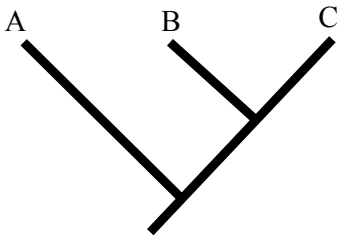
Tree thinking pretest

This quiz is in three sections. Questions 1-10 assess your basic understanding of phylogenetic trees. Questions 11-15 assess whether you are equipped to accurately extract information from the kinds of trees you are likely to encounter in biology textbooks. Questions 16-20 use some examples from drawn from the phylogenetic research literature, generally involving applied biological phenomena, to see how readily you can make sense of such studies.

1) Which of the following is a correct interpretation of the tree shown? (Select all that apply)

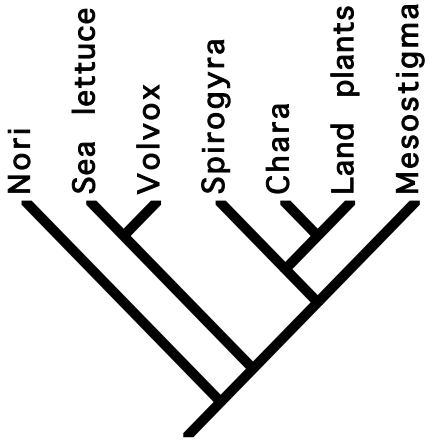


a) C is descended from B, which is descended from A
b) C is the most advanced species
c) A is the most ancient species
d) B is an intermediate between A and C
e) None of the above

2) Referring to the same tree, which statements about common ancestry hold? (Select all that apply)

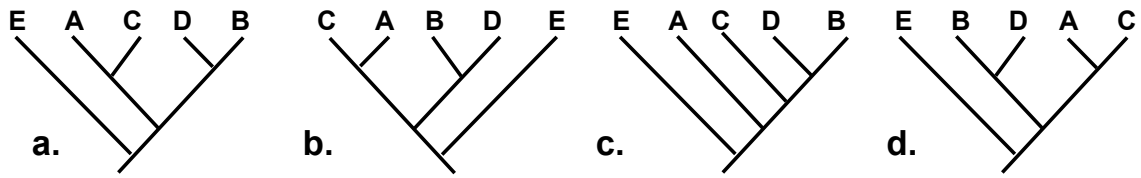
a) A is the common ancestor of B and C
b) The common ancestor of A and B lived after the common ancestor of A and C
c) B and C share a more recent common ancestor than B and A
d) Any common ancestor of A and B is also an ancestor of C
e) None of the above

3) Consider the tree to the right. Viridiplantae may be defined to include all the descendants of the last common ancestor of volvox and land plants. Which taxon or set of taxa are <u>not</u> in Viridiplanta?



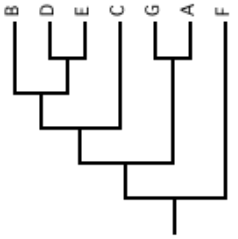
a) Nori
b) Mesostigma
c) Nori, mesostigma
d) Nori, mesostigma, volvox
e) Nori, mesostigma, volvox, spirogyra, chara

4) Which of the four trees below depicts a different pattern of relationships than the others?

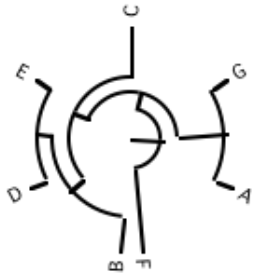


5) Which of the four trees below depicts a different pattern of relationships than the others?

a 

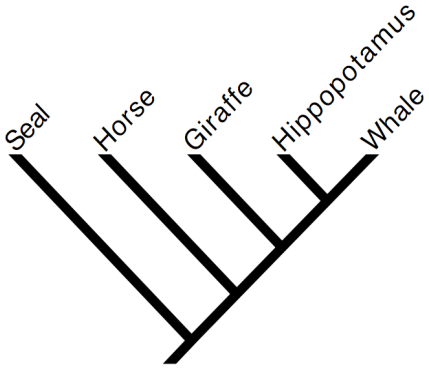
b 

c 

d 

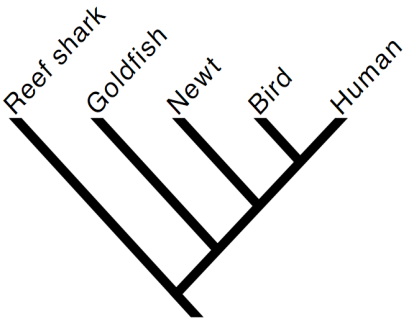
6) By reference to the tree to the right, which of the following is an accurate statement of relationships?

a) A seal is more closely related to a horse than to a whale
b) A seal is more closely related to a whale than to a horse
c) A seal is equally related to a horse and a whale
d) A seal is related to a whale, but is not related to a horse



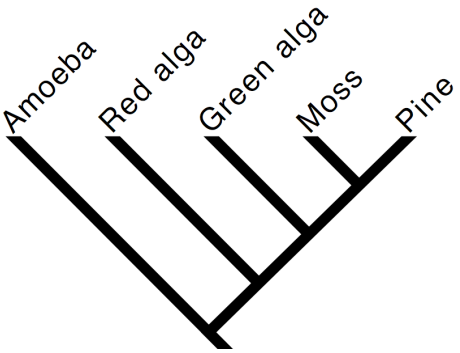
7) Assume that the tree to the right is correct. Which of the following is true?

a) Reef sharks are older than newts
b) Reef sharks gave rise to newts
c) The common ancestor of goldfish and humans lived before the common ancestor of birds and humans
d) Reef sharks and goldfish have no common ancestor
e) Birds came before humans



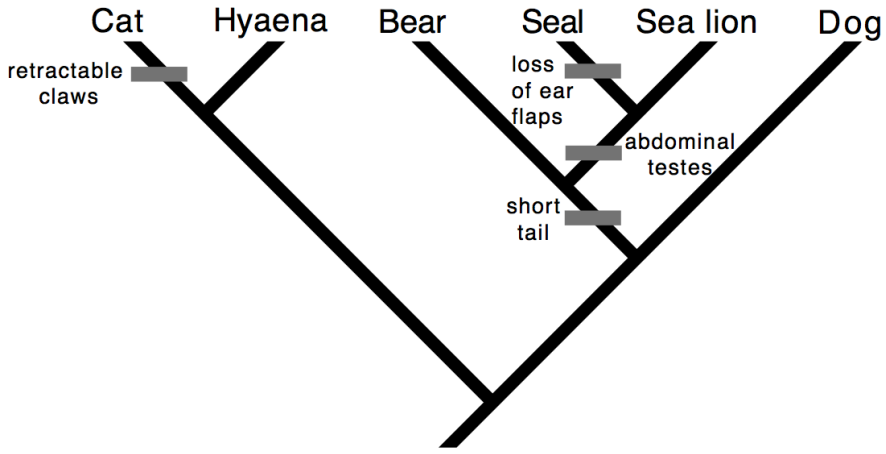
8) By reference to the tree to the right, which of the following is an accurate statement of relationships?

a) A green alga is more closely related to a red alga than to a pine
b) A green alga is more closely related to a pine than to a red alga
c) A green alga is equally related to a red alga and a moss
d) A green alga is related to a red alga, but is not related to a moss



9) Looking at the same tree as question #8, three students have different interpretations. Student A says that pine is the most advanced species because it is the most recent. Student B says that the pine is the least advanced species because all the other branch off it. Student C says that all the species are equally advanced because that have all evolved the same amount of time from their common ancestor. Which student is correct?

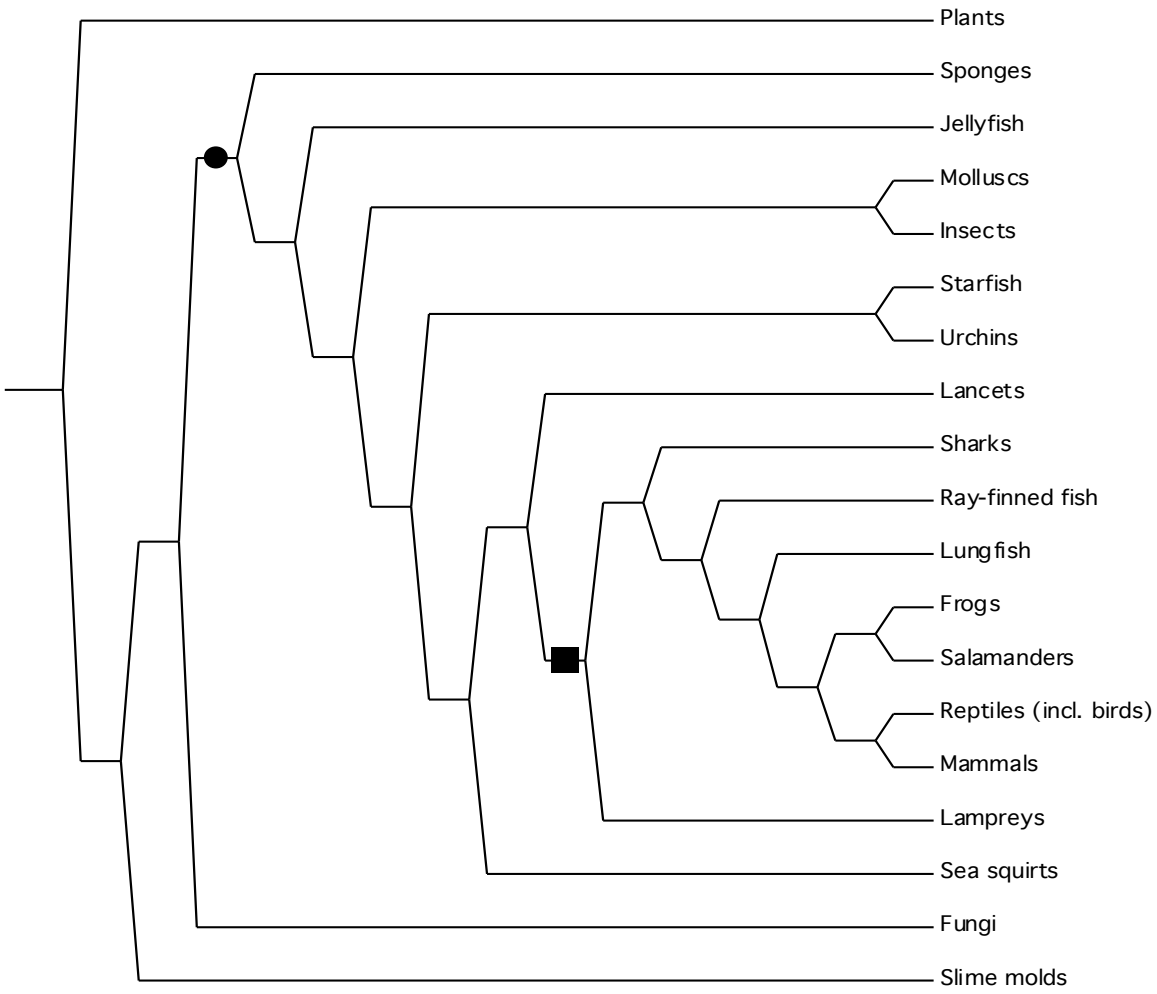
a) Student a
b) Student b
c) Student c
d) None of the students



10) In the above tree, assume that the ancestor had a long tail, ear flaps, external testes, and fixed claws. Based on the tree and assuming that all evolutionary changes in these traits are shown, what traits does a seal have?

a) long tail, ear flaps, external testes, and fixed claws
b) short tail, no ear flaps, external testes, and fixed claws
c) short tail, no ear flaps, abdominal testes, and fixed claws
d) short tail, ear flaps, abdominal testes, and fixed claws
e) long tail, ear flaps, abdominal testes, and retractable claws

11-15) Refer to the tree below. The square marks the branch where a vertebral column arose. All descendants of this lineage have a vertebral column and are called "vertebrates". The circle marks the branch where collagen and embryo formation evolved. All descendants of this branch are called animals.



11) The term "Invertebrates" has historically been applied to include all animals that lack a vertebral column. Which of the following is not an invertebrate?

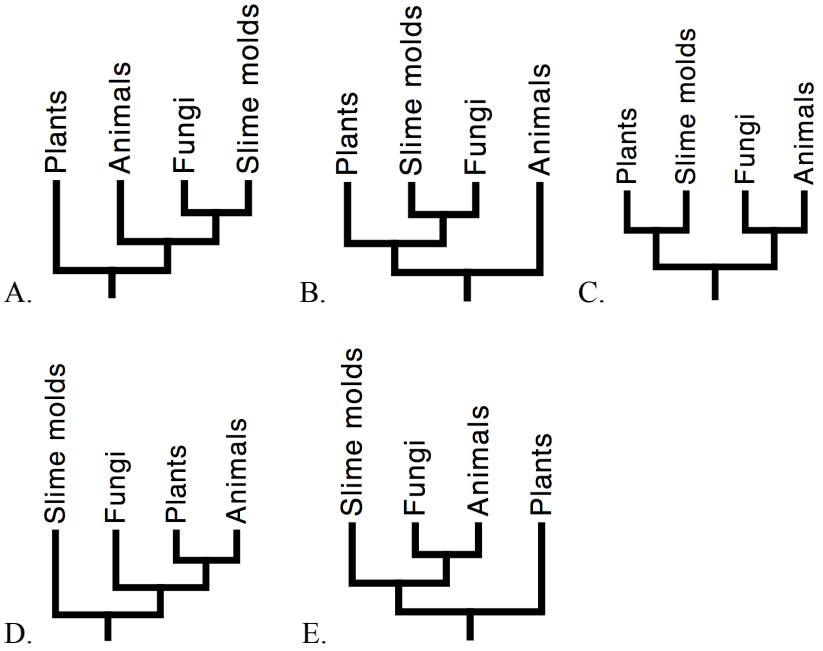
a) Frog
b) Sponge
c) Mollusc
d) Arthropod
e) Cnidarian

12) Which of the following is a true statement about "invertebrates" (select all that apply)
a) Invertebrates are all more closely related to each other than to any non-invertebrate
b) The traits that all invertebrates share are those that were present in the first animals
c) Some invertebrates have a vertebral column
d) Some invertebrates (e.g., starfish) are more closely related to vertebrates than they are to other invertebrates (e.g., insects)
e) None of the above

13) Which of the following is a true statement? (select all that apply)
a) Some organisms have a vertebral column but lack collagen
b) Some organisms have embryos but lack a vertebral column
c) All organisms with a vertebral column also have embryos
d) All organisms that lack a vertebral column have collagen
e) None of the above

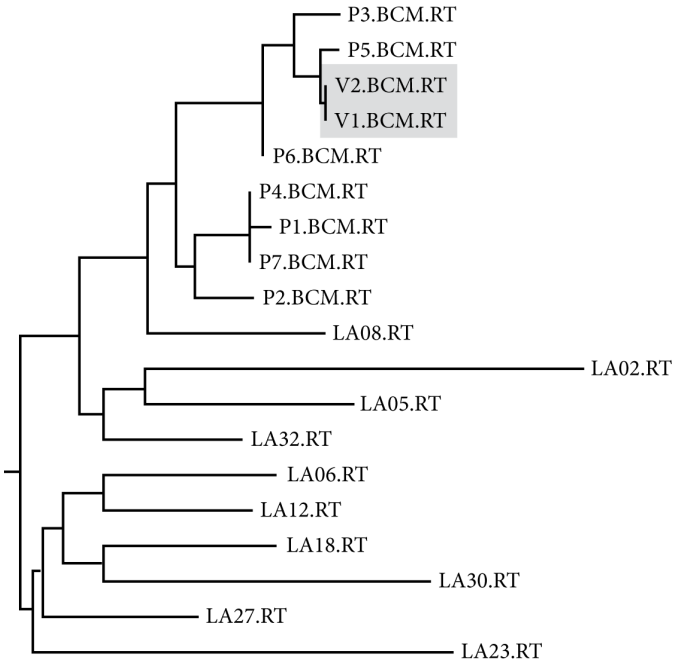
14) Each internal branch on this tree is an ancestor of 1 to 19 of the listed tips. Which of the following branches exist on this tree?
a) Ancestral to plants and fungi, but not mammals
b) Ancestral to plants and mammals, but not fungi
c) Ancestral to mammals and frogs, but not salamanders
d) Ancestral to molluscs and sharks, but not jellyfish
e) Ancestral to reptiles and sharks, but not ray-finned fish

15) Supposing you collapse animals into a single clade. Which of the following trees would correctly show the relationships of animals to the non-animal groups?



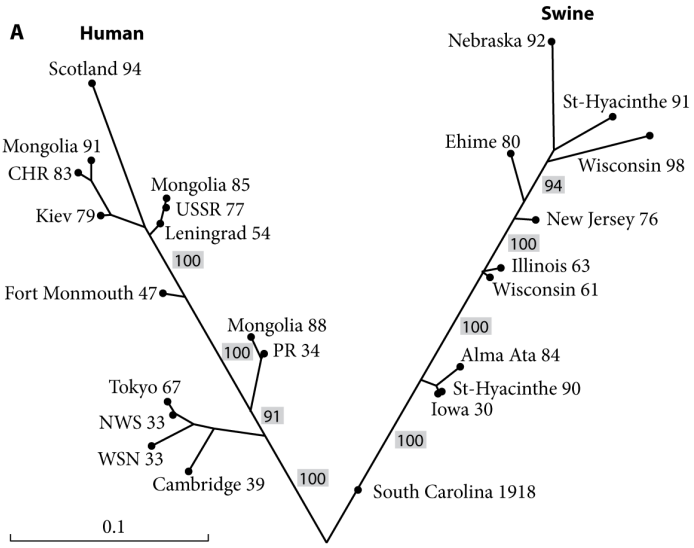
16) A doctor was accused of murdering a victim ("V") by injecting her with virus from one of his patients ("P"). The tree shown (from Metzker et al. 2002, PNAS) is based on an analysis of the DNA sequences of viruses taken from P, V, and a series of other local accessions ("LA") – representing other infected individuals in the local area. What can be concluded from the tree?

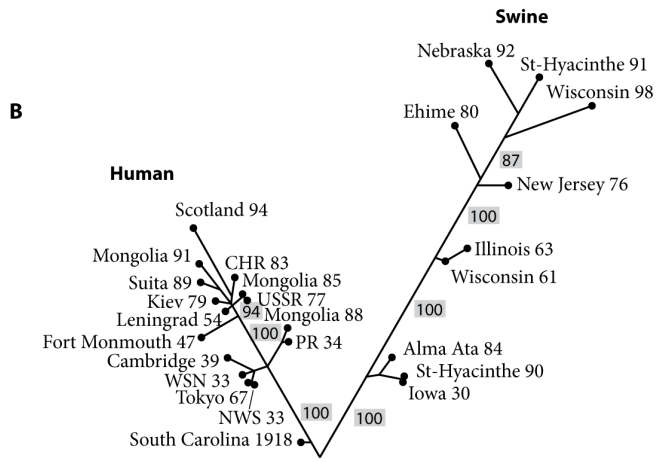
a) The doctor is innocent: the victim gave the virus to the patient.
b) The doctor is likely guilty: the victim was infected with a virus from the patient
c) The tree is ambiguous as to the doctor's guilt: either the patient's virus infected the victim or vice versa
d) The doctor is innocent: the patient was probably infected twice, once by the victim and once by LA # 08.



17) The trees (from Gibbs et al. 2001, Science) show the phylogeny estimated for the some influenza viruses from humans and swine. Tree A was estimated from one part of the genome, whereas tree B was estimated from a different part of the genome. Assuming these trees are correct and properly rooted, how does this result support the inference that the South Carolina 1918 strain (exemplar of the 1918 flu pandemic) arose from recombination of human and swine viruses?

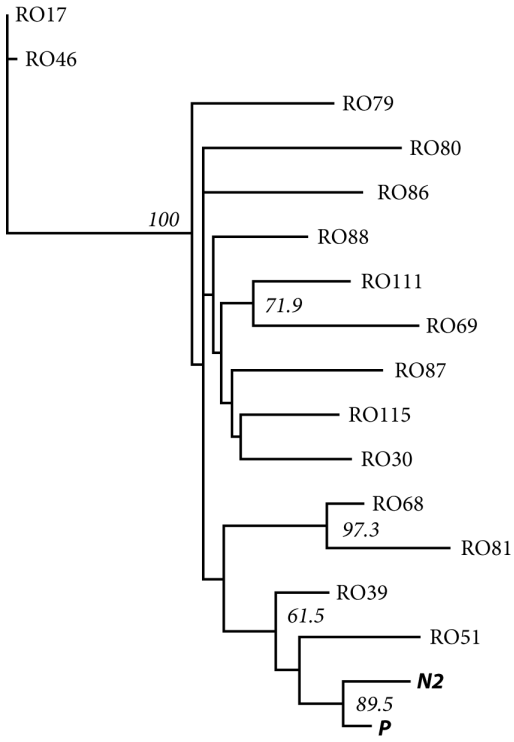
a) The fact that the South Carolina 1918 strain is near the root of both trees suggests that it is of mixed identity
b) The fact that the South Carolina 1918 strain is more closely related to the swine strains in tree A but to the human strains in tree B
c) The fact that the South Carolina 1918 strain is a direct ancestor of all the swine strains in tree A but came from a human
d) The fact that the South Carolina 1918 strain is more closely related to the Iowa 30 swine strain than to the Scotland 94 human strain in both trees





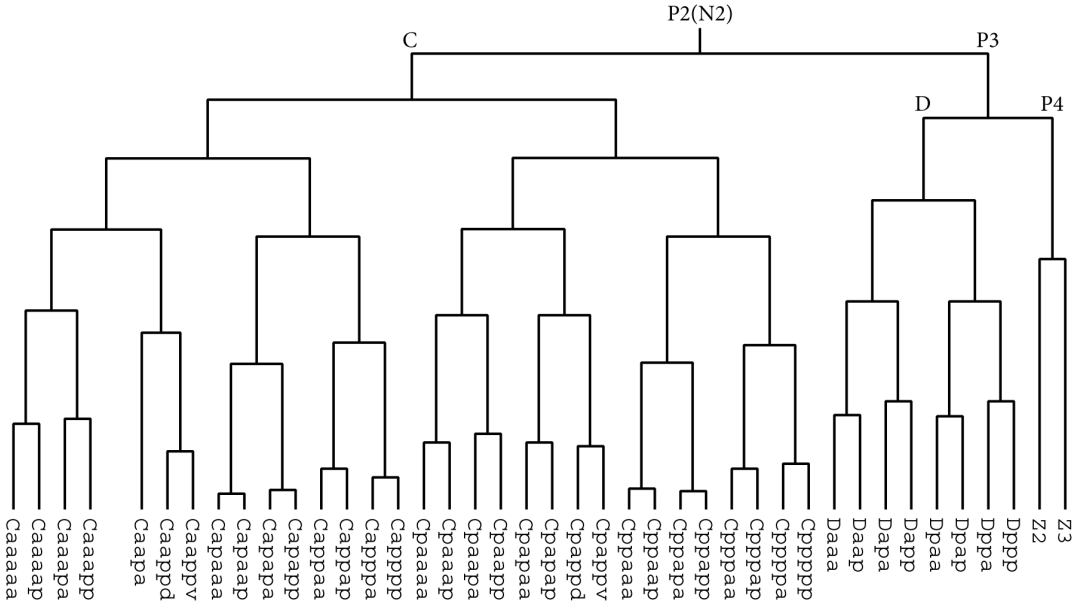
18) The tree shown (from Goujon et al. 2000, J. Virol.) was estimated from HIV viral sequences for the purpose of determining whether nurse (N2) infected a patient (P) with HIV-AIDS. The tree also includes viral sequences from a number of other infected individuals ("RO") from the same region. Based just on this tree what should you conclude?

a) The tree is definitive: the nurse infected the patient
b) The tree is definitive: The patient infected the nurse
c) The tree is definitive: Both the nurse and the patient were infected by RO51
d) The tree is ambiguous: either the patient's virus infected the nurse or vice versa
e) None of the above

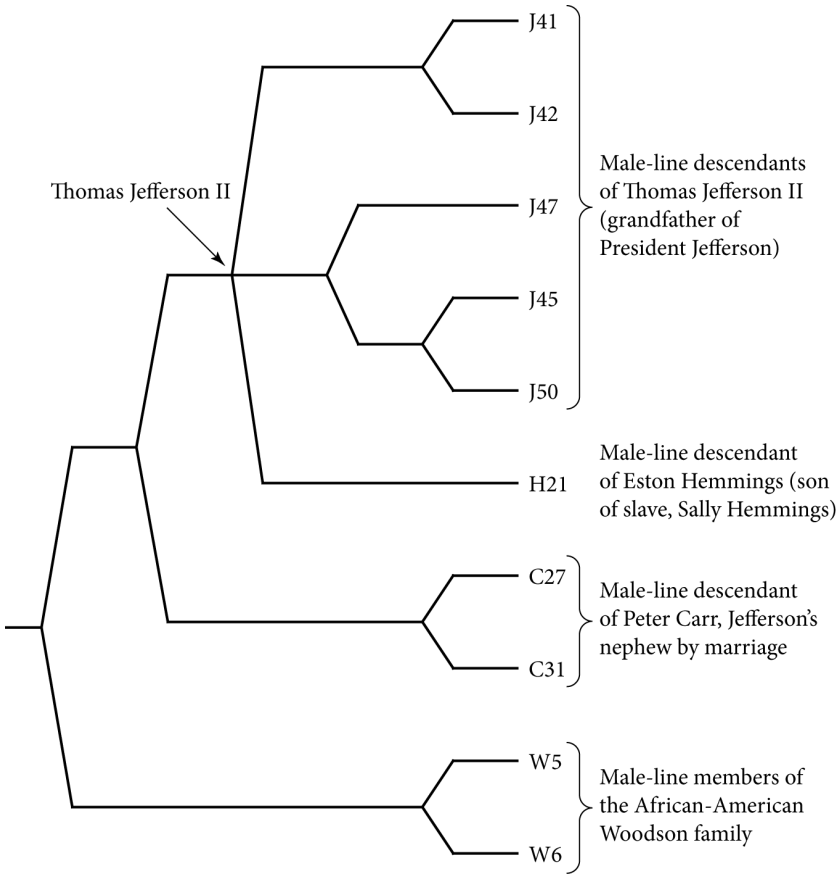


19) The tree shown below (from Zhao et al. 2008, Dev. Biol.) tracks the fate of cell lineages in the nematode *Caenorhabditis elegans*, a model system for molecular and developmental biology. As a *C. elegans* embryo grows into a mature worm, the cells divide and different lineages of cells give rise to different parts of the body. Given the tree, what can we say about the Z2 and Z3 cells that form the germline?

a) They are derived from P4 cells
b) They are derived from the D cells
c) Z cells are more closely related to P3 cells than to D cells
d) Z cells are related to P4 cells but not to P3 cells
e) Z2 probably have more features in common with Dppp cells than with Z3 cells



20) Thomas Jefferson has been accused of fathering Eston Hemmings, born to his slave Sally Hemmings. The Y-chromosome is only passed on to males so it can be used to study male-lineage relationships. The tree shown (based on Foster et al. 1998, Nature) shows the relationships among the Y-chromosomes of one male-line descendant of Eston Hemmings (H21), as well as several male-line members of the following families: the Jeffersons, the Carrs (related to Peter Carr who has been proposed as a possible father of some of Sally Hemmings children), and the Woodsons (which includes other descendants of Sally Hemmings). Given this tree, what should we conclude about the claim that Thomas Jefferson fathered Eston Hemmings?



a) Thomas Jefferson or one of his close male relatives fathered Eston Hemmings
b) Eston Hemming was fathered by a member of the Woodson family
c) Thomas Jefferson did not father Eston Hemming, but rather Peter Carr probably did
d) The tree contains no evidence as to the father of Eston Hemmings