

ZOO503 ZOOGEOGRAPHY & PALEONTOLOGY

MOST IMPORTANT MCQs FOR MID TERM

Prepared by: Sir Mughal, Admin: BS Zoology Announcement

Group link: <https://chat.whatsapp.com/BjC6W0jZx8o9yaC2ISh1Gu>

Contact: 0313-2310940

Dear fellows, as you know that exam of this subject will now entirely objective based. A little effort has been made to facilitate you all. Hope you find it helpful. Underlined words are possible answers that could be made out of the statements. All answers are correct and cross checked with handouts, Google and ChatGPT.

1. Paleontology is the branch of science concerned with fossil animals and plants.
2. Paleontology lies on the border between Biology and Geology.
3. Plants and animals in the past that were quite unlike any modern organism.
4. 250 million years ago, the Earth went through a phase of substantial global warming, a drop in oxygen levels and acid rain, and 95% of species died out.
5. A great branching tree that links us all back to a single species somewhere deep in the Precambrian.
6. Biostratigraphy, the use of fossils in dating rocks, is a powerful tool for understanding deep time, and it is widely used in scientific studies, as well as by commercial geologists who seek oil and mineral deposits.
7. The enquirer might hope to see common patterns among the observations, and these common patterns would point to an explanation, or law of nature. This statement was given by Sir Francis Bacon.
8. All men are mortal. Socrates is a man. Therefore Socrates is mortal. This statement was given by Aristotle.
9. The Earth had been hit by a meteorite 65 million years ago, caused the extinction of the dinosaurs and other groups.
10. Fossil sharks' teeth were known as glossopetrae worn as amulets.
11. Earliest fossils were found in Prehistoric era.
12. Robert Hooke was one of the first to hint at the idea of extinction.
13. Cuvier is known as father of comparative anatomy.
14. Until the late 18th century, scientists accepted calculations from the Bible that the Earth was only 6000– 8000 years old by dissecting the head of a huge modern shark.
15. Limited Knowledge of the fossil record in the 1820s and 1830s.
16. Lamarck s' gave idea of "Great Chain of Being" or the Scala naturae. "All organisms were linked in time by a unidirectional ladder, from simplest at the bottom to most complex at the top".
17. Charles Darwin (1809–1882), developed the theory of evolution by natural selection in the 1830s.
18. Modern genetics was established early in the 20th century.
19. "Archaeopteryx", true "missing link" predicted by Darwin only 2 years before incomplete remains of Neanderthal man in 1856.

20. Archaeopteryx lithographica, specimen displayed at the Museum für Naturkunde in Berlin.
21. Older, simpler, forms of life were recognized after 1960 by the use of advanced microscopic techniques, and some aspects of the first 3000 million years of the history of life are now understood.
22. In 1947, the first soft-bodied Ediacaran fossils were found in Australia.
23. The origin of modern stratigraphy was Leonardo da Vinci and his drawings.
24. The law of superposition is an axiom that forms one of the bases of the sciences of geology, archaeology, and other fields dealing with geological stratigraphy.
25. Strata either perpendicular to the horizon or inclined to the horizon were at one time parallel to the horizon.
26. If a body or discontinuity cuts across a stratum, it must have formed after that stratum.
27. There are eight types of Stratigraphy.
28. Scottish scientist James Hutton (1726–1797) challenged “no vestige of a beginning,– no prospect of an end”.
29. Earth as a dynamic and changing system, Lithostratigraphy.
30. A bed is a lithologically distinct layer within a member or formation and is the smallest recognizable stratigraphic unit.
31. A succession of contiguous formations with common characteristics is called a group.
32. Groups themselves may comprise a super-group.
33. Cuvier and Brongniart compared different strata in Paris basin and supposed Biological catastrophs in between.
34. John Phillips formally defined the three great eras separated by extinction events naming Paleozoic (ancient life), Mesozoic (middle life) and Cenozoic (recent life).
35. The main operational units of a biostratigraphy are called biozones.
36. Stratigraphic ranges can also be influenced by the Signor–Lipps effect.
37. Graptolites (1 myr) and Ammonites (25 kyr) are the best known and most reliable zone macrofossils.
38. Conodonts, dinoflagellates, foraminiferans and plant spores are used in petroleum exploration. It comprises of small samples, drill cores and chippings.
39. Sequence Stratigraphy is a branch of geology that attempts to subdivide and link sedimentary deposits into unconformity bound units on a variety of scales.
40. Cyclostratigraphy is the study of astronomically forced climate cycles within sedimentary successions.
41. The Earth today can be divided into six main provinces Nearctic, Paleartic, Neotropical, Ethiopian, Oriental and Australasian.
42. German scientist Alfred Wegener suggested that the continents moved across the Earth’s surface on a liquid core, suggesting that continents could in fact drift.
43. George G. Simpson suggested three passages, Corridors (open at all times), Filters (allowed restricted Access), Sweepstake routes (opened only occasionally).
44. Barrier for some organisms may provide a corridor for others.
45. Isthmus of Panama separated the Atlantic and Pacific oceans.
46. Isthmus of Panama connected North and South America.
47. Modern oceans are littered with islands.
48. Island biogeography is the study of the species composition and species richness on islands.
49. Most islands are isolated from the mainland, and they are important powerhouses of speciation.

50. Galápagos, or Aldabra, have become important sites for biologists to watch evolution in action.
51. A fold and thrust belt is a series of mountainous foothills adjacent to an orogenic belt, which forms due to contractional tectonics.
52. One bad fossil is worth a good working hypothesis.
53. Techniques to unstrain Cambrian trilobites from Kashmir, distorted by earth movements during the uplift of the Himalayan mountain belt.
54. Taphonomy is the paleontological study includes all the processes that occur after the death of an organism and before its fossilization in the rock.
55. Physical and chemical processes during transport and compaction damage hard tissues.
56. Plants preserve as permineralized tissues, coalified compressions and cemented casts.
57. Lagerstätten means exceptional preservation of soft parts of body.
58. Body fossils mean the partial or complete remains of plants or animals.
59. Trace fossils means the remains of the activity of ancient organisms, such as burrows and tracks.
60. When large animals feed on dead plant or animal tissues, the process is termed scavenging.
61. When microbes, such as fungi or bacteria, transform tissues of the dead organism, the process is termed decay.
62. Factors controlling decay include Oxygen, Microbial nutrients, Temperature & pH.
63. Soft parts of animals are made from volatiles, forms of carbon that break down readily.
64. Refractories are the organic carbons much less liable to break down, such as cellulose.
65. Early mineralization of soft tissues depends on three factors: Rate of burial, Organic content & Salinity.
66. Physical and chemical effects occurring after burial are termed as Diagenesis.
67. Amber is a fossilized resin.
68. Obrution deposits means sedimentation rates are so rapid that carcasses are buried virtually instantly.
69. Mineralization of soft tissues occurs in three ways.
70. Disarticulation means skeletons that are made from several parts may become disarticulated separated into their component parts after scavenging or decay of connective tissue.
71. Abrasion is that shells, bones and wood may be abraded by physical grinding and polishing against each other and against other sedimentary grains.
72. Bioerosion means the removal of skeletal materials by boring organisms such as sponges, algae and bivalves.
73. Shells, bones and wood may undergo bioerosion.
74. Addition of CaCO₃ is called Carbonate concretion.
75. In 1972, David Raup explained all the factors that make the fossil record incomplete.
76. Common organisms such as rats are more likely to be fossilized than rare ones such as pandas.
77. Animals that live in shallow seas, or plants that live around lakes and rivers, are more likely to be buried under sediment.
78. Once the organism is buried in sediment, the chemical conditions must be right for the hard parts to survive.
79. After a rock has formed, the rock may be transformed by the passage of mineralizing waters.
80. Tectonic movements must subsequently raise the fossiliferous rock to the Earth's surface, or the fossil remains forever buried and unseen.
81. The functions of single fossil organisms are called paleoautecology.

82. The composition and structure of fossil communities is called **paleosynecology**.
83. Populations and paleocommunities may be analyzed with a range of **statistical techniques**.
84. A census of an extraordinarily preserved **Lagerstätte** deposit can help in the estimation of the **Taphonomic loss**.
85. **Taphocoenosis** is the end product that is finally preserved.
86. **Populations** are the building blocks of **communities**.
87. A classic keystone species is the **elephant Incumbent** Species.
88. **Photic zone** is the depth of water penetrated by **light**.
89. **Benthos** are the beasts that live in or on the **seabed**.
90. **Infaunal** organisms live beneath the sediment–water interface.
91. **Epifaunal** organisms live above the sediment–water interface.
92. **Guilds** are groups of functionally similar organisms occurring together in a community.
93. **Megaguilds** are a range of adaptive strategies based on a combination of life position.
94. Last **600 million** years, Earth has oscillated at least **five** times between icehouse and greenhouse conditions, spending most of the time in **greenhouse** climates.
95. There are **five** climate zones.
96. **Calcretes** (soils rich in calcium carbonate) and **evaporites** (evaporated salts) help identify dry, arid climates.
97. **Dropstones** (stones that plummet from the bottoms of melting icebergs into seabed sediments) and Tillites (rocks and sand left behind by an advancing glacier) indicate **polar conditions**.
98. Evolution by natural selection is a core scientific model that was set out by **Darwin**.
99. Evolution takes place both within **species lineages** (phyletic gradualism) and at the **time of speciation** (punctuated equilibrium).
100. **Cladistics** is a method of reconstructing **phylogeny** based on the identification of shared derived characters.
101. **DNA** has been extracted from fossils such as woolly mammoths, but not from truly ancient fossils.
102. Darwin laid the framework for Evolutionary Biology **150** years ago.
103. Paleontological aspects of evolution, such as the tree of life and studies of processes over thousands and millions of years, are sometimes called **macroevolution**.
104. **Microevolution** are all the smaller-scale and shorter-term processes studied by biologists and geneticists in the laboratory or in the field.
105. **Local** populations may be isolated from other populations of the same species.
106. The **cohesion** of a species is maintained over its natural range by processes of **gene flow**.
107. The process of splitting of a population to form two species is **speciation**.
108. **Phyletic gradualism**, where evolution takes place in the lineages, and speciation is a side effect of that evolution.
109. Ladder goes from **lower to higher**, **simple to complex**.
110. In **Cladistics**, we reconstruct the Life's Hierarchy.
111. **Phylogenetically** uninformative characters fall into two main categories: **Convergences** & **Plesiomorphies**.
112. **Convergence** in evolution is when features, or organisms, evolve to look the same perhaps because they live the same way.
113. **Plesiomorphies** are characters that are shared by the organisms of interest, but also by other groups.
114. **Monophyletic Groups** are groups that had a single origin and include all the descendants of that common ancestor.

115. **Clades** are distinguished from two kinds of non-natural groups: **Paraphyletic groups** & **Polyphyletic groups**.
116. **Willi Hennig** (1913–1976), an eminent German entomologist, stressed the need to develop a new, more objective method in systematics, which has come to be called **cladistics**.
117. The branches in the cladogram join at branching points, or **nodes**, each of which marks the base of a clade.
118. **Hennig** called the phylogenetically informative characters “**Apomorphies**” or derived characters.
119. **Apomorphies** are features that arose once only in evolution.
120. **Apomorphies** shared by two or more species are termed **synapomorphies**.
121. Time estimation comes from the concept of the **molecular clock**.
122. Fossil species are identified according to their **external form**; this is termed the **morphological species concept**.
123. Specific organs may show positive (grow faster) or negative (grow slower) **allometry**.
124. **Modern analogs** may provide exact parallels with some fossil organisms.
125. **Sexual selection** is the set of evolutionary processes that depend on interactions between the **sexes**.
126. **Sexual dimorphism**, in which males and females may show different sizes, and different specialized features (horns, antlers, tail feathers).
127. **Ecophenotypic effects**, where local ecological conditions affect the form of an organism during its lifetime.
128. The ratio of eye diameter to body length diminishes as the animal approaches adulthood. This is an example of **allometric (different measure) growth**.
129. If there is no change in proportions during growth, the feature is said to show **isometric (same measure) growth**.
130. The ratio of eye diameter to body length diminishes as the animal approaches adulthood. This is an example of **allometric growth**.
131. If there is no change in proportions during growth, the feature is said to show **isometric growth**.
132. **Ernst Haeckel’s** idea was that the sequence of **embryonic stages** mimicked the past evolutionary history of an animal.
133. The synapomorphies of **vertebrates** appear first, then those of **tetrapods**, then those of **amniotes**, then those of **mammals**, of primates, and of the species *Homo sapiens* last.
134. Certain developmental abnormalities called **atavisms**, or throwbacks, show former stages of evolution, such as human babies with small tails or excessive hair.
135. During mass extinctions, **20–90%** of species were wiped out.
136. It is difficult to study mass extinctions in the **Precambrian**.
137. There have been **Neoproterozoic** events between the **Ediacaran** and **Early Cambrian** faunas.
138. The **end-Permian** mass extinction was the **largest** of all time
139. **Extinction**, is now a key theme in discussions about the future
140. **Dodo** became extinct in **17th** century.
141. The most spectacular extinctions are known as **mass extinctions**.
142. There may have been only **five or six mass** extinctions throughout the known history of life, although there were many extinction events.
143. Paleontologists talk about the “**big five**” mass extinctions of the last **540 myr**.
144. The **Phanerozoic** and the current extinction crisis are sometimes called the “**sixth extinction**”.

145. The idea of periodicity of impacts was reawakened by Rohde and Muller (2005) who argued for a 62 myr periodicity in mass extinction.
146. End-Ordovician mass extinction occurred 445 Ma.
147. The end-Permian, or Permo-Triassic, extinction was the most devastating of all time.
148. The peak of eruptions by the Siberian Traps was dated at 251 Ma, matching precisely the date of the PT boundary.
149. An unusual clay band right at the KT boundary, within a succession of marine lime stones.
150. 10 km meteorite (asteroid) had hit the Earth.
151. 1991, Crater was identified in Chicxulub in Mexico.
152. The Deccan Traps in India represent a vast outpouring of lava that occurred over the 2–3 myr spanning the KT boundary.
153. Bacteria in rocks up to 3.2 Ga, indicated by stromatolites.
154. Cellular fossils 3.5 Ga are highly controversial.
155. The first widely accepted cellular fossils date from 2.5 Ga.
156. Red algae from 1.2 Ga show that sex had originated.
157. Simple organic molecules in meteorites are called carbonaceous chondrites.
158. The biochemical theory for the origin of life, as proposed by Oparin and Haldane in the 1920s.
159. The last universal common ancestor of life (LUCA) was a hyperthermophile, a simple organism that lived in unusually hot conditions.
160. In 1968, Francis Crick suggested that RNA was the first genetic molecule.
161. Walter Gilbert first used the term “RNA world” in 1986.
162. The Precambrian period is divided into three zones.
163. The oldest sedimentary rocks from the Isua Group in Greenland, dated at 3.8–3.7 Ga.
164. The oldest rocks are from Canada and are dated at 3.8–4 Ga, and some mineral grains from Australia have even been dated to 4.4 Ga.
165. Around 0.8–0.6 Ga is indicated by increased levels of marine sulfate.
166. Endosymbiotic theory was presented by Margulis in 1970.
167. Lipid biomarkers indicate that eukaryotes were around at least by 2.7 Ga.
168. The oldest eukaryote fossil may be Grypania, a coiled, spaghetti-like organism that has been reported from rocks as old as 1.85 Ga.
169. One of the oldest multicellular organisms/eukaryote is Bangiomorpha 1.2 Ga.
170. Micropaleontology is a multidisciplinary science, focused on the study of microorganisms or the microscopic parts of larger organisms.
171. Radiolarians are animal-like protozoans with siliceous tests.
172. Diatoms are plant-like protozoans with silicic skeletons.
173. Foraminifera are shelled & heterotrophic, Phanerozoic sedimentary rocks, considerable bio stratigraphic and paleoenvironmental value.
174. Radiolarians are usually composed of a framework of opaline silica.
175. The acritarchs are probably polyphyletic.
176. The dinoflagellates, or “whirling whips”, comprise a group of microscopic algae with organic-walled cysts.

177. Dinoflagellate biomarkers have been identified in Upper Proterozoic and Cambrian rocks.
178. Ciliophora consist of some 8000 species of single-celled organisms that swim by beating cilia.
179. Chromistans are paraphyletic group of eukaryotes that usually contains chloroplasts with chlorophyll c.
180. Nanoplankton are defined as plankton less than 63 µm across.
181. Coccolithophores appeared in late Triassic period.
182. The Centrales prefer marine environments while the Pennales are more common in freshwater lakes.
183. The first pennate diatoms appeared during Paleogene colonizing freshwater for the first time.
184. Molecular data shows three main grouping of animals.
185. There are five lines of evidences, body fossils, trace fossils, fossil embryos, the molecular clock and biomarkers.
186. Bilaterians evolved after the Marinoan glaciation.
187. The Cambrian explosion generated a range of new body plans during a relatively short time interval.
188. Ordovician Radiation marked by accelerations in diversification at the family, genus and species levels along with complexity in marine communities.
189. Molecular data suggest metazoans have been around for at least 600 myr.
190. During Metazoan time as many as 35 separate phyla have evolved.
191. Earliest metazoans occur in Ediacara biota 600–550 Ma.
192. The oldest locomotory trace fossils are from about 550 Ma northwest Russia.
193. Best Embryo Fossil example is Doushantuo Formation, South China 580 Ma.
194. Molecular clock, the metazoan clade excluding the sponges and cnidarians, has been placed at anywhere between 900 and 570 Ma.
195. Body plans are usually defined by the number and type of enveloping walls of tissue together with the presence or absence of a Coelom.
196. The first metazoans were multicellular with one main cell type & peripheral collar cells or choanocytes, with a whip or flagellum.
197. Seen in sponges, characterized by cells organized in two layers separated by jelly-like material punctuated by so called wandering cells or amoebocytes.
198. In diploblastic organisms, two layers are separated by acellular mesogloea.
199. Triploblastic organisms have three layers of tissues from the outside in: the ectoderm, mesoderm and endoderm.
200. Many animals such as the soft-bodied mollusks (slugs) possess a hydraulic skeleton in which the movement of fluid provides support.
201. Most invertebrate skeletons grow by the addition of new material, a process termed as accretion.
202. Arthropods grow by periodic bursts between intervals of ecdysis or molting.
203. The demospinges and calcispinges are the simplest animals.
204. The cnidarians are the most basal eumetazoans.
205. The three great evolutionary faunas of Phanerozoic, Cambrian, Paleozoic modern developed during last 550 myr.
206. The Ediacaran biota consisted of enigmatic tubular and frond-shaped, mostly sessile organisms that lived during the Ediacaran Period (ca. 635–542 Mya).
207. Cambrian explosion occurred 541 million years ago.
208. GOBE stands for Great Ordovician Biodiversification Event.

209. Evolutionary radiation of animal life during the **Ordovician Period**, **40 my after the CE**.
210. The majority of “**Paleozoic**” taxa were derived from **Cambrian stocks**.
211. Out of **25** or so commonly recognized animal phyla fewer than **nine (35%)** have an adequate fossil record.
212. **Burgess Shale** and other exceptionally preserved faunas suggest that many of these soft-bodied groups dominated certain marine paleocommunities.
213. The **platyhelminths** or the flatworms are **bilateral animals**.
214. **Platydendron** from the Middle Cambrian Burgess Shale has been ascribed to the **Platyhelminthes**.
215. **Parazoans** are metazoans composed of multicellular complexes with few cell types and lack variation in tissue or organs.
216. **Sponges** are filter-feeding members of the sessile benthos.
217. **Archaeocyaths** are Cambrian organisms of sponge grade.
218. **Cnidarians** are the simplest of the higher metazoans with a radial diploblastic body plan and stinging cells or **cnidoblasts**.
219. One hypothesis suggests that a **Precambrian** colonial organism may have been a source for the bilaterians.
220. Unique porous structure and cellular body plan, lack of true tissues, mostly lack symmetry, true differentiated tissues, and organs, although their cells, like those of the protists, can switch function. These are characteristics of **sponges**.
221. Skeleton in sponges are composed of a **colloidal jelly** or **spongin**.
222. **Ascon** have sacs with a single chamber lined by flagellate cells
223. **Sycon** have a number of simple chambers with a single central paragaster.
224. **Leucon** are most common where a series of sycon chambers access a large central paragaster.
225. It is believed that the center of the **Archaeocyatha** origin are now located in **East Siberia**.
226. Jellyfish belongs to class **scyphozoa**.
227. **Octocorallia** class includes corals, sea anemones.
228. The sea wasps and box jellyfish belong to class **cubozoa**.
229. **Lophophore** is a filamentous feeding organ.
230. **Craniiformeans** & **rhynchonelliformeans** are calcareous shells.
231. **Brachiopods** dominated the filter-feeding benthos of the Paleozoic.
232. Living **brachiopods** are relatively rare, occupying mostly cryptic and deep-water habitats.
233. Only the **cyclostomes** surviving the combined effects of the **end-Permian** and **end-Triassic** mass extinctions.
234. **Brachiopoda** is the most successful invertebrate phyla.
235. The brachiopods experienced **five** main extinction events.
236. The end-Ordovician event occurred in **two** phases, glaciation & loss of almost **80%** of brachiopod families.
237. Late Devonian period severely affected **Orthides** & **Strophomenides**.
238. The End-Permian mass extinction demise over **90%** of brachiopod species, disaster taxa including lingulids, later diversified within a few clades dominated by the **rhynchonellides** and **terebratulides**.
239. End-Triassic event removed the majority of the remaining **spiriferides** and the last **strophomenides**.
240. The genus **Bowerbankia** is a relatively simple **Bryozoan**.
241. In **Spiralians**, a ring of **10** tentacles direct food to mouth leading into a **U** shaped gut.
242. Oldest **bryozoan** occurs in the **Tremadocian** Stage of the Lower Ordovician.

243. The Phylum Mollusca can be traced back to at least the **Late Precambrian**, when **Kimberella** probably fed on algae in **Ediacaran** communities.
244. Most gastropods undergo **torsion** in early life; they have a single shell, often coiled.
245. **Cephalopods** are the most advanced mollusks, with a head, senses and a nervous system.
246. Nautiloids, Ammonoids and the Coleoids are **cephalopods**.
247. **Annelid worms** were a sister group to the **mollusks**.
248. The Phylum **Mollusca** includes the slugs, snails, squids, cuttlefish and octopuses.
249. The **radula** in Mollusks is composed of **chitin** and designed to scrape and in some cases drill.
250. The **mantle** is a sheet of tissue lying dorsally over the visceral mass that is responsible for secreting the shell.
251. Shell is made by secretion as **calcium carbonate**, mainly **aragonite**, with an organic matrix and an outer organic layer.
252. **Odontogriphus** possesses a radula, a broad foot and a stiffened dorsum, so placing it firmly within the mollusks, close to **Kimberella**.
253. **Bivalves** are twin-valved shellfish superficially resembling the **brachiopods**.
254. Termed **lamellibranchs** or **pelecypods**, but they were first named Bivalvia by **Linnaeus** in **1758**.
255. An origin from among coiled forms such as **Pelagiella** may link the **monoplacophoran** grade through the **Tommotian Aldanella** to the gastropods.
256. The **Scaphopoda**, or elephant-tusk shells, have a single, slightly curved high conical shell, open at both ends.
257. The first scaphopods appeared during the **Devonian** and apparently had similar lifestyles to living forms such as **Dentalium**.
258. **Rostroconchs** are relatively recently a small class of mollusks.
259. The **Rostroconchs** occupy a pivotal position in molluskan evolution.
260. The gastropods and cephalopods were probably derived independently from a separate **monoplacophoran ancestor**.
261. **Rostroconchs** developed from within the **monoplacophoran plexus** with a loss of segmentation.
262. The majority of spiralian were **Eogastropoda**.
263. The development of a chambered shell with a **siphuncle**, which gave **Cephalopods** a considerable control over attitude and buoyancy.
264. In shelled cephalopods such as nautiloids and ammonoids a calcareous tube containing living tissue running through all the shell chambers, serving to pump fluid out of vacant chambers in order to adjust buoyancy is called **Siphuncle**.
265. **Trilobites** appeared in Early Cambrian and during the **Paleozoic**.
266. **Arthropods** are spectacularly diverse group of legged invertebrates accounting for about **three-quarters** of all species living on the planet today.
267. Trackways of **euthycarcinoids** (i.e. stem-group mandibulates) show that **Myriapods** moved onto land even earlier (Late Cambrian).
268. Insects first appeared during the **Early Devonian** and diversified rapidly. There are probably **10 million** species of living insects.
269. Insects had probably already evolved flight before the **Mid Carboniferous**, when giant **dragonflies** patrolled the forests.

270. Certain arthropods have fused head and thorax called **cephalothorax**.
271. During a geological history of at least **540 million** years, the five subphyla of arthropod have adapted to life in marine, freshwater and terrestrial environments.
272. Highly derived arthropods, lack **specialized mouthparts**.
273. Earliest arthropods were **trilobites**.
274. **Trilobites** (such as Choubertella and Schmidtiellus) first appeared in the **Early Cambrian** and survived until the end of the **Permian**.
275. **Prosoma** (head and thorax) is present with **6 segments** with appendages.
276. An **opisthosoma** (abdomen) with **12 segments**, pair of chelicerae (pincers) on the first segment of the prosoma.
277. The merostomes includes the aquatic horseshoe crab **Limulus** and the giant sea scorpions or **eurypterids**.
278. The **arachnids** mainly comprise the terrestrial spiders and scorpions.
279. **50** genera of **eurypterids** have been described.
280. Arachnids may have **book lungs** or **tracheae** or **both**.
281. **Myriapods** are varied group comprising the millipedes, centipedes, symphylans and pauropods.
282. Fossil footprints of **Arthropleura** were found at **Laggan Harbour, Isle of Arran, Scotland**.
283. The giant **Arthropleura**, nearly **2 m** long, hoovered their way through the lush, green vegetation of the Late **Carboniferous** forests.
284. Trackways from **Middle Ordovician** rocks in the English Lake District (Johnson et al. 1994) suggests that arthropods were on land about **50 myr** earlier.
285. Trace fossils from Cambrian rocks in **Ontario** push arthropod life on land back (MacNaughton et al. 2002) suggesting the presence then of large, amphibious **Euthycarcinoids**
286. **Euthycarcinoids** are an enigmatic group of arthropods with **antennae** and **mandibles**.
287. **Hexapoda** may prove to have as many as **10 million** living species when the rich faunas of the tropics have been completely described.
288. **Hexapoda** can be divided into **pterygotes** (with wings) and **apterygotes** (without wings).
289. Oldest insect probably the springtail **Rhyniella** praecursor from the Lower Devonian **Rhynie Chert** of the Orcadian Basin of northeast Scotland.
290. By the **Late Carboniferous** a very diverse insect fauna had evolved, with forms such as the **dragonflies** and **mayflies** capable of powered flight.
291. **Crustaceans** first appeared in the **Cambrian period**.
292. The First Crustaceans are **Canadaspis** from the **Burgess Shale**.
293. **Acorn** barnacles were found during Late Cretaceous.
294. **Malacostracans** include two subclasses, **Phyllocarids** and **Eumalacostracans**.
295. **Ostracodes** are crustacean arthropods, abundant and widespread in aquatic environments.
296. **Carpoids** were probably stem-group echinoderm.
297. **Graptolites** are hemichordates closely related to the living **rhabdopleurids** with similarly constructed **rhabdosomes** and **ultrastructure**.
298. The **6000** or so living echinoderm species include familiar forms such as sea lilies, sea urchins, sand dollars, starfish and sea cucumbers.

299. **Graptolites** are closely related to **cephalochordates** and **urochordates** or **tunicates**.
300. **Apatite** is a group of phosphate minerals, usually referring to hydroxylapatite, fluorapatite and chlorapatite, with high concentrations of OH⁻, F⁻ and Cl⁻ ions, respectively, in the crystal.
301. **Armored fishes** were abundant in Devonian seas and lakes.
302. **Synapsids** dominated ecosystems on land during the Permian and Triassic.
303. The first reptiles were **small insect eaters**.
304. The non-mammalian members are described as mammal-like reptiles in classical systematics; they can also be called **stem mammals** or **proto-mammals**.
305. **Synapsids** evolved from basal amniotes and are one of the two major groups of the later amniotes; the other is the **sauropsids**, a group that includes modern reptiles and birds.
306. **Diapsids** are a group of **amniote tetrapods** that developed two holes (temporal fenestra) in each side of their skulls about **300 million** years ago during the late Carboniferous period.
307. **Bone** is a network of collagen fibers on which needle-like crystals of hydroxyapatite (a form of apatite, CaPO₄) accumulate.
308. In humans; early skeleton, cartilage, progressively mineralizes by **apatite**.
309. The **neural crest** appears in the early embryo as a strip of cells where the backbone will develop.
310. The first vertebrates had **no jaws**.
311. **Hemicyclospis** are extinct genus of primitive jawless fish, closely related to **Cephalaspis** that lived in the Devonian period.
312. Today, the **50** or so species of lampreys and hagfishes, eel-shaped animals exist.
313. For over **150** years a mystery, known only from their jaw elements – no one knew which animal had produced them.
314. **Conodonts** were first identified by the Latvian embryologist and paleontologist **Christian Pander** in **1856**.
315. **Platforms** have a wide range of shapes, with denticulate processes extending both anteriorly, posteriorly and/or laterally from the area of the basal cavity.
316. The basal vertebrates, lacked jaws, jaws probably evolved during the **Ordovician**.
317. Oldest jaw-bearing fishes were the **placoderms**, such as **Coccosteus**.
318. The first shark like **chondrichthyans** or cartilaginous fishes, came on the scene during the **Early Devonian**.
319. Small fishes, mostly in the range **50–200 mm** in length, and they bore numerous spines at the front of each fin and spaced rows on their undersides.
320. Fishes with ray-like fins are called the **actinopterygians**.
321. Bestknown forms of tetrapods are **Acanthostega** and **Ichthyostega**, which were **0.6 and 1 m long**, respectively.
322. **4000** species of mainly small animals that live in or close to water.
323. All living amphibians appear to be closely related forming a clade, the **Lissamphibia**.
324. The **cleidoic** (closed) egg, **Amniotic** egg (Tough semipermeable shell), **Clade** Amniota (reptiles, birds, mammals).
325. Oldest-known amniote is **Hylonomus** from the mid Carboniferous of Canada.
326. The three major skull patterns seen in amniotes: **anapsid, diapsid and synapsid**.
327. The turtles appeared first in the Late Triassic, **Proganochelys**.
328. First synapsids, known from the Late Carboniferous and Early Permian grouped loosely as “**pelycosaurs**”.
329. **Synapsids** radiated dramatically in the Late Permian as a new clade, the **Therapsida**.

330. **Thrinaxodon** had whiskers, hair on other parts of its body.
331. Reptiles typically have **six** bones in the lower jaw and the **articular** bone articulates with the quadrate in the skull.
332. In mammals, there is a **single** bone in the lower jaw, the **dentary**, which articulates with the **squamosal**.
333. Dinosaurs famously ruled the Earth for **160 Myr** of the Mesozoic. Replaced by the mammals **65 Ma**.
334. Both groups of mammals and Dinosaurs evolved side by side through the **Late Triassic, Jurassic and Cretaceous**.
335. After the end-Permian mass extinction event **251 Ma**, diapsid reptiles diversified in the Triassic.
336. Dinosaurs were a hugely successful group for **160 myr** of the **Mesozoic**.
337. Birds evolved from dinosaurs, and radiated during **Tertiary**.
338. Molecular and paleontological evidence show that modern mammals radiated in the **Late Jurassic and Early Cretaceous**.
339. Humans arose **6–8 Ma**.
340. **Erythrosuchus** was one of the first of the **archosaurs**.
341. **Lepidosaurs** are the second major diapsid clade Lizards and snakes.
342. **Snakes** have mobile skulls, swallow prey animals several times the diameter of the head.