# TOPIC 5.4: CLADISTICS

Clades

Cladistics involve classifying organisms into groups of species **(clades)**
- A clade consists of a single common ancestor and all descendants

Cladograms are tree diagrams where each branch point represent the splitting of two new species groups from a common ancestral species
- Each branch point (node) represents a speciation event
- The more nodes between groups, the less related the groups are

CLADE   NOT A CLADE
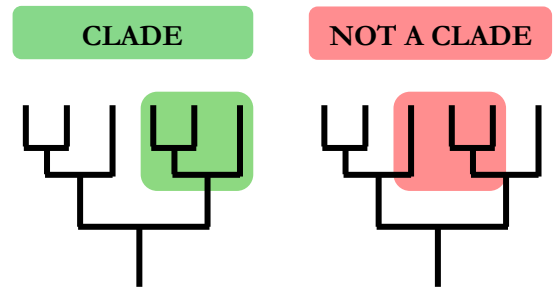
Structural Evidence

Historically, cladograms have been constructed based on structural characteristics, however this **not** always a reliable method for establishing evolutionary connections
- Related species may have distinctive *(homologous)* features
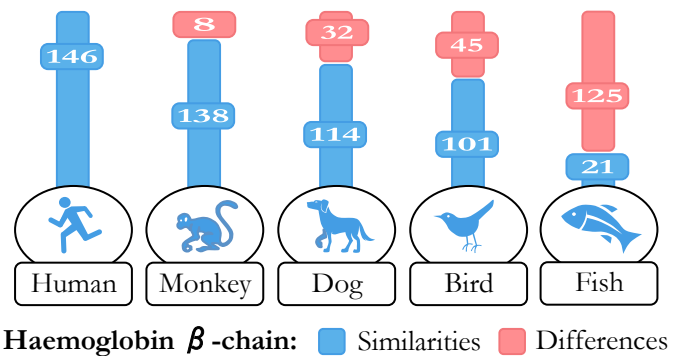- Unrelated species may have similar *(analogous)* features

HOMOLOGOUS	ANALOGOUS
Structures look different	Structures look similar
Due to different selection pressures	Due to common selection pressures
Species **do** share a common ancestry	Species do **not** share a common ancestry
Evidence of *divergent* evolution	Evidence of *convergent* evolution
E.g. Pentadactyl limb	E.g. Fins (whale vs shark)

Molecular Evidence

Cladograms are now being generated via a comparison of biochemical evidence (i.e. DNA or amino acid sequences)
- Related species will have sequences with more similarities
- Amino acid sequences will accumulate differences at a slower rate to DNA sequences (due to degeneracy)

If a sequence accumulates mutations at a constant rate, the time of divergence can be calculated based on the number of mutations between the two species (molecular clock)

	Human	Monkey	Dog	Bird	Fish
Differences		8	32	45	125
Similarities	146	138	114	101	21

Haemoglobin β-chain: ■ Similarities ■ Differences

Cladograms

Structural Data: Compare characteristics via a table

	Lungs	Endothermic	Hair / skin
Fish	–	–	–
Lizard	✔	–	–
Bird	✔	✔	–
Rodent	✔	✔	✔

Molecular Data: Compare sequences via multiple alignment

												Mutations
fish	F	A	A	A	A	F	Q	F	G	F	T	I	4
lizard	F	S	T	A	A	F	R	P	P	H	T	V	3
bird	F	S	T	A	A	F	R	G	G	H	T	I	1
rodent	F	S	T	A	A	F	R	F	G	H	T	I	0
Consensus	F	S	T	A	A	F	R	F	G	H	T	I	

Example: Humans and Other Primates

Gibbon   Orangutan   Gorilla   Chimp   Man

Millions of years ago