



Lecture 20:

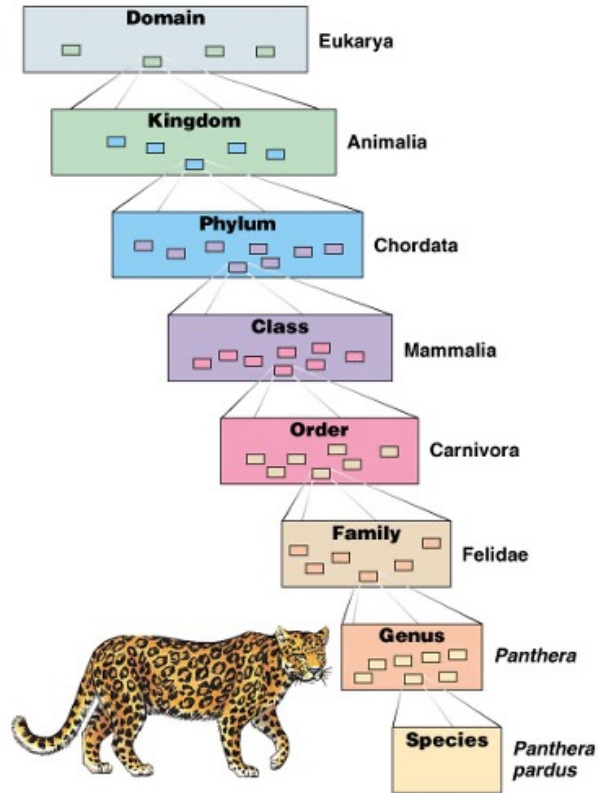
Phylogeny

Course 410

Molecular Evolution



Taxonomy



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Hierarchical classification

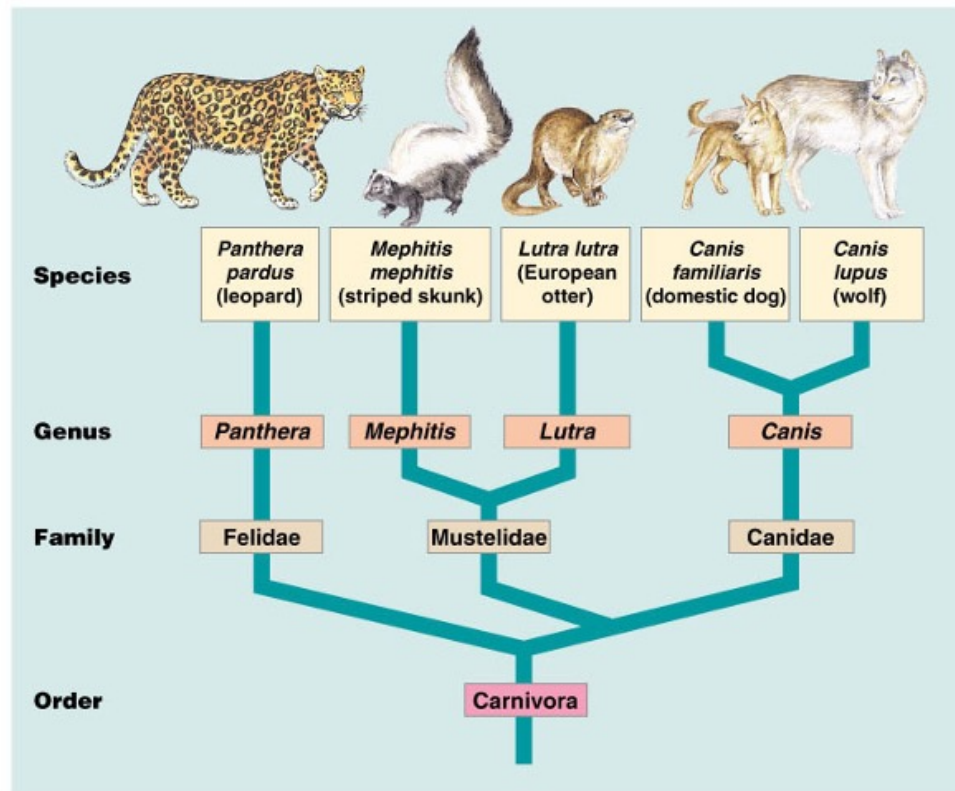
Binomial nomenclature
Carl Linnaeus (1735)



**Are species classified and
named randomly?**

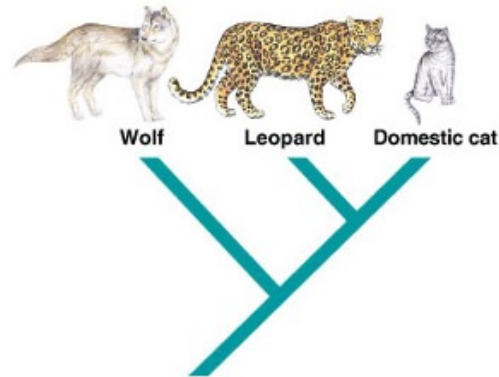
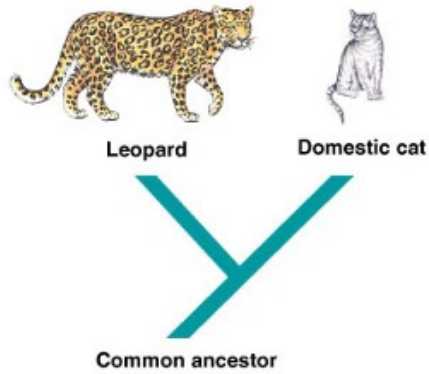
Taxonomy and relationships

The connection between classification and phylogeny



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Cladograms

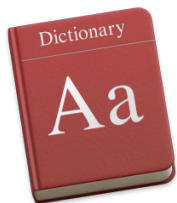


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clad·o·gram | 'kladə,gram, 'klādə,gram |

noun *Biology*

a branching diagram showing the cladistic relationship between a number of species.



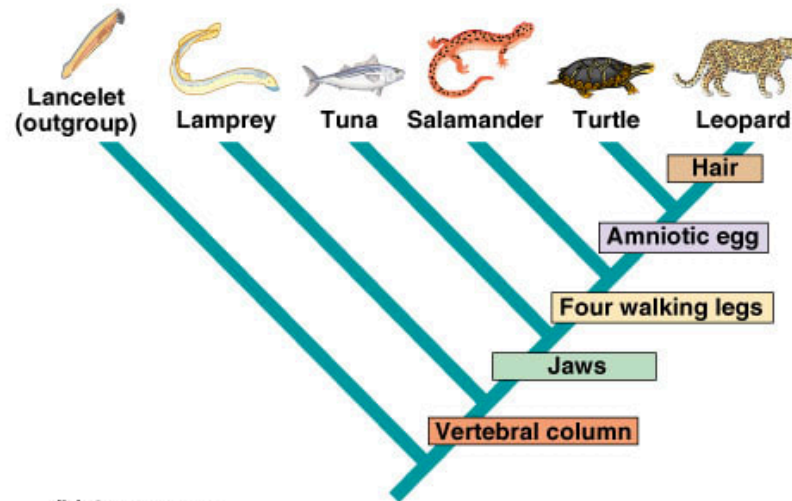


What are the cladograms based on?

Constructing cladograms

CHARACTERS	TAXA					
	Lancelet (outgroup)	Lamprey	Tuna	Salamander	Turtle	Leopard
Hair	0	0	0	0	0	1
Amniotic (shelled) egg	0	0	0	0	1	1
Four walking legs	0	0	0	1	1	1
Jaws	0	0	1	1	1	1
Vertebral column (backbone)	0	1	1	1	1	1

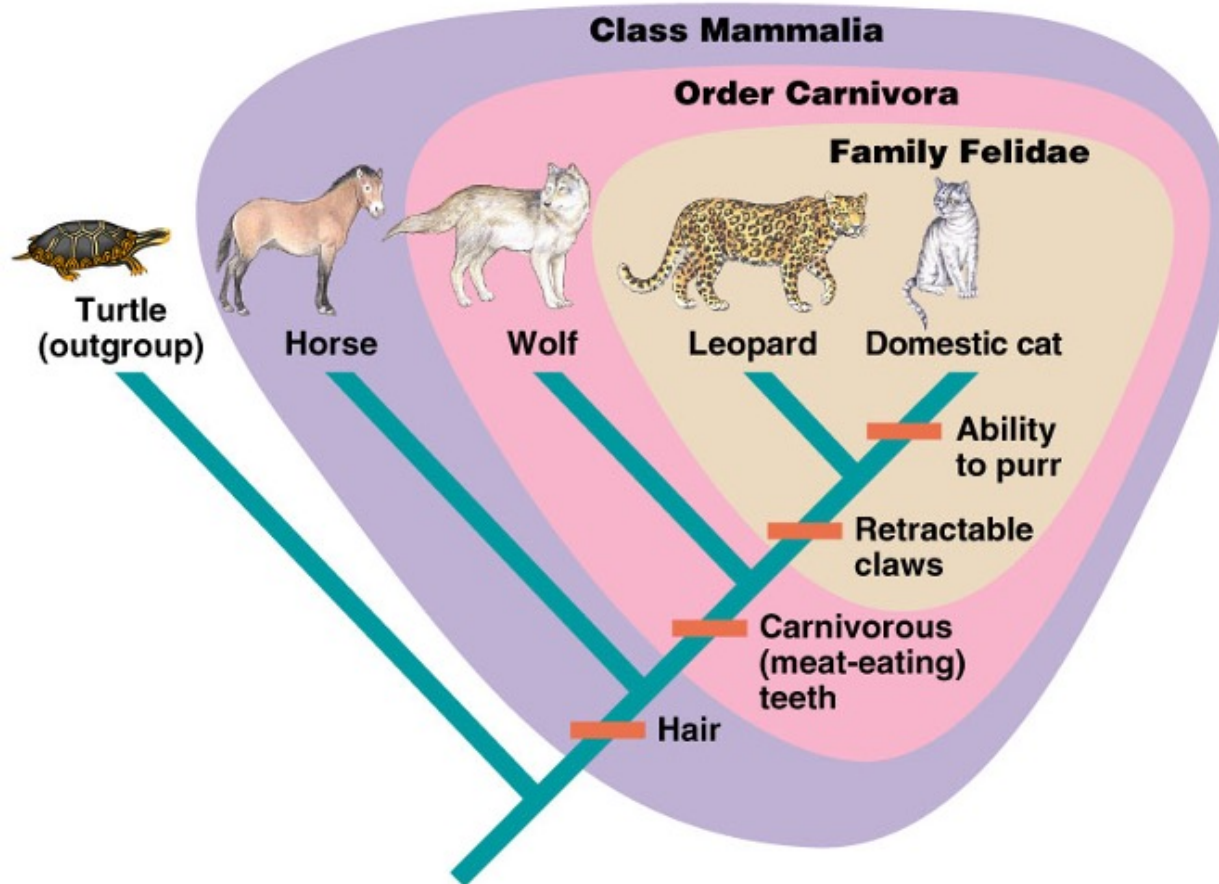
(a) Character table



(b) Cladogram

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Cladistic and taxonomy



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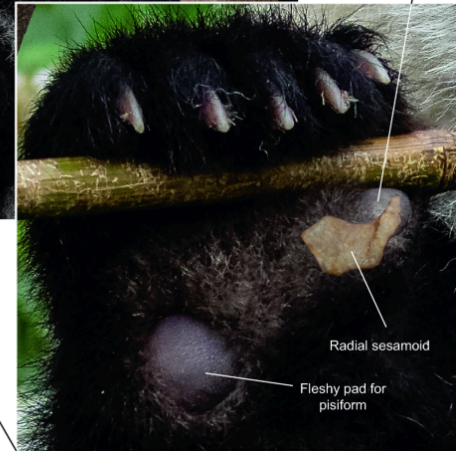
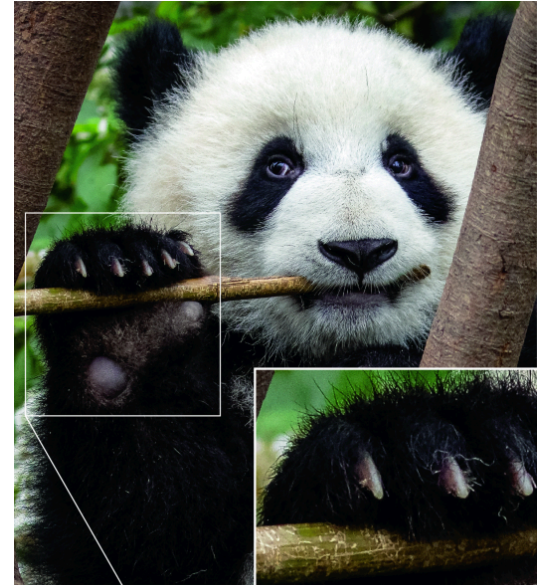
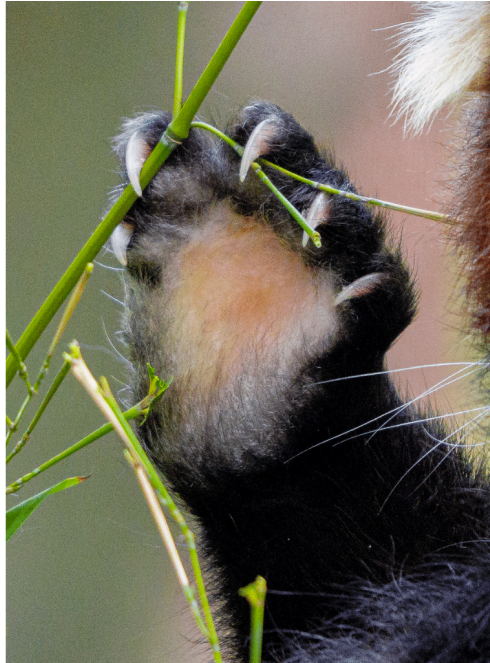


**Can structures be misleading when
comparing species**

Convergent evolution and analogous structures



Convergent evolution and analogous structures



phy·log·e·ny | fī'lājənē |

noun

the branch of biology that deals with phylogenesis. Compare with [ontogeny](#).

phy·lo·gen·e·sis | ,fīlō'jenəsəs |

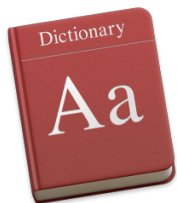
noun *Biology*

the evolutionary development and diversification of a species or group of organisms, or of a particular feature of an organism. Compare with [ontogenesis](#).

phy·lo·ge·net·ic | ,fīlōjə'nedik |

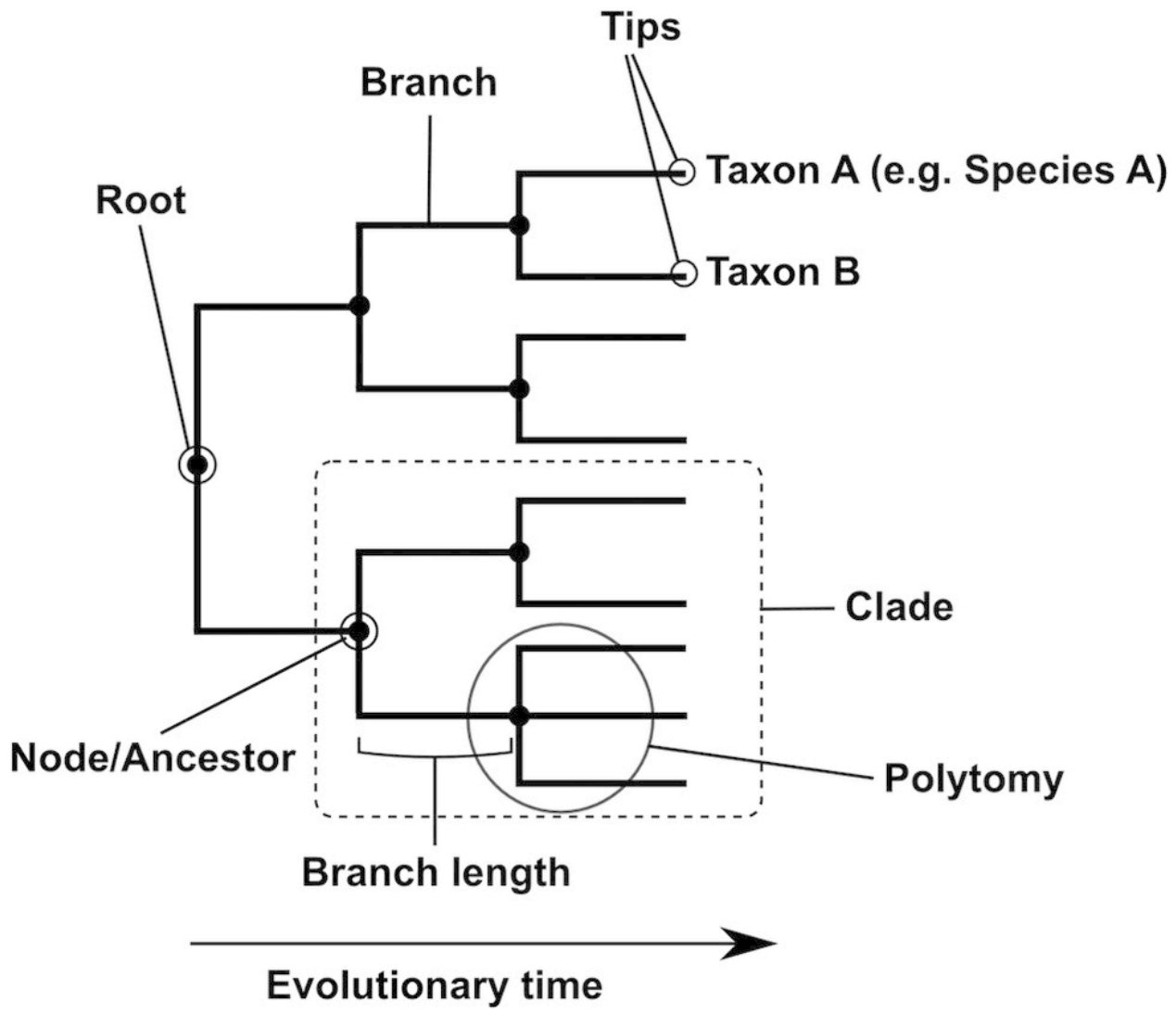
adjective *Biology*

relating to the evolutionary development and diversification of a species or group of organisms, or of a particular feature of an organism: *the phylogenetic relationship of mammalian species.*





Phylogenetic tree terminology





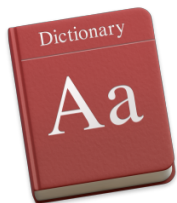
Trees and meanings

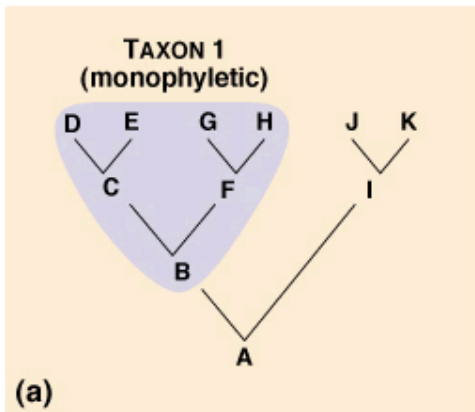
Monophyletic

mon·o·phy·let·ic |,mäŋə,fī'ledik |

adjective *Biology*

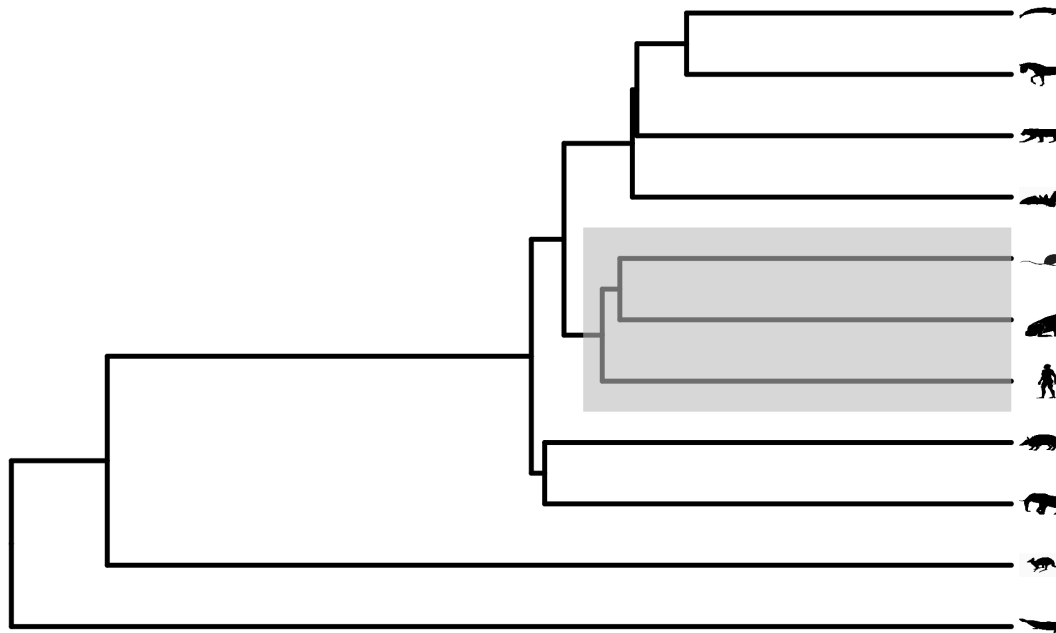
(of a group of organisms) descended from a common evolutionary ancestor or ancestral group, especially one not shared with any other group.





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(A) Monophyletic group

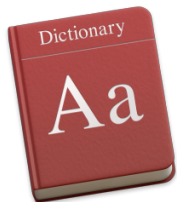


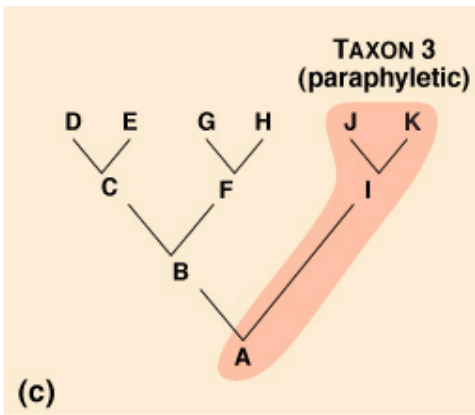
Paraphyletic

par·a·phy·let·ic | ˌperəˌfɪˈlɛdɪk |

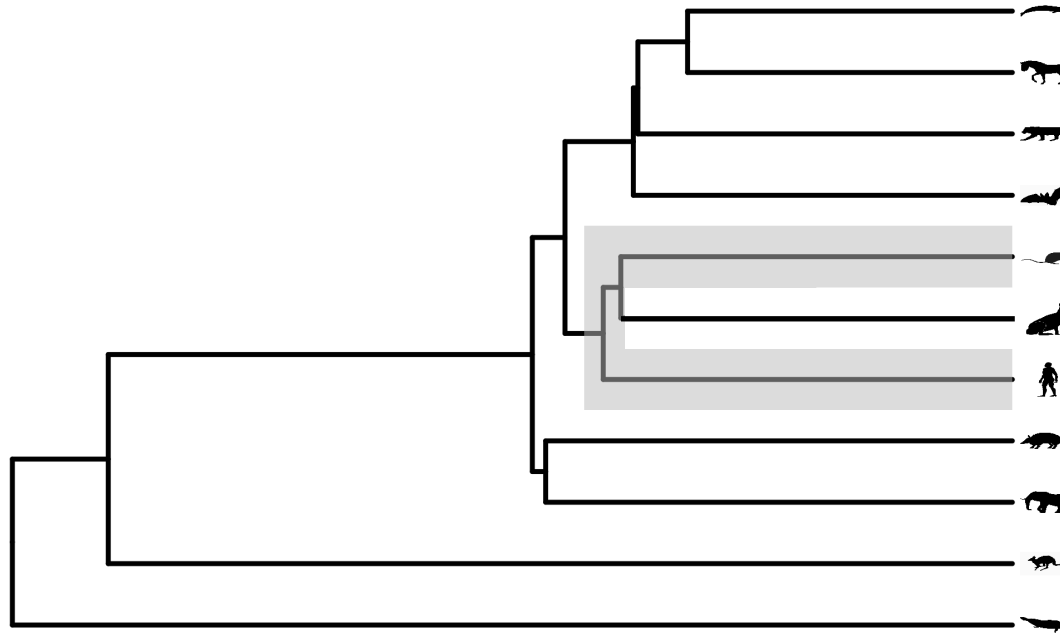
adjective *Biology*

(of a group of organisms) descended from a common evolutionary ancestor or ancestral group, but not including all the descendant groups.





(C) Paraphyletic group

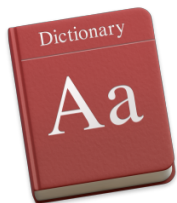


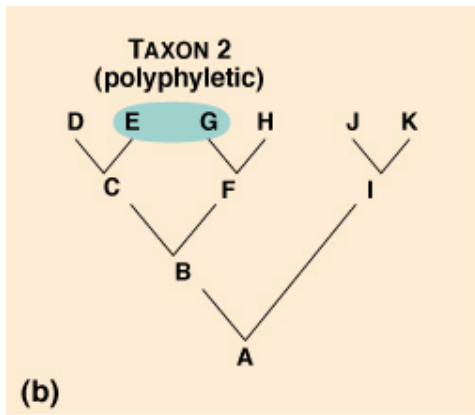
Polyphyletic

pol·y·phy·let·ic |,pälē,fī'ledik|

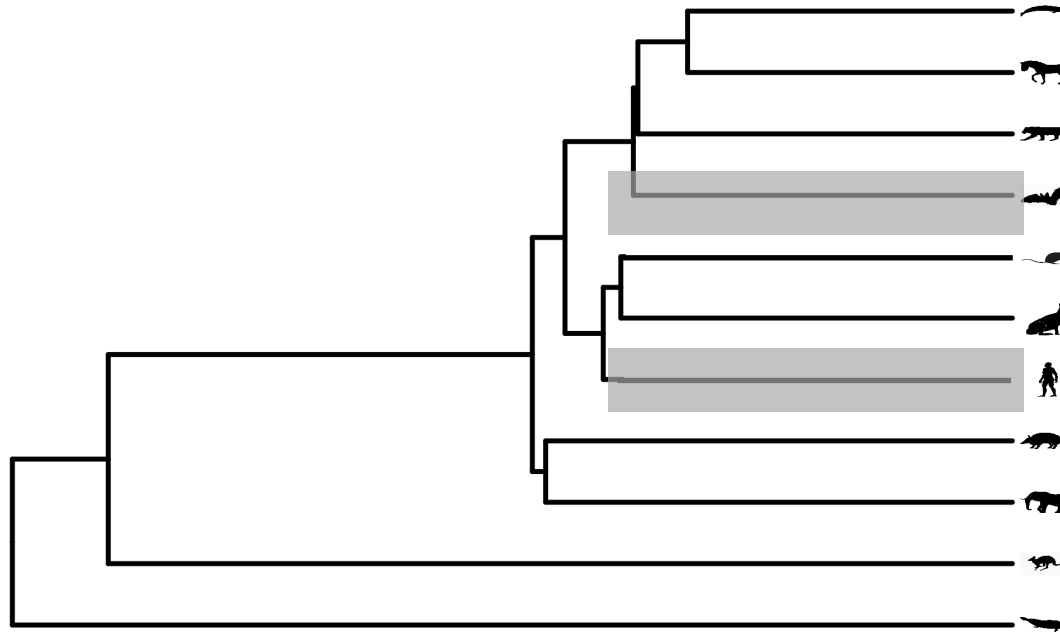
adjective *Biology*

(of a group of organisms) derived from more than one common evolutionary ancestor or ancestral group and therefore not suitable for placing in the same taxon: *the aschelminthes may be a polyphyletic grade.*





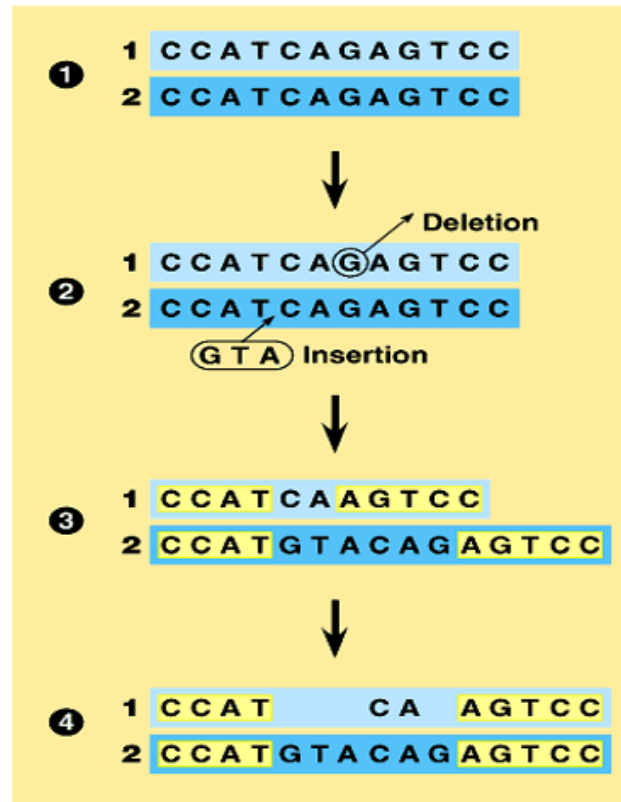
(B) Polyphyletic group





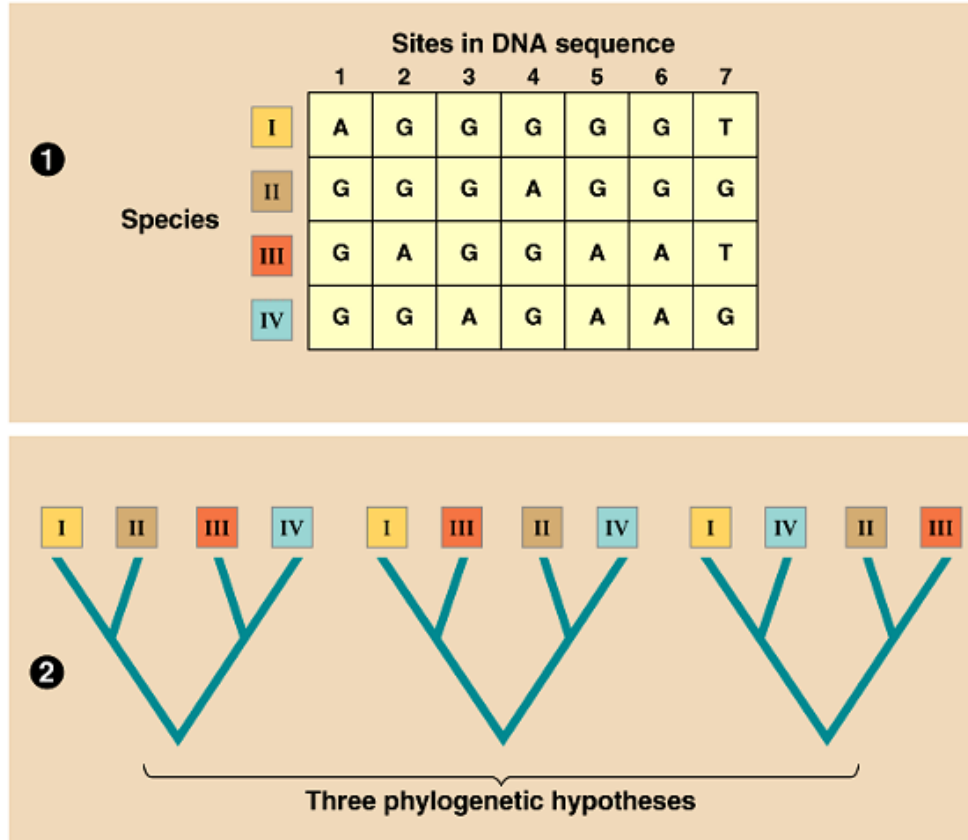
Molecular phylogeny

Sequence alignment



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Molecular systematics



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Testing the trees

Parsimony

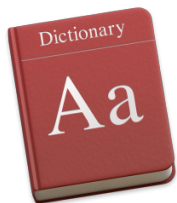
par·si·mo·ny | 'pārsə,mōnē |

noun

principle of parsimony (also law of parsimony)

the scientific principle that things are usually connected or behave in the simplest or most economical way, especially with reference to alternative evolutionary pathways.

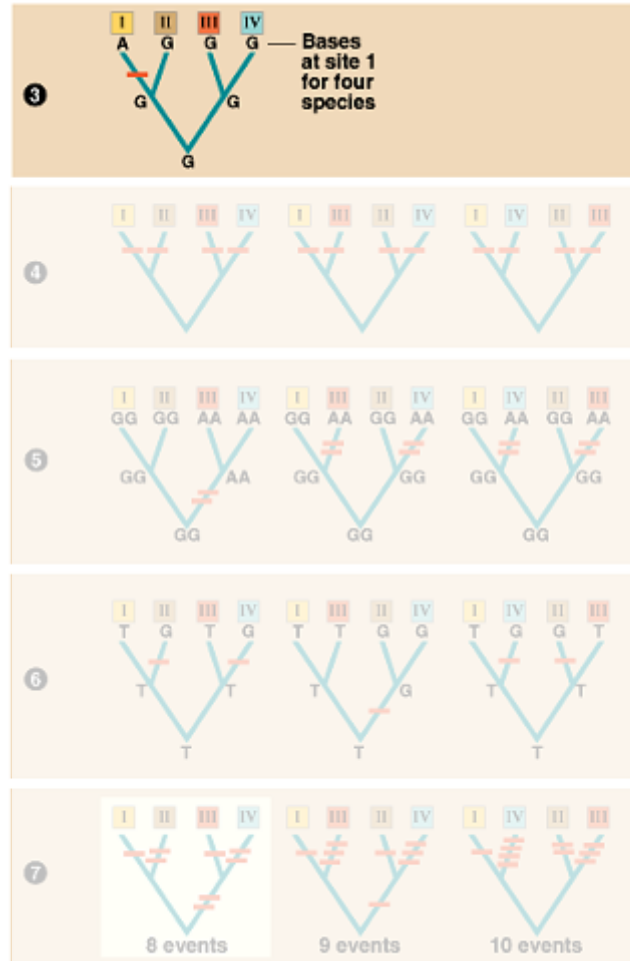
Compare with [Occam's razor](#).





Sites in DNA sequence

	1	2	3	4	5	6	7
I	A	G	G	G	G	G	T
II	G	G	G	A	G	G	G
III	G	A	G	G	A	A	T
IV	G	G	A	G	A	A	G



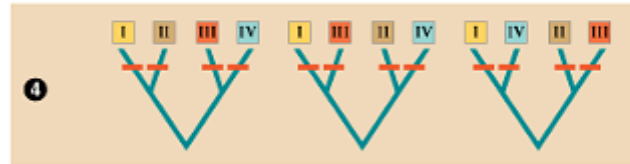
Site 1

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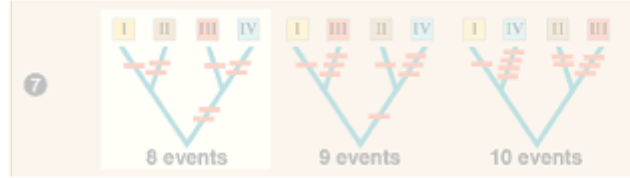
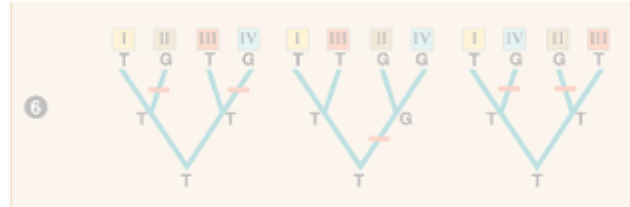
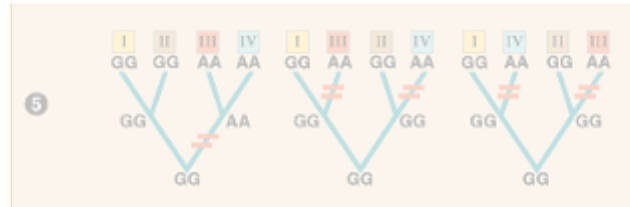


Sites in DNA sequence

	1	2	3	4	5	6	7
I	A	G	G	G	G	G	T
II	G	G	G	A	G	G	G
III	G	A	G	G	A	A	T
IV	G	G	A	G	A	A	G



Sites 2-4

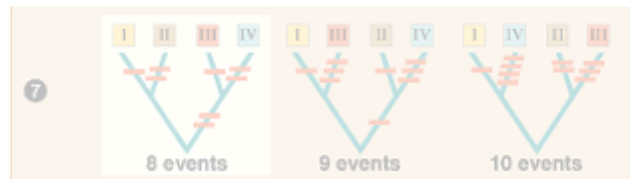
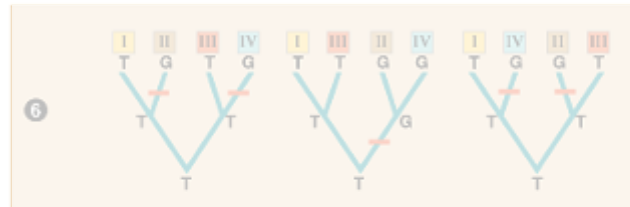
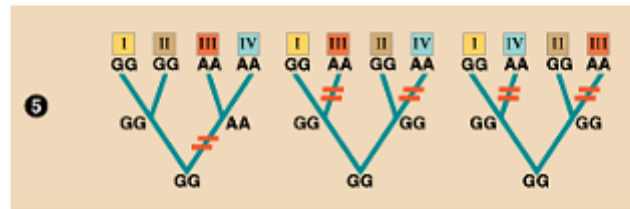
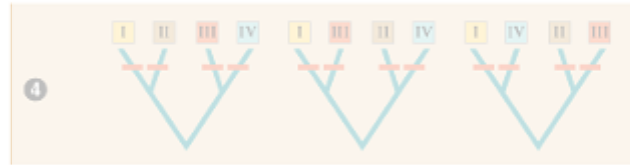


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Sites in DNA sequence

	1	2	3	4	5	6	7
I	A	G	G	G	G	G	T
II	G	G	G	A	G	G	G
III	G	A	G	G	A	A	T
IV	G	G	A	G	A	A	G



9 events

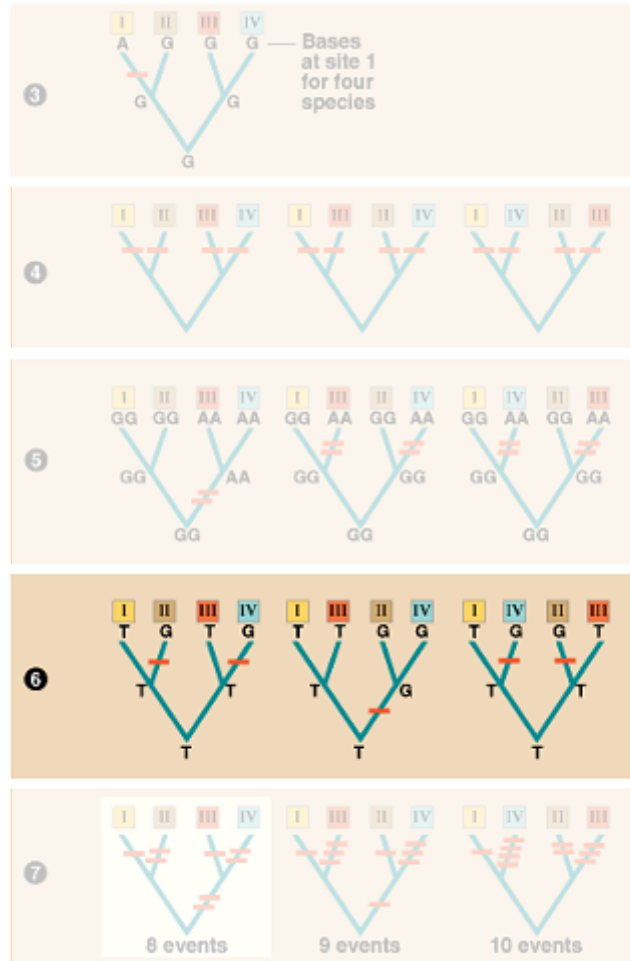
10 events

Sites 5-6



Sites in DNA sequence

	1	2	3	4	5	6	7
I	A	G	G	G	G	G	T
II	G	G	G	A	G	G	G
III	G	A	G	G	A	A	T
IV	G	G	A	G	A	A	G

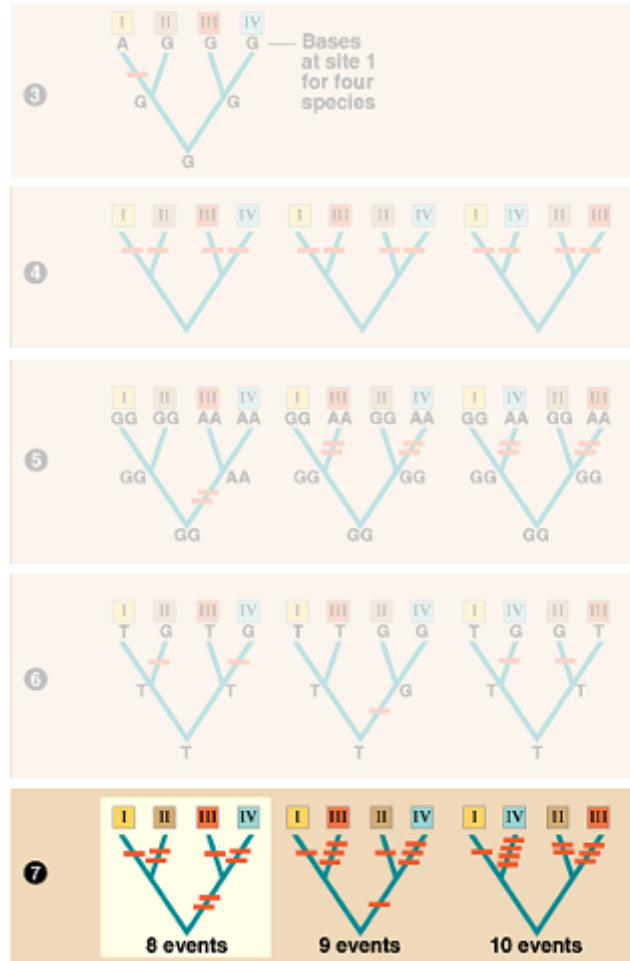


Sites 7

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		Sites in DNA sequence						
		1	2	3	4	5	6	7
Species	I	A	G	G	G	G	G	T
	II	G	G	G	A	G	G	G
	III	G	A	G	G	A	A	T
	IV	G	G	A	G	A	A	G



All sites

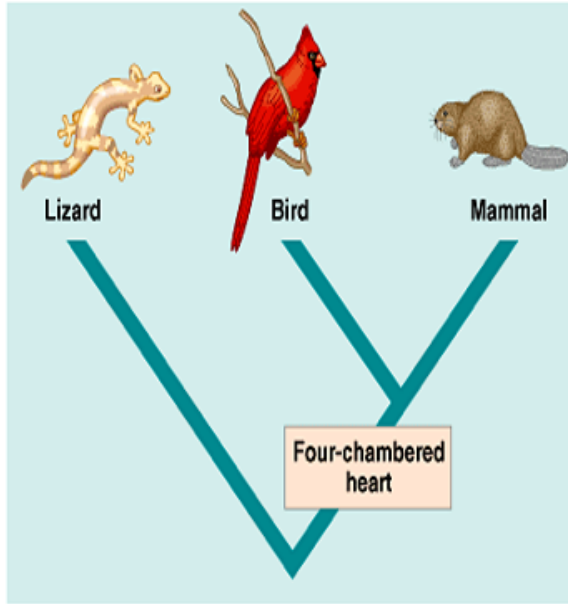
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Are molecular phylogenies independent or dependent on the sequences used?

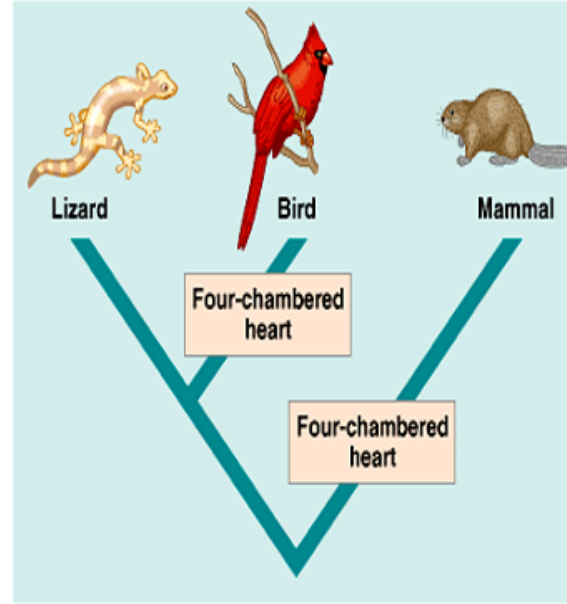


Are molecular phylogenies independent or dependent on characters under study?

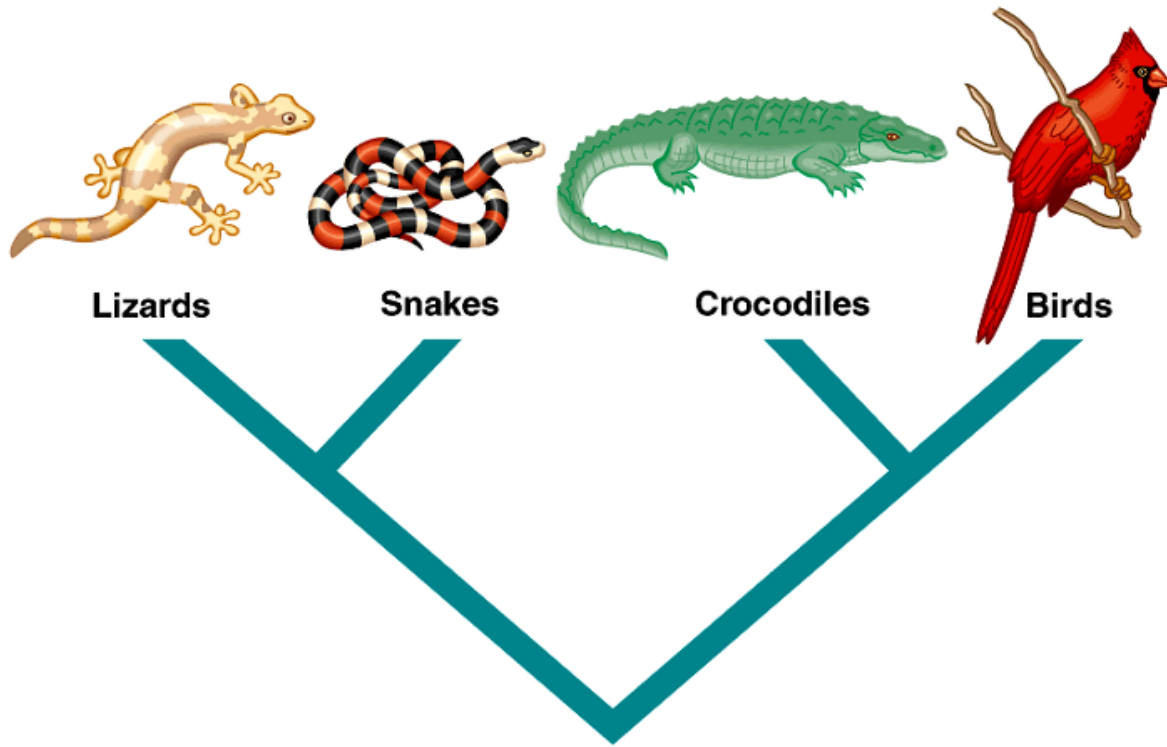


(a) Mammal–bird clade

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(b) Lizard–bird clade



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