

# Phylogenetic Tree Free Response Key

Graded By:  
 Seat Number \_\_\_\_\_  
 Period \_\_\_\_\_

Staple this to the test when you are finished

Total Points \_\_\_\_\_

Place the appropriate letter (A,B,C, etc.) by each answer on the test as you find them. Place an “X” or a check by the letter on this sheet if it was answered correctly. Leave it blank if it was missed. Add the points and place the total points of the top.

Phylogeny is the evolutionary history of a species.

(a) The evolution of a species is dependent on changes in the genome of the species. **Identify** TWO mechanisms of genetic change, and **explain** how each affects genetic variation. **(4 points maximum)**

	<b>Identification</b> <b>(1 point each; 2 points maximum)</b>	<b>Explanation</b> <b>(1 point each; 2 points maximum)</b>
____A.	DNA (molecular) Mutation, e.g., point, frameshift, insertions, deletions	Change in nucleotide sequence or amino acid sequence or protein structure or gene expression, or change in phenotype
____B.	Duplication, e.g., gene, chromosome, genome, sympatric speciation	Gene “families,” which then diverge by mutation; change in ploidy
____C.	Rearrangement, e.g., gene order, inversions, chromosome fusion, transposons	Chromosome structure altered; change in crossover frequency
____D.	Cellular Crossing over, independent assortment, segregation, nondisjunction (meiosis) Random fertilization (sexual reproduction)	Increase gamete diversity Many possible gamete combinations
	Population Genetic drift or bottleneck or founder effects Gene flow (migration) Geographic isolation or allopatric speciation Nonrandom mating (sexual selection) Sympatric speciation Natural selection	Population allelic/gene frequencies altered or gain or loss of alleles/genes Reproductive fitness/differential success

(b) Based on the data in the table below, **draw** a phylogenetic tree that reflects the evolutionary relationships of the organisms based on the differences in their cytochrome *c* amino-acid sequences and **explain** the relationships of the organisms. Based on the data, **identify** which organism is most closely related to the chicken and **explain** your choice. (4 points maximum)

THE NUMBER OF AMINO ACID DIFFERENCES IN CYTOCHROME *c* AMONG VARIOUS ORGANISMS

	Horse	Donkey	Chicken	Penguin	Snake
Horse	0	1	11	13	21
Donkey		0	10	12	20
Chicken			0	3	18
Penguin				0	17
Snake					0

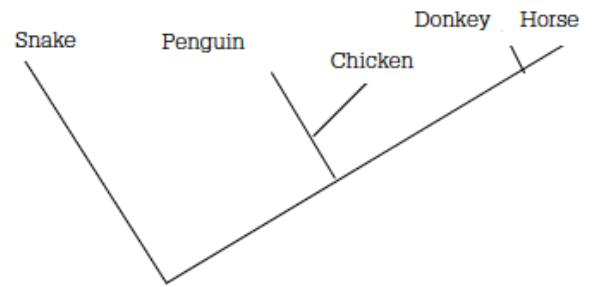
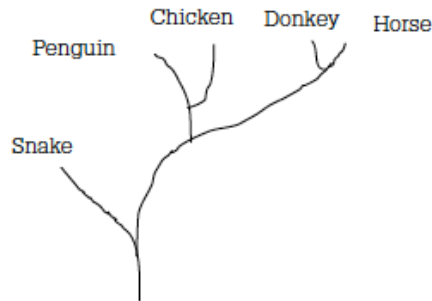
Phylogenetic tree: rooted trees with common ancestor, and with snakes, birds, mammals in correct relative order (1 point for tree)

\_\_\_ E.

\_\_\_ F.

\_\_\_ G.

\_\_\_ H.



- Cytochrome *c*: the more differences in amino acids of cytochrome *c*, the less closely related, OR fewer differences, more closely related. (1 point)
- Penguin is most closely related to chicken. (1 point)
- Three amino acids differing between penguin and chicken/penguin has fewest differences from chicken. (1 point)

(c) **Describe** TWO types of evidence—other than the comparison of proteins—that can be used to determine the phylogeny of organisms. **Discuss** one strength of each type of evidence you described. **(4 points maximum)**

- \_\_\_ I.
- \_\_\_ J.
- \_\_\_ K.
- \_\_\_ L.

<b>Description</b> <b>(1 point per box; 2 points maximum)</b>	<b>Strength</b> <b>(1 point each; 2 points maximum)</b>
<b>Fossil</b> Observe past organisms	Shows direct evidence of common ancestor, follow evolution (changes over time) from common ancestor
<b>Homology: morphology</b> Organismal structure/form Vestigial structures	Similarities in form(s) show common ancestry/DNA
<b>Homology: embryology/development</b> Morphology of embryos; changes in gene expression during development	Similarities in development show common ancestry/DNA
<b>Homology: reproduction</b> Comparison of reproductive strategies or life cycles: cell division, gamete production, gamete type, etc.	Similarities in reproduction strategies show common ancestry/DNA
<b>DNA sequence</b> Comparison of DNA sequences in specific genes; molecular homologies	Similarities in sequences show common ancestry
<b>Biogeography</b> Analysis of organism distribution(s)	Uses both past and present information to show common ancestry/DNA
<b>Direct observation/behavior</b> Watch organism in natural setting	Similarities in behaviors indicate common ancestry/DNA