CHAPTER 3 - BIOCHEMISTRY AND THE ORIGIN OF LIFE

We will return to the non-living portion of the universe later when we consider astronomy, fossils and the like. For now, we will move to living things and consider whether the origin of life seems to be more reasonably explained by Initial Complexity or Initial Disorganization.

I. ORIGIN OF LIFE.

In centuries past many believed that living things could arise spontaneously from decaying vegetation, rotting meat and the like. However, as experimental techniques improved, scientists learned that organisms such as flies made their way into an environment through contamination and lack of sanitation. Pasteur's and similar experiments disproved the spontaneous generation of life (*abiogenesis*) by showing that without contamination, no such organisms appeared. Thus, the discussion about how life originated has shifted from decaying material to lifeless chemicals on the early earth.

A. INITIAL COMPLEXITY.

Visual # 3-1

The first living things came into existence in a complex, fully functional condition. We would expect to find evidence that from the time these organisms first appeared, conditions on earth have been suitable to sustain life - probably not too different from the way things are now. We also expect to find life coming only from life.

B. INITIAL DISORGANIZATION.

Life is believed to have resulted from purely natural processes through chemical reactions. Since conditions on the earth at present would not allow this to happen, we should find evidence that the chemical conditions on the early earth were much different. We would also expect that, under the right conditions, life could again be produced from nonlife.

Visual # 3-2

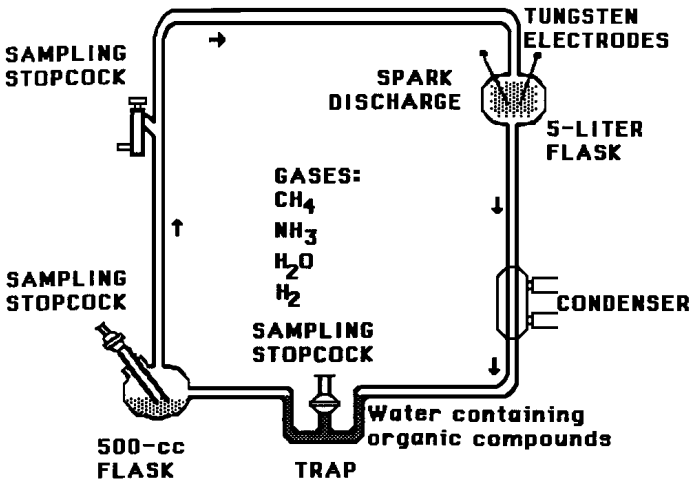
The Russian biologist A.I. Oparin (1924) and British biochemist J.B.S. Haldane (1928) recognized that every living thing includes the elements carbon, hydrogen, nitrogen, oxygen, phosphorus and sulfur (CHNOPS). They proposed that the early atmosphere was much different than at present, consisting largely of hydrogen, methane, ammonia, and water vapor, commonly known as the "primordial soup." These gases would have furnished carbon, hydrogen, nitrogen, and oxygen, which are believed to have mixed together and then been bombarded by energy sources such as lightning, ultraviolet, heat, or shock waves. The resulting chemical action should have formed amino acids, then proteins, and finally living cells. In other words, the first living cell evolved billions of years ago when the right mixture of chemicals happened to come together in the right place at the right time under exactly the right conditions.

C. ACTUAL OBSERVATION.

In the 1950's a University of Chicago doctoral student named Stanley Miller devised an experiment to test part of this hypothesis by finding out if some of the simplest components of cells, *amino acids*, could form under such conditions. Miller attempted to simulate the atmosphere proposed by Oparin and Haldane in an apparatus that brought together methane (CH_4), ammonia (NH_3), water vapor (H_2O), and hydrogen (H_2) in a spark chamber. (There was no sulfur or phosphorus.) Others later used different energy sources such as heat, UV, or impact energy in their experiments. The were struck periodically by electric sparks, and the compounds produced were removed every so often by a trapping mechanism. After a while Miller found that his apparatus had indeed produced some amino acids.

Visual # 3-3

As a result of experiments such as this, many people think that life has been produced in the lab. It has not. Dr. Miller said only that he had been able to produce some amino



Basic design of Miller's apparatus.

The actual device on display at the Denver Museum, 2008.

acids. Those who claim that scientists have produced life under laboratory conditions either do not know, or else deliberately ignore, the fact that a living cell is far more complex than just a few amino acids. Cells are made of hundreds or thousands of *proteins*, each of which are made of hundreds of amino acids of various types fastened together in a precise arrangement.

An amino acid is characterized by the presence of an amine group, which has the chemical formula NH_3^+, bonded to carbon. There are hundreds of possible types of amino acids. However, cells use only twenty specific kinds. Though experiments such as Miller's have produced at least fifteen of these twenty, the desired acids are only a tiny portion of what comes out of the experiments. Other products include at least twice as many kinds of amino acids *not* used in living things, various sugars, all the bases used in DNA and RNA, and many other miscellaneous organic (carbon-based) and inorganic compounds.

Visual # 3-4

Following are some of the major problems with the Oparin-Halane hypothesis. An in-depth technical treatment can be found in *The Mystery of Life's Origin: Reassessing Current Theories* by Thaxton, Bradley, and Olsen, Philosophical Library, 200 W. 57th Street, New York, New York 10019, 1984.

1. THE PROBLEM OF ATMOSPHERIC OXYGEN.

Visual # 3-5

Oxygen is one of the most highly reactive substances in nature, second only to fluorine. If it were present in the earth's early atmosphere, the other gases mentioned above would react with it at least as rapidly as with each other, producing "garbage compounds" useless in forming living cells. As a result, free oxygen has been excluded from origin-of-life experiments (Miller & Orgel, 1974, 33). However, the very lowest Precambrian sediments contain "red beds," geologic formations that obtained their characteristic color through oxidation (Abelson, 1966, 1355). Oxidation requires oxygen. Thus, the evidence from geology indicates that from the time sediments began to accumulate (supposedly billions of years ago), the earth's atmosphere has always contained free oxygen (Henderson-Sellers et al., 1980, 74).

Distributions of carbon, sulfur, uranium, and ferric and ferrous iron sediments are all influenced by the amount of free oxygen. These distributions are quite similar in all strata no matter what their supposed age. This indicates that the Precambrian atmosphere contained a great deal of oxygen (Dimroth & Kimberley, 1976, 1161).

Australian sediments dated at 3.46 billion years point to the conclusion that the atmosphere contained about as much oxygen as it does at present (Hoashi et al., 2009). Thus, we have no indications that the conditions used in origin-of-life experiments have ever existed in nature. The geologic record argues against such a belief.

Even the standard evolutionary scenario for the origin of the earth would lead us to conclude that there was oxygen present all along. This planet is supposed to have first come together as a swirling cloud of gases and dust, then eventually turned into a ball of molten rock, and finally arrived at its present condition. In such a case, the densest elements such as iron would sink to the center of the swirling cloud. Oxygen, though, is very light compared to most other elements. Its reactivity might have caused a great deal of it to be trapped underground in chemical compounds, but there would be no reason for every bit of the oxygen in the newly accreting earth to go underground. It would have been present in the atmosphere in significant amounts from the beginning.

Though the red beds and other sedimentary deposits are well known in the scientific community, textbooks and popular literature say that the earth's early atmosphere did not contain free oxygen. They state that the oxygen was released from inside its crust long after life appeared. The textbook authors are deliberately withholding the evidence of free oxygen.

a. Lack of evidence for a primordial soup.

The evidence for free oxygen is not the only problem. The primordial soup would have covered much of the earth's surface for millions of years until life began 3.5 to 4 billion years ago. However, we have no evidence that the soup ever existed (Brook & Shaw, 1973, 359). The oldest sedimentary rocks known, the "Dawn Rocks" of Western Greenland, contain no traces of it (Denton, 1986, 261). They are dated about 3.9 billion years, only a few hundred million years younger than the earth itself. No other ancient rocks known contain traces of the soup either.

Once cannot argue that the sediments were incapable of trapping chemical compounds. The presence of oxidized deposits shows that they were. Those who choose to believe in either the primordial soup or a non-oxygen atmosphere must do so in spite of the evidence, not because of it.

b. How Living Things Deal With Oxygen.

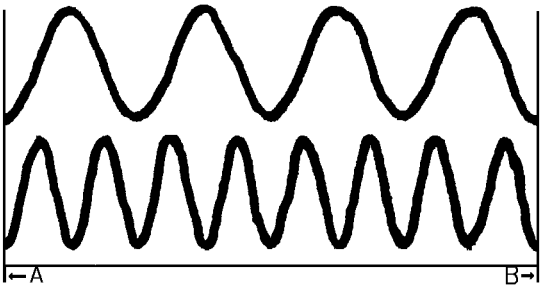
Visual
3-6

Since oxygen interferes with the reactions needed to produce a cell and since we live in an oxygen-rich atmosphere, how can animals and plants put chemicals together into amino acids and cells? The answer lies in DNA (deoxyribonucleic acid), found in the cells of every living thing. Cells are able to perform the needed chemistry despite the presence of oxygen because DNA provides the blueprint to bring the right chemicals together in the proper order. It also guides the reproduction of all the parts of the cell including itself. Since there would have been no DNA present at the beginning, we can certainly see why those who believe in Initial Disorganization must insist -- despite the evidence -- that there was no free oxygen present. Even if it a cell could have come together by accident, though, it could not have reproduced without some sort of information storage system. Life would have quickly become extinct.

2. THE OXYGEN-ULTRAVIOLET DILEMMA.

This section has to do with waves and energy, so you should be sure your students understand some basic concepts concerning those two subjects.

WAVES, FREQUENCY, AND WAVELENGTH



Light is a form of electromagnetic radiation, which travels in waves. Shown are simplified graphs of two waves. Waves such as light are three-dimensional, but for purposes of illustration we can use two-dimensional drawings.

A wave goes from minimum to maximum intensity and back a certain number of times per second, its *frequency*. If the distance between points A and B represents one second, the upper wave goes through four cycles a second, while the lower goes through eight cycles per second. The upper has a frequency of 4 hertz (Hz), while the lower has a frequency of 8 Hz.

If the space between A and B represents distance instead of time, we measure *wavelength* rather than frequency. If A and B above are one centimeter apart the wavelength of the lower wave is 1/8 cm, while that of the upper is 1/4 cm. For extremely short wavelengths, we use nanometers. (One nm $=10^{-9}$ meters.) A human hair is between 50,000 and 100,000 nm thick.

Visible light has a wavelength between 390 nm (extreme violet) and 760 nm (extreme red). Its frequency is between about 10^{14} and 10^{15} Hz. Microwaves have a wavelength between a few millimeters and a few centimeters, and a frequency from about 10^{10} to 10^{12} Hz.

For electromagnetic waves, the frequency times the wavelength = c, the speed of light (about 3 X 10^{8} meters per second in a vacuum).

Visual # 3-7

Some of the ultraviolet (UV) radiation coming from the sun is deadly to living things, some is not. The kind that would have been present on the early earth is the deadly variety.

Short-wave (less than 200 nm) UV is sometimes used as an energy source in origin-of-life experiments. However, the sun produces far more long-wave (greater than 300 nm) than short. The 310 nm wavelength seems to have just the right frequency of vibration to cause maximum damage to organic compounds such as those in our skin cells, somewhat like the way certain sounds vibrate at the exact frequency to shatter glass. The reason the 310 nm UV does not kill us is that the atmosphere's ozone layer filters out most of it before it can reach the earth's surface. Even a small amount of this wavelength can cause skin damage (Abelson, 1966). It is therefore excluded from origin-of-life experiments.

We saw above that the Oparin-Haldane scenario is only plausible if there were no free oxygen present in the early atmosphere. However, ozone is a form of oxygen. If there were no free oxygen, there would have been no ozone layer and the long-wave UV would have reached the earth's surface at full strength. A typical modern organism would have absorbed a lethal dose in about three tenths of a second (Sagan, 1973, 195-200).

This places us in a dilemma. The **presence** of free oxygen prevents the reactions needed to form the components of cells. The **absence** of free oxygen allows long-wave UV to destroy these components as fast as they can form.

Students should be aware that this paradox has not been resolved, despite the efforts of Sagan and others. They may also wish to explore the reasons that Dr. Francis Crick,

Nobel laureate for his co-discovery of the structure of DNA, proposed the "Directed Pan-Spermia" model in which he says life had to begin in space rather than on earth. (More later in this chapter.)

3. THE TRAPPING MECHANISM.

Visual # 3-8

Every origin-of-life experiment based on the Oparin-Haldane hypothesis uses some sort of energy source to produce amino acids from the mixture of gases present in the apparatus. A trapping mechanism then removes the amino acids before the energy source operates again. This is necessary because the amino acids are easily destroyed by the same energy source that produced them.

The earth's natural energy sources (lightning, volcanic heat, etc.) are hundreds or thousands of times stronger than those used in the lab. It would be essential to remove organic compounds from repeated contact with the natural sources. However, no one has identified any plausible trapping mechanism in nature. Despite a number of guesses as to how this hypothetical natural trap could have operated, there is no evidence that such a mechanism has ever existed (Thaxton et al., 1984, 102-104).

If there was such a trap, it would have to be far more complex than those used in the lab. Not only would it have to remove the amino acids from contact with the energy at the wrong time, it would also have to bring them back into contact at the right time in order for them to link up into more and more complex molecules. These would also have to be removed and brought back into contact with the energy repeatedly, at exactly the right times, until a complete cell came together.

4. NITROGEN FIXATION.

Amino acids center around an *amine* group, which in turn is based on a nitrogen atom. Miller's experiment and others like it use ammonia to furnish the nitrogen for the amine groups. However, the source of the ammonia in the hypothetical primordial soup poses a problem.

Visual # 3-9

A molecule of nitrogen in the atmosphere consists of two atoms (N_2) tightly bound together in something called a triple covalent bond, which is extremely hard to break. This renders nitrogen almost inert, to the point that it can be used to put out fires.

Because of the extreme unreactivity of nitrogen, it must be *fixated* in order to be used in the amino acids needed by living things. That is, the N_2 molecule must be split apart in order to produce the ammonium (NH_4^+) and nitrate (NO_3^-) ions that they need. The great majority of nitrogen fixation in nature is done by bacteria. Since it takes fixated nitrogen to make any living thing (including bacteria) and it takes bacteria to make fixated nitrogen, we have a problem. Before life began, no bacteria would have been present to furnish the fixated nitrogen needed for life to begin.

Visual # 3-10

There is one naturally occurring non-biological mechanism for nitrogen fixation: lightning. Since the other proposed energy sources such as UV, impacts, and heat do not produce fixated nitrogen, we must rule them out as energy sources and rely on lightning only. This means that the trapping mechanism referred to above must be far more sophisticated than anything found in nature. It must (1) allow lightning to strike atmospheric nitrogen in order to fixate it, then (2) allow the ammonia produced to spread around but still stay in the vicinity of the other necessary chemicals nearby (though ammonia tends to dissipate quickly), then (3) hold all the components in place until needed, then (4) allow the lightning to strike **exactly the same place** again, at a greatly reduced strength, so as to combine the ingredients without destroying them. That would have to be a far more complex trap than anything proposed so far.

5. THE PROBLEM OF OPTICAL ISOMERS (Enantiomers).

This topic involves biochemistry, mathematics, and probability.

Visual # 3-11

The simplest known living cell is composed of about 600 proteins, each consisting of about 400 amino acids - a total of about 24,000 amino acids. Most cells are far more complex than this.

Initial Disorganization leads us to believe that the first cell and all its descendants are the product of purely natural processes, so they should be made up of the kind of components which occur by natural chemical action. Initial Complexity, on the other hand, leads us to expect evidence of design. Cell structure should be far too complex to be the result of random chemical processes.

a. Chirality of amino acids and sugars.

Cells are made up of proteins, which in turn are made up of amino acids. The DNA within the cells is made up of deoxyribose sugars linked by bases. Nineteen of the twenty amino acids used in cells, as well as the sugars used in DNA, can exist in at least two *enantiomers* or *optical isomers*. These are mirror images of each other, labeled right-handed (dextrorotary, abbreviated as "D-") or left-handed (laevorotary or "L-"), according to the direction light reflecting from them is polarized. Unless the right-handed acids are continually removed, those produced by the experiments previously mentioned are a *racemic* mix, or about 50/50 (White et al., 1964).

If amino acids and cells were the result of random chemical action, we should find about a 50/50 mix of L- and D- forms in living cells. We do not. Every one of the proteins in our bodies, as well as those of every other known living thing, contain **one hundred percent** left-handed amino acids (Lewin, 1982, 93; Watson, 1965, 123). (A few organisms use D- acids in hard structures such as shells, but not in any of their proteins.) Of the millions or billions of sugars in each strand of DNA, every one known is the D- form (Asimov, 1960, 29).

Only with sophisticated equipment and careful supervision can we increase the percentage of L- acids in origin-of-life experiments. Even then, scientists have been unable to obtain 100% L- acids. Even if we start with only the L- form, we still have a problem: L- amino acids isolated anywhere except in living organisms undergo a process called *racemization* (randomization -- remember the tendency toward increasing entropy throughout nature) by which some become right-handed. They are only stable in living organisms (Wysong, 1976, 73-76).

b. Optical Isomers and Probability.

The number of possible combinations of L- and D- amino acids and L- and D- sugars is unimaginably vast. Yet living cells use only L- amino acids in their proteins and D- sugars in their DNA. Let us consider whether this could happen by random chance.

Visual # 3-12

As noted above, the simplest known living cell contains about 600 proteins, each of which contains about 400 amino acids. But suppose the first cell was far simpler, consisting of only 125 proteins of 100 amino acids each. To simplify calculations even more, let us assume that instead of being composed of 20 different kinds of amino acids, our hypothetical cell was made up of only one kind. Thus, we need 12,500 L- amino acids in a row.

If the L- and D- forms were equally available, the probability that only the L- acids would be used would be about the same as the probability of flipping heads 12,500 times in a row - one in $2^{12,500}$, or less than one in 10^{3760}. This is a "1" with

3,760 zeroes after it. To put it another way, it is about as likely as flipping 12,500 coins at the same time and having every one come up heads.

Let's try to grasp the size of this number. The total number of atoms in the known universe is commonly estimated at about 10^{80}. Imagine that you have this many machines designed to flip 12,500 coins at once. The goal is to have any one of the machines flip all heads just one time. How long would it take?

The most extravagant claim for the age of the universe is about twenty billion ($2x10^9$) years. We will be generous and give it thirty billion, or about 10^{17} seconds. If each of your 10^{80} machines had been flipping a billion times per second for this long (assuming they didn't wear out), each would have tried about 10^{27} times so far. There would have been a total of about 10^{107} tries. Remember, though, you need 10^{3760} to be reasonably sure to get all heads even once. Your machines need to keep working about 10^{3653} times as long as they already have.

This is ridiculous, of course. The probability of finding only left-handed amino acids in even such a simple cell is so small that it's a virtual impossibility. (Mathematicians usually consider an event with a probability of less than one in 10^{50} impossible.) In the real world there are many types of chemicals trying to react with each other, not just one type of amino acid.

Those who believe in Initial Disorganization must make up a story about how this 100% left-handedness could have arisen by chance. The latest term for such a made up story is the "pathway." Some proposed pathways are that perhaps the left-handed amino acids gathered on rare metals such as platinum, or maybe they gathered on clay, or maybe they came from meteorites. None of these is based on observation. Rather, they are an attempt to explain how the living universe could have gone from simple to complex rather than being brought into existence in a complex condition from the start.

6. THE PROBLEM OF CHEMISTRY.

Some believe chemistry is the answer to the problem of how a cell could have formed by accident. This is incorrect. Chemistry *is* the problem.

A cell consists of much more than a few amino acids strung together. There have to be thousands of the correct ones, in the correct sequence.

First, even if we assume the early earth had the right chemicals and environmental conditions to form the amino acids and other components of cells, at least four more stages would be necessary to produce a cell by random chemical action.

Visual
3-13

- These components would have to overcome the natural attraction between positive and negative in order to work their way through any useless compounds present and join together into longer segments (*polymers*) such as starches, proteins, and partial or complete strands of DNA and RNA. Remember, these are lifeless chemicals that don't know what they are supposed to do.
- These polymers would have to join together into gelatinous blobs called *coacervates* or *microspheres*, which would then be capable of attracting other molecules to themselves. At least one of these microspheres would have to absorb the necessary molecules to be able to reproduce in order for evolution to begin. This would require at least a minimally functional strand of DNA or something like it.
- The first such successful microsphere/cell would then have to form a membrane around itself to protect itself from the environment.
- Finally, it would have to experience some unknown process and come alive.

Could it happen?

a. Interfering Cross-Reactions.

Even under tightly controlled conditions, origin-of-life experiments produce mostly useless material. Products have included not only 15 of the 20 types of L- amino acids used by living cells but also the useless D- form of these types, at least 40 other useless kinds of both L- and D- amino acids, many types of L- and D- sugars, at least 5 kinds of bases, and numerous other biologically useless compounds.

Because these can combine in myriads of ways, there would be constant *interfering cross-reactions*. Any molecule with a positively charged end would react indiscriminately with the nearest negatively charged one, rendering great quantities of potentially useful material useless or even harmful. The proper amino acids would be physically prevented from linking up into proteins by all the other chemicals in their way.

Since these are lifeless chemicals, the amino acids do not know where they are supposed to go and what other amino acids they are supposed to link up with. They simply react with whatever comes along first.

b. Oversimplification of the Oparin-Haldane Hypothesis.

Chemically speaking, it is not too difficult to put together a mixture of gases to produce amino acids and other simple organic compounds. However, joining these products into polymers and coacervates is a different story. Because even the most sophisticated experiments produce mostly the wrong types of chemicals, biochemists do not start with the kind of chemical soup that comes out of an apparatus like Miller's. Instead, they buy the desired compounds in purified form from a chemical supplier. Only then do they have any hope of assembling more complex biological substances.

Visual # 3-14

This is not enough, though, because Miller's primordial soup of methane, ammonia, hydrogen, and water vapor is too simple. The only elements available in this soup are *carbon*, *hydrogen*, *nitrogen*, and *oxygen*. However, at least two other elements would be needed to form even the simplest cell. The amino acids cysteine and methionine require *sulfur*. The nucleotides in DNA/RNA require *phosphorous*. Besides these, even the "simplest" photosynthetic plants require *magnesium*. Many other elements are crucial to life too: *calcium*, *iron*, and so on. When we add all of these into the mix the chemistry gets so complicated that biochemists trying to prove life was an accident don't even try to make the substances they need. They buy them from a very **non-accidental** source, a chemical manufacturing company.

c. Probability of Forming a Cell.

Visual # 3-15

The simplest known cell is far more complex than the hypothetical one mentioned previously. It contains about 600 proteins, each composed of about 400 L- amino acids. It consists not of one type of amino acid as in our previous illustration, but *twenty* types. They must be arranged in correct sequence in order for life to occur. Nevertheless, let us suppose the first living cell was far simpler than any known. Wysong tells us that the simplest one theoretically possible would contain about a hundred twenty-four proteins, averaging about four hundred amino acids each. Assuming that we somehow exclude D- amino acids from the system, he calculates the probability that even such a simple cell could form by chance at less than one in $10^{64,480}$ (Wysong, 1976, 73-76).

For the sake of argument, let us make a fantastically generous assumption: each time the chemicals fail to link up properly they separate and try again. Even so, when we allow D- amino acids into the system as they would be in nature, the probability becomes about one in $10^{78,436}$. This number is so large that to write it you would have to put a "1" with enough zeroes to fill over 1307 lines at sixty zeroes per line, or about twenty-two single-spaced pages.

Since there are millions of different types of cells, the first one could have been any one of the possible types. Let us assume there could have been as many types of cells as there are electrons in the whole universe, 10^{80}. It doesn't help. The probability that any one of these 10^{80} could form by chance is still only one in $10^{78,356}$. This is still more than 78,000 orders of magnitude beyond impossible.

d. Inability to Reproduce.

Suppose the correct amino acids could overcome these fantastic odds and link together exactly the right way into proteins, which then joined properly to form a living cell.

This does not solve the problem of the origin of life. In addition to the proteins, there would have to be some sort of information storage system to enable it to reproduce. Otherwise, life would end as soon as the first cell died.

Some sort of at least minimally functional information storage system would have had to come together at exactly the same time and place as the first cell, then merge with it and develop a cell membrane. If the storage system was DNA, it would have had to use only the correct D- sugars in proper order, bonded by the correct bases. If it was something else, it would later have had to mutate into DNA by millions of copying mistakes while maintaining at least minimal function every step of the way.

Students should take all the above factors into account as they contrast three points of view: (1) Despite the improbability, life began by random chemical processes on the early earth. (2) Life could not have begun on earth. It must have arisen some other place where chemical conditions were more favorable, then arrived here later. (3) Life began by design.

It is not the function of the school to persuade students that any of these is correct, but to present them with as much information as possible so that they can reach intelligent conclusions on their own.

7. THE DNA/ENZYME DILEMMA.

Every organism's DNA is made up of the same four compounds known as *bases* or *nucleotides*, usually represented by the letters A, C, G, and T (Adenine, Cytosine, Guanine, and Thymine). This enables DNA to work in a fashion similar to Morse code, which uses dots, dashes, and pauses to convey any desired message.

Visual # 3-16

The structure of the DNA strand is a double helix - the geometric shape followed by the threads on a screw - made up of millions or billions of nucleotides in precise sequence. The strand is divided into *chromosomes*, which are in turn divided into *genes*. (Normal human DNA contains 46 chromosomes and tens of thousands of genes.) Finally, the genes consist of many nucleotide *triplets* (groups of three). During cell reproduction many of the triplets specify the placement of one amino acid in the new cell, though others have different functions such as marking the end of a gene.

The arrangement of nucleotides in a DNA strand conveys the information to produce a specific kind of organism. Even cells considered simple contain a vast amount of

information. For example, the DNA of the single-celled bacterium *Escherichia coli* is made up of over four million nucleotides (Wysong, 1976, 73-76)), all in correct sequence. If we were to represent each of them by a letter, we would need over six volumes of three hundred pages each just to write down the instructions needed to put together this one supposedly simple cell.

Visual # 3-17

DNA is not only the most complex information storage system known, but it also reproduces itself. It is not enough to keep the cell operating, though. The cell's day-to-day operation requires a great many chemical reactions that take place much too slowly on their own to be biologically useful. These processes occur quickly enough only because they are speeded up by thousands of different types of special protein molecules known as *enzymes*. An enzyme's precise shape enables it to hold specific molecules in place so they can react with other molecules. The enzyme is not changed, but it makes the process happen much faster than normal, in some cases, billions of times faster. Without enzymes the chemical reactions would be too slow and life would be impossible. (This is why a high fever is dangerous: It stops your enzymes from operating, and you die.)

Visual # 3-18

Living cells use thousands of types enzymes. One of most important things they do is perform the chemistry needed to manufacture DNA. However, the cell needs DNA to perform the chemistry needed to manufacture *them* (Horgan, 2011). If the first living cell did not have DNA it could not have made enzymes, but if it did not have enzymes it could not have made DNA. Neither DNA nor enzymes could have evolved by gradual changes in dissimilar mechanisms. Both had to be present from the very beginning.

DNA is extremely low in entropy and high in information. We have never seen random chemical processes produce a decrease in entropy even on a small scale; indeed, the Second Law of Thermodynamics tells us that they cannot. The interrelationship between DNA and enzymes is a strong argument for Initial Complexity.

8. THE CELL MEMBRANE.

The concept of initial disorganization leads us to expect that cells should be made up of components that occur naturally. Initial complexity leads us to expect evidence of design.

Visual # 3-19

One of the essential parts of a cell is the protective double-walled membrane which encloses it. Initial disorganization leads us to believe that the first cell was composed of amino acids which came together into proteins which then came together into a complete structure. DNA somehow joined together with it. A membrane composed of fatty substances known as *phospholipids* formed around the whole collection. Soon, the cell began to reproduce.

Phospholipid membranes like those that enclose cells can occur naturally. However, a serious problem arises. A cell in the process of reproducing needs a ready supply of many chemicals including phosphates, which are a crucial component of DNA. However, phospholipid membranes are almost completely impermeable to phosphates and many other important components of cells. Thus the first cell, surrounded by its impermeable membrane, could not have taken in the raw material it needed to reproduce. It would quickly have become extinct.

Living cells are unaffected by the impermeability problem because of a number of microscopic gateways called *permeases* or *ion channels.* Each ion channel is composed of three or four highly specialized protein molecules that function together to allow

only specific molecules or ions in or out of the cell. These are placed at strategic locations around the perimeter of the cell. They allow only the correct components to enter at only the right places. Why do they appear at all, much less at exactly the right places? Because DNA contains the information used to construct the cell membrane and place them where they need to be.

This is a wonderful topic for a study in contrasts. On the one hand, students might take DNA's specification of how to construct permeases and where to place them as evidence for design. On the other hand, they should look for alternative explanations. They should carefully study known and hypothetical chemical processes to look for ways random chemical action could have produced permeases simultaneously with the membrane and the rest of the cell. They may not reach a conclusion, but they will be made to think.

D. ORIGIN OF LIFE SUMMARY.

Visual # 3-20

We have seen that there are at least eight major problems with the Oparin-Haldane Hypothesis for the origin of life by chemical processes:

1. Non-Oxygen atmosphere required.
2. The Oxygen-Ultraviolet dilemma.
3. The need for a sophisticated trapping mechanism.
4. Nitrogen fixation.
5. Optical isomers.
6. The problem of chemistry.
7. The DNA/Enzyme dilemma.
8. Impermeability of the cell membrane.

Students should consider whether the evidence points more strongly to initial complexity (creation) or initial disorganization (evolution).

II. IS THERE LIFE IN OUTER SPACE?

In recent years astronomers have claimed to discover hundreds of planets around other stars. This naturally raises the question: *Is there life on other planets?* Anyone who expresses doubt is labeled a religious fanatic who either doesn't know or doesn't care about science. Certainly,

Visual # 3-21

rejection of the possibility of life in outer space is based on a belief that the Bible is right in this area, which is beyond the reach of human testing. This is religious. However, those who say there *is* life out there base their assertions on a belief that the Bible is *wrong* in this area, which is beyond the reach of human testing. This is every bit as religious.

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Students should be made aware of an obscure but nevertheless interesting model, "Directed Panspermia." This scenario, proposed by Nobel Prize winner Dr. Francis Crick (co-discoverer of the structure of DNA), holds that life began elsewhere in the universe, then was sent to earth by an advanced civilization somewhere out in space. He proposed this idea because he concluded that conditions on the earth have never been favorable to produce life from nonliving chemicals. Rather than accepting the possibility that life was the result of an unknown **non-natural** process performed by a being outside of nature, he proposed that it is the result of unknown **natural** processes performed by unknown beings who are themselves part of nature. This is religion, not science.

A. BASIC REQUIREMENTS FOR LIFE.

Let us assume that the reports of planets around other stars are correct. Based on the data made public so far, these planets would have to be extremely massive to cause enough motion to be detectable from earth. They would also have to be orbiting very close to their

parent stars in order for the period of the motion (e.g., a complete orbit in just a few days or weeks) to be recognizable. In such a case, they would have to be too large and too close to their respective stars to support carbon-based life.

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Why is carbon so important? Of all the naturally occurring elements (atomic numbers 1 through 92), carbon is the only one capable of forming the very long chains necessary for life. The artificially manufactured radioactive elements with atomic numbers 93 through 118 are also incapable of forming chains. Even if numbers 93 and higher exist in space, they would also be far too unstable to be used as building blocks for anything. Thus, if life exists anywhere in the universe, it has to be based on carbon. The problem is that all the hypothetical planets reported so far would be too massive and too close to their stars for carbon-based compounds to exist. These compounds break down at the temperatures which would exist on any such planets.

Besides carbon, two other elements necessary for the chemistry of life are hydrogen and oxygen. These have to be available somewhere from the environment. However, hydrogen is the lightest element and in its gaseous form would quickly escape from almost any planet's atmosphere, especially if the planet is hot. In order for it to be available to form carbon-based compounds, it must first be bound to one or more other elements. The simplest and most plentiful compound containing both hydrogen and oxygen is water, H_2O. Scientists have discovered that anaerobic bacteria can exist without oxygen in its gaseous form (O_2), but no known living things can exist without liquid water. Without water in its liquid phase, it is practically impossible to bring in nutrients and remove wastes.

This leads to another problem. There is only a narrow range of distances from a star in which water can exist as a liquid (the "Goldilocks zone" -- not too hot, not too cold, but just right). If a planet is too close to a star, any water would turn to steam; if it is too far, the water would freeze. The amount of red and blue shift calculated for every alleged planet so far indicates that if they really exist, only a handful could possibly have liquid water.

B. WHAT THE BIBLE SAYS ABOUT LIFE IN SPACE.

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Since the question of whether there is life in space is ultimately religious, it is appropriate to discuss what the Bible has to say. The Bible implies that the only place in the universe there is flesh-and-blood life is right here on earth. (Angels and demons do not count because they are not made of flesh and blood.)

- Genesis 1:14-18 says that the heavenly bodies are to furnish light, serve as signs, and mark off seasons, days, and years. It doesn't say anything about them being anybody's dwelling place.
- Romans 5:12 tells us that through one man sin entered the world (Greek *kosmos*, which includes not just the earth but the whole universe) and with sin came death. Romans 8:19-22 tells us that all of creation groans in travail because of what happened right here on earth. If there were other beings out there who never sinned, it would be unjust of God to subject them to decay because of something we humans did here. Yet the Bible and science (the 2nd Law of Thermodynamics) both say that death and decay extend throughout the cosmos.
- The effects of Adam's sin go still farther. The Bible tells us that his sin affected not only the earth but heaven itself. Jesus had to take his blood into the Holy of Holies in heaven to purify it (Heb. 9:22-24). What happened in the Garden of Eden was so significant that the Son of God had to die to undo its effects.
- Deuteronomy 4:32 says that from one end of the heavens to the other, God has never

dealt with anyone the way He did with Israel. If extraterrestrials sinned, God did not give them the same chance for redemption He gave us. Is this fair?

- If beings on other planets sinned too, then the devil must have been hopping from planet to planet tempting them since the beginning of the universe. Were we the first, or just part of a long series?
- 1 Corinthians 15, often called the Resurrection Chapter, tells us that the first Adam brought sin and death, but the Last Adam, Jesus, brought righteousness and resurrection. If somebody on another planet (let's call him Zorblatt) sinned, would Jesus have to be the Last Zorblatt on that planet? And if all of creation groans because of what happened on earth, then Zorblatt's sin didn't have much of an effect anyway. Would Jesus have to die on each planet where somebody sinned?
- The Bible says He died once and for all (Heb. 7:27, 9:26-28). If He needed to die someplace else for somebody else, then the Bible is wrong.
- 2 Peter 3:10 says that when Jesus comes back to judge the earth, not only will the elements here melt with fervent heat, but even the heavens (the rest of the universe) will pass away with a great noise. The Big Bang is a future event, not past!

Size means nothing to God. The earth may be just a tiny speck in the physical universe, but it is the center of His spiritual plans. We who have been saved by the blood of Jesus are trophies of grace. Ephesians 6:12 tells us that we wrestle not against flesh and blood, but against principalities and powers and spiritual wickedness in high places. The principalities are the demonic forces who rebelled against God soon after the beginning of the world. Ephesians 3:10 tells us why the church exists: God is using us, sinners redeemed by the blood of Jesus and saved by grace, to display his wisdom and goodness to those same principalities and powers (Eph. 3:10). How many planets does He need to show them that they made the wrong choice, and to show the angels who did *not* rebel against Him that they made the right choice? Only one. This is where the action is.

Could God have created microbes on other planets? Genesis shows us that everything he did on the earth was to prepare it for human habitation. He *could* have created microbes out in space if He wanted to, but why would He?

C. WHAT ABOUT REPORTS OF UFOs?

As long as UFOs (Unidentified Flying Objects) remain unidentified they are nothing more than an intellectual curiosity. The problem comes when we try to identify them. Cults have sprung up around the idea that extraterrestrials are hovering nearby with the answers to all our problems.

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Most UFO's turn out to be ordinary physical phenomena such as classified military aircraft, reflected light, or a burning ball of swamp gas. There have also been cases of fraud such as a publicity-seeking farmer in the United Kingdom flattening the crops in his field to make it look like a UFO landing site. But what about those few reports that have no known scientific explanation? What about the eyewitness accounts of people who claim they were abducted by aliens?

Christians have an advantage over the rest of the world because we know who our enemy is and what his tactics are. Satan's most effective tool has always been deception. He is so good at it that he can make people think that he, the very embodiment of evil, is an angel of light (2 Cor. 11:14). When God allows it, he and his fallen angels are able to interact with the physical world to some extent (Job 1:16, 19), even to the point of being able to do things to people's bodies (Job 2:6-7). In the last days he will be allowed to deceive many for a short time (2 Thess. 2:9-12, Mt. 24:24). There have been experiments

where hypnotists planted memories of events that never really happened, yet seemed real to the subjects. Why should we doubt that Satan can do the same, even throwing in a few punctures and bruises for good measure? He's pretty good at deception; he's had thousands of years to practice.

Anyone who doubts that alien encounters are a demonic deception should compare the drawings and descriptions from decades ago with those of the present. Most of the earlier reports described little green men in flying saucers. Now they tell of beings with disproportionately large heads and catlike eyes who travel in sophisticated machines capable of incredible maneuvers. Either the aliens and their ships have evolved tremendously in the last few decades, or else Satan knows what we expect to see and makes sure we get it.

People are eager to believe in UFOs because we are buffeted with problems: suffering, death, war, uncertainty about the future, and so on. We have no answers and things keep getting worse and worse. Those who believe UFOs are from advanced civilizations believe that when the aliens show up they will have all the answers, none of which will require us to make any sort of spiritual change. The Bible says that God has the answers, but He requires you to repent. UFOs, on the other hand, let you live any way you want to.

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One of the best arguments against aliens having arrived on this planet comes from an unlikely source: the Search for Extra Terrestrial Life, or SETI. This organization consists of many highly trained professionals who have dedicated their lives to finding signs of intelligent life coming from other stars. They look for nonrandom radio signals that might come from aliens unintentionally transmitting their communications into space, in much the same way that earthly TV and radio signals radiate outward from this planet. The search has been going on nonstop without success since the mid 1960's. Nevertheless, supporters believe in their cause so strongly that there are plans to put up more and more radio telescopes costing many millions of dollars.

We might ask those who believe UFOs are already here, *If aliens have arrived on earth, why spend all this money looking for them in space?*

III. CHAPTER SUMMARY:

1. The biochemical problems with trying to assemble even the simplest imaginable cell are insurmountable by natural processes alone. A reasonable person would conclude that something (or someone) outside of nature may be responsible.

2. Belief in extraterrestrial life is an issue of religion and is not supported by scientific evidence.

3. The Bible makes it plain that God is responsible for life, and that it exists only where He wants it to.