**Instructions**: Read the below blurb and answer the following questions.

**Blurb**:

Why are there one- and two-horned species of rhinos?

Citation: Phylogeny, ecology, and behavior. Brooks, Daniel R., and McLennan, Deborah A., 1991. The University of Chicago Press.

Diagram

Description automatically generatedThe preceding hypothetical example demonstrates the dangers of addressing evolutionary “why” questions within the context of a single species. However, omitting the historical component from evolutionary explanations will generate similar problems in formulating the relevant evolutionary hypothesis, regardless of the number of species investigated (Ridley 1983; Wanntorp 1983; Brooks 1985; Brooks and Wiley 1988). Coddington (1988) provided an excellent example of this in his reanalysis of the adaptationist explanation for the presence of one-horned and two-horned species of rhinos. Lewontin (1978) postulated that the one-horned condition and the two-horned condition represent independently achieved, equally functional, adaptive peaks in the evolution of antipredator defense structures. This scenario implies that both conditions arose *de novo* from a hornless condition. Coddington investigated this hypothesis by mapping horn number onto a phylogenetic tree for the rhinoceratids (fig 5.16).

The distribution of horn numbers on the phylogenetic tree suggests that the two-horned condition is plesiomorphic for the group, including extinct species. The single-horned condition is derived from the two-horned condition through the loss of the frontal horn. Since the two conditions were not achieved independently from a nonhorned condition, and thus do not represent two alternative adaptive peaks. It is difficult to postulate an equally adaptive, antipredator function for each character state. Nor is it possible to state that two horns are better than one, because the plesiomorphic condition is two horns. However, as in the preceding example, placing the problem within a phylogenetic framework generated at least two new questions. The “whys” of two horns must be examined within the context of the ancestor and the environment in which the trait originated. Although difficult, this call for a detailed knowledge of past environments should excite students of paleoecology (a discipline also called “historical ecology” [Rymer 1979] or “zooarchaeology” by archaeologists). A more tractable question concerns the reduction in horn number from two to one in the genus Rhinoceros. If we cannot unequivocally postulate that horn number represents adaptive antipredator responses, perhaps we should consider other possibilities. Ample opportunities exist for students of behavior and ecology to collect data, map them onto the phylogeny, and investigate associations between changes in, for example sexual behavior, habitat preference or predation pressures, and changes in horn number.

**Questions**:

In your own words:

1. Describe what the authors mean when they say a) something arose *de novo*, b) that a trait is plesiomorphic for the group, and c) that a trait or traits represent an adaptive peak. (Please google, read papers, or look up definitions for these things, but rephrase them in your own words for the actual answer).
2. Describe the question that Lewontin was trying to answer when he provided the evidence of one-horned and two-horned rhinoceros.
3. Describe why Coddington (and the authors of the blurb) argue that Lewontin’s reasoning was flawed.
4. The authors argue that “A more tractable question [to ask with this group] concerns the reduction in horn number from two to one[horn]”; Why do you think they consider this a more tractable question?