ANSWER KEY.

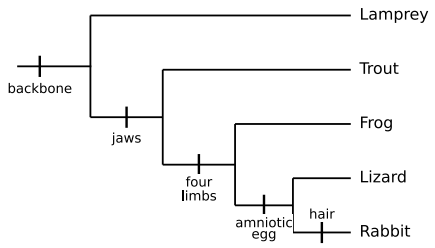
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Cladograms and Phylogenetic Trees

Biology | ANSWER KEY

Answer in complete sentences. Use the trees and graph as evidence.

1. The cladogram shows five vertebrate groups. The bars mark where traits first appear.



Each bar marks where a new trait first appears. All groups to its right inherit it.

(a) Which trait do the frog, lizard, and rabbit share that the trout does not have?

(b) Which two groups share the most recent common ancestor?

(c) Which group is the outgroup?

(a) **Four limbs**

(b) **The lizard and the rabbit** (they share the amniotic egg)

(c) **The lamprey**, which branches off first

2. The tree shows how four apes are related.



(a) Which ape is the closest living relative of humans?

(b) About how many million years ago did the ancestors of humans and orangutans split?

(a) **Chimpanzee**

(b) **About 15 million years ago**

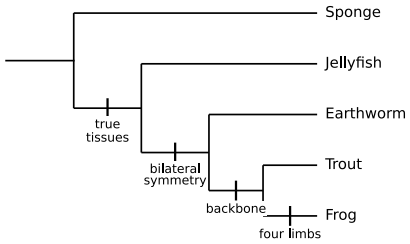
3. A student says, "The species at the bottom of a cladogram are more advanced than the species at the top." Explain what is wrong with this statement.

All the tips are living groups, and the order of the tips does not matter. Swapping the branches at a node does not change the tree. Only the branching pattern shows how closely groups are related.

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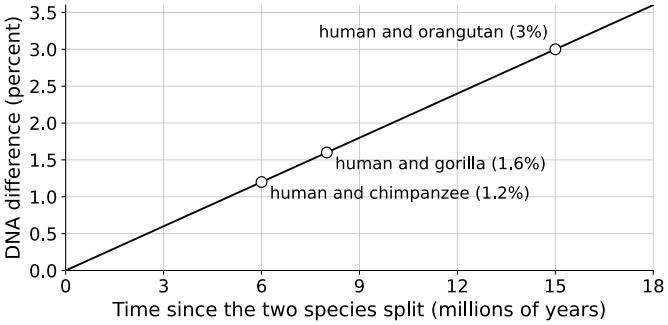
4. Use the trait table to draw a cladogram of the five animals. Mark where each trait first appears.

Animal	True tissues	Bilateral symmetry	Backbone	Four limbs
Sponge	No	No	No	No
Jellyfish	Yes	No	No	No
Earthworm	Yes	Yes	No	No
Trout	Yes	Yes	Yes	No
Frog	Yes	Yes	Yes	Yes



Each animal has one more trait than the one before it, so the branches split off in the order sponge, jellyfish, earthworm, trout, frog.

5. The graph shows a molecular clock for primates.



(a) Use the graph to find the clock rate in percent DNA difference per million years.

(b) Two species differ by 4.0% in their DNA. About when did they split? Show your setup with units.

(a) 3.0% ÷ 15 million years = **0.20% per million years**

(b) 4.0% ÷ 0.20% per million years = **20 million years ago**

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