

Draft

- PRELIMINARY DRAFT -

THE STUDY OF ORIGINS

HILLSBOROUGH COUNTY SCHOOLS

Secondary Education
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Draft document

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This is a preliminary draft of the student materials for the Origins curriculum. It has been prepared by teachers through the use of the Goals and Guidelines approved by the Hillsborough County School Board, as well as other materials compiled by the Origins Curriculum Committee.

Additional materials yet to be developed are:

- 1) teacher's guide
- 2) student evaluation materials
- 3) program evaluation materials
- 4) resource list and bibliography
- 5) structured discussion materials

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THE STUDY OF ORIGINS

INTRODUCTORY UNIT

Have you ever wondered how the universe came about or how life originated on earth? These questions have been asked by humans as far back as the beginning of recorded history. Apparently we are very curious organisms! Today we are again attempting to explain ORIGINS. In this unit you will be introduced to four explanations of Origins. The four proposed explanations of Origins are controversial. Since television is a recent invention, and no "instant replays" of the beginning are available, how can anyone really know the final answer?

There exists today a wide spectrum of explanations of Origins. Some explain Origins by NATURAL PROCESSES governed by natural laws. Natural processes are the properties and regularities of physical, chemical and living things which are at least potentially observable or discoverable by human beings. The natural laws of logic, mathematics, physics, chemistry, astronomy, geology, and biology, among others, are human attempts to formally state these properties and regularities. Some explain Origins by saying it was done by a SUPERNATURAL INFLUENCE, a happening or event not defined nor explainable by natural laws of the universe. Supernatural events are beyond the ability of humans to repeat, to control, or even to test. Still others combine both the supernatural and natural processes to explain Origins by investigating natural results of supernatural events.

Our study of Origins will be limited to SCIENTIFIC EXPLANATIONS. Scientific explanations use a controlled process of gathering data and drawing conclusions known as the SCIENTIFIC METHOD.

The general sequence of steps in the Scientific Method is as follows:

- STEP 1: Identify Problem [What question is to be asked?]
- STEP 2: Gather Information [What data or information do we know about already?]
- STEP 3: Form Hypothesis (suggested explanation) [What do we suggest as an explanation or think happened?]
- STEP 4: Experiment [How can we find out in a test if the hypothesis is correct?]
- STEP 5: Make Observations [What happened in the test?]
- STEP 6: Record Findings [Write down results and measurements so others can repeat them and comment.]
- STEP 7: Draw Conclusions (Does the experiment prove or disprove the hypothesis?)
- STEP 8: Retest [Does a repeat confirm the same results?]

Science is the system of knowing about the Universe through data collected by the scientific method. As data are collected, theories are advanced to explain and account for what has been observed. The true test of a theory valid in science is fourfold: (1) can it explain what has been observed? (2) can it predict what has not yet been observed? (3) can it be tested by further experimentation? and (4) can it be modified as required by the collection of new data?

A THEORY

Sometimes a conclusion supported by the scientific method is formulated into a THEORY, an explanation verified after repeated testing by many independent workers. Since there are several proposed explanations for Origins, it is very important that we know how a theory is formed to better understand the four explanations of origins.

HOW IS A THEORY FORMED?

Just what is a theory? A theory may be defined as a "hypothesis which has withstood several critical experimental tests successfully." Do you recall the "Cell Theory" or the "Germ Theory"? Today we accept them with no difficulty, since they have been verified by many independent scientific workers. But remember, a scientific hypothesis, theory, or law is always on "probation." They are all subject to disproof in light of new data. You may remember the experiments of Redi, Spallanzani, and Pasteur disproving the "Theory of Spontaneous Generation." This theory was accepted by people in Pasteur's time. However, experimentation by these scientists proved this theory incorrect. Spontaneous generation does not occur under conditions existing at this time, but new ideas and theories can be formed from what was learned when it was studied.

FOR YOU TO DO

Now check your understanding of the Scientific Method by matching the statements describing an experiment (A-G) below with the steps in the scientific method (1-7):

THE EXPERIMENT

- A. Two bean seedlings were put in a dark cabinet. Two other bean seedlings were put in a well-lighted window. Both groups were watered and fertilized.
- B. Is light necessary for normal growth of bean seedlings?
- C. The two seedlings in the cabinet turned yellow and stopped growing after four days. The two seedlings in the window continued to grow and were green.
- D. Bean seedlings do need light for normal growth.
- E. Science journals indicate that bean seedlings need light to grow normally.
- F. According to the data collected, bean seedlings do need light to grow.
- G. The following information was measured during the experiment:

SEEDLING	PLACE	4 DAYS GROWTH
#1	Cabinet	2.50 cm.
#2	Cabinet	2.43 cm.
#3	Window	5.75 cm.
#4	Window	6.25 cm.

THE SCIENTIFIC METHOD STEPS

- _____ 1. Problem
- _____ 2. Collected Information
- _____ 3. Hypothesis
- _____ 4. Experiment
- _____ 5. Observations
- _____ 6. Recorded Data
- _____ 7. Conclusion

THE EXPLANATION

Now, what kinds of explanations attempt to answer our original question of Origins? There are several very complex explanations including scientific, theological, and even philosophical explanations. However, since this is science, let's concentrate on the SCIENTIFIC explanations, of which we will study and compare only four: NEODARWINISM (abbreviated ND), PUNCTUATED EQUILIBRIUM (abbreviated PE), CREATIVE EVOLUTION (abbreviated CE), and SCIENTIFIC CREATIONISM (abbreviated SC).

Let us agree on the definitions of these four explanations:

NEODARWINISM:

Life originated from non-life by physical-chemical processes under special conditions and all organisms, both living and extinct, are related by descent with modification.

PUNCTUATED EQUILIBRIUM:

Life originated from non-life by physical-chemical processes under special conditions and all organisms, both living and extinct, are related by descent with modification. The rate at which modification has occurred has been extremely rapid in some instances and nearly static in others. Most speciation results from rapid genetic modification.

CREATIVE EVOLUTION:

A supernatural influence originated and may actively continue to maintain all of the matter and energy in the universe and the natural laws which govern it. This supernatural influence may continue to act in the universe. Some believe the supernatural influence created in the natural processes of chemical and biological evolution and from these originated the diversity of living things on earth. Others believe that the diversity of living things may have been brought about partially by evolution and partially by subsequent creative acts.

SCIENTIFIC CREATIONISM:

Life appeared on earth abruptly as various original and different groups of organisms in fully functional form. Genetic variability permits changes within populations (microevolution) but excludes changes from one major group to another (macroevolution).

THE PARAMETERS

The topic of Origins is controversial and sometimes emotional. It's important that we examine each of the four explanations with an open mind, without prejudice, and to show respect for people holding other ideas or positions. In view of this "open-mindedness," let's explore the four explanations by using these parameters: (1) ASSUMPTIONS; (2) EVIDENCE; (3) MECHANISMS; and (4) LIMITATIONS.

First, to understand what these parameters mean, read the following story. Afterwards, check your understanding by matching the appropriate statement with the proper parameter.

A woman finds her jewelry missing. She gives the explanation to the police that her jewelry was stolen from her bedroom. Now, the police assume, accept as fact (ASSUMPTION) that the jewelry was indeed stolen. After investigating, the police discovered fingerprints (EVIDENCE) on the dresser where the jewelry was located. Further investigation revealed that the bedroom window was broken and lifted, suggesting to police how possible entry to the room was made (MECHANISM). However, police question (LIMITATION) this idea since the room was located on the 23rd story of the building! Apparently, other ideas must be considered and further investigation is necessary before we really know "WHO DID IT?"

- | | |
|---------------------|-----------------------|
| _____ 1. Assumption | A. Fingerprints |
| _____ 2. Evidence | B. Jewelry was stolen |
| _____ 3. Mechanism | C. Room location |
| _____ 4. Limitation | D. Broken window |

SUMMARY

You should now know the names and definitions of the four explanations, the steps in a scientific method, the four tests for a scientific theory, and the meaning of the four parameters. Perhaps as we learn more about Origins you might want to fill out the chart on the next page as you go along. You will use the completed chart at the end of the readings to participate in discussions.

Remember that the purpose of this unit is not to persuade you that any one explanation is better than any other, but to give you a chance to learn about how explanations are formed and about these four different viewpoints.

Now that we have established the groundwork for the study of Origins, proceed on to the next pages and read about the four explanations of Origins and their parameters. Hopefully, after having compared these explanations, you will be better informed as to what the study of ORIGINS is all about...

EXPLANATION	ASSUMPTIONS	MECHANISMS	EVIDENCE	LIMITATIONS
Neodarwinism				
Punctuated Equilibrium				
Creative Evolution				
Scientific Creationism				

ORIGINS AUDIOVISUAL PRESENTATION

SLIDE	SCRIPT
No. 1 Rainbow of Origins	Origins. Where do we come from? People have always wondered how living things came into existence. In considering the subject of Origins, it is important that we understand that there exists a wide spectrum of explanations. Our study will be limited to <u>scientific explanations</u> and of those we will be studying only four: <u>Neodarwinism</u> , <u>Punctuated Equilibrium</u> , <u>Creative Evolution</u> , and <u>Scientific Creationism</u> .
No. 2 Cartoon of man and mousetrap.	You will be learning about new ideas during this unit. New ideas must be considered by all, openly. New ideas lead to experimentation and new technology. New ideas open the way to knowledge and understanding.
No. 3 Men pulling in opposite directions. See drawing.	The subject of Origins is a deep controversy. Differences of opinion may arise. Individuals on all sides of this controversy sometimes have strong feelings or prejudices. The number of people supporting any one viewpoint does not say anything about the accuracy of that viewpoint. Even though you may not agree with parts of this unit, listen and learn.
No. 4 Evidences of origin, universe, man, etc. Scattered words.	What scientific evidence do we have of the origin of man? How did living organisms come into existence? How was the universe formed? Answers still elude us.
No. 5 Picture of the Curies.	As students studying scientific explanations you must recognize the methods used in an attempt to answer such questions.
No. 6 Man and woman in lab.	Scientists gain their knowledge through experimentation and observation.
No. 7 Woman and man in lab.	Scientific work is based on fact and evidence, not on opinion or faith. Scientific facts must be observed, measured, tested, and recorded.
No. 8 Cartoon showing scientific method	How do scientists work? As you learned earlier in this course, a process called the <u>scientific method</u> to solve problems. This method includes experimentation, observation and accurate measurements. Using this method, they collect facts as evidence and from these, conclusions are drawn. If one scientist's conclusion can be supported by experiments done by other scientists, a <u>theory</u> will be born.

SLIDE	SCRIPT
No. 9 Question mark; theory.	What is a theory? A theory is a hypothesis that has been tested and verified again and again. A theory tentatively offers an explanation of an observed event. A theory must be relevant to the facts. A theory must be: testable, predictable, explainable, and modifiable.
No. 10 The cell theory	Can you name some theories? Do you remember the cell theory?
No. 11 The atomic theory	The atomic theory?
No. 12 The electron theory	The electron theory?
No. 13 The germ theory	The germ theory?
No. 14 Spontaneous generation	Theories can be disproved in light of new data. The "theory" of spontaneous generation stated that life ordinarily arises from nonlife. People once thought that mice form from old rags and grain...that tadpoles grew out of mud and that geese and people develop in trees! The theory of spontaneous generation is a good example of how a theory was disproved through experimentation and the presentation of new data.
No. 15 - 23 Words on individual slides See slide 16.	We will be using the following words as we study about Origins. As you see the words think about what they mean to you.
No. 24 All words on one slide	When we complete our study of origins you will have a better understanding of these words.
No. 25 Rainbow	You will be studying four explanations of origins in this unit. The purpose of this study is <u>NOT</u> to persuade you that any one of the explanations is <u>better</u> than any other, but to give you a chance to <u>learn about</u> these four different viewpoints.
No. 26 Definition of Neodarwinism	Commentator read definition.
No. 27 Graph of Neodarwinism	See slide. This slide and those that follow are graphics representing each explanation. Time is represented along the bottom and the number of species along the side. The graph of Neodarwinism shows a gradual increase in the number of different species as time goes on.

SLIDE	SCRIPT
No. 28 Definition of Punctuated Equilibrium	Commentator read definition.
No. 29 Graph of PE	See slide. The graph of PE shows a "jerky" or step-wise increase in the number of species with time. Periods of rapid change alternate with periods of little change called <u>stasis</u> .
No. 30 Definition of Creative Evolution	Commentator read definition.
No. 31 Graph of CE	Creative Evolution could progress by either PE or ND or both.
No. 32 Definition of Scientific Creationism	Commentator read definition.
No. 33 Graph of SC	All groups of organisms were initially present due to an original creation. The number of groups of organisms has decreased due to extinction during time.
No. 34 Cartoon of student studying.	Why should we study origins? In order to be a better informed person, we must explore the scientific, theological, and philosophical explanations of the origins of the universe, of man, and of other living forms. Our study of Origins in this unit will be limited to <u>four scientific explanations</u> .
No. 35 Cartoon of man with door open in mind.	One thing should be very evident at this time. We must approach this subject with an open mind, realizing that we must be aware of and understand the personal beliefs of all peoples.

NEODARWINISM (ND)

EXPLANATION

One explanation for the origin of life studied extensively for many years is called Neodarwinism (ND). NEODARWINISM simply means new ideas added to the basic principles Darwin developed. Neo means "new" and Darwin was the scientist who described this idea involving evolution. Neodarwinism offers this explanation for the origin of life:

Life originated from non-life by physical-chemical processes under special conditions and all organisms, both living and extinct, are related by descent with modification.

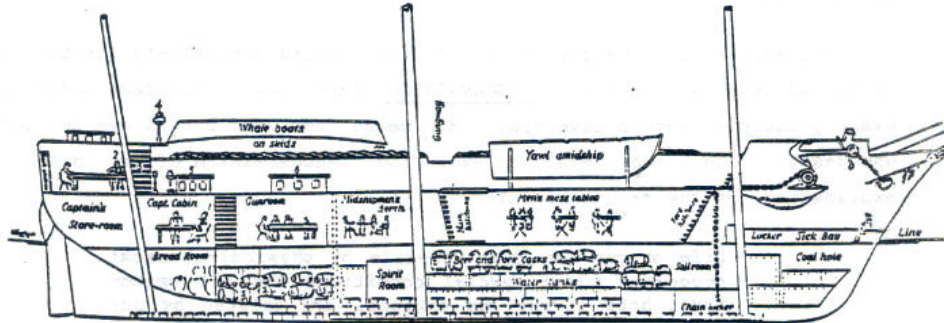


CHARLES DARWIN

Darwin's ideas and explanations will be investigated first, then new modifications involving genetics and early life will be explored. Finally, a summary of mechanisms and evidence, assumptions and limitations will be made. It is important to note that this explanation of Origins, as the study of science demands, is continually being reviewed and studied by scientists. Changes in this explanation may occur as science makes new, important discoveries.

MECHANISMS AND EVIDENCE

Darwinism



H.M.S. Beagle 1832

1 Mr Darwin's seat in Captain's Cabin 2 Mr Darwin's seat in Poop Cabin 3 Mr Darwin's drawers in Poop Cabin
4 Azimuth Compass 5 Captain's skylight 6 Gunroom skylight

The voyages of the British explorer ship, H.M.S. Beagle, in the 1830's supplied science with a great deal of important information. Charles Darwin was the naturalist aboard the Beagle on her survey trips to South America. The naturalist's job involved studying the plants, animals, and other "natural" things encountered on the voyage. Darwin's observations of plants and animals led him to draw some conclusions about relatedness among living things:

- 1) More organisms are reproduced than can survive.
(Overproduction)

This observation can be seen abundantly in nature today. Fishes and frogs are two animals which have the ability to produce thousands of offspring, yet relatively few survive.

- 2) The number of individuals in a species remains relatively constant due to competition within the species. (Competition)

Species are groups of organisms which have common characteristics and are able to breed and produce fertile offspring in nature. Darwin found that through generation after generation, population sizes of species remained about the same. When the number of individuals of a species changed, Darwin thought the change was brought about by some difference in the environment, like extreme temperatures or food shortages.

- 3) Because of Genetic Variation, the members of a population are not identical. These are differences in the inherited traits of organisms which are visible in members of the population.

If you examine individuals of any species, physical differences are easy to find. Cattle ranchers may find that some cattle grow larger than others. The cattle which grow the largest are prized by ranchers. The ranchers then choose or select those largest cattle for breeding. Darwin saw many differences among individuals of the same species of birds, turtles, and frogs during his visits to South America. He also saw the results of careful breeding of show pigeons by pigeon breeders when he returned to England. The variety of pigeons produced by these breeders truly impressed Darwin.

- 4) Due to these Genetic Variations, some individuals are better adapted to survive than others.
(Adaptation)

Darwin found in his studies that animals and plants with weaknesses simply could not compete successfully for the resources needed for survival. Organisms with the best adaptations to their environment were the ones best able to survive.

- 5) Those individuals that do survive will pass on their successful genetic variations to their offspring. (Natural Selection)

These successful individuals may live longer and thus have a higher reproductive rate. Their offspring will inherit their traits and, in turn, also have a greater chance for success or survival. Darwin thought this was the way the most effective characteristics were passed from one generation to the next.

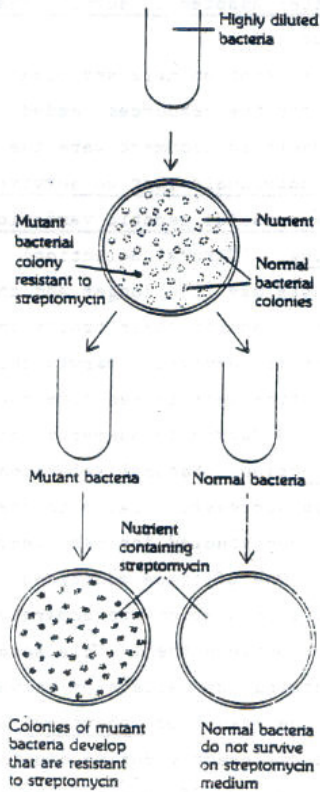
These five concepts led Darwin to summarize his ideas about evolution in a phrase called Natural Selection. Natural selection allows the fittest individuals to reproduce and pass successful traits to their offspring.

Darwin's ideas have been studied for many years, with additions being made to his original thoughts. One of these additions is the concept of REPRODUCTIVE ISOLATION. If members of a population are separated from each other, reproduction may not occur between them. This separation might be geographical, such as that between mountains and valleys or between islands and mainland. The separation might also be the result of behavioral differences, if members are isolated because they act differently during courtship behavior. Bird songs and nest building techniques are ways of causing behavioral isolations. Both these types of separation result in reproductive isolations. Individuals are isolated

from each other, making it impossible to breed. After many generations of isolation, the members of one part of the original group may lose the ability to reproduce with members of the other part.

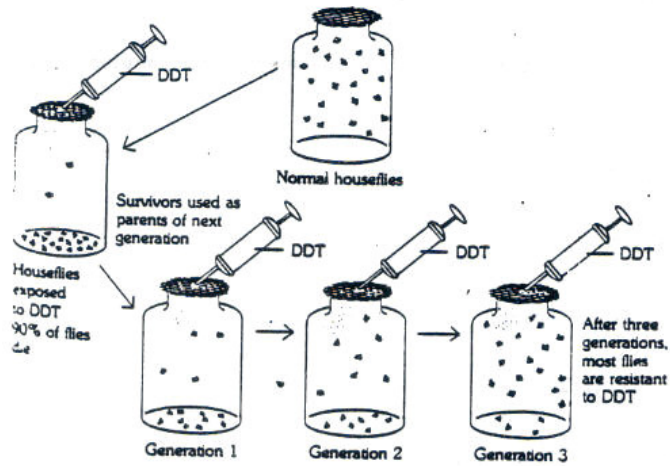
Changes which occur in individuals within a species is called MICRO-EVOLUTION. Microevolution is believed to be responsible for the differences resulting in reproductive isolation among individuals of the same species. These microevolutionary changes may eventually lead to the production of a new species.

Microevolution can be demonstrated experimentally in the laboratory. E. coli bacteria can be made immune to the antibiotic Streptomycin by selecting for generations of the bacteria which possess and then pass on this immunity to their offspring.



Developing a strain of bacteria resistant to streptomycin

Developing a strain of houseflies resistant to DDT



Houseflies resistant to the pesticide DDT are produced in similar fashion.

The same result occurs when breeders select for certain characteristics in domestic animals. It also occurs naturally when DDT is sprayed in the environment. Only the flies resistant due to a genetic variation can survive and they only will reproduce.

At present, change above the species level resulting in higher taxonomic groups, called MACROEVOLUTION, can not be produced in organisms experimentally.

FOR YOU TO DO

Use the following in original sentences that explain the meaning of these terms:

Competition

Species

Genetic Variation

Natural Selection

Reproductive Isolation

Microevolution

Macroevolution

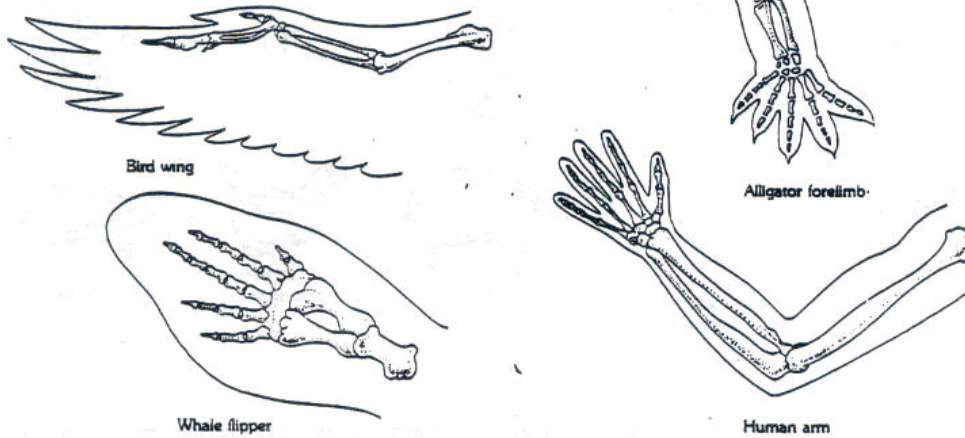
Answer these questions according to the information given on Neodarwinism.

- 1) What is the basic explanation for the origin of life described by Neodarwinism?
- 2) List Darwin's 5 major conclusions regarding relatedness among living things.
- 3) Name your own example of an organism which over-reproduces, causing its offspring to compete for survival. Describe what happens.
- 4) Why is the idea of genetic variation important in Neodarwinism?
- 5) Which one of Darwin's 5 conclusions most closely resembles "survival of the fittest"?
- 6) List two ways organisms can be reproductively isolated.
- 7) Macroevolution cannot be produced experimentally. Why is that significant?

Mutations and Variations

Scientists have used new techniques and methods of research to support Darwin's ideas. Similarities found among living things may indicate that many organisms are related, perhaps by common ancestors. Organs and body parts in different species that have a similar structure, such as those in figure 1, but different functions are called HOMOLOGOUS. The presence of homologous structures in closely related organisms does not prove evolution, but the examination of these structures together with studies involving embryological development support Darwin's explanation of the origin of species.

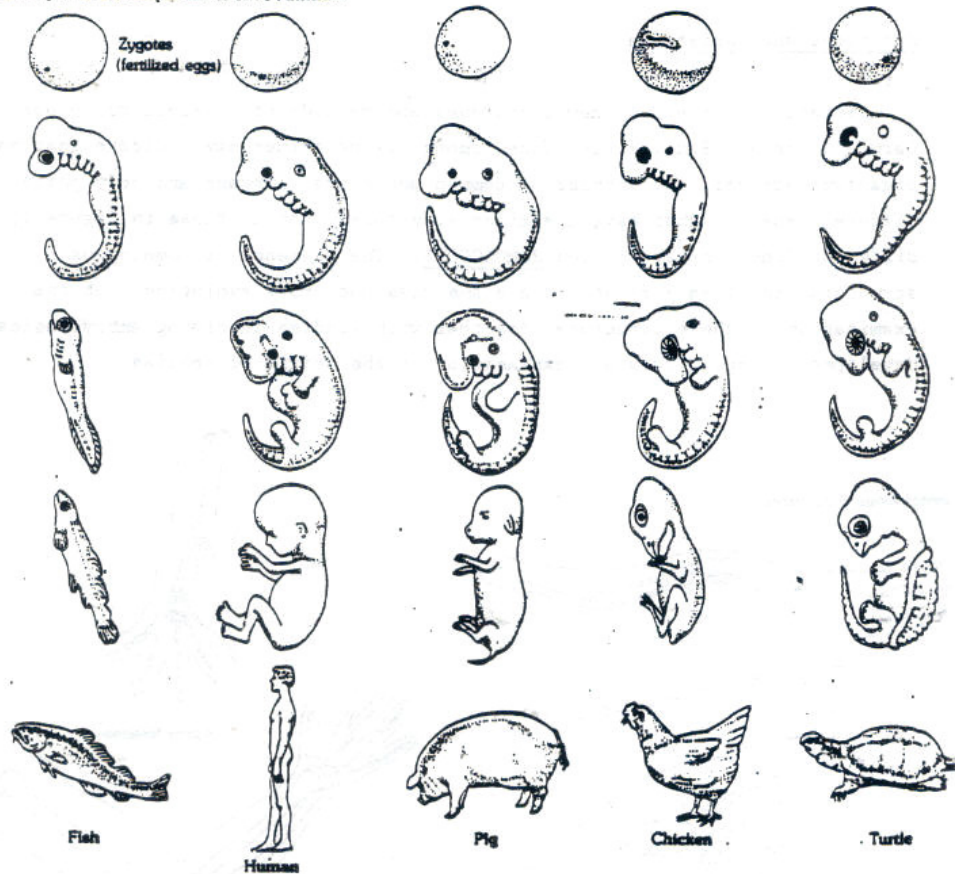
Homologous Structures



How many "arm bones" do each of these diagrams show?

Scientists have studied these homologies by examining the embryological development of different organisms. Embryology is the study of development of maturing fertilized eggs. Many similarities between embryos of various related organism are found when the early stages of embryonic development are studied. These studies suggest that the same fundamental processes occur in the development of a variety of homologous structures in related organisms.

Embryonic Development of Five Animals

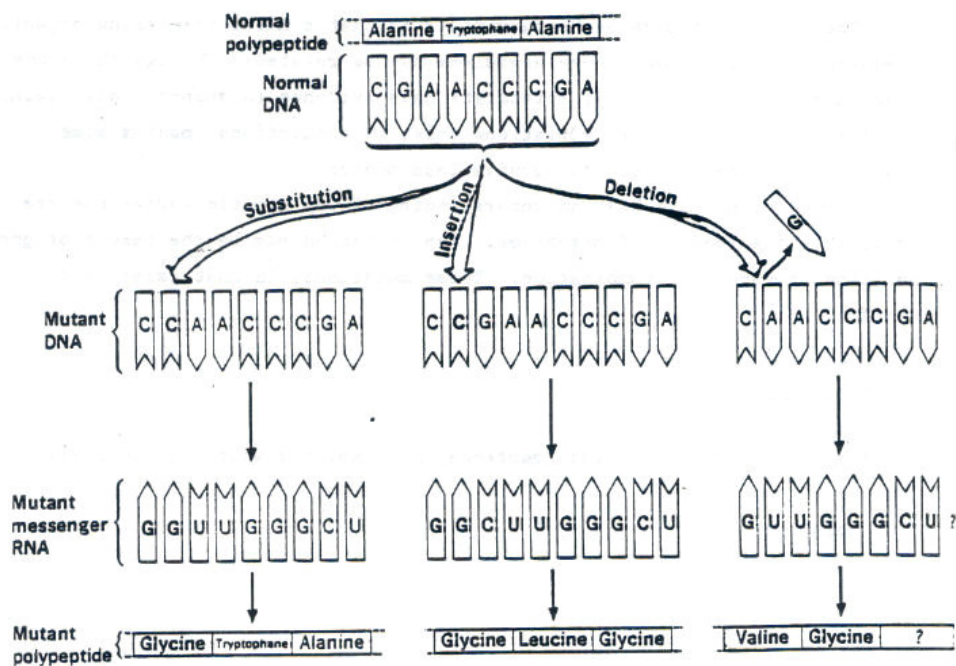


The study of biochemistry has, in recent years, played an important role in the support of Darwin's explanations. Biochemical homologies can also be recognized among organisms. The fact that all organisms have DNA, RNA and a protein synthesis system in common is considered evidence for relatedness.

Many chemical analyses and comparisons of proteins and DNA have been made. In these studies, similar organisms are found to have similar structure of DNA and proteins. Widely different organisms have widely different DNA structures. When species from different orders of mammals are compared, the differences in their DNA structures is greater than when species within the same genus are compared. Detailed studies of plant pigments, photoreceptor systems, and immunology have supported the idea of homologous biochemistry.

Darwin could not explain how differences existed among individuals in a population. He did not have an understanding of the genetic principles which we know of today. Scientists studying heredity, geneticists, have supplied information about GENETIC VARIATIONS which supports Darwin's claim about differences among individuals in a population.

Genetic variation is caused by two processes: Mutation and the recombination of genes. One type of MUTATION involves a change in the bases of a DNA code of a gene. This change may cause a different amino acid to be used in the production of a particular protein. This new protein may not be useful for the organism. Mutations, then, can be the result of changes in the hereditary material caused by "mixing up" information on the genes.



Basic types of DNA mutations. Note how the messenger RNA and the resulting polypeptide are affected.

Since most mutations are recessive, a mutant gene may remain in the population for a long time without being expressed. Most mutations are harmful. However, environmental conditions might be altered, and the mutant gene may be useful under new environmental conditions.

Genetic variation can also be caused by GENETIC RECOMBINATION. Genetic recombination is based upon genetic information being contributed by two parent cells that produce offspring with characteristics from each parent cell. During the process of meiosis, these genes are independently assorted, and then combined and recombined in fertilization. The variety of hereditary types that is possible in any species is enormous! New mutations form new genotypes which then make new phenotypes. These phenotypes are subjected, then, to natural selection. Scientists have shown that most mutations are not selected for by natural selection.

One assumption made by Neodarwinists is that similarities among organisms frequently indicate that these organisms may be related. Through the study of biochemistry and embryology, scientists have evidence to support this claim. Charles Darwin stated that variations exist in populations, making some individuals better adapted to survive than others.

Modern scientists have an understanding of why genetic variations are present in the species of organisms. The variation may be the result of genetic mutation or genetic recombination. These mutations, in most cases, are harmful.

FOR YOU TO DO

Use these TERMS in an original sentence that explains what each word means.

Homologous

Embryology

Geneticists

Mutation

Genetic Recombination

Answer these questions according to the information given on Neodarwinism.

- 1) How are whale flippers and human arms homologous?
- 2) How is biochemistry linked to studies involving relatedness among species?
- 3) Genetic variation can be caused by both mutations and genetic recombination.
True or False.
- 4) In most cases, are mutations harmful? Why or why not?
- 5) When could mutations become helpful?

The First Life

As you studied earlier in this course, the cell theory states that all cells are produced from previously existing cells. You may have wondered how the first life arose if all cells are produced from pre-existing cells. Scientists have been perplexed by this problem, too. Until recently, they had no answer. However, a hypothesis proposed by A. J. Oparin, a Russian biologist, in 1936 provides a possible explanation to the problem. This hypothesis is appealing to scientists because:

1. it explains the origin of living things from non-living things by existing chemical and physical processes, and natural laws and
2. the hypothesis is testable.

This hypothesis, of course, assumes existing physical-chemical processes are the same as those which may have operated on the primitive earth.

Oparin's hypothesis also assumes that the atmosphere of the young earth was quite different from the atmosphere of the modern earth. Scientists are reasonably certain that the earth was a molten mass early in its history. At these high temperatures, a reducing atmosphere probably existed, with the atmosphere composed of methane, ammonia, hydrogen, and water vapor.

Oparin hypothesized that violent electrical storms, heat from the molten earth, and/or cosmic radiation provided the energy to enable chemical reactions to take place. These reactions eventually led to the first cell. The steps in Oparin's hypothesis are listed in the diagram to the left.

The series of events described may seem a bit far-fetched to you. As a student of science, you may ask, "What proof is there that these events occurred? Have any experiments been done?"

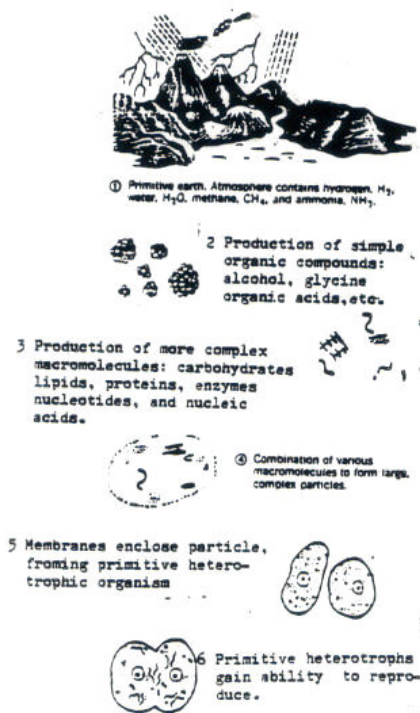


Fig. 1: Oparin's Hypothesis

Early scientists also had their doubts. They thought that organic molecules, such as amino acids, could not be synthesized. Then, a remarkable series of experiments was performed.

Harold Urey, a Nobel prize-winning scientist, became interested in the evolution of chemical compounds under primitive earth conditions. He discussed his ideas with Stanley Miller, one of his students. In 1953, guided by Urey, Miller performed an experiment to test the first stages of Oparin's hypothesis.

Miller's apparatus is shown in Fig. 2. The sealed apparatus contained methane, hydrogen, ammonia, and water. The water was kept constantly boiling to provide water vapor. Energy was provided by an electric spark, duplicating the effect that violent electrical storms may have had on the primeval earth.

The gases were heated and circulated for one week. At the end of the week, Miller analyzed the solution in the flask, and found a great variety of organic compounds. Among the molecules present were amino acids, the building blocks of proteins!

In a later experiment, Melvin Calvin exposed a mixture of carbon dioxide and water to radiation, and produced organic acids. This experiment showed radiation could also have been the source of energy that caused formation of organic compounds on the early earth.

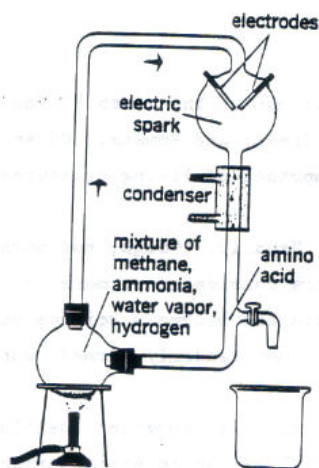


Fig. 2: Miller's Apparatus

In 1964, Sydney Fox conducted an experiment in which he synthesized cell-like structures called microspheres from a mixture of amino acids. This test simulated steps 3-5 of Oparin's hypothesis.

Fox found that a heated mixture of amino acids would lose water, and form peptide bonds. These condense into larger molecules of protein-like particles he called proteinoids.

These proteinoids perform simple enzymatic activities, and in water or salt solution form bacteria-like structures surrounded by a membrane. The membrane is double-layered and semipermeable, resembling a cell membrane. The resulting microspheres appear to reproduce, by budding. Could these be what the first cell looked like?

Although experiments show that life could have evolved on the primitive earth if the conditions assumed were correct, Oparin's hypothesis remains a hypothesis. More evidence would be required, and more experiments performed before we can conclude that his hypothesis is a theory.

- 1) Which of the steps in Oparin's hypothesis was simulated by Calvin?
- 2) Who simulated steps 3, 4 and 5 of Oparin's hypothesis?
- 3) Which came first, the proteinoid or the microsphere?

Fossils

The word fossil, literally, means "dug out of the earth." Fossils were dug out of the earth even in the times of the Greeks and Romans. Often they took the form of bones or shells. Some were imprints of living creatures, or their footprints.

People wondered about these fossils. Usually, though, not much importance was attached to these fossils, and they were considered as mere curiosities.

The study of fossils, paleontology, did not become a science until 1791, when William Smith showed that fossils were not randomly formed, but were found in layers in sedimentary rock.

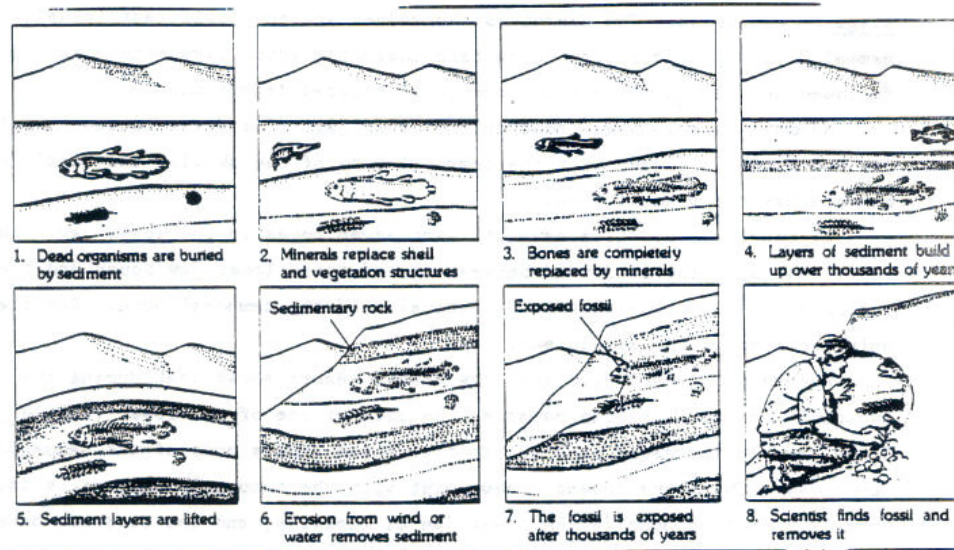
Paleontologists, scientists who study fossils, consider fossils to be any evidence of a once living organism. A fossil may be an entire organism that has been preserved through time, such as the frozen fossils of woolly mammoths or insects preserved in amber. More frequently, though, a fossil is an incomplete record of a living thing, and consists of a bone, a skull, a tooth, or some other hard part of the organism. Sometimes fossils are just imprints in stone of once living organisms, showing outlines or surface features.

How are fossils formed? A special series of events must take place.

First, the organism, or part of it, must be buried or otherwise protected from decay and the ravages of scavengers. In the case of the mammoth, a young animal may have fallen into a crevasse in a glacier, and so was preserved in a frozen state. More often though, parts of the organism, usually skeletal structures, may be replaced slowly by minerals, forming a hardened fossil. In

another process, layers of surrounding sediment may harden into rock, forming an imprint of the organism. Thousands of years later, an uplifting of the earth's crust and the process of mountain building may expose part of the buried fossil for the keen-eyed observer to discover. Figure 3 illustrates the process of fossil formation in a stream bed.

Fig.3: Fossil formation in a stream bed



Fossilization is a rare event. Usually, a complete organism does not become a fossil preserved, but only such preservation happens in those hard parts which can resist decay long enough to allow fossilization to occur. Finally, Neodarwinists assume that only a fraction of the fossils ever formed on earth have been exposed and discovered. Many may still lay buried in rock.

Fossils that have been found fit into one of three categories:

- 1. EXTINCT ORGANISMS** - Many fossils represent species that no longer exist, such as the many types of dinosaurs.
- 2. LIVING ORGANISMS** - Some fossils represent species that have undergone little change, and exist today looking much like ancient fossils. Examples of such species are the cockroach, the horseshoe crab, and the coelocanth. These "living fossils" present a problem to evolutionists, since they indicate long periods of relative stasis (little change) in the fossil record.

3. ANCESTRAL ORGANISMS - Still other fossils represent ancestors related, but not identical to species living today. Paleontologists are able to show how some ancient ancestors may have evolved into modern day living things.

The ancestors of modern mammals are thought by Neodarwinists to have been reptiles. The evolution from reptile to mammal has been traced by careful examination of transitional fossil skulls. A transitional organism represents a stage of evolution. The organisms themselves are not "half reptile-half mammal." Small differences in certain characteristics like bone size can be followed as the characteristics change in related organisms.

Mammals have a single bone in the lower jaw. The joint between the lower jaw and skull is formed with the temporal bone of the skull. The middle ear of mammals has three small bones.

By contrast, reptiles have at least seven bones in the lower jaw. The reptilian jaw joint is formed between one of these lower jaw bones and the quadrate, a skull bone that is an extension of the temporal bone. Reptiles have only one bone in the middle ear.

According to Neodarwinists, the fossil record shows that during the evolution of reptiles into mammals, the size of one of the lower reptile jaw bones greatly increased in size, to become the single bone of the mammalian lower jaw. This bone formed a new joint with the temporal bone, as is found in mammals. Another bone in the lower jaw of reptiles, and the quadrate bone in the skull, become reduced in size. These bones were incorporated into the middle ear.

Thus, the fossil record indicates that mammals evolved from reptiles. Neodarwinists today contend that all species may have evolved from earlier species.

Radiometric Dating

You may wonder how a scientist can tell where a fossil fits in the line of descent. Is there a way of telling how old a fossil is? With the discovery of radio-active isotopes, a method of measuring the age of fossils and rocks has been provided.

ISOTOPES of an element contain atoms with the same numbers of protons and electrons, but differing numbers of neutrons. Most carbon atoms, for example, have 6 protons, 6 electrons, and 6 neutrons. However, some carbon atoms have 6 protons and electrons, but 5, 7, or 8 neutrons. These would represent various isotopes of carbon.

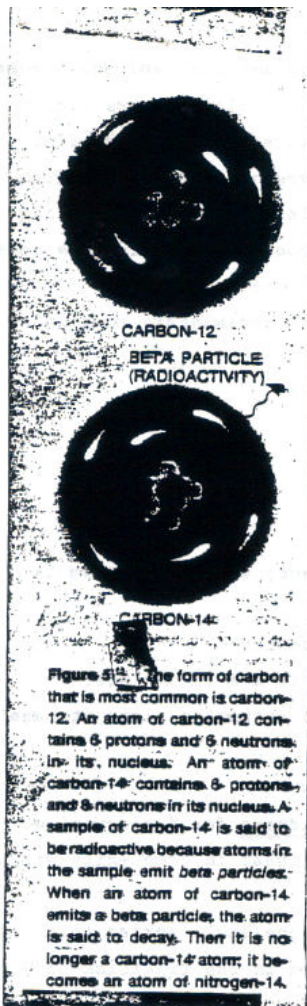


Figure 5. The form of carbon that is most common is carbon-12. An atom of carbon-12 contains 6 protons and 6 neutrons in its nucleus. An atom of carbon-14 contains 6 protons and 8 neutrons in its nucleus. A sample of carbon-14 is said to be radioactive because atoms in the sample emit beta particles. When an atom of carbon-14 emits a beta particle, the atom is said to decay. Then it is no longer a carbon-14 atom; it becomes an atom of nitrogen-14.

Some isotopes are unstable, and break down into other elements while releasing various parts of their atoms. These unstable isotopes are radioactive, and are called radioisotopes.

It has been discovered that it takes a certain amount of time for radioactive isotopes to decay into another element. This rate of decay is called the half life of the radioisotope. Carbon 14, a radioisotope of carbon, has a half life of approximately 5500 years. This means that after 5500 years, half of the radioactive carbon atoms originally present in a substance will have decayed to nitrogen 14. (See figure 4.)

This change in the number of radioactive atoms is a very orderly and predictable process. The rate of decay is not influenced by refrigeration, heat, or pressure. Thus, if we know the number of atoms on hand at a particular time, and their half life, we can calculate exactly how many atoms there will be at some future or past date.

Scientists use this process to determine the age of fossils and rocks by first determining how many radioactive atoms must have been present in an ancient organism, then comparing that to the amount in the present day fossil. This laboratory process may be complicated by a number of factors leading to dating anomalies or dates that do not agree. Great care must be taken that errors in methodology are not made. All dating should be repeatedly checked by reputable laboratories.

Radioactive carbon dating may be used to estimate ages of fossils up to twenty thousand years. For older fossils, the ages of surrounding rocks is measured by similar radiometric methods, using uranium, potassium, and rubidium,

which have longer half lives. On the basis of these methods, and the assumptions underlie them, the earth is estimated to be 4.5 billion years old.

Some problems arise in dating sedimentary (layered) rock surrounding fossils. Since the eroded sediment forming this type of rock is made from eroding rocks of different ages, dating is difficult. Anomalies in dating do exist. Sometimes layers of sedimentary rock is associated with igneous rock (hardened molten rock). Igneous rock can be dated more accurately. If the igneous rock overlays the sedimentary rock, then the sedimentary rock is at least as old as the igneous rock.

SUMMARY

The following are assumptions on which the theory of Neodarwinism is based:

1. The fossil record reflects a sequence of descent.
2. Both the fossil record and discoveries of it are incomplete.
3. The age of the earth is very old. Current estimates place its age at about 4.5 billion years.

The following statements are considered as evidence for Neodarwinism:

4. The fossil record shows that organisms increase in complexity with time.
5. The fossil record includes some specific bone/skull series that include even minor structural changes, for example in the transition of a reptile to a mammal skull.
6. Radiometric and other forms of dating indicate a great age for the earth.

Finally, the evidence from the fossil record and radioactive dating does have some limitations:

1. There are long periods of stasis in the fossil record.
2. There are dating anomalies.
3. Fossil discoveries present a limited record of the sequence of descent.

FOR YOU TO DO

Use the following words in an original sentence that explains the meaning of the words:

proteinoid
fossil
isotope
half life
anomalies
microsphere

Answer these questions according to the information given on Neodarwinism:

1. Give two reasons why Oparin's hypothesis is appealing to some scientists.
2. Although Oparin's hypothesis has been tested in the laboratory, it remains a hypothesis. Why?
3. Why is fossilization considered a rare event?
4. Name the three categories into which fossils fit.
5. Why do dating anomalies exist?

PUNCTUATED EQUILIBRIUM

EXPLANATION

A scientific theory must be able to be modified to better account for observed information. Punctuated Equilibrium is an explanation of evolution that actually is a modification of Neodarwinism.

Neodarwinism has several limitations. Two of these are that there are long periods of stasis in the fossil record, and that the fossil record presents only a limited record of the sequence of descent.

Paleontologists studying Punctuated Equilibrium do not deny that Neodarwinism mechanisms can occur. However, they do assert that in some cases macroevolution can occur more rapidly than in the gradual process assumed by Neodarwinism.

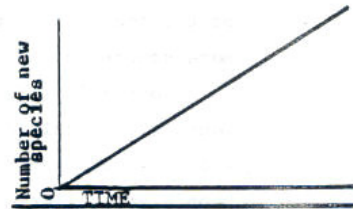
Punctuated Equilibrium asserts that the gaps in the fossil record are the result of a pattern of bursts of rapid speciation alternating with long periods of little evolutionary change (stasis).

The main difference between Neodarwinism and Punctuated Equilibrium is one of rate. Neodarwinism assumes that microevolution, or the small changes within a species, can lead to macroevolution. Thus, in Neodarwinism, evolution is pictured as a slow, gradual process. Punctuated Equilibrium states that while gradual changes can occur, macroevolution can also occur rapidly.

MECHANISMS

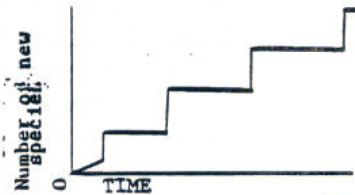
This comparatively "rapid" evolution does not occur overnight, but changes still take hundreds of thousands of years. However, the time interval is short compared to the more gradual evolution described by Neodarwinists. According to the theory of Punctuated Equilibrium, new species often emerge as a result of reproductive isolation and mutations. The actual mechanisms of Punctuated Equilibrium are built around three basic concepts: founder's effect, mutations, and behavioral isolation.

Neodarwinism = ND



Neodarwinism: Slow, gradual change. Microevolution leads to macroevolution.

Punctuated Equilibrium = PE



Punctuated Equilibrium: Stasis interspersed with higher rates of speciation.

Founder's Effect

For the evolution of new species to occur, according to the theory of Punctuated Equilibrium, a small number of organisms from a population were reproductively isolated and started a new population. These original members of the new population were called founders. FOUNDER'S EFFECT states that organisms moving to a new area will determine what genes will be most prevalent in the future population. Some alleles* present in the original population will not be present in the new population, since they were not common in the genetic make up of the founders. Other alleles that were present in the founders will become more common in the new population.

Founder's effect is illustrated in the history of a genetic disease in South Africa called porphyria. Eight thousand South Africans have this disease, and every one can trace their ancestry back to one of four people! These four people are children of Ariaanthe and Gerrit Janusz, Dutch emigrants who married in South Africa in 1688. Apparently, one of these two people possessed a defective gene causing porphyria, and passed it on to four of their eight children. From there it spread throughout the rapidly expanding South African population. The disease became much more prevalent in South African Dutch populations than in the original Dutch population.

Behavioral Isolation

Animals breeding at the same time in an area may have different mating behaviors which prevent them from interbreeding. This type of reproductive isolation is termed BEHAVIORAL ISOLATION, and may include a variety of visual and auditory factors often related to courtship and mating behavior. Paleontologists who study punctuated equilibrium believe that, in some instances, behavioral isolation commonly leads to speciation. Behavioral isolation appears rapidly in population cage experiments during large changes or fluctuations in population size. To illustrate how this occurs, a series of population cage experiments was carried out with Drosophila pseudoobscura, a species of fruit fly.



19-5 Foot-stamping, bowing, and strutting distinguish the courtship behavior of the male sage grouse. This fixed action pattern involves a number of inborn or hereditary movement forms that are specific to the male sage grouse and are as constant as his anatomical characteristics.

*Alleles are genes that code for different forms of the same protein. For example, blue and brown are both alleles for eye color.

A small number of flies were placed in a large cage and the population was allowed to expand rapidly. When the population had reached a peak, eight males and females were removed and used to start another population in a different cage. The cycle of expansion and reduction was repeated three more times. At the end of the experiment, mating preferences of females (in Drosophila the females choose their mates) in the three populations was tested. There was a significant tendency for females in each of the population cages to choose mates from their own cages, as opposed to choosing mates from other cages. Thus, sudden appearance of behavioral isolating mechanisms can be demonstrated in the laboratory. Perhaps some small difference in courtship behavior or scent had evolved, making "stranger" fruit flies less attractive to those females.

Mutations

That mutations, even minor ones, affect the embryology of an individual can exert large influences on the adult's phenotype, is another mechanism of Punctuated Equilibrium.

In a stable population; the effects of mutations are to some extent buffered or lessened during embryological development. The mechanism for this buffering is not well understood by scientists, but its existence can be demonstrated. However, when the population is not stable, buffering breaks down, and mutations have a greater affect on the adult phenotype. The instability in the population may be caused by environmental stress, such as a severe drought, or by changes in population size, as when founders move into a new area.

Chromosomal deletions or duplications may also exert large changes on the phenotype leading to formation of new species. Polyploidy, a sudden multiplication of the normal number of chromosomes, is common in plants. Probably one-third of the modern plant species arose through polyploidy. Polyploid plants are often larger and hardier than their diploid relatives, and tend to be highly variable. This variability is important in speciation.

In animals, polyploidy is less common because it may interfere with sex determination, leaving the organism sterile.

Chromosomal aberrations (chromosomes changed in position) and deletions also exert large influences on the phenotype. For this reason, scientists feel they too can lead to rapid speciation.

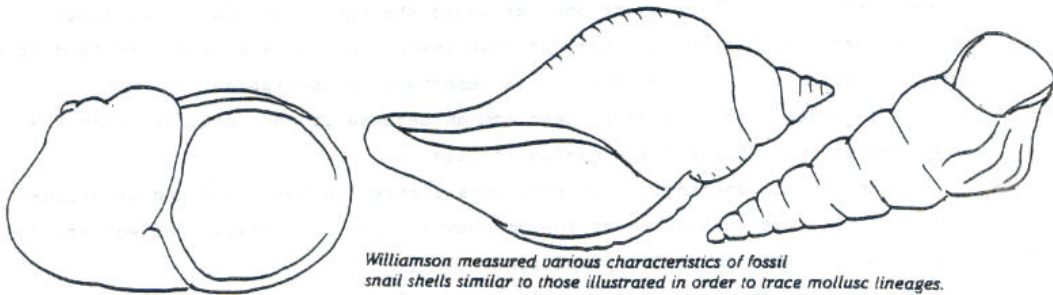
Are there any cases in which Punctuated Equilibrium can be studied? A 1981 study of mollusk fossils in Kenya seems to support Punctuated Equilibrium.

These snail and clam fossils have provided information suggesting how one species evolves into another. The evidence supports the evolutionary explanation suggested by punctuated equilibrium: A species remains unchanged for long periods and then abruptly transforms during times of environmental stress.

The fossils came from deposits near a lake in Northern Kenya. Over 3,300 individuals (fossils of 13 mollusk species) buried through a depth of 400 meters of sediment were studied. Many species appeared to remain unchanged for long periods of time. Some species living in the lake today may not have changed at all over millions of years! Scientist found geological evidence of two sharp drops of the ancient lake levels. Further evidence from the mollusk fossils indicated that all the species studied then underwent a "brief" period of rapid change. At the end of this period, 5,000 to 50,000 years, evidence of new species was found. The discovery of this series of mollusk fossils supports the idea of macroevolution occurring in a relatively brief time span.

In addition to finding new species appearing to evolve from long established ones, the studies of these mollusks have also shown the presence of intermediate or transitional forms. These are individuals having characteristics of both the "old" and "new" species.

The studies of these snails and their relatives provide scientists with some contemporary evidence to support Punctuated Equilibrium.



Williamson measured various characteristics of fossil snail shells similar to those illustrated in order to trace mollusc lineages.

From: Principles of Paleontology (Second Edition) by David M. Raup and Steven M. Stanley. W. H. Freeman and Co. ©1978.

FOR YOU TO DO:

Use the following words in an original sentence that explains the meaning of the words:

Behavioral isolation

Founder's effect

Polyploidy

Answer these questions according to information given on Punctuated Equilibrium.

Questions:

1. The large number of Latin names in the Tampa phone book is an example of which mechanism of Punctuated Equilibrium?
2. Can behavioral isolation be demonstrated experimentally?
3. Does punctuated equilibrium suggest gradual or rapid changes in the evolution of one species into another?
4. Identify two reasons why the mollusk studies in Kenya support the evolutionary explanation suggested by Punctuated Equilibrium.
5. What is an intermediate form?

CREATIVE EVOLUTION

EXPLANATION

Creative Evolution asserts that a supernatural force or influence created the natural laws that are at work in the natural world.

Creative Evolution says that the origin of living things comes about through natural laws originated by a supernatural influence. The supernatural influence is assumed to act to bring organisms into existence in a naturally occurring process called evolution.

All events which are not governed by regular, natural processes and laws are termed supernatural. Natural results of supernatural events can be studied by scientists, however.

MECHANISM

Creative Evolution is in agreement with mechanisms of both Neodarwinism and Punctuated Equilibrium. It is different from these two explanations in that it attributes the origin of the natural laws by which evolution works to a supernatural influence.

All of us have seen natural laws at work. When we slide down a sliding board or drop a glass, we see the natural law of Gravitation take effect. Other laws govern the motion of planets and particles (Newton's Laws of Motion, Laws of Thermodynamics), the reactions of chemicals and gases (Gas Laws), and therefore the life of organisms on the earth. Even chance follows the Law of Averages or Probability!

What three natural laws are in effect when you flip a coin?

Scientists are constantly working to discover how the universe and living things are controlled by natural laws. Scientists study observable natural events and sometimes they can describe certain regular tendencies of these events by general statements called natural laws. "What goes up must come down" and "things tend to stay where they are" are descriptions of regular tendencies which are also described as Newton's Laws of Motion. When a natural law is "discovered" or first described by a scientist, the law is usually named after the scientist. The scientist, however, did not put the law into effect originally or make the law work.

EVIDENCE

The evidence used to support Creative Evolution is the evidence for a finite beginning of the Universe and its matter, energy and natural laws. Calculations made by space scientists indicate the Universe was once much smaller and much hotter than it is now so that even matter itself could not form as we know it today. Mathematical extrapolations and observations of starlight indicate that an event resembling an explosion, termed the Big Bang, began the movement of galaxies away from each other. Scientists can trace backwards in time and interpret by means of natural processes, events occurring very shortly after the Big Bang. But the Big Bang itself is not describable by natural laws. Natural laws became operable suddenly, after the Big Bang. Natural laws governing motion, chemical reactions and processes of energy exchange can be used to explain the behavior of the Universe since the Big Bang. The subsequent cooling of the Universe, the formation of elements, and the movement of galaxies have all been studied by scientists by using the scientific method and the natural laws of science and mathematics. Biology also is studied by the application of natural laws and the scientific method. Living organisms also exhibit regular tendencies such as the chemical reactions and energy exchanges in metabolism. The mechanisms of Neodarwinism and Punctuated Equilibrium are all natural processes governed by natural laws.

LIMITATIONS

Since Creative Evolution shares mechanisms and evidences of Neodarwinism and Punctuated Equilibrium it also shares their limitations. Additionally, supernatural acts themselves cannot be studied by scientists.

Events in nature like the Big Bang cannot yet be understood by scientists. Events which do not appear to follow natural laws may never be fully understood by scientists. What happened before the sudden occurrence of the natural laws which govern the Universe in the Big Bang cannot be studied by scientists.

SUMMARY

Creative Evolution describes the events like those prior to the occurrence of natural laws in the Big Bang as supernatural since they follow no natural laws. Creative Evolution says that all natural processes are governed by natural laws created by a supernatural influence. That evolution is a natural process is supported by a large body of evidence for both Neodarwinism and

Punctuated Equilibrium. Change brought about by natural processes occurs everywhere in nature from the birth and death of stars to the origin and extinction of certain species. The scientific evidence for evolution in no way violates natural law. Evolution does not disprove the existence of a supernatural influence working through natural laws.

FOR YOU TO DO

1. Supernatural influence is a part of Creative Evolution...True or False
2. Creative Evolution is considered to be a natural process exclusively...
True or False
3. Natural laws are named after scientists who put the law into effect...
True or False
4. Scientists describe regular, general tendencies in nature called explanations...True or False
5. Supernatural events cannot be fully described by natural laws...
True or False
6. Results of supernatural events can be studied by scientists...
True or False
7. Evolution disproves the existence of supernatural influences...
True or False
8. Creative Evolution says that evolution is a natural process and does not violate any natural laws...True or False
9. Evolution disproves the existence of supernatural influences...
True or False
10. Creative Evolution says that evolution is a natural process and does not violate any natural laws...True or False

SCIENTIFIC CREATIONISM

EXPLANATION

How did life start on Earth and how did it change? A growing number of scientists think that all life was brought into being by supernatural acts of special creation. Scientific creationists assume life appeared on Earth abruptly as various original and different groups of organisms in fully functional form. The fully functional organisms were created with all structures present and working. Humans looked like humans, cats looked like cats, and roses looked like roses. Scientific creationism asserts that this sudden occurrence was a singular event, happening only once, and that the resulting living forms have changed only slightly due to the process of environmental adaptation. According to Scientific Creationism, this abrupt appearance was due to an influence outside the realm of scientific investigation. However, there is a growing body of information to support scientific creationism. The vast majority of this scientific evidence comes from two main areas:

1. the thermodynamics of living systems
2. the fossil record.

The following unit presents data and evidence with possible mechanisms to support the scientific creationist's view of origins.

FOR YOU TO DO

Answer these questions according to the information given in the Explanation of Scientific Creationism. Circle answers when a choice is given.

1. According to scientific creationism, what brought life into existence?

2. What type of changes (large changes, small changes) have occurred between original and present day organisms?
3. According to Scientific Creationism, original organisms looked about the same as those of today. (True or False)
4. Humans looked like humans, dogs looked like dogs, and trees looked like trees in the original creation. (True or False)
5. All structures, or parts, were present and working on all the organisms originally created. (True or False)
6. How many times has creation occurred according to Scientific Creationism?

7. What two main areas of scientific evidence support Scientific Creationism?
A. _____
B. _____

MECHANISMS AND EVIDENCE

Thermodynamics and Living Systems

In Scientific Creationism, it is assumed that natural systems are apparently stable, but eventually run down or decay. It is further assumed that in order for systems to be maintained or improved, both controlling and directing mechanisms must be employed. These two assumptions lead to a need for a master plan of a supernatural influence to explain the structural, functional, and biochemical similarities among organisms of different groups.

THERMODYNAMICS

Scientific creationists believe the First and Second Laws of Thermodynamics support their explanation of an original, special creation. The First Law states that energy is not created or destroyed under ordinary conditions existing today. The total amount of energy that is present will never change and will always be present somewhere, in some form. This law supports the explanation that all life, energy, and matter were created at one time in the past and that creation is finished. (See Figure 1)

The First Law states that matter and energy can neither be created nor destroyed, but can be changed. The illustration shows matter I in place, with energy holding it together; energy is released from matter I but it is still available somewhere; matter I is now changed to matter II but arranged differently. Matter and energy have been neither created nor destroyed, but they have been changed.

1st Law of Thermodynamics

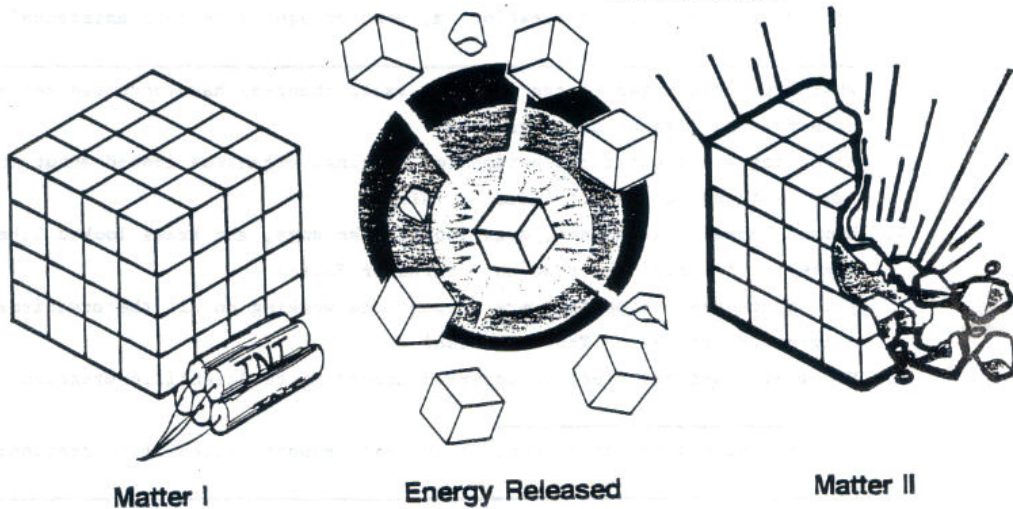
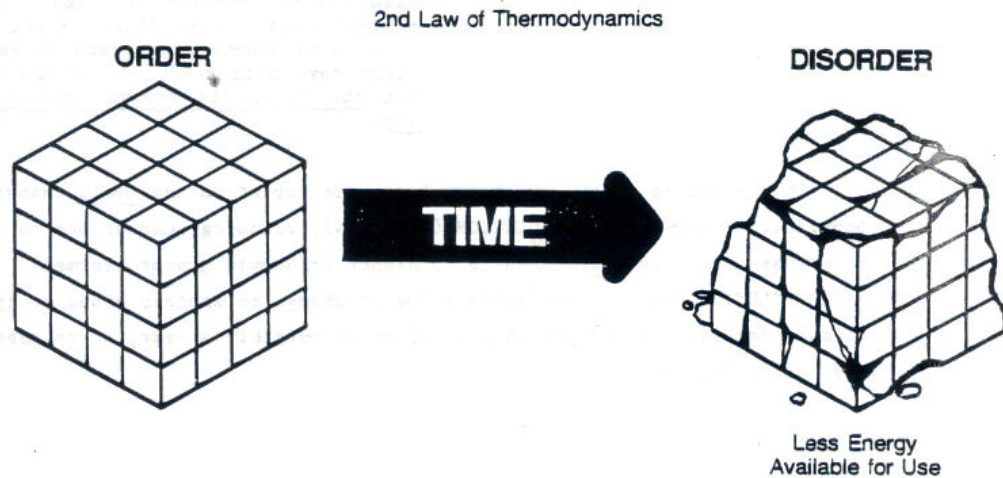


FIGURE 1

The Second Law of Thermodynamics states that whenever there is an energy transfer, such as a chemical reaction, some of the usable energy started with cannot be recovered. When energy is used to do work, some of this energy becomes unavailable to do work again. For example, for every 100 calories in the food you eat, you may be able to do only 50 calories of work. The other 50 calories are lost as heat to the surroundings. All of the original 100 calories of energy are still there somewhere, but half of them have diffused into space and cannot be used to do any more work. This law always holds true when physical, chemical, or biological systems are operating. (See Figure 2)



The Second Law says that all energy processes, i.e., chemical, physical, etc., run down when left alone and new energy is brought in. This running down of a system, or increase in entropy, means: a system can be very ordered or complex; but, over a period of time it will run down and be less ordered or complex. Some of the energy it had in the first place becomes unavailable; it is still in existence but it can't be used. This is what entropy means and this is what the Second Law of Thermodynamics is all about. Creation scientists use these facts to show that there is no natural tendency to go from disorder to order or from simple to complex.

FIGURE 2

Living Systems

In the universally accepted cell theory, it is stated that cells must come from pre-existing cells and that all life is based on cells. In cells, the controlling nature of chromosomes has tended to keep cells from changing drastically without harmful effects to the organism. Growth and reproduction of organisms is controlled by the DNA in each cell.

Biochemical pathways direct the use of energy within the living cell. When one or the other of these mechanisms is drastically altered, such as changes or alterations in a gene, termed **MUTATIONS**, death of the individual or extinction of the group usually occurs. Figure 3 below shows an example of mutations in the fruit fly, Drosophila.

The fruit fly, Drosophila, has been studied through more than 1500 generations. It has been treated with x-rays and other means to speed up the **MUTATION** rate. These mutations cause many kinds of changes to take place. White-eyed flies, flies with partial eyes, blind flies, sterile flies, flies with stubby wings, and flies with no wings have been produced through mutation, but the fruit fly always remains a fruit fly.

This tends to allow for abnormal genetic variation and small changes within populations, termed **MICROEVOLUTION** (Figure 4), allowing adaptations to occur. This does not allow large changes to higher taxonomic groups, termed **MACROEVOLUTION**, which would allow a dog to change to another group or type of animal, for example, to possibly a cat or to possibly a bear, or to possibly an ape. (See Figure 4)

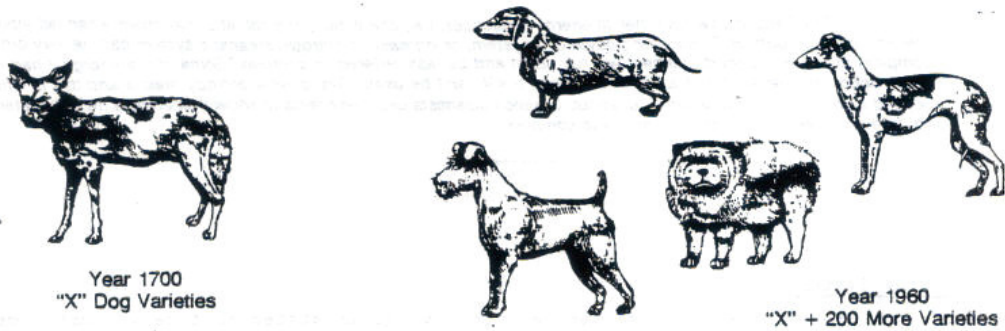


FIGURE 4

Thus the Universe as a whole is governed by the laws of thermodynamics energy conservation and decay. Life within the Universe is governed by the Law of Biogenesis. This law states that life forms come from similar life forms and that life, too, must conform to the universal laws of conservation of energy and general decay of systems, known as the Law of Thermodynamics.

The extreme complexity of the living cell, the requirement of all systems to act in specific sequence, and the fact that there is no natural tendency to go from disorder to order or from simple to complex tends to support the idea of a master plan for scientific creationism.

FOR YOU TO DO

Using the information you just studied about scientific creationism, answer the following questions. Circle answers when a choice is given.

1. What does Scientific Creationism assume about natural systems? _____

2. What two mechanisms are necessary for systems to be maintained or improved? _____

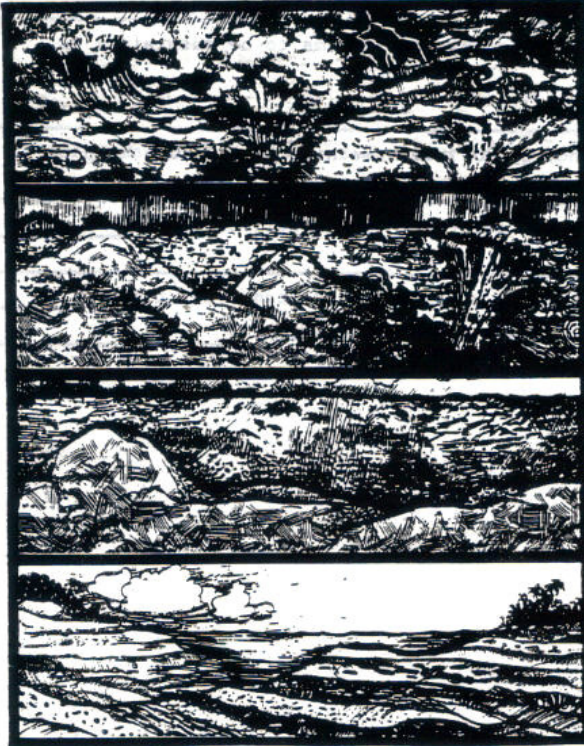
3. Is there a natural tendency to go from something simple to something complex? _____
4. Where must all life come from according to the cell theory? _____

5. Has a fruit fly ever reproduced anything other than a fruit fly? _____
6. What type of changes are allowed by MICROEVOLUTION? _____

Catastrophism and Fossil Evidence

Scientific Creationism is based on the assumption of CATASTROPHISM. The definition of CATASTROPHISM is the idea that changes in the earth's crust have generally been affected suddenly by physical forces. Catastrophism is the opposite of gradualism.

It is the contention of scientific creationists that catastrophism, in the form of one or more large-scaled floods, produced widespread sedimentation, fossilization, and extinction. Creationists consider most of the vast sedimentary layer of rock covering the earth today to have been deposited by such a flood. These flood waters came quickly and destroyed almost all of the animal life and much of the terrestrial plant life. This flood covered the highest mountains. The evidence for a global flood includes continent-wide sedimentary formations along with vast fossil graveyards. The diagrams below in Figure 5 show the stages of the catastrophic flood as understood by creationists.



STAGE 1

Violent earth movements (faulting) on the ocean floor, bursting open underground water reservoirs, generated ocean waves which inundated the land surface.

STAGE 2

Torrential rain and the gushing of subterranean water continued until the flood waters engulfed continents. Millions of organisms were buried by sand, lime, and mud.

STAGE 3

Sedimentary strata with fossils were also formed during the retreat of the flood water.

STAGE 4

As the oceans assumed their present basins, canyons were eroded in the soft sediments, mountains were uplifted, and a cooler climate began to prevail. The ice age was an after-effect of the flood.

Dr. Richard Bliss explains the effect of the flood on the fossilization of organisms in the following manner:

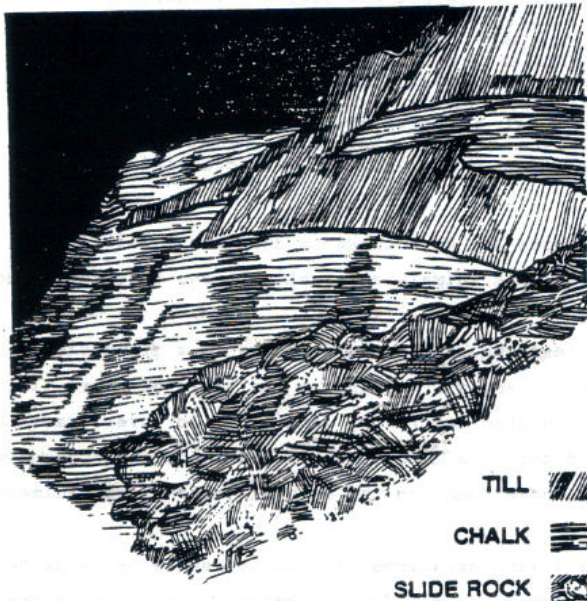
"As the flood waters were rushing forth and producing a complicated mix of materials, the higher density objects and the objects that were more streamlined, such as sea shells, settled out first. The land animals that could move quickly went to the higher ground. Many of these animals at higher levels were eventually trapped and buried. Fishes, and worms were quickly buried in the sediment. The creationist points out that the type of fossils found in a particular area is in keeping with the ecological habitat in which this life would be found. For example, Cambrian rocks were actually formed by the burial of bottom-dwelling sea animals. Creationists believe that these would be buried first during a flood followed by successive strata."

One or more widespread floods are chronicled in numerous fossil finds showing various land animals and sea animals apparently thrown together without separation.

Hydraulic sedimentation research also lends evidence to a flood based sedimentation mechanism. Some scientists working in the field of hydraulic sedimentation research have simulated laboratory conditions to investigate the type of sediment patterns produced in a flood. These distribution patterns were found to be about the same as those found in the naturally occurring sediment layers.

Apparent rapid burial of living organisms is also evidenced by large beds of closed bivalve fossils and numerous tree fossils extending vertically through many geologic layers (polystrate trees). Clams usually open when they die. The fact that millions of these fossil clams were closed when found shows they may have been buried rapidly, still alive. Polystrate trees are petrified trees extending up through layer after layer of rock. This indicates the layers of rock were probably laid down at one time by a catastrophic flood completely surrounding the tree with the different geologic layers. (See Figure 6)

It follows then, that creationists assume that most fossil bearing rocks could have been laid down in one or more large-scaled, wide-spread catastrophes. Figure 7 below shows an example of how, at various locations, rocks are grossly out of order according to the geologic column. Assumptions are required to explain this arrangement which does not show an increase in complexity with time.



"120 million year old" Cretaceous (chalk) and "1 million year old" Pleistocene mixed together in England.

FIGURE 7

The major groups of organisms are found throughout the layers of rocks in the crust of the Earth. Cambrian rocks, one of the earliest formed layers of rock, hold fossils of most major animal phyla (taxonomic group), including Chordata. This indicates that representatives of these groups of organisms were present when this early layer of rock was formed. A chart of the various rock layers is shown above. In addition to animal phyla, pollen grains and wood elements of angiosperm and gymnosperm plants have been found in several places in the world in Cambrian and Pre-Cambrian rocks. This indicates that advanced plants were on earth at least as long as animals.

Scientific creationists say that there are no undisputed transitional fossils among major groups. Transitional forms are plants and animals with structures and parts that seem to be changing into some other structure or part. Also, creationists point out that of the two million or more different species of plants and animals now living on the earth, there are no transitional forms to be found. This would indicate the creation of fully functional forms. No examples of any partly formed organs can be found among these millions of species. All organs and structures are fully formed and functional. These are evidences of an abrupt appearance of distinct original groups.

Scientific creationists contend that the fossil record does not show, for example, a transition from reptile to mammal skull. An article discussing this subject (Mar.-Apr. 1978 American Scientist) is filled with speculative terms on how four bones of the reptile jaw might have migrated up into the mammal ears, forming the stirrups and anvils. There are no transitional fossils that show this migration. There are no transitional forms showing, for instance, three or two jaw bones, or two ear bones.

Even the appearance of human fossils in combination with ancient organisms has been reported. Disputed evidence of human footprints have been found with fossils of crushed trilobites and dinosaur tracks. Human skeletal remains have been found in Cretaceous sandstone. This indicates a possible coexistence of trilobites, humans, and other organisms attributed to typical Cretaceous organisms, such as the dinosaur. Human molars and objects of steel and iron have been found in Oligocene rock and coal, linking humans and human activities to typical Oligocene organisms.

Scientific creationism interprets the fossil record to show animals in three categories: 1) animals that have remained virtually unchanged from earliest times, such as the cockroach and many mollusks; 2) animals that have changed slightly from earliest times, such as lizards and coelocanths; and 3) those animals that have become extinct, such as dinosaurs and Archeopteryx. Creationists consider Archeopteryx to be the oldest known bird since the fossil shows feathers.

FOR YOU TO DO

Answer these questions according to the information given about Scientific Creationism in the material.

1. Which idea (GRADUALISM, CATASTROPHISM) do scientific creationists use to in their explanation?
2. According to scientific creationists, how have the vast sedimentary layers of rock covering the earth today been deposited? _____

3. Why are smaller animals found in lower layers of rock? _____

4. What happened during the flood to animals that could move to higher ground?

5. What evidence is there that living animals and plants were buried rapidly?

6. What are polystrate trees? _____
7. What is the significance of discovering fossils of most major animal groups in the earliest formed layers of rock? _____

8. Define Transitional Forms: _____

9. According to scientific creationism are there any transitional forms in the 2 million or more species of plants or animals now living on earth?

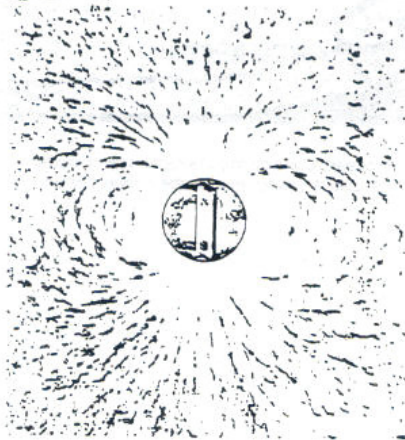
10. Since scientific creationists do not allow for transitional forms, how do they make categories for animals according to the fossil record?

Age of the Earth

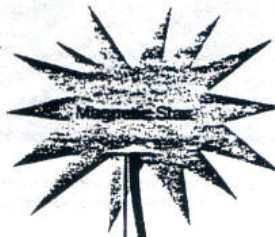
The age of the earth is not the most important question to the creationist. Time is an open question since creation could have occurred at any time in the past. Whether the earth is very old or very young will not change the explanation of scientific creationism. Research in various fields does indicate a relatively young age for the earth. These studies include: decay of the earth's magnetic moment, rate of shrinkage of the sun, low ocean sedimentation quantity, radiometric dating and rapid dissipation of the heat of the earth.

Data concerning decay of the earth's magnetic field indicates a young earth. The earth acts as a huge magnet and 130 years of observation of the decay rate of the earth's magnetic field shows the half life (length of time for half of the existing strength of the magnetic field to decay) to be estimated at 1,400 years. This would, assuming a constant rate of decay, give a magnetic field 10,000 years ago that was many times stronger than it is today. This means the age of the earth may be less than 10,000 years. If the rate of decay was constant, more than 10,000 years ago the magnetic field would probably have been too powerful for life to exist. (See Figure 8)

Figure 8)



This shows how the earth acts as a huge magnet.



This diagram shows the magnetic decay curve

predicted by Dr. Thomas Barnes, University of Te

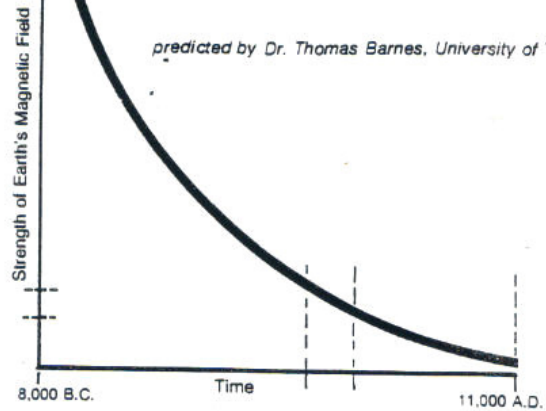
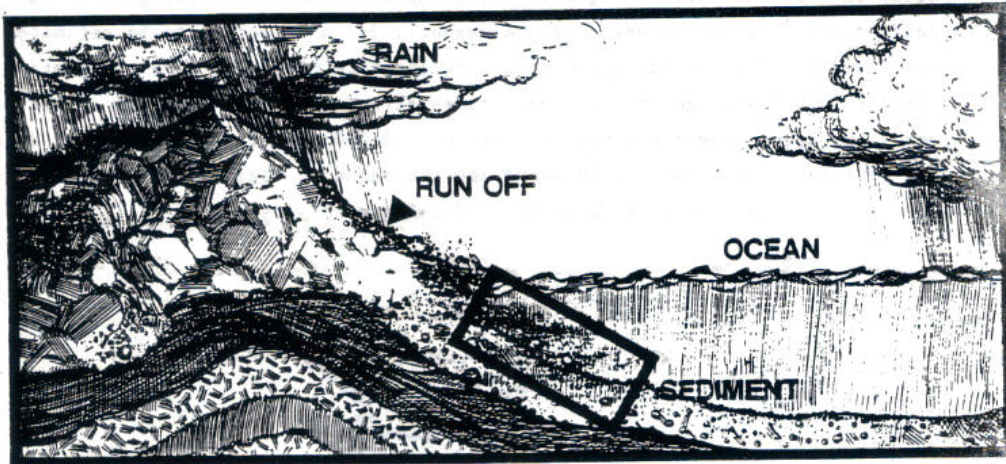


FIGURE 8

Another study showed that the sedimentary deposits in the oceans are very small and with all factors considered, it would probably not have taken more than 9,000 years to deposit this sediment. Since water erodes the continents and deposits the sediments in the ocean, and considering the rapid rate of modern erosion, the thinness of the ocean sediments indicate to creationists a young age for the ocean basins.



Water erodes the continents and deposits the sediments in the ocean. Considering the rapid rate of modern erosion, creationists believe that the thinness of the ocean sediments indicates a young age for the ocean basins.

FIGURE 9

Radiometric time clocks work just like most clocks, but like the hourglass timepiece in Figure 10 it is necessary to know how much radioactivity and products there were in the beginning and how much there are now.

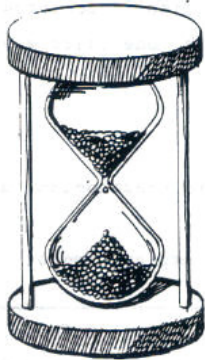


FIGURE 10

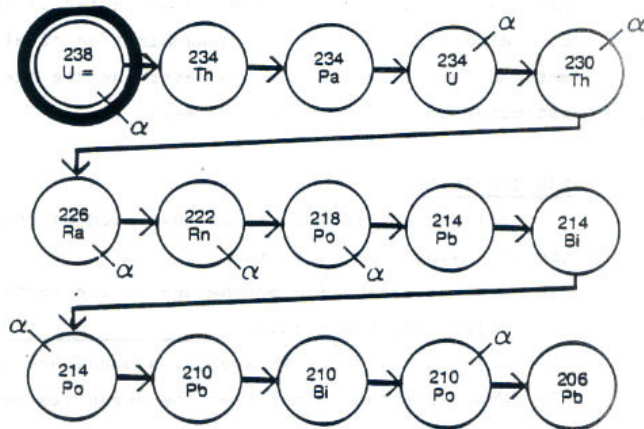


FIGURE 11

The diagram in Figure 11 shows how uranium (U-238) decays to lead (Pb-206). Creation scientists show this clock can give young ages. They also show that these clocks may not always decay at a constant rate.

Radiometric methods have significant problems concerning assumptions needed to determine the age of the earth. Data used for these radioactive clocks could give evidence of a very old or a very young earth. An example of the problems incurred is shown by an examination of some lava in Hawaii that was known to be less than 200 years old, but was determined to be millions of years old by reputable scientists.

Still another study shows that during the past 400 years the sun has been shrinking at the rate of 0.1% per century or five feet an hour, meaning that, based on the present rate, 20 million years ago the sun would have extended out to the earth's orbit. Scientific creationists assert that the cooling of the earth's interior and the rate of shrinking of the sun both support the young age of the earth. In 1975, in an examination of all 74 scientifically accepted methods, or different ways to determine the age of the earth, one-third gave estimates of less than 10,000 years.

FOR YOU TO DO

Using the information you just studied about scientific creationism, answer the following questions.

1. Will determination of the age of the earth change the explanation of Scientific Creationists? _____
2. There is evidence to support a young age of the earth...True or False.
3. What does the thinness of the ocean sediments suggest about the age of the earth? _____
4. If decay rates are not constant will estimates of the earth's age change? _____
5. Radiometric methods do have significant problems...True or False.
6. One third of the many different dating methods indicate a young earth... True or False.

SUMMARY

Scientific creationists assert that the evidence available supports the view that all life was created as distinct groups of organisms. These original organisms changed slightly to form genetic variations (microevolution), but did not change to new types of organisms (macroevolution). A large-scale catastrophe could have caused widespread sedimentation, fossilization and extinction, and formation of most of the geologic sediments.

While the act of creation is not experimentally demonstrable, there is evidence to support various mechanisms for the continuation of life virtually unchanged through time. Science cannot provide a final answer to the question of what happened at the very beginning of the universe. What can be done is to continue to examine the Earth in an effort to unravel the mysteries of its origin and ours.

FOR YOU TO DO

Using the information you just studied about scientific creationism, answer the following questions.

1. Scientific creationism allows for small genetic variations...True or False.
2. Scientific creationism allows for large changes to new types of organisms... True or False.
3. Scientific creationism says that (GRADUALISM, CATASTROPHISM) caused the earth to look like it does today.
4. Creation can be demonstrated in the laboratory...True or False.
5. There is evidence to support Scientific Creationism...True or False.