**FIGURE 101.** Pectoral girdle of *Amia*, a primitive actinopterygian. Note supracleithrum and its connection to the posttemporal bone. This articulation joins the pectoral girdle to the rear of the skull and is the typical arrangement in fish. *(from Kardong).*
FIGURE 102. Appendicular skeleton of *Eustenopteron*, a crossopterygian from the late Devonian. Note supracleithrum and its connection to the posttemporal bone observed in actinopterygians remains apparent, joining the pectoral girdle to the rear of the skull. Also note the scapulocoracoid. It is small and serves to articulate the humerus thus it is both homologous and analogous to the scapulocoracoid in other fishes. (After Romer, Jarvik).
FIGURE 103. Appendicular skeleton of *Eryops*, a labyrinthodont (temnospondylid) amphibian from the Carboniferous. The supraleithrum has been lost, freeing the pectoral girdle from its connection to the rear of the skull. Note the increased size and prominence of the scapulocoracoid as it enlarges it will evolutionarily give rise to the prominent scapulae of later tetrapods. The cleithrum, clavicle and interclavicle have begun to shift ventrally to form the ventral yoke of the pectoral girdle. (After Romer, Jarvik).
FIGURE 104. Appendicular skeleton of *Ichthyostega*, an Devonian ichthyostegalian labyrinthodont amphibian. The number of digits carried on the forelimb is not known, but seven digits were present on the hindlimb. The supraleithrum and its connection to the posttemporal bone and skull are lost. A primitive tetrapod pectoral girdle consisting of scapulocoracoid, cleithrum, clavicle and interclavicle is well-developed. (after Jarvik).
A. Pectoral Girdle

B. Pelvic Girdle

FIGURE 105. Comparative functional morphology of appendicular girdles in tetrapods. A. The pectoral girdle is not attached directly to the vertebral column, thus the muscles of the pectoral girdle support the anterior part of the tetrapod body in a musculcular sling. The relative position of the limb determines the direction of force transfer in the body. In this example, the legs are positioned directly below the body. Most of the force is transmitted to the muscular sling. Force vectors driving the upper limbs together dorsally are reduced. B. The pelvic girdle is attached directly to the vertebral column via the sacrum. (from Kardong)
FIGURE 106. Changes in the role of the pectoral girdle with changes in limb posture.
A. Sprawled posture directs most of the force medially to the pectoral girdle. The medial elements of the pectoral girdle assume a major role in resisting this compressing force. Thus the interclavicle and coracoid are enlarged and strengthened to maintain the girdle.
B. As limbs are brought under the body, these forces are directly less toward the midline and more in a vertical direction: the lateral compressing force is thus transformed into a vertical force on the muscular pectoral sling. In evolutionary lines that have shifted limb posture there is a pronounced loss or reduction of medial pectoral elements and a corresponding increase in lateral elements such as the scapula. (from Kardong)
**Figure 107. Primitive gaits.** A. Locomotor stability. During the trot (left) diagonally opposite feet meet the ground together. The center of mass lies on or near the line connecting these two points of support. The same walking stance is stabilized (tripodal gait, right) by adding a third point of support. In this case the tail is pressed to the ground to form a triangular support around the center of mass. B. In the lateral-sequence gait the center of mass (open circle) never leaves the triangle of support established by a gait cycle of three of the four limbs. (from Kardong)
Figure 108. Role of limb rotation in terrestrial locomotion. A. Terrestrial but noncursorial salamanders achieve limb recovery by an overhand swing of the arm outside the parasagittal plane. B. Cursorial animals such as dinosaurs achieve limb recovery by a pendulum-like swing in the parasagittal plane. This keeps the limbs directly below the body to support body weight. The pendulum-like swing improves the ease, efficiency, and speed of limb recovery.
(from Kardong)
FIGURE 109. Changes in limb posture and terrestrial locomotion. A. The sprawled posture exhibited by a salamander was typical of fossil amphibians as well as of most reptiles. B. The posture exhibited by placental mammals appear in an early form in synapsid reptiles. Later reptile lineages carried the limbs under the body, dramatically increasing the efficiency of rapid terrestrial locomotion. Note the concomitant reduction in spinal flexure. (after Kardong)