BATES COLLEGE, GEOLOGY

Teaching Ontogeny and Heterochrony Using Dog Skulls

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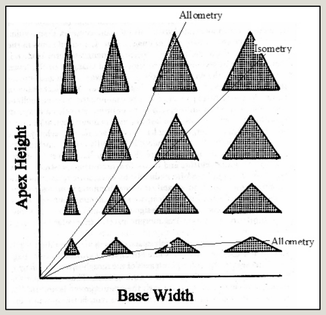
Overview & Objectives

This exercise focuses on teaching the concept of heterochrony through an examination of ontogeny. Allometric and isometric growth during development are compared and related to evolutionary changes over geologic time. Dogs, having the greatest degree of morphological variation among living mammals, are used as examples.



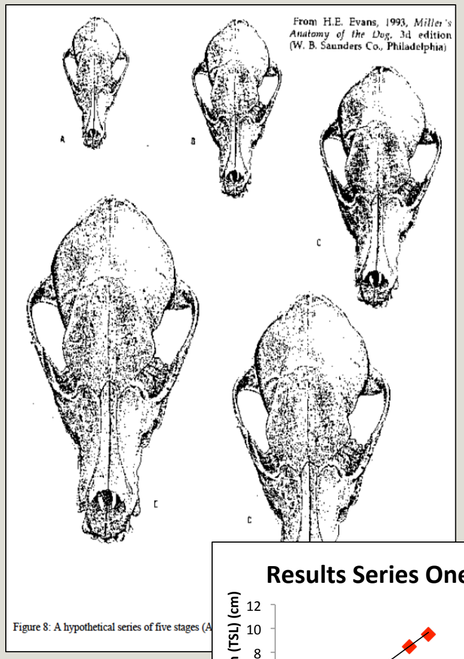
Allometric growth involves a change in shape with a growth in size; isometric growth does not include any shape changes (McGhee 1999)

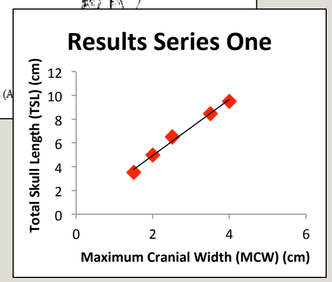
Step One: The students observe morphological differences among living dog breeds

Examples of adult dog skulls, all available from Skulls Unlimited (www.skullsunlimited.com): Labrador Retriever (top,$85), Bull Terrier (left, $180), English Bulldog (Right, $92)

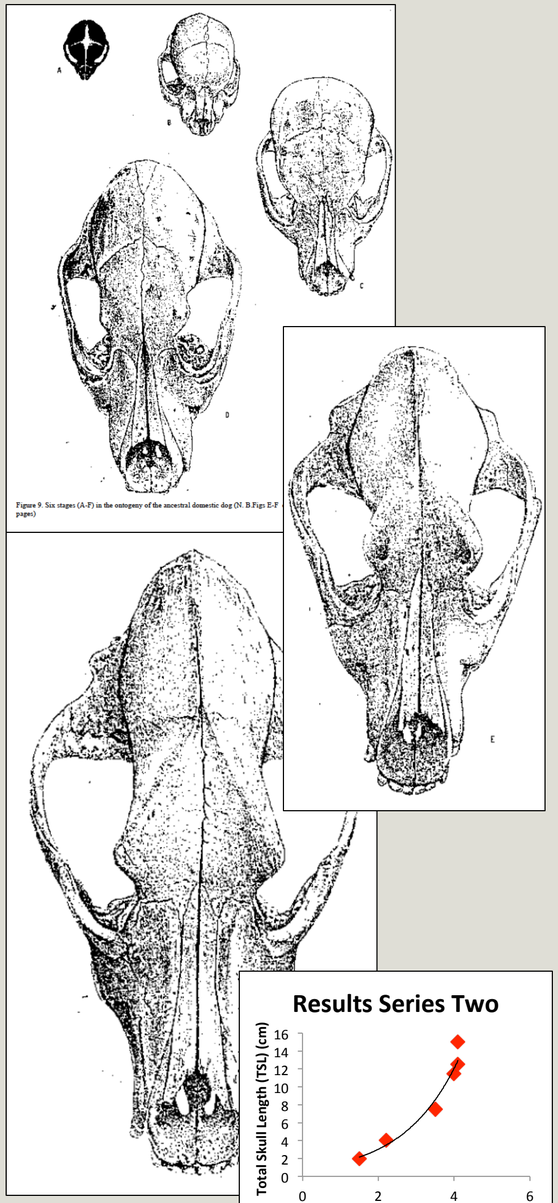
Step Two: Measuring the length and width of dog skulls through ontogeny (growth from puppy to adult). Two examples of a possible canine ancestor are given: one exhibiting isometric growth, one allometric. The students are not told which is which in advance, and the results are plotted in Excel (width vs. length)

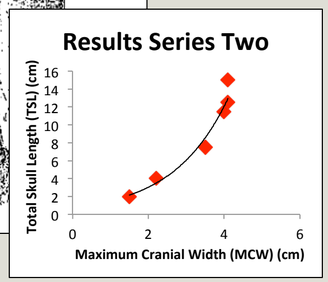
Ancestor Ontogeny Series One





Ancestor Ontogeny Series Two





Step Three: Conclusion and wrap up. Measure the additional skull specimens with calipers and plot them on the allometric curve. The students answer a series of questions in the lab manual relating their skull measurement trends to evolutionary change.

Important concepts:

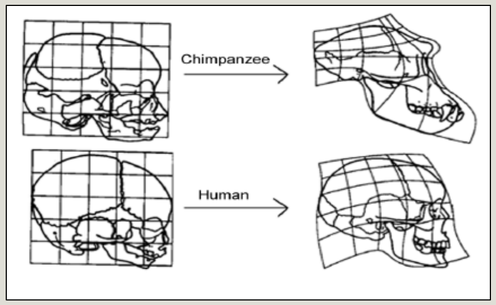
Identify allometrc vs. isometric growth patterns

Relate allometric changes to the modern diversity of dog breeds; predict where additional dog breeds would plot on the allometric curve

Cat breeds do not exhibit the range of morphology that dogs do; based on this information, predict what type of ontogeny they undergo

Relate these developmental changes to long-term evolutionary changes: heterochrony

Allometric growth in humans vs. chimpanzees



ACKNOWLEDGEMENTS

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