TREE OF LIFE

1. **DESCRIPTION**: Teams will create an evolutionary tree and demonstrate their understanding of the mechanisms of biological evolution.
   A TEAM OF UP TO: 2   **APPROXIMATE TIME**: 50 minutes

2. **EVENT PARAMETERS**:
   Each team may bring one 8.5" x 11" sheet of paper that may contain information on both sides in any form and from any source along with two non-programmable, non-graphing calculators.

3. **THE COMPETITION**:
   Part I: Evolutionary Tree
   a. Participants will be given a character matrix with taxa as rows and characters as columns. Taxa may be any extinct or extant organisms. All taxa will be of the same taxonomic rank. Characters may be morphological features, cellular structures, or DNA, RNA, or protein sequences. All characters will be the same type of data. The maximum dimensions of the matrix are 20 rows by 20 columns.
   b. Participants will also be given a tree diagram with unlabeled branch tips. The tree diagram may be rooted or unrooted, bifurcating or multifurcating, and cladistic or phylogenetic.
   c. Using the provided character matrix, participants will be asked to label the tips of the evolutionary tree showing the relationships among organisms following the criterion of maximum parsimony.
   d. Using their evolutionary tree, participants will be asked questions related to tree type, outgroups, ancestral traits, derived traits, evolutionary histories, and phyletic groups including clades.

   Part II: Mechanisms of Evolution
   a. Teams may be asked questions about the following microevolutionary topics:
      i. Mutation and genetic variation
      ii. Genetic drift
      iii. Gene flow including vertical and horizontal gene transfer
      iv. Natural, artificial, kin, and sexual selection
      v. **Division C only**: Hardy-Weinberg equilibrium, Wright-Fisher model, Hamilton's rule
   b. Teams may be asked questions about the following macroevolutionary topics:
      i. Species concepts
      ii. Adaptation, exaptation, and phenotypic plasticity
      iii. Divergent evolution including speciation, adaptive radiation, and character displacement
      iv. Convergent evolution and parallel evolution
      v. Coevolution
      vi. Extinction
      vii. **Division C only**: phyletic gradualism vs. punctuated equilibrium, molecular clocks

4. **SAMPLE QUESTIONS**:
   Part I: Evolutionary Tree
   a. Why are phylogenetic trees more informative than cladograms?
   b. What taxon is the outgroup of the evolutionary tree?
   c. Is character X an example of parallel homoplasy or reverse homoplasy?
   d. Which taxa share the plesiomorphy of breathing via gills?
   Part II: Mechanisms of Evolution
   a. Describe how whole genome duplication can influence evolution.
   b. Based on the adaptive landscape, is the population at its optimum fitness?
   c. Is the population experiencing stabilizing, disruptive, or directional selection?
   d. Explain how character displacement occurs in Darwin's finches.
   e. What is the evolutionary significance of Wallace's line?
   f. Do the graphs of trait variability show evidence for phenotypic plasticity?

5. **SCORING**:
   a. High score wins. Each part of the exam will count for approximately ½ of the total score. Points will be assigned to the evolutionary tree branch tips as well as the questions in Parts I and II.
   b. Selected questions from Part II will be used as tiebreakers.