Dinosaurs Practical

1. Calculating dinosaur speeds

[Alexander, R. McN. 1976. Estimates of speeds of dinosaurs. *Nature* 261: 129-30]

$$l/h = 2.3(u^2/gh)^{0.3}$$

where l is stride length, h is the height of the hip above the ground, u is running speed, and g is the gravitational acceleration. u^2/gh is the Froude number, which applies to situations where inertia and gravity interact.

The equation can be rewritten:

$$u = 0.25g^{0.5}l^{1.67}h^{-1.17}$$

which simplifies roughly to:

$$u = 1.4(l/h) - 0.27.$$

Calculate running speeds of the dinosaurs tabulated, in ms^{-1}, and plot speeds against body weights, and against stride length (l). Are there any correlations evident? Would you expect weight and/or stride length to correlate with speed? If not, what should?

	Stride length, l (m)	Hip height, h (m)	Weight (tonnes)
THEROPODA			
Tyrannosaurus	3.0	2.1	6
Allosaurus (1)	3.0	2.0	2
Allosaurus (2)	2.4	1.0	2
Megalosaurus	1.3	1.1	1.2
Ornithomimid (1)	1.9	1.2	0.15
Ornithomimid (2)	3.2	1.9	0.15
PROSAUROPODA			
Anchisaurus (1)	1.8	1.1	0.5
Anchisaurus (2)	1.5	0.6	0.5
SAUROPODA			
Apatosaurus (1)	2.5	3.0	28
Apatosaurus (2)	1.6	1.5	28
ORNITHOPODA			
Hadrosaur	4.2	3.4	11

2. Dinosaur specimens

Draw each specimen, and label the noted features. Remember to keep the drawing clear, large, and with a scale bar.

(a) Compare the teeth of a carnivorous dinosaur (*Megalosaurus* [No.] or *Albertosaurus* [No.]) and a herbivore (*Iguanodon* [No.). What are the key differences?

(b) Compare the skeletons of the small theropod *Compsognathus* [No.] and the first bird *Archaeopteryx* [wall outside lab.]. Label the key similarities and differences on a drawing of each.

(c) Look at the vertebra of *Iguanodon* [No.] and the toe bone of *Megalosaurus* [No.]. Draw these, and note features that tell you something about the taphonomy (mode of transport and preservation) of each.

(d) Draw the skull of the prosauropod *Plateosaurus* [No.] and note its key anatomical features.

(e) Look at the dinosaur eggshell fragments [No.] under the microscope and note key features on the outer surface and on the cross-section.

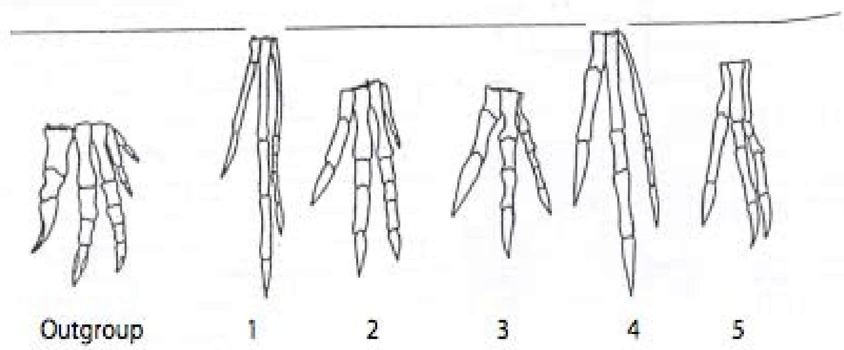
3. Phylogeny of the Theropoda

The purpose of this exercise is to try to reconstruct a phylogeny of theropod dinosaurs, and to see whether different sets of evidence, here hands and skulls, give the same results. Six skulls and six hand skeletons of dinosaurs are shown. Numbers 1-5 are theropod dinosaurs (carnivores), while 'OUT' is a representative member of the outgroup, in this case a Late Triassic prosauropod dinosaur, a herbivore. The fingers are numbered from 1 to 5 on each hand.

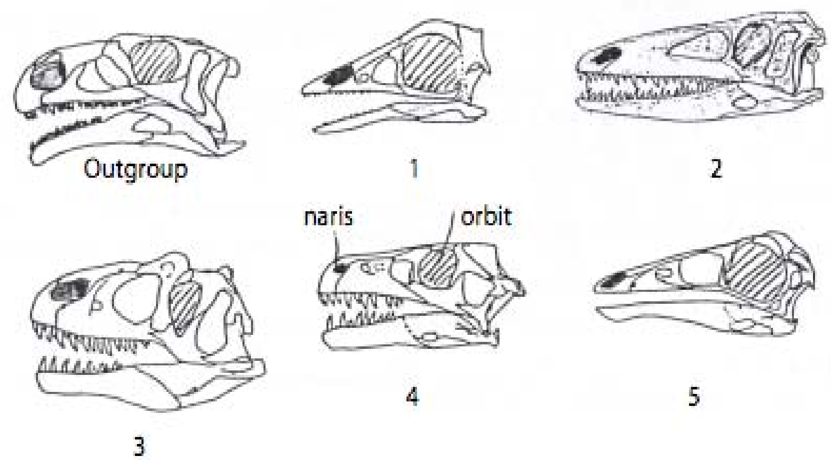
1. For hand and skull, establish a number of **characters**, divide them into **character states**, and decide **polarity** by comparison with the **outgroup**. A character could be "number of fingers", and the character states could be 3, 4, or 5. Comparison with the outgroup ('OUT') shows that 5 fingers is the primitive condition, and 4 or 3 are derived character states.

2. Code the character states as '0' for the primitive state, and 1(, 2, 3...) for the derived state(s). Make up a character state <u>matrix</u>, a table of characters vs. specimens. Find inclusive derived characters from this matrix that might define subgroups of the theropods 1-5.

3. Construct a cladogram, or cladograms, of dinosaurs 1-5. ***Do hands first, then skulls*.** There is no single clearcut answer, and several equally convincing cladograms may arise. Discuss why this may be.



HANDS



SKULLS