

1. Outline the fossil record of early vertebrates (what kind of fossils, where were they found, when were they formed) from the Cambrian to the Late Silurian.
2. List the three main types of mineralized tissue in vertebrates and describe the basic unit of mineralized tissue. How is vertebrate mineralized tissue different from that of invertebrates and why? Why is the origin of bone still unclear? Describe the current hypotheses for the origin of bone, including fossil and any other available evidence.
3. Diagram the relationships among the major groups of jawless vertebrates and between the jawless vertebrates and the gnathostomes (i.e., reproduce the cladogram!). To what groups does the name "ostracoderm" apply? Is this a monophyletic group? Defend your answer. Does the current traditional classification system accurately reflect evolutionary relationships within this group? Defend your answer.
4. Is the traditional order Cyclostomata a valid taxon according to cladistic philosophy? Why or why not? What is the current consensus on the phylogenetic position of the Myxinoidea relative to other vertebrates?
5. Compare and contrast the characteristics of lampreys and hagfish (hint: use the boxes from the text p. 111).
6. Compare and contrast lampreys and hagfish in terms of taxonomic diversity (i.e., approximate number of species and families) and general ecology (habitat, food habits, behavior).
7. Describe the mucus system of hagfish (what is it, how does it work, what is its function?). Describe the unique features of the digestive and circulatory systems of hagfish. Discuss the conservation status of hagfish, with special attention to any features of their biology that place them at particular risk.
8. Describe the life history (i.e., general stages from hatching to adult, including migrations and metamorphoses) of lampreys. Discuss the invasion of the Great Lakes by lampreys and describe efforts currently being used to control them there.
9. Describe the basic characteristics shared by the ostracoderms and what we infer about the general ecology of these animals.
10. When did gnathostomes first arise; when did their early radiations take place? Describe the major sets of changes that characterize the Gnathostomata and discuss both the general and specific selection pressures that might have favored them.

11. Summarize Mallat's hypothesis for the evolution of jaws from gill arches by describing the structure and function of the four stages he proposes. Be sure to include the proper anatomical names and homologies involved.
12. Describe the function(s)/benefits of jaws and fins (e.g., what "new" functions did they permit; what advantages did they provide).
13. Who were the placoderms? How were they similar to and different from the ostracoderms?
14. Describe the diversity of jawed and jawless fishes throughout the Devonian. By the Late Devonian, which lineages were still surviving?