

The History of Life: Study Guide

This study guide was prepared having you, the student, in mind since this is the first exam of this course. I hope it will help you to study and be prepared for the exam. I expect you to learn the technique of preparing your own study guide for the next exams. I will not provide a study guide for the next two exams: YOU HAVE TO DO IT! The study guide is presented as series of bullets made of short (succinct) statements which are issues and themes covered in my lecture. Read them and complement your study by reading the corresponding section in the textbook.

CHAPTER 1

Introduction to Earth History

- 1. The Earth is approximately 4.6 billion years old)*
- 2. Geologists are involved in the exploration and production of A) Iron, B) Gasoline, C) Water*
- 6. “Retrodiction” involves looking back in time*

Scientific theories

- 8. A scientific theory A) explains large numbers of facts B) incorporates provisionally accepted hypotheses, C) has withstood much testing*
- 9. Evolution is the great unifying theory of Biology, whereas Plate tectonics is the great unifying theory of Geology.*
- 12. “Scientific Methodology” involves A) empirical observations, B) hypothesis building, and C) testing*

Basics of plate tectonic theory

- 10. Using plate tectonic theory, scientists have learned that the rigid lithosphere “floats” on top of the ductile asthenosphere*
- 11. The lithosphere includes the crust and the upper mantle*
- 13. The Earth’s surface consists of a mosaic of lithosphere plates.*
- 15. Tectonics directly involves the study of plate movement*

Principles

- 21. Uniformitarianism is fundamental to the interpretation of Earth processes*
- 22. “Uniformitarianism” tell us that geologic processes that act today have acted in the past*
- 23. James Hutton is the author of the principle of Uniformitarianism.*
- 26. According to the now discarded view of Neptunism, mountains are irregularities in the Earth’s crust formed during its creation.*
- 27. The concept that mountains and granitic rocks are formed by the forced intrusion of magma is called Neptunism*
- 28. The science of layered rocks is known as Stratigraphy, and was developed from three principles first stated by the Dutch physician Nicholas Steno*
- 29. Changes in A) Particle density, B) particle size, and C) composition can cause layering to form.*
- 30. You find a stack of sedimentary rocks. This stack consists of three beds of rock, with bed A on top, bed C on the bottom, and bed B in the middle. We know that Bed A is the youngest from the principle of superposition*

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32. Geologists, who specialize in Stratigraphy usually use this method to study stacks of rock layers: They work from the bottom layers up
35. Lateral continuity terminates at the limits of the beds depositional range
36. The book *Principles of Geology* is a very influential book, which provided documentation for the great antiquity of the Earth. It was written by Charles Lyell in 1830.
37. According to the principle of Catastrophism erosional surfaces and mass extinctions are caused by violent rapid calamities such as the biblical "Great Flood".
38. Georges Cuvier of France was a supporter of Catastrophism, and believed that mass extinctions was the plan of a supernatural being to achieve perfection.
39. The principle of Biotic succession was not introduced to the scientific community by Nicholas Steno.
40. A bed of limestone contains pieces of granite within it. The granite is older when compared to the limestone.
41. William Smith introduced the principle of biotic succession
44. Footprints are excellent examples of geopetal structures, and can be used to determine the top or bottom of beds
49. If we find a limestone bed on one side of the Grand Canyon, and we find another similar limestone bed on the other side, we can assume that they were once part of the same sedimentary bed by using the principle of Lateral continuity
50. We find tilted sedimentary beds. These beds were not deposited like this. We know this from our understanding of the principle of Original Horizontality

Overview of Earth systems

17. Animals use oxygen for respiration, and plants use carbon dioxide for photosynthesis.
20. The principle of "Uniformitarianism" is fundamental to an understanding of modern day Geology, it was introduced to the scientific community in the 18th century,
18. Bacteria, plants and fungi have been altering the Earth's surface for billions of years.

CHAPTER 2

Sedimentary Rocks

38. Sedimentary rocks are NOT derived from substantial increases in pressure and/or temperature
39. The finest sediments are classified as clay
40. "Coccoliths" are a common type of marine organism found in limestone
41. A) grain-size, B) grain-shape, and C) grain-sorting are commonly used to describe siliclastic sediments/rocks
42. Quartz is not a common constituent of carbonate sedimentary rocks
43. Olivine is NOT commonly found within sedimentary rocks that are formed from evaporite minerals.
44. The cementation of rocks occurs for sedimentary rocks during diagenesis
46. Bedding is a characteristic commonly found in A) Igneous, B) Metamorphic, and C) Sedimentary rocks.

CHAPTER 3

Stratigraphic correlation techniques

1. The geologic time scale has been constructed over the past 200 years.

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- 2. The uplift of sedimentary beds from mountain building will result in erosion of the rocks, and the formation of an erosional surface. This erosional surface A) exposes older sedimentary rocks, B) is an unconformity surface, C) represents missing time.*
- 3. Georges Cuvier was NOT involved in formulating the principles of relative dating as they are used today.*

the scope of Stratigraphy

- 5. Stratigraphy can involve the study of A) Igneous rocks, B) Metamorphic rocks, C) Sedimentary rocks*
- 6. Unconformity bound beds of rock are the basis of correlation for Sequence stratigraphy correlation*
- 7. Mappable rock types are the basis of correlation for Lithostratigraphic correlation.*
- 9. The fundamental unit used for lithostratigraphy is the formation*
- 11. The lithostratigraphic term "formation" is A) clearly identifiable, B) has a definable top and bottom, and C) mappable*
- 12. Biostratigraphy is the stratigraphic application of the principle of biotic succession*
- 13. The fundamental unit used in biostratigraphy is the biozone*
- 14. Index fossils have a wide geographical distribution, and existed on the Earth for a relatively short period of time*
- 16. If fossils are rare and unconformities are hard to find then lithostratigraphy is probably the best method used for correlation.*
- 22. Marine sedimentary rock layers are deposited during a sea level rise. Later, there is a global sea-level fall. Erosion occurs for a few thousand years or so. The sea returns and more marine beds are deposited a disconformity has formed*
- 24. Flat sedimentary layers are deposited by advancing seas. An orogeny uplifts these rocks and tilts them at an angle. These tilted beds are then eroded for 10's of millions of years. Later the seas return, and lay down flat sedimentary beds on top of the eroded tilted ones. The result is the formation of an angular unconformity*
- 25. The only unconformity that has crystalline igneous or metamorphic rocks underneath the erosional surface is the nonconformity*
- 26. You find folded sedimentary rocks beneath an erosional surface. Above the erosional surface you find flat lying beds. You are looking at an angular*
- 33. The Global boundary Stratotype Section and Point (GSSP) is based on a evolutionary event, and is accepted globally*
- 34. The GSSP concept was introduced in the 1970's, to provide accepted definitions for chronostratigraphic units.*
- 35. A Global Standard Stratotype Age (GSSA) has been established for the base of each geochronostratigraphic unit.*
- 36. The largest unit of geologic time is known as the Eon*
- 37. The smallest unit of geologic time is known as the Epoch*
- 38. The tangible stratigraphic representation of each time unit is referred to as a chronostratigraphic unit.*
- 39. Eras are divided directly into Periods*
- 40. The chronostratigraphic equivalent of the Period is known as a System*
- 41. The smallest chronostratigraphic unit is known as a Stage*
- 42. Precambrian time represents 87 % of the age of the Earth.*

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44. *Geochronology refers to numerical age dating*
45. *After two half lives the amount of parent isotope remaining will be 25 percent*
46. *The type of radioactive decay known as Beta emission involves the release of an electron.*
47. *The type of radioactive decay known as Alpha decay involves the release of two protons and two neutrons by the parent isotope.*

CHAPTER 4

Life on Earth and its fossil record

1. *Based on the earliest found fossil, life appeared on the earth approximately 3.5 billion years ago.*
2. *Complex multicellular organisms appeared on our Earth 2 billion years ago.*

Classification of Life on Earth

3. *The proper way of describing the genus and species of modern human using the Linnaean Hierarchy is *Homo sapiens**
4. *The fundamental unit used for classifying organisms, using the Linnaean classification scheme, is called the species*
5. *Humans belong to the genus *Homo**
6. *The largest subdivision of life in the Linnaean classification scheme is known as the Domain*
7. *Dogs and wild gray wolves belong to different species. However, it is possible for wild gray wolves and domestic dogs to interbreed and produce fertile offspring, because they have undergone reproductive isolation for a short time.*
8. *Turtles do NOT belong to the class Mammalia (Mammals)*
9. *Eukaryotic cells are more complex than prokaryotic ones, and have heritable organelles.*
10. *Chloroplasts, Mitochondria, and Sperm tails can be present in eukaryotic cells.*
11. *All prokaryotes are unicellular, and they can produce sulphur and sulphate end products.*
12. *Humans belong to domain Animalia*
17. *The oldest fossils that have been found to date are 3.5 billion years old.*
18. *Stromatolites are A) built up into mounds, B) eubacteria, C) produced by cyanobacteria*
22. *Mushrooms are a type of fungi*

Archaea

13. *Archaeobacteria are Prokaryotes*
14. *Archaeobacteria metabolize by chemosynthesis, and are primitive forms of life*
15. *Archaeobacteria can live in extreme environments such as boiling water, and are not found in the earliest fossil-bearing rocks.*
16. *The oldest fossils that have been found have been identified as belonging to domain Bacteria*

Subtopic

Bacteria

19. *Bacteria can A) be involved in cheese production, B) decompose feces (dung), C) live in soil*

Protoctista

20. *Protoctists are eukaryotes, and are thought to have evolved from the symbiosis of two kinds of eubacteria*
21. *The following types of organisms are Protoctis: A) Algae, B) Diatoms, C) Foraminifera*

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Animalia

21. *Animals are eukaryotes, and reproduction involves the formation of a zygote*
22. *Corals are animals*
23. *Foraminifera are not classified as an “animal”.*
24. *Sponges are animals classified as invertebrates and metazoans (tissues are organized into organs)*
25. *Animals account for the largest proportion of macroscopic organisms, preserved in early Pre-Cambrian strata.*

Ecology of Life Forms

26. *Paleoecology is best described as the study of factors that influence the distribution and abundance of species in the past*
27. *The discovery of Foraminifera within rock strata would point towards a saltwater paleohabitat.*
28. *Habitats which contain no oxygen are referred to as anoxic*
29. *Food webs are usually complex*
30. *Plants use raw materials to produce their own food so they are autotrophs*
31. *An organism that ingests mud and extracts organic materials is known as a deposit feeder*
32. *Barnacles that live attached to floating logs are classified as pseudoplanktonic*
33. *A white tip shark is a good example of a Nektonic organism*

Types of Fossils

34. *The remains of a 1st century Roman soldier preserved in rock would be classified as a subfossil*
35. *The following would be considered to be a body fossil: A) Bone. B) Leaf impressions, C) Shell*
36. *The following would be considered a trace fossil: A) Animal tracks, B) Bite marks, C) Burrows*
37. *The study of the processes leading to fossilization is called Taphonomy*
38. *An organisms hard body parts, which are inedible will most likely be preserved as fossils*
41. *Moldic preservation is the type of fossilization that occurs when skeletal material in sedimentary rocks dissolves away leaving behind only a cavity and impressions in the matrix.*
42. *When pore spaces are filled with silica in for bone or wood the Permineralization process has occurred.*
43. *Recrystallization is a form of alteration in fossil preservation*
44. *Archaeobacteria fossils have been mostly found in rocks associated with Volcanic vents*
45. *Most of the known record of Eubacteria fossils is preserved as stromatolites*
46. *The known fossil record for Eubacteria goes back to 3.5 billion years ago.*

Major Groups of Fossils

47. *The following types of organisms are proctotists A) Coccolithophorids, B) Diatoms, and C) Radiolarians*
48. *Fusulinids are a small rice-shaped foraminifera commonly found in later Paleozoic Era rocks.*
49. *Spores of the first known terrestrial plants have been found in Cambrian strata.*
50. *Brachiopods, Corals, and Mollusks are commonly found in Sedimentary rocks.*

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CHAPTER 5

Evolution

1. *The extinction of a species is an example of macroevolution*
2. *The changes that you have gone through since you were born are an example of ontogenetic change*
3. *The evolution of the domestic dog from the wolf over the past 10-15 thousand years is an example of macroevolution*
4. *The religious belief of special creation led to the doctrine of fixity of species in the 1700's.*
5. *The changes that occur as genetic traits are passed down from parents to their children is an example of microevolution*
6. *The doctrine of use and disuse is not accepted today. Whereas the concept of adaptation is widely accepted by modern day biologists.*

Darwinian synthesis

7. *Starting in about the mid 1800's, biological evolution was widely accepted by the scientific community.*
8. *Charles Darwin's book "On the Origin of Species by Means of Natural Selection" fueled debate pertaining to "Biological Evolution"*
9. *The mechanism introduced that drives biological evolution was introduced in the 1850's by Charles Darwin and Alfred Wallace. This mechanism is called natural selection*
10. *Embryos of vertebrates are nearly indistinguishable in their early ancestry, and thus indicate a common ancestry*
11. *Analogous organs in organisms have the same function, but different evolutionary origins.*
12. *The wisdom teeth of human beings probably served an important purpose in the evolutionary past, but no longer serve a function, they are an example of a vestigial structure.*
13. *The earliest whales had rear legs for walking.*
15. *Charles Darwin and Alfred Wallace proposed natural selection as the mechanism for biologic evolution.*
16. *Natural selection involves: A) competition for resources B) competition for mates C) more individuals than can be supported by the environment*
17. *Organisms that are poorly adapted to their environment will be selected out*
18. *Gregor Mendel carried out experiments on garden peas that demonstrated how changes in organisms arise and accumulate in a species in the 1850's and 1860's.*

Variance and inheritance of traits

21. *The building blocks of proteins are Amino acids*
22. *DNA stores information in genetic code, which is a sequence of nucleotides in a DNA segment that constitutes a gene.*

Modern Genetics

Haploid Cells. A cell is haploid if it contains exactly half of a species' typical full set of genetic material.

25. *Variations within populations would tend to lead to higher chances of survival and adaptation*
26. *The way an organism appears and functions is called its phenotype*
28. *The letters C, G, T, A stand for different nucleotides*
29. *Using genetic changes to track evolutionary history is known as molecular evolution.*

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30. Using the concept of the molecular clock, the greater the amount of differences in amino acid sequences for separate species the greater amount of time since they shared a common ancestor

Speciation processes

34. The Species is the basic level on which macroevolutionary processes operate.

35. The rise of a daughter population within the geographic range of an ancestor species can lead to sympatric speciation.

36. Parapatric speciation involves the formation of hybrids

37. The speciation pattern, where the formation of species occurs through the formation of intermediates is called Anagenesis

38. The concept of punctuated equilibria calls for rapid evolution, and the formation of few intermediate forms.

39. A cladogram is a depiction of evolutionary relationships using a branching stick diagram.

40. Sea turtles, seals and fish have all developed fins for swimming, but they are not closely related, this is an example of convergent evolution

Phylogenetics

41. Natural groups contain the ancestor and all of its descendents

42. Paraphyletic groups contain some decedents of the common ancestor, and the common ancestry itself.

43. Polyphyletic groups contain some of the ancestor of a common ancestor, without containing the common ancestor itself.

46. Copes law states that animals will tend to increase in body size, until a limit is reached
Assymetry

48. Natural selection has a long history of reinforcing right/left behavioral differences in organisms.

49. Assymetry is common in nature.

50. Under normal conditions some extinctions occur, and during mass extinctions species disappear in a relatively long amount of geologic time.

CHAPTER 7

5. The following was used to support the original hypothesis of continental drift: A) jigsaw fit of the continents A) matching rock types B) matching fossil ranges

1. Earth's surface has been reshaped by tectonic processes such as A) crustal remelting B) folding C) mountain building

4. In 1915, Alfred Wegener first introduced the idea that all of the continents were joined together as a single land mass called Pangea. He introduced this hypothesis and called it continental drift

2. New oceanic lithosphere basaltic in composition is produced at the mid-ocean ridges

3. The theory of plate tectonics is supported by: A) continental drift B) ocean basin expansion C) seafloor spreading

18. Harry Hess believed that mantle convection is the mechanism responsible for seafloor spreading.

14. In 1937, geologist Alexander du Toit realized that Pangea did NOT become fully assembled until the Late Paleozoic

29. The lithosphere consists of the) crust and the upper mantle

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19. According to the theory of seafloor spreading basaltic lava crystallizes out on the mid-ocean ridge to form new oceanic crust.
23. In 1965, Canadian geologist J. Tuzo Wilson pointed out that transform faults dissect the mid-ocean ridges, indicating that seafloor spreading must be occurring.
24. In 1969, Edwin H. Colbert and others discovered *Lystrosaurus* a mammal-like reptile in Antarctica, indicating that the continents were joined in the past
26. Most plates move on the order of 1-7 centimeters per year.
28. Plate boundaries are delineated by active volcanoes and earthquake epicenters.
30. Relatively rigid, lithosphere floats on top of partially molten asthenosphere.
32. New oceanic lithosphere is created at the mid-ocean ridges, and is destroyed at the deep ocean trenches
33. Oceanic lithosphere moves partly because of pushing from the mid-ocean ridges, and partly because of pulling from the trenches at the ocean margins.
9. Alfred Wegener studied the distribution of glacial tills in the tropics. He concluded that a continental glacier formed one single range centered at the South pole
34. The subduction zone is a convergent plate boundary
36. At divergent plate boundaries plates pull apart under tensional forces.
37. Grabens and normal faulting occur due to tension at divergent boundaries.
38. At a transform fault boundary plates slide past one another
40. A good example of a passive margin is the US East coast, where subduction is not occurring.
43. Using the theory of Plate tectonics, scientists currently believe that the ocean floor is renewed every 200-300 million years.
44. Accretionary wedges form adjacent to deep ocean trenches. These sediments are likely to become folded and regionally metamorphosed into a chaotic mixture called a *mélange*.
45. The Japanese islands are an island arc that has formed from the collision of oceanic lithosphere with oceanic lithosphere.
46. At transform fault boundaries oceanic lithosphere is not created, destroyed or subducted
48. Orogenesis involves the building of mountain chains and therefore the deforming of granitic crust.
49. The Himalayan mountains formed from the collision of continental plate with continental plate.
50. The welding together of continental plate with continental plate produces a suture zone.