Lab 3: Evolution (Phylogeny and Cladistics)

Cladistics: method of hypothesizing relationships among organisms
Cladogram: diagram showing relationships among organisms
Clade: a group consisting of an ancestor and all of its descendants
Taxon: (plural: taxa): a species or group of organisms

Outgroup: organism(s) that serve as a reference group for determining the evolutionary relationships among the species of interest (ingroup)

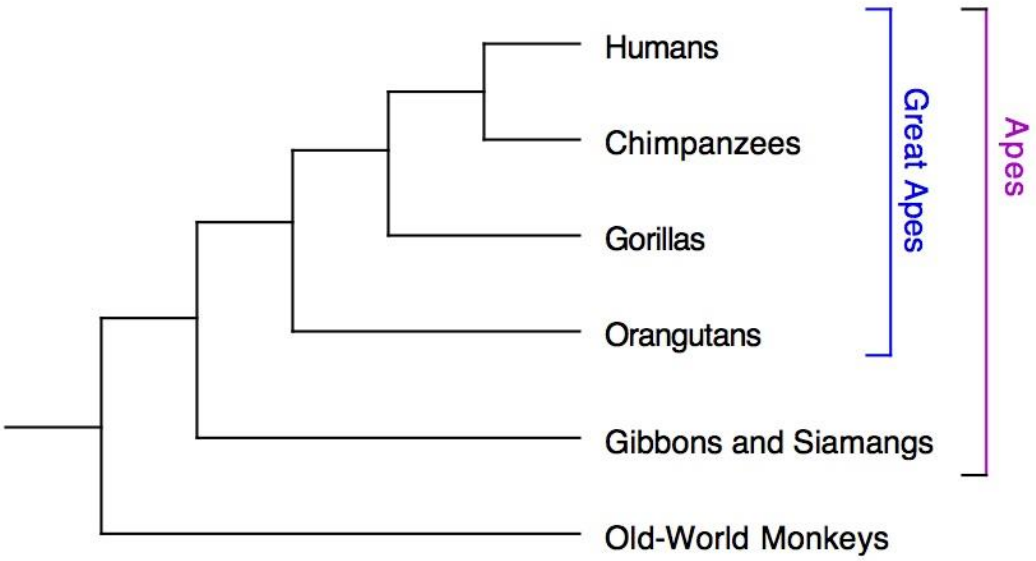
Autapomorphy: a characteristic unique to one taxon
Synapomorphy: shared derived characteristics (define a group of organisms)
Plesiomorphy: an ancestral character state that is retained in the descendants

Monophyletic group: ancestor + all descendants
Paraphyletic group: ancestor + most descendants
Polyphyletic group: group characterized by 1+ homoplasies
Homoplasies: character states which appear to be the same but which not been inherited from a common ancestor (e.g. bat vs butterfly wings)

Assumptions used in cladistics:

1) any group of organisms are related by descent from a common ancestor
2) There is a bifurcating pattern of cladogenesis
3) Change in characteristics occurs in lineages over time

Examine the following cladogram and answer the following questions.



1) Which taxon is most closely related to chimps?

2) Are orangutans more closely related to gorillas or Siamangs?

3) What is the outgroup?

4) What is the basal-most taxon for the ingroup?

5) Draw a circle around a monophyletic group. Label it.

6) Draw a circle around a paraphyletic group. Label it.

7) Compare the anatomy of the following organisms by filling out the chart below (put an **X** if the trait listed is present in that organism).

	Fly	Trout	Lizard	Eagle	Cat
Eyes					
Internal skeleton					
Lungs					
Fur					
Eggs with shell					

8) According to the anatomical evidence, is the cat more closely related to lizards or fish?

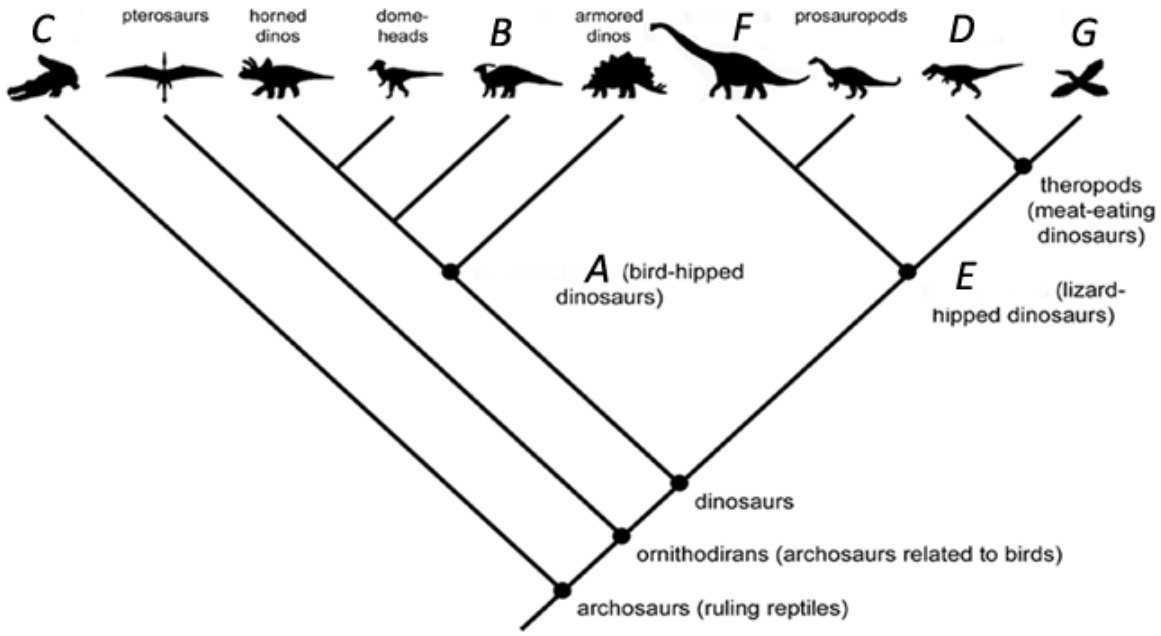
9) Draw and label a cladogram for these organisms in the space below.

Archosaur Phylogeny

10) Examine the following chart listing the synapomorphies for various groups of Archosaurs. Use this information to match the groups (column on the left) to the appropriate letters marked on the cladogram on the next page (marked A-G).

	Sprawled stance	Columnar stance	Perforate acetabulum	Bird-hipped	Lizard-hipped	Elongate necks
Crocodilians	x					
Avian Theropods (Birds)		x	x	x		
Nonavian Theropods (T rex)		x	x		x	
Ornithischians		x	x	x		
Saurischians		x	x		x	
Sauropods (Brachiosaurus)		x	x		x	x
Ornithopoda (Hadrosaurus)		x	x	x		

	Extensive armor/plates/spikes	Expanded shelf at back of skull	Feathers	Toothless beak	Jaw articulation ventral to maxilla tooth row	Asymmetrical distribution of tooth enamel
Crocodilians						
Avian Theropods (Birds)			x	x		
Nonavian Theropods (T rex)			x			
Ornithischians						
Saurischians						
Sauropods (Brachiosaurus)						
Ornithopoda (Hadrosaurus)					x	x


C
pterosaurs
horned dinos
dome-heads
B
armored dinos
F
prosauropods
D
G
theropods (meat-eating dinosaurs)
A (bird-hipped dinosaurs)
E (lizard-hipped dinosaurs)
dinosaurs
ornithodirans (archosaurs related to birds)
archosaurs (ruling reptiles)

A-

B-

C-

D-

E-

F-

G-