolution/nhmag.html>

Be sure to read this article before your workshop!

1. What are the basic claims of the Intelligent Design "camp?"

