

Simulation of Early Embryonal Development Dynamics

From One Cell to Many

Stuart Pivar



Synthetic Life Lab

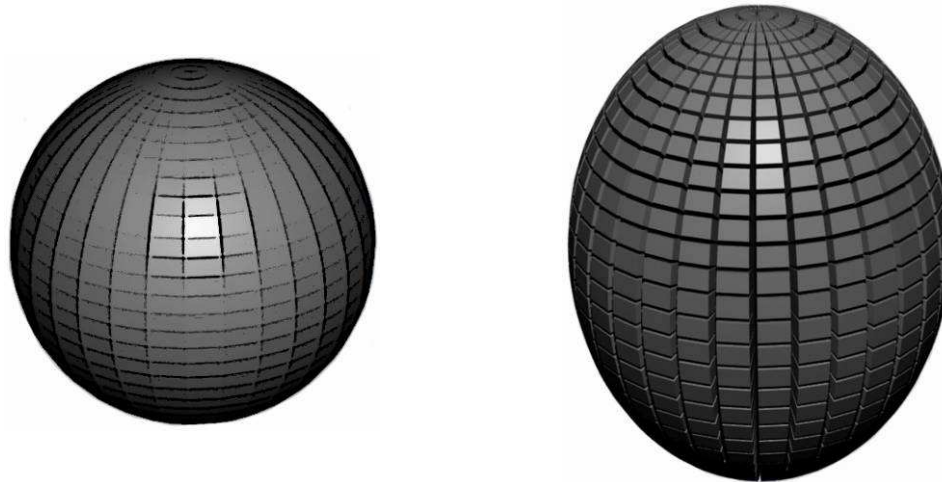
New York, NY 10023, USA

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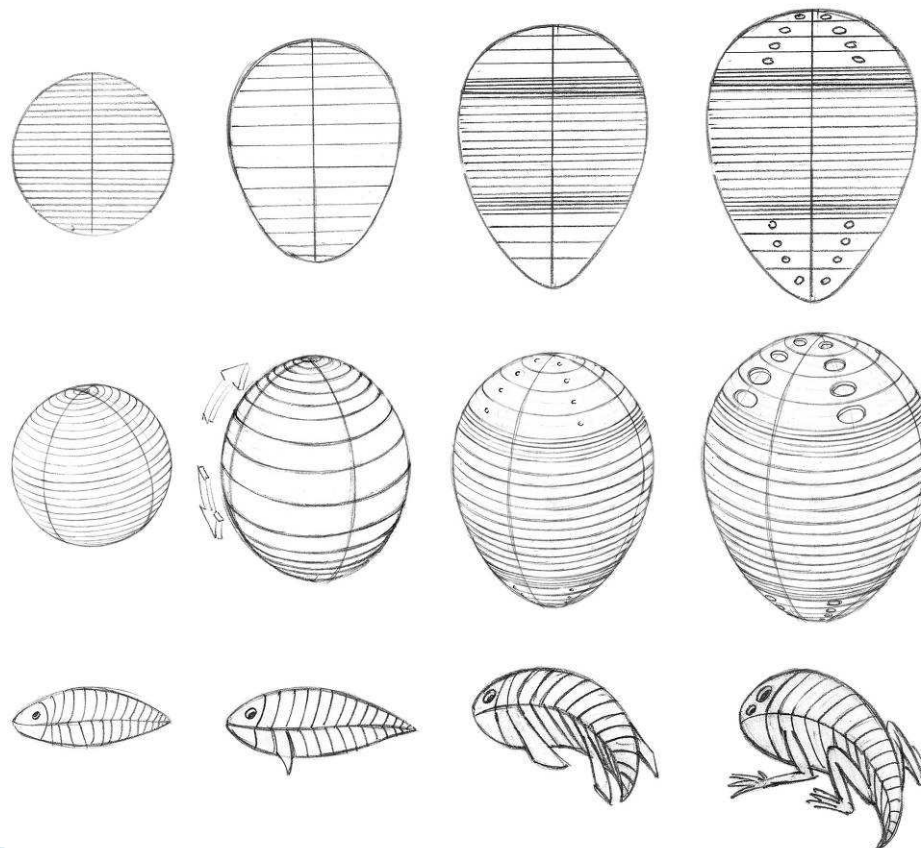
The Premise

- ▶ The form of the vertebrate skeleton is encoded in the patterned membrane of the egg cell from which it descends
- ▶ Vertebrate evolution is directed by developmental changes of the egg membrane pattern over evolutionary time

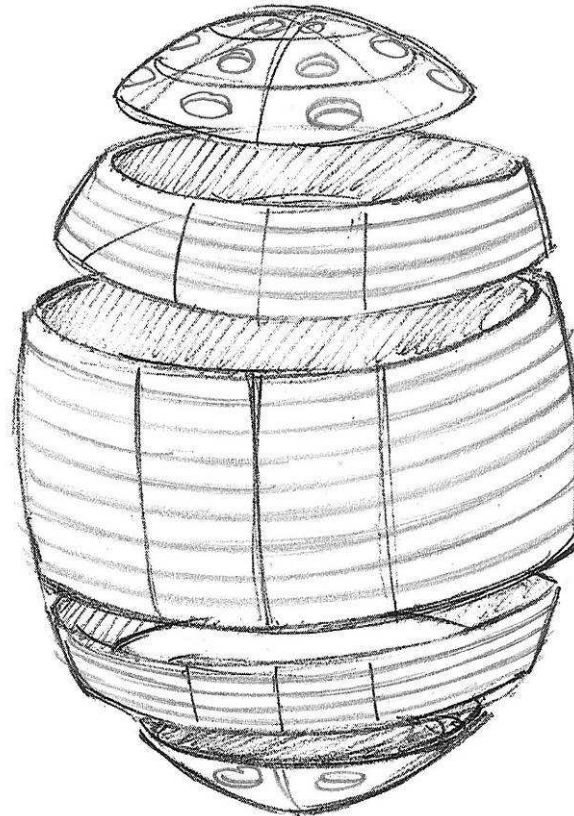


The Primordial Egg

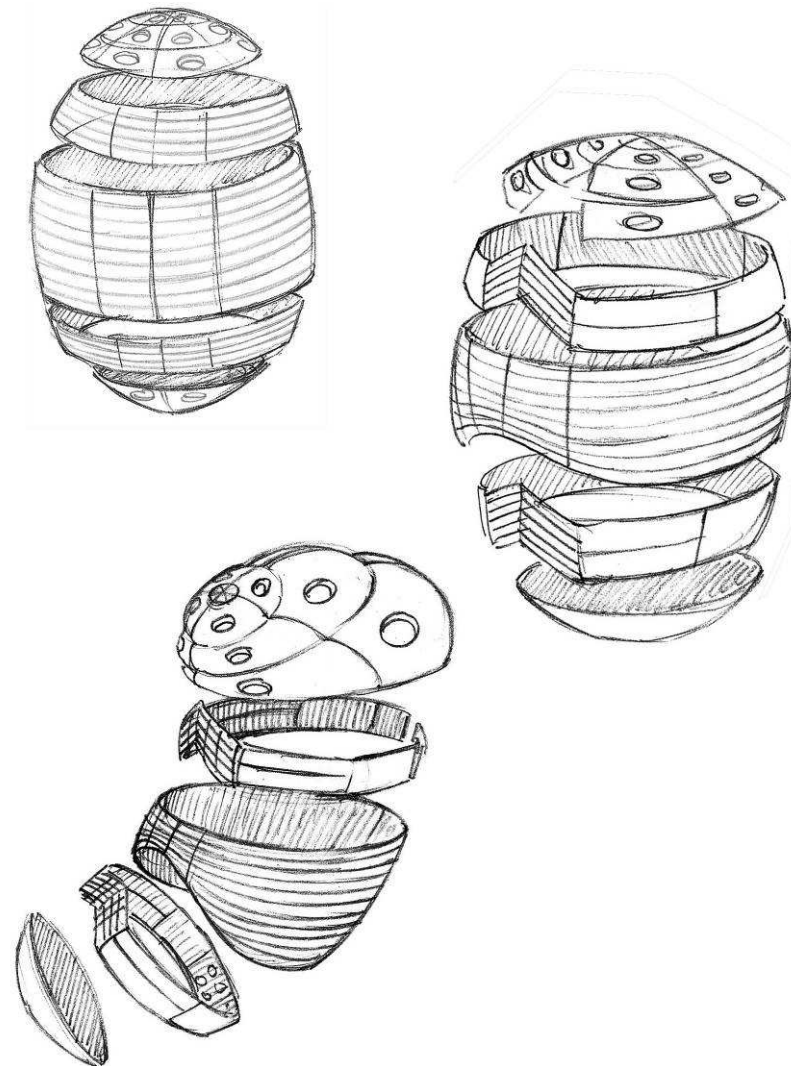
- ▶ Egg membrane pattern
 - rows and columns of lipid molecules
 - inflation
 - segmentation
 - apical holes



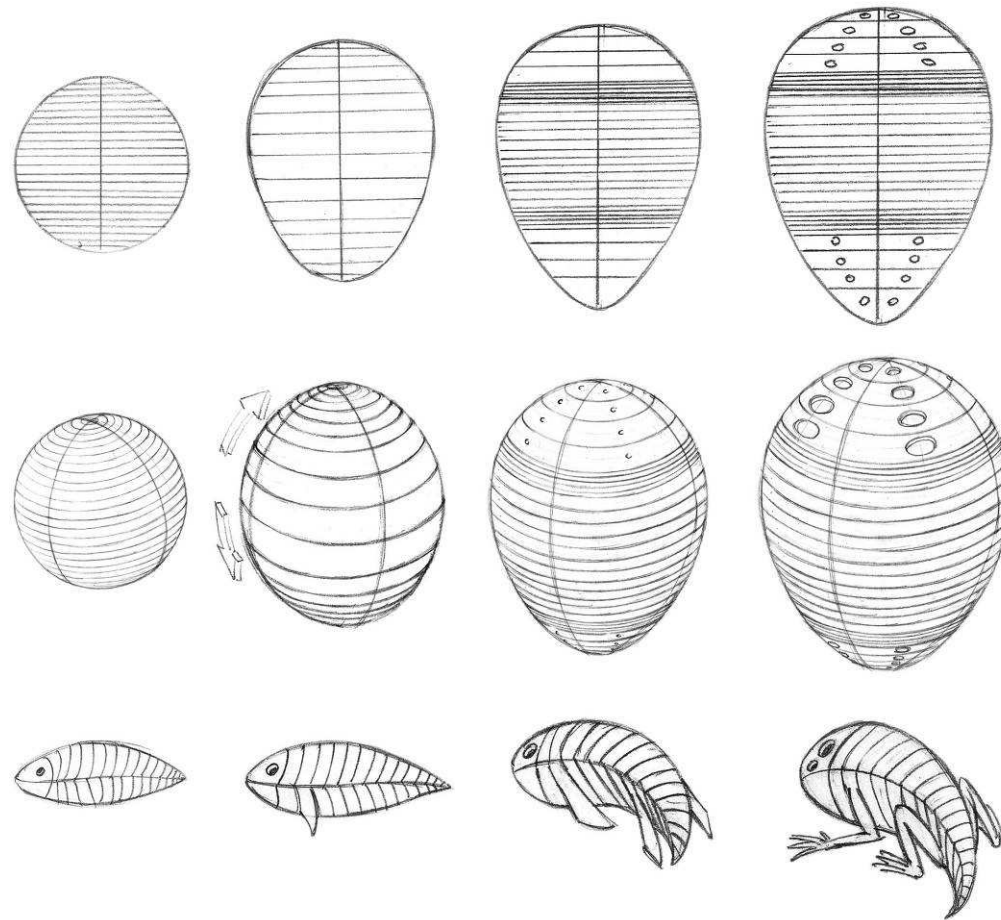
Ideal Egg Membrane Pattern



Morphogenesis



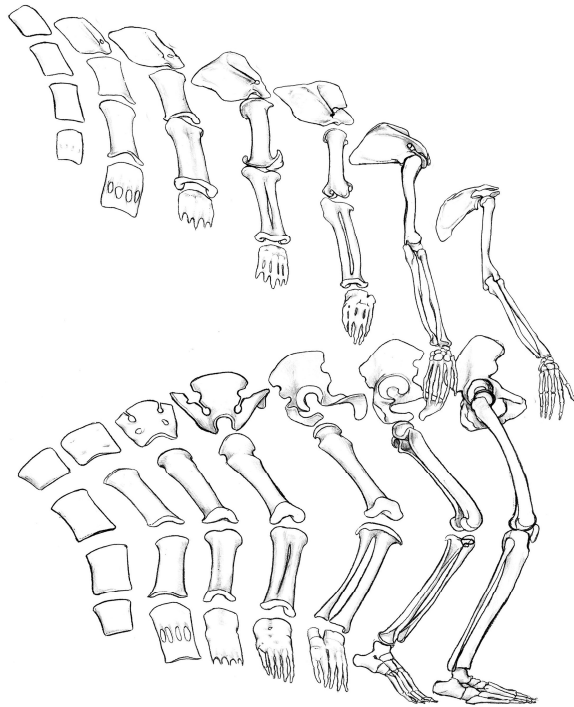
Evolution From Fish to Tetrapod



Corroborational Evidence

Bone Form

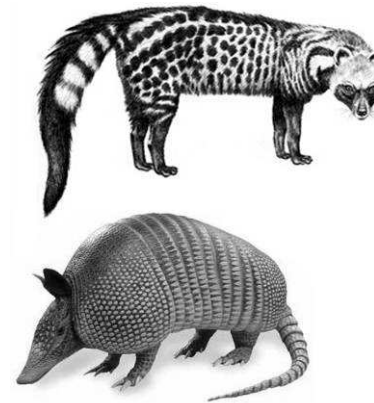
Origin of long bones



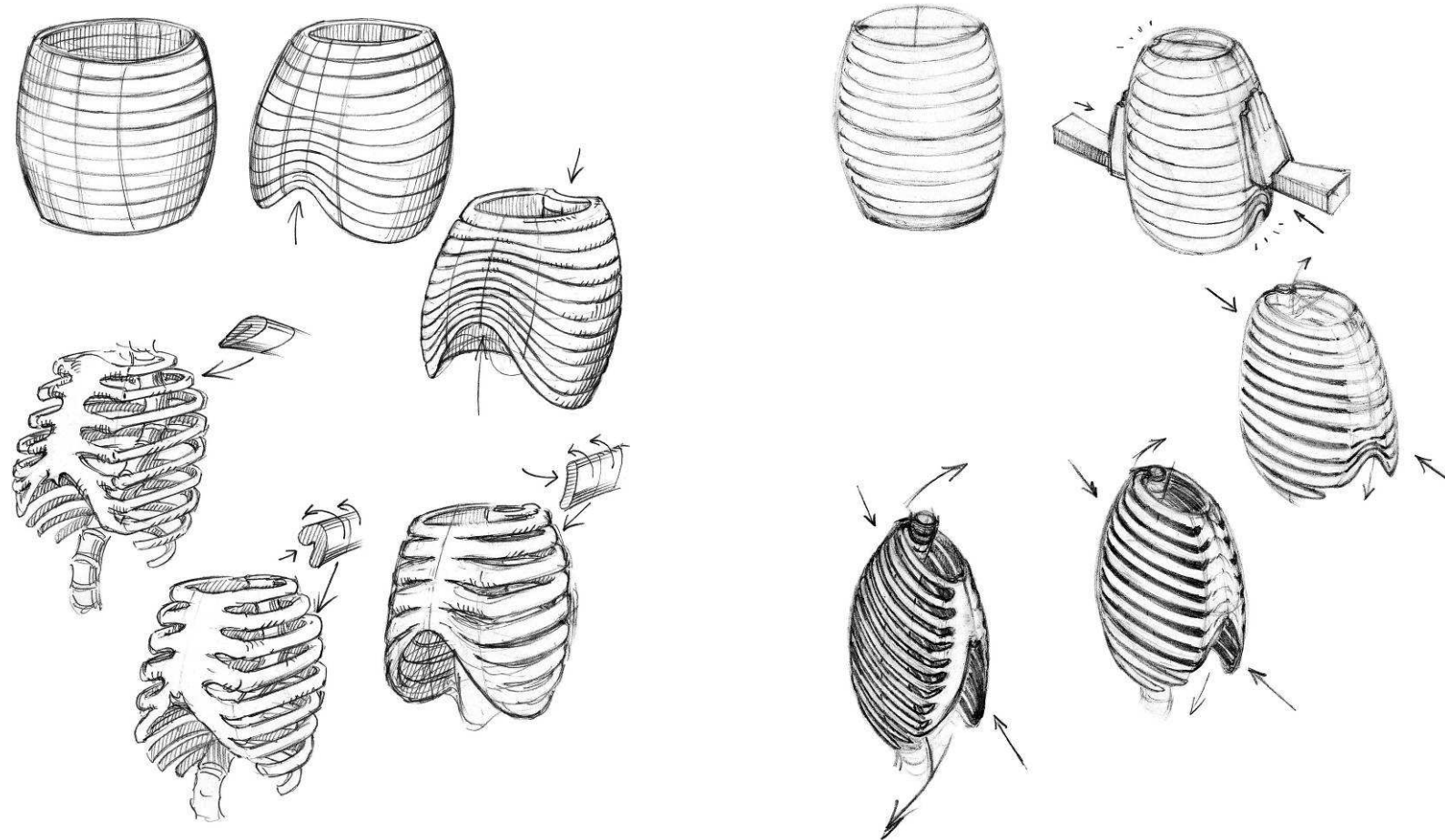
Patterning

Hides

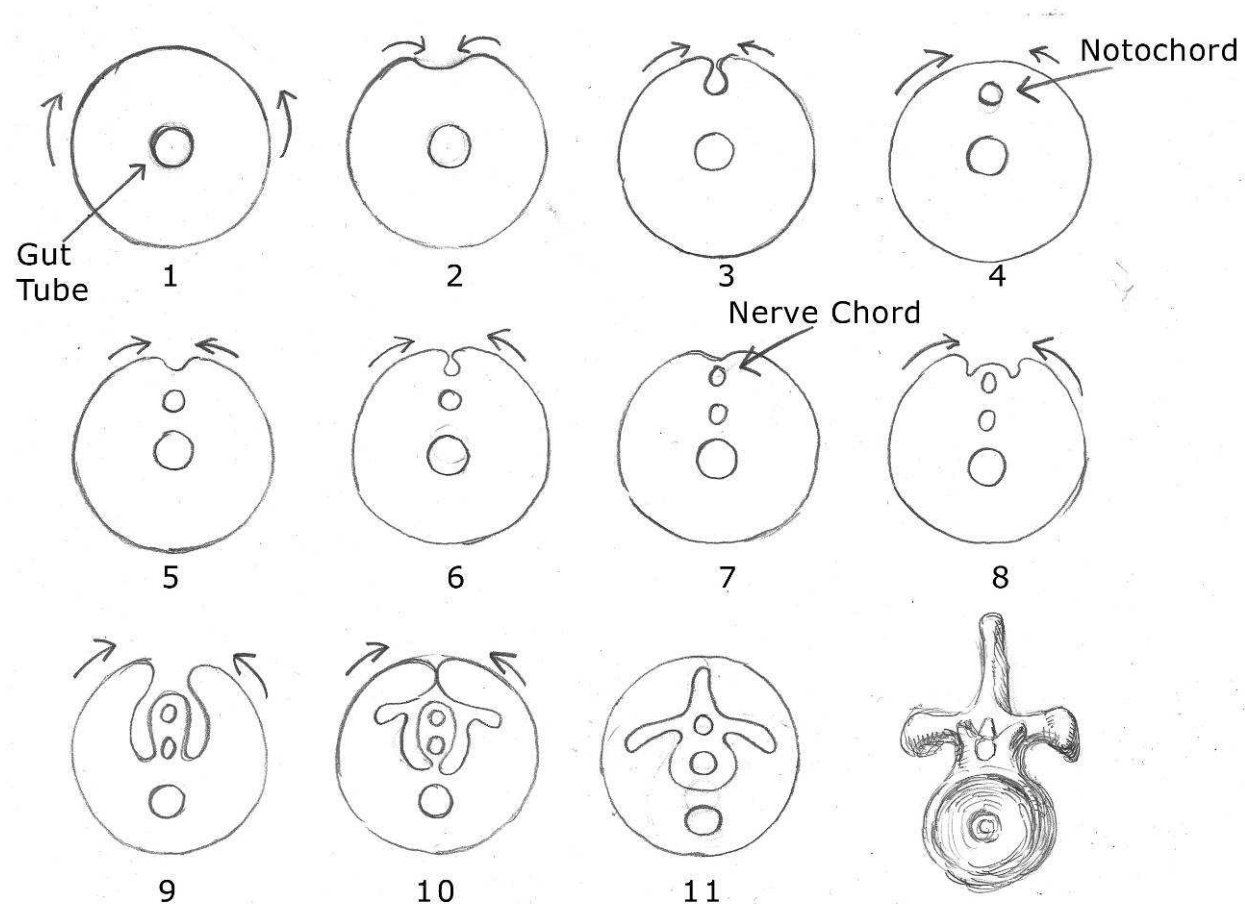
Scales



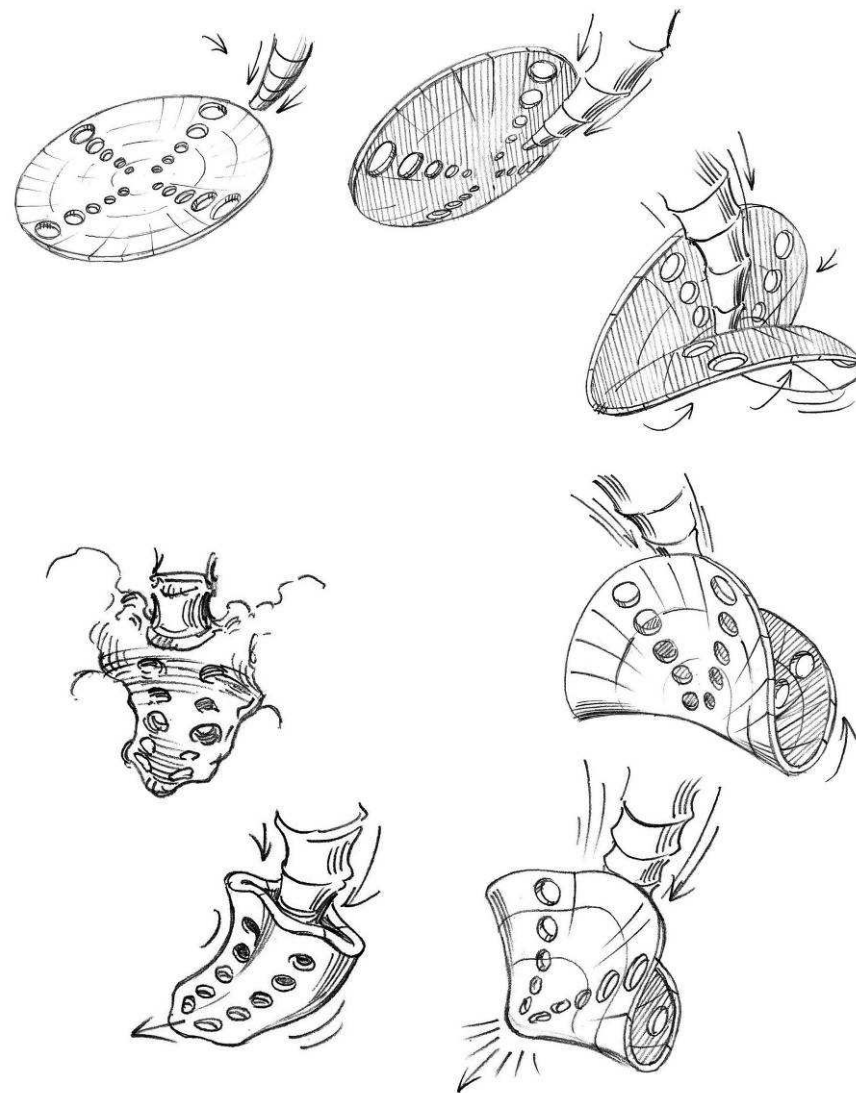
The Ribs and Sternum



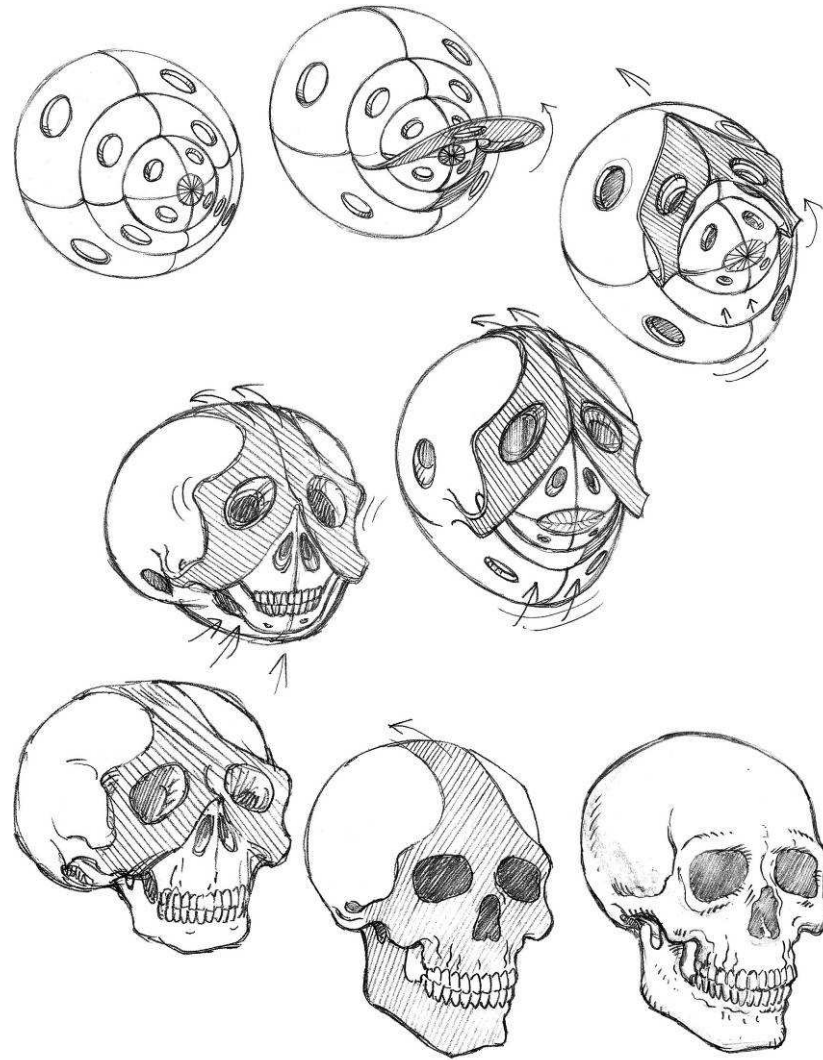
The Spinal Column



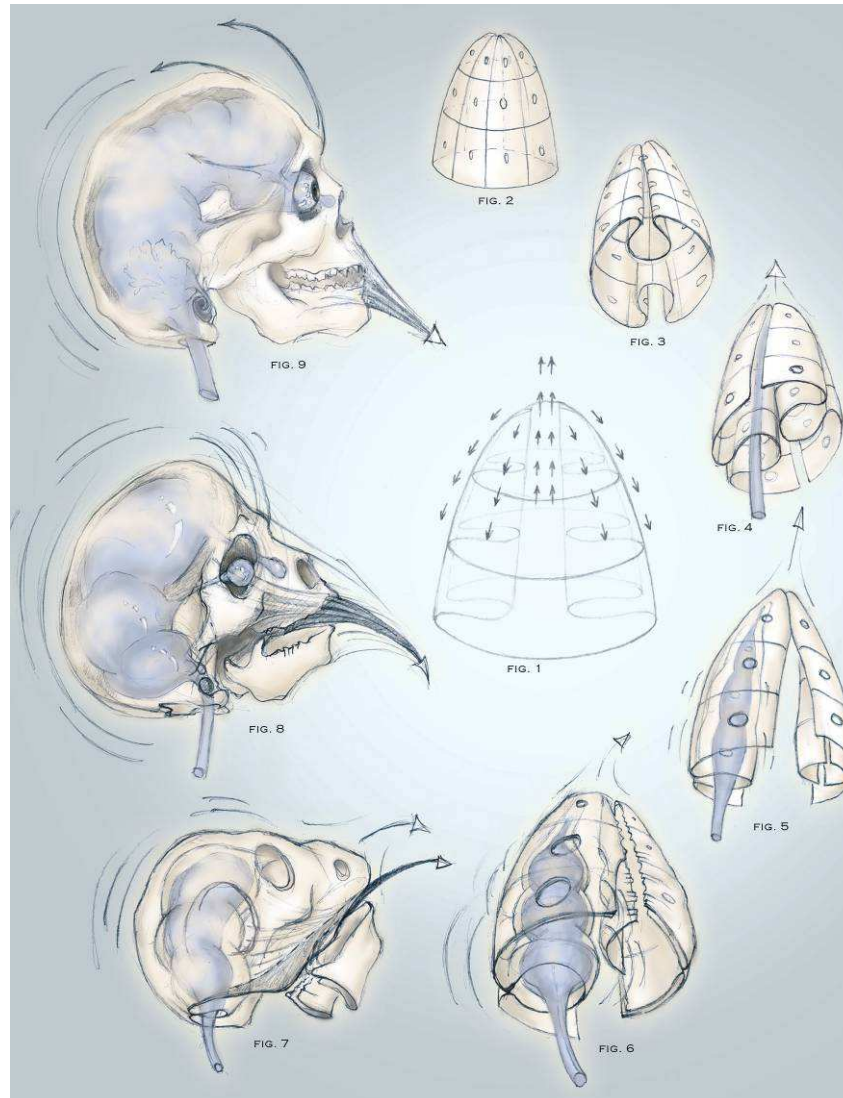
The Sacrum



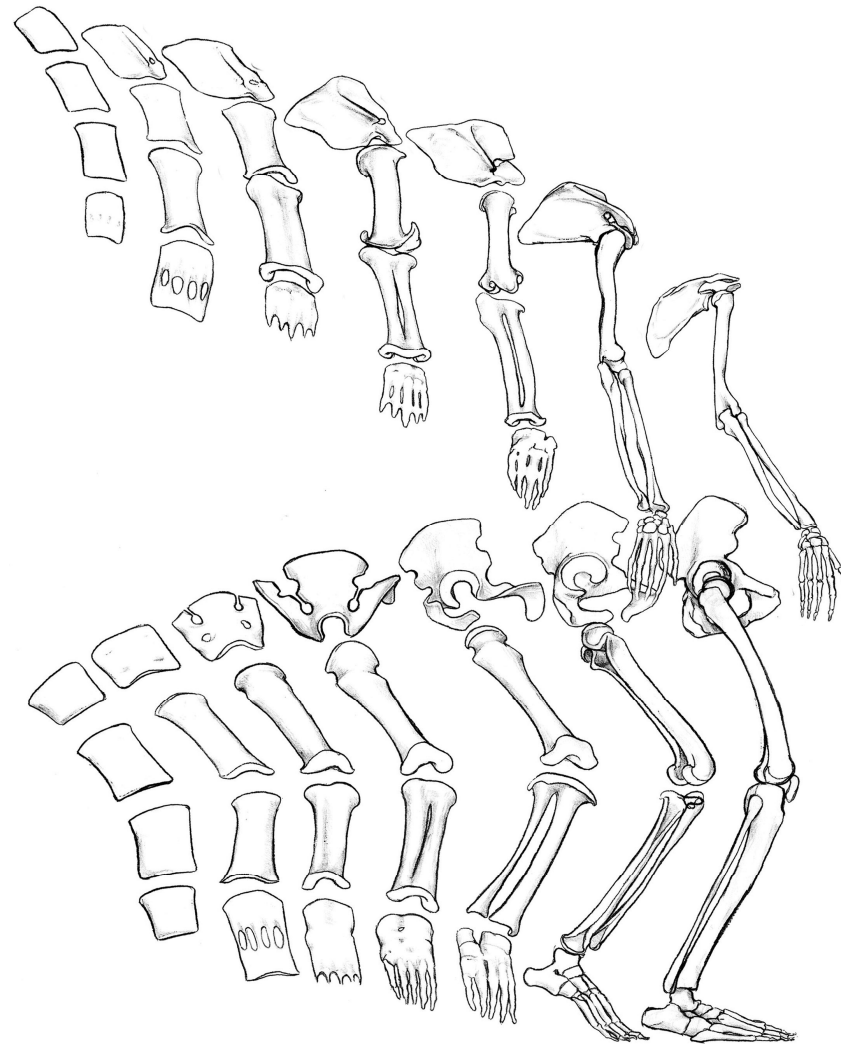
The Skull



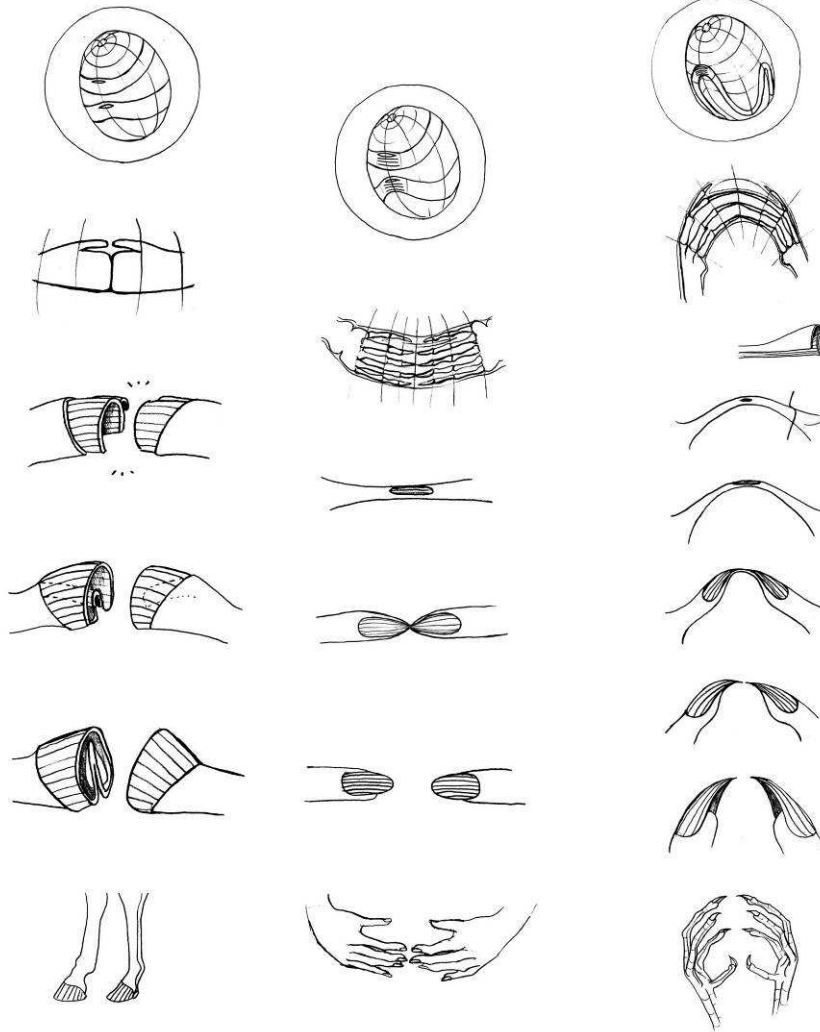
The Skull (cont'd)



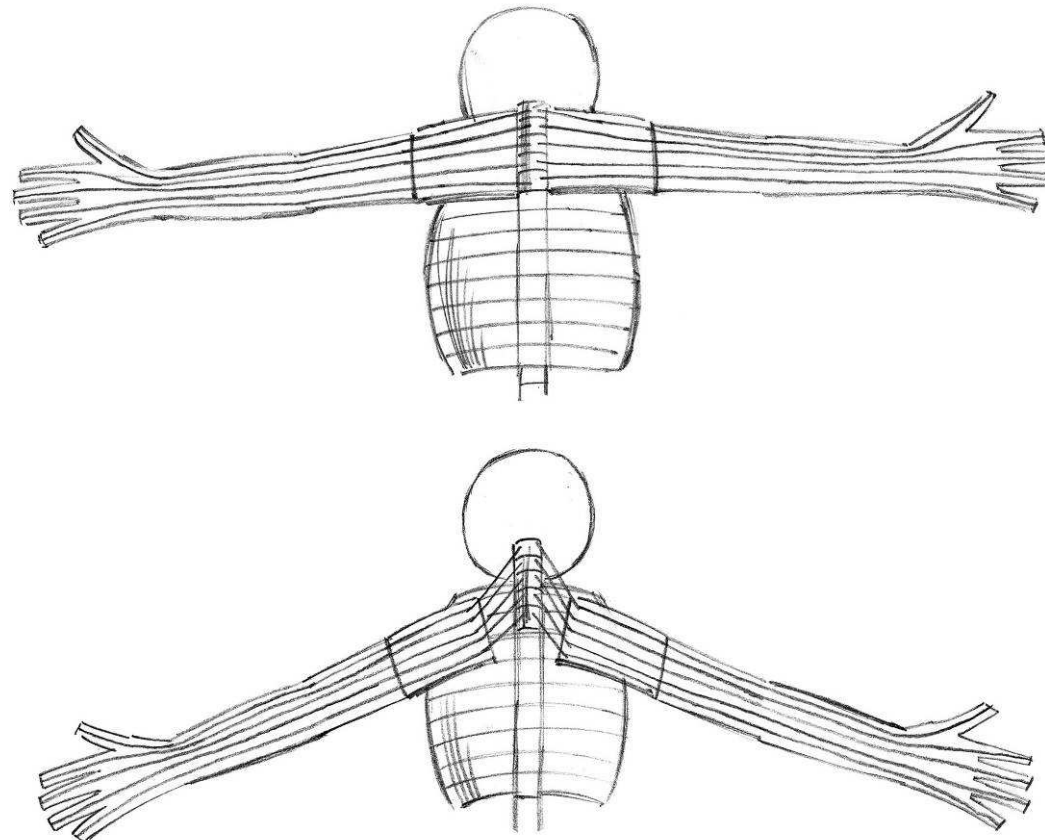
The Limbs



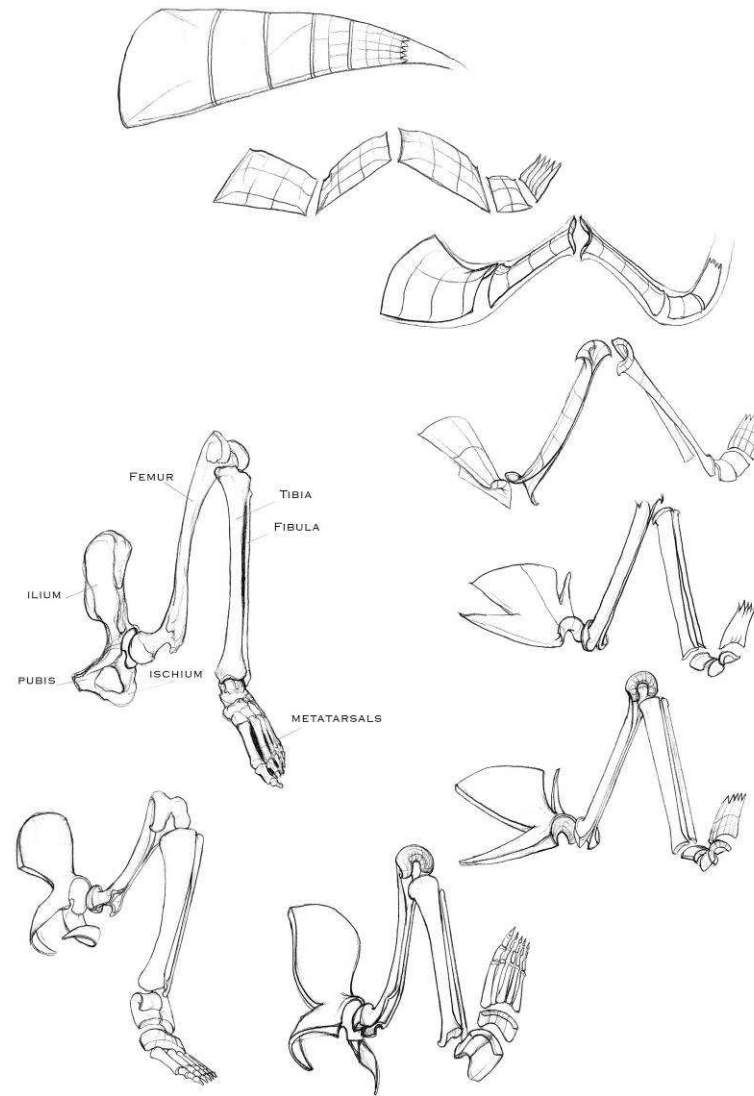
The Limbs (cont'd)



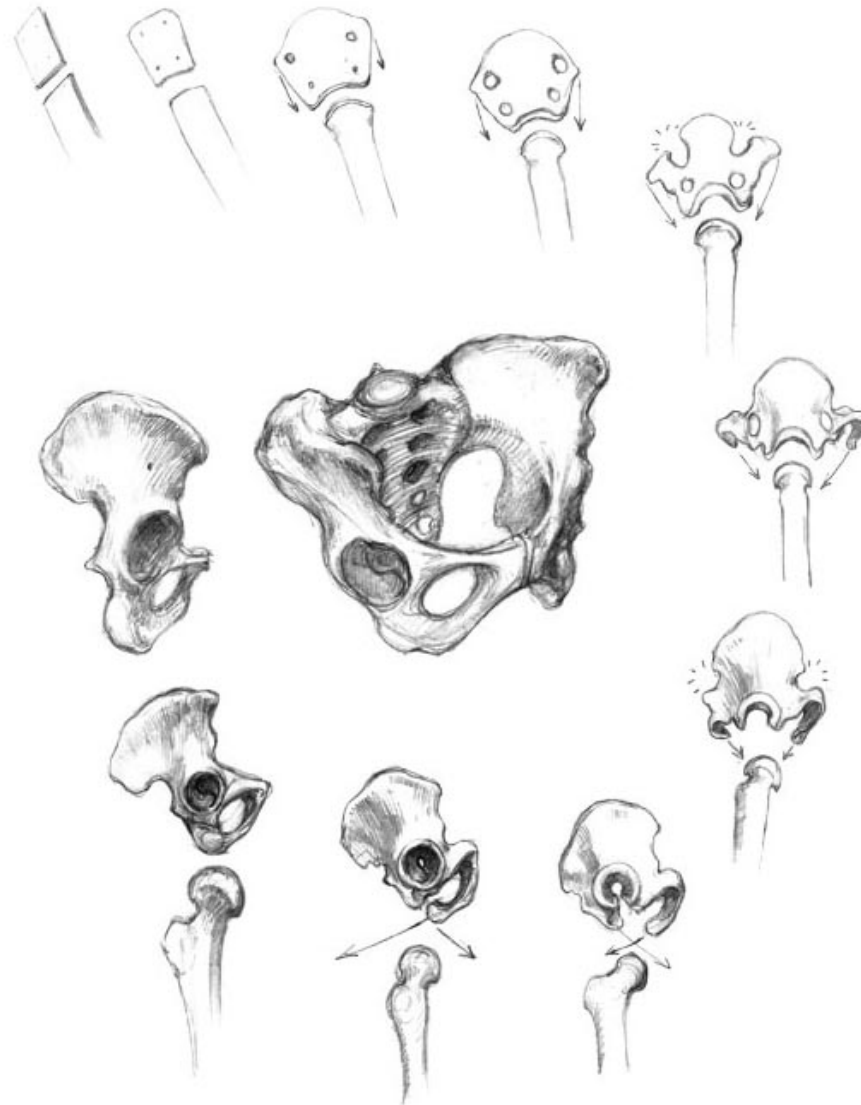
The Limbs (cont'd)



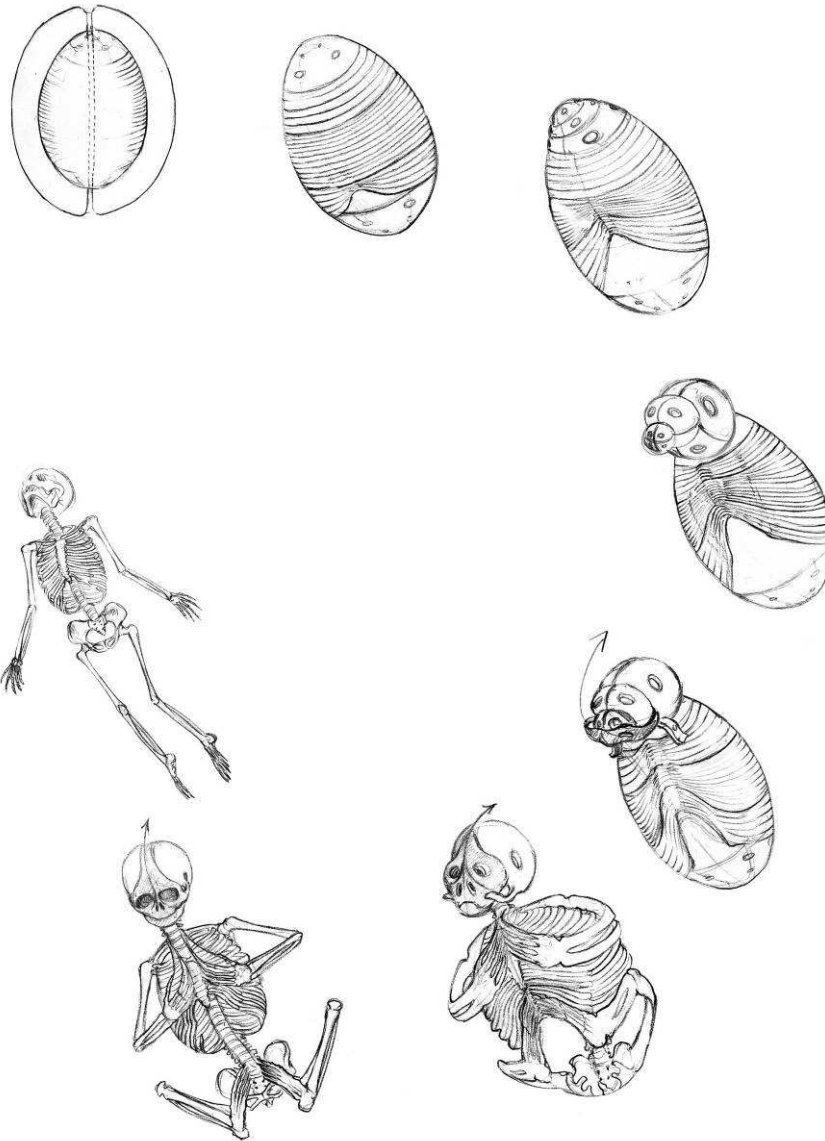
The Limbs (cont'd)



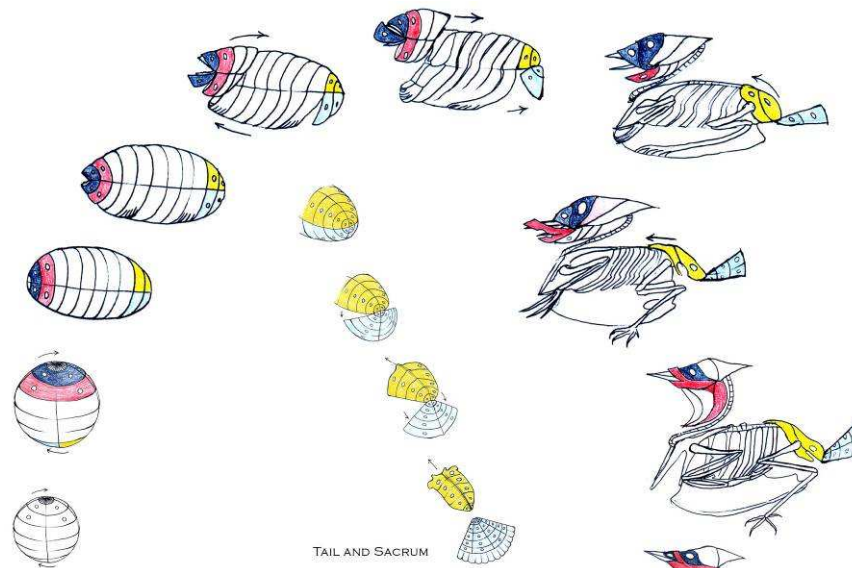
The Limbs (cont'd)



The Skeleton



The Skeleton (cont'd)



SEMPALMATE



LESSER FLAMINGO



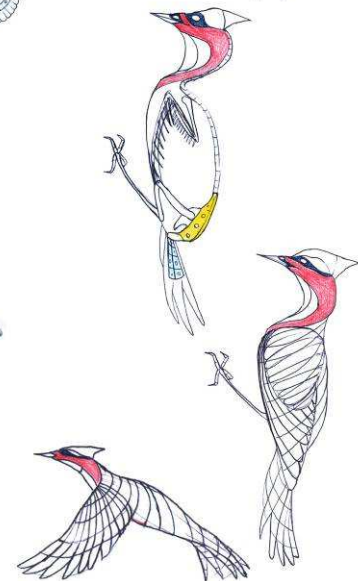
ROSEATE SPOONBILL



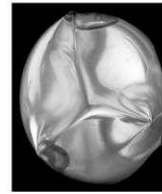
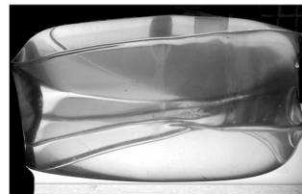
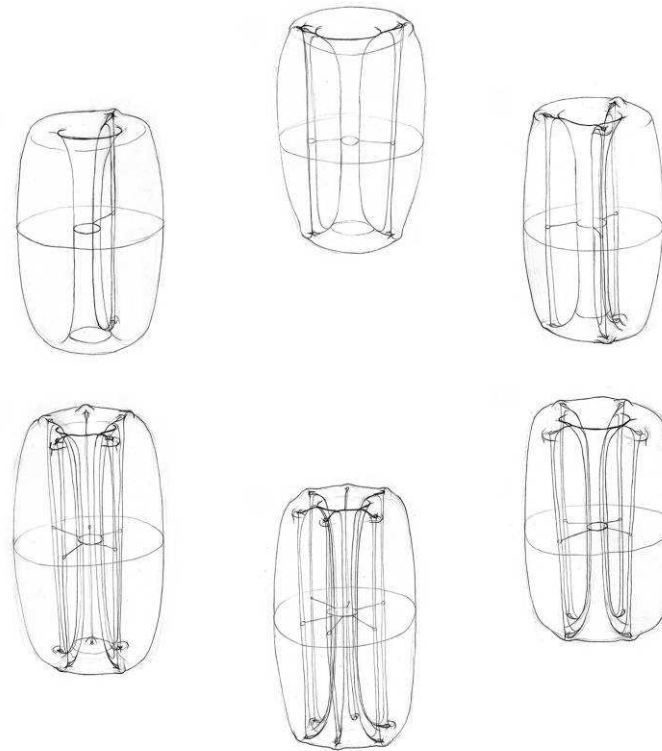
HORNED LARK



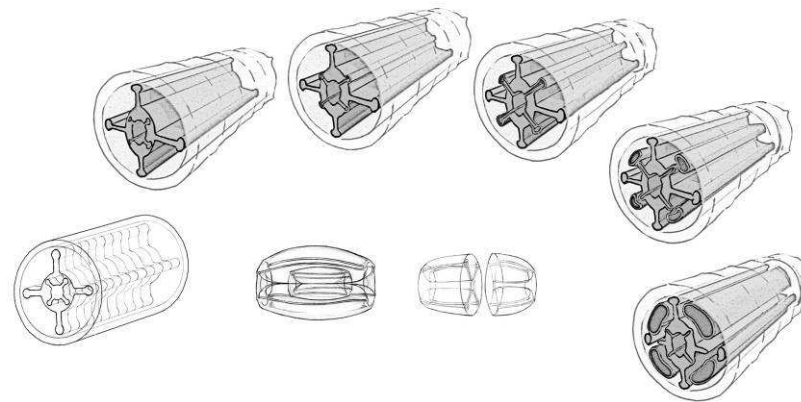
RUDDY TURNSTONE



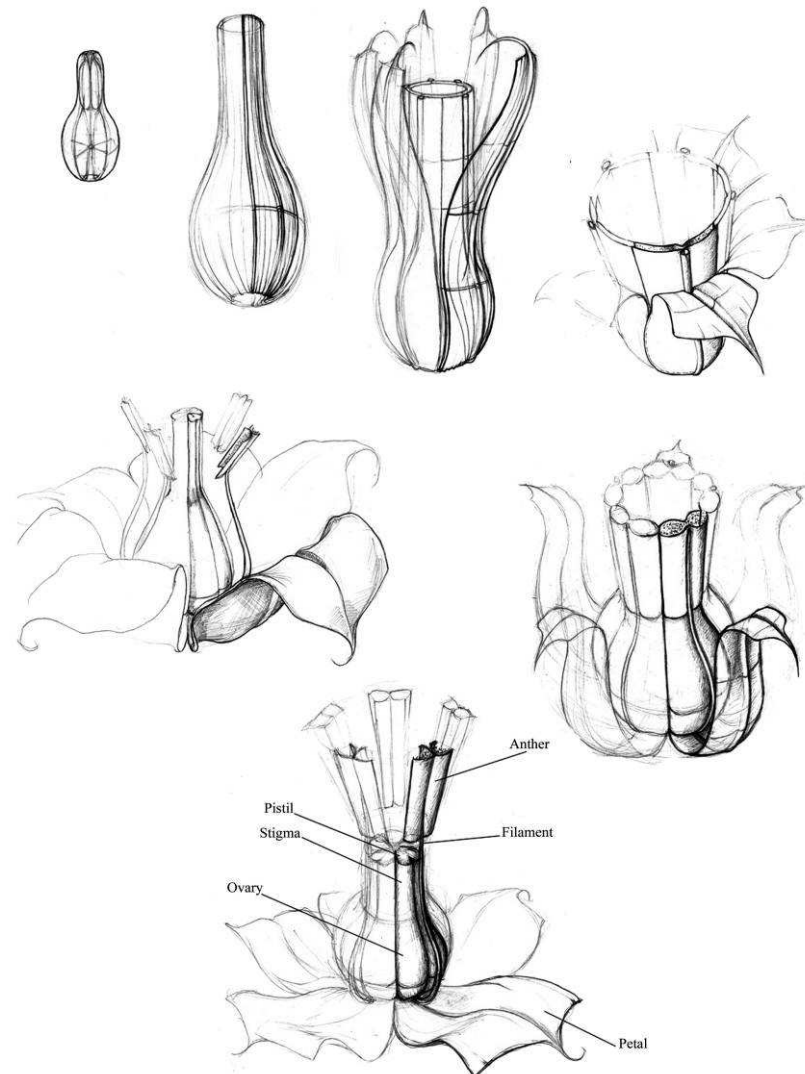
Flower and Fruit Toroidal Primordium



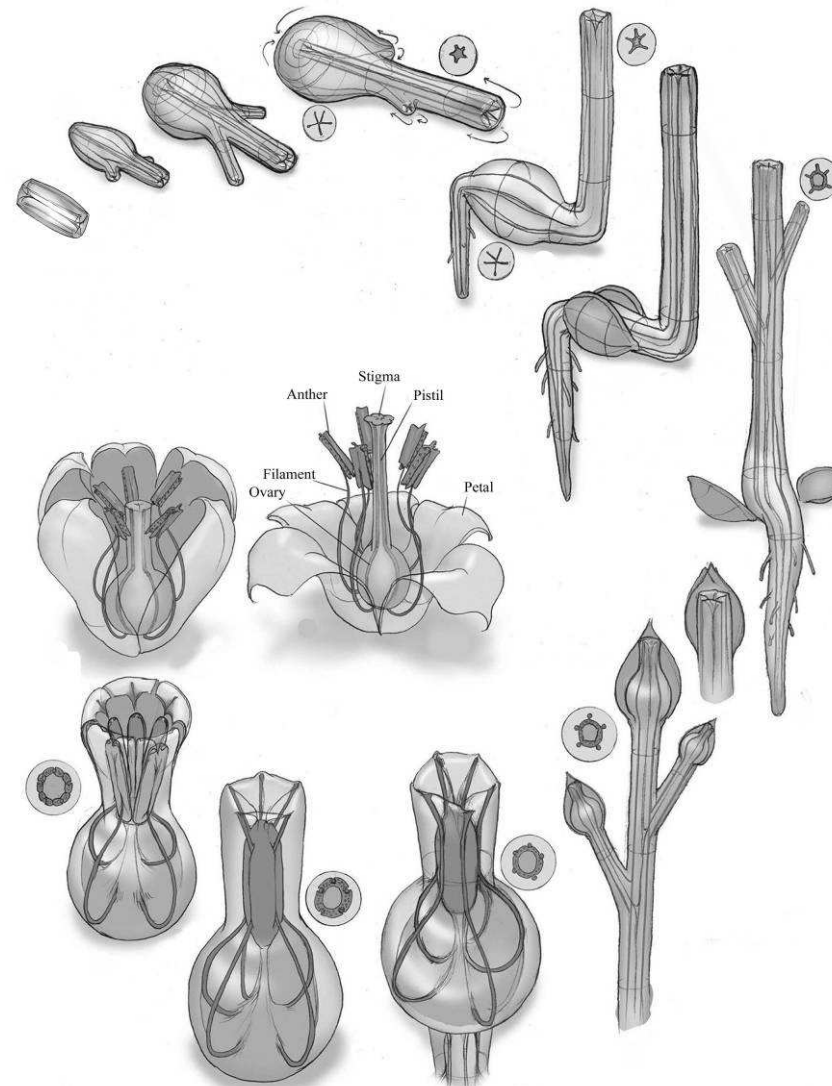
The Archetypal Fruit Form



The Archetypal Flower Form



The Archetypal Flower Form (cont'd)



Synthetic Life Lab



From left: Peter Sheesley, Kathy Hall Ph.D., Carole Syrota, Sammy Shin, Ryan Toth, Stephen Halker, Stuart Pivar, and Melissa Ludwig

For more information visit <http://www.syntheticlifelab.com/>

