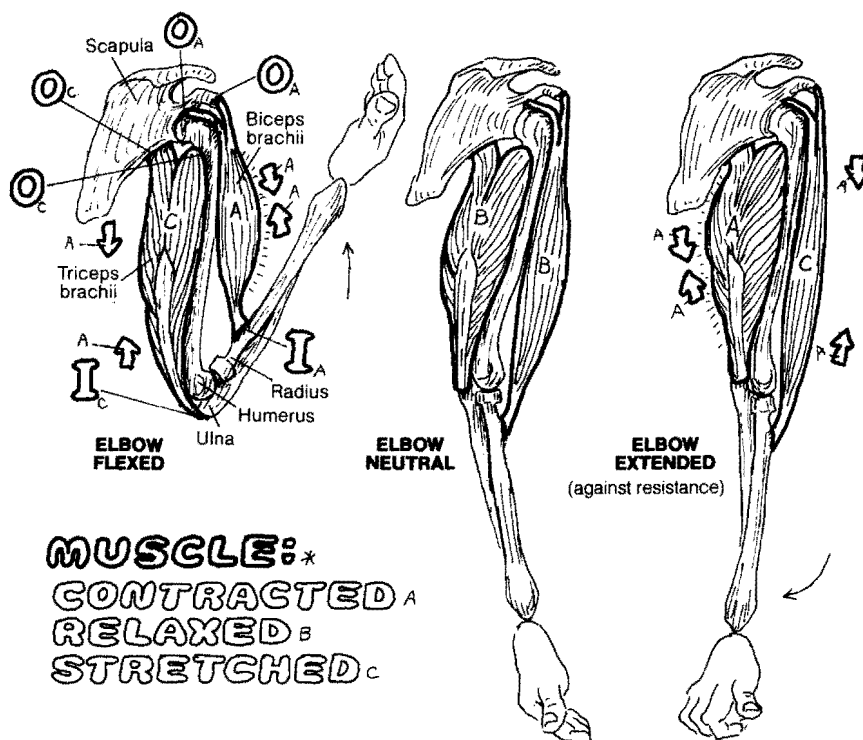


## INTEGRATION OF MUSCLE ACTION

CN: Use a bright color for A and a light one for E. (1) Color the small arrows and the large letters of origin (O) and insertion (I) adjacent to the examples of contracted and stretched muscles. (2) In the lower illustration, color the portions of pronator teres and pronator quadratus that are outlined by dotted lines. These parts of the muscles are normally concealed by the radius in this lateral view.

When a skeletal muscle shortens (contracts), a joint is moved, and two bones come closer together, isometric contraction excepted. Muscles never push; they always pull. In any given movement between two bones, one bone is generally fixed, and the other moves. The muscle attachment at the fixed bone is the *origin*; the attachment at the moving bone is the *insertion*. In complex movements where it is difficult to identify a "fixed" bone, the origin of the muscle is the more proximal attachment.

When a muscle contracts across a joint, other muscles crossing that joint are affected. No one muscle acts alone in joint movement. In flexion of the elbow joint, for example, biceps brachii (and brachialis, not shown) *contract*, while triceps brachii is *stretched*. Conversely, in elbow extension, triceps is contracted, and the biceps/brachialis muscles are stretched. In neutral, all three are *relaxed* (at rest). Tense (contracted) muscles can often be relaxed by gentle stretching.



## ACTORS IN ELBOW FLEXION WITH SUPINATION vs. PRONATION \*

No muscle acts alone in the movement of a joint. In the movements shown at right, various muscles are functionally integrated in the simple act of lifting an object, with the forearm supinated in the first case, and pronated in the second case.

### PRIME MOVER (AGONIST) A'

The primary muscle effecting a desired joint movement is called the *prime mover* (agonist). There may be more than one; in elbow flexion with the forearm supinated, brachialis and biceps brachii are both prime movers; biceps adds significantly to the lifting power because of the added work in supinating the radius during elbow flexion. With the forearm pronated and supination resisted, the biceps loses that supinating power, and brachialis, unaffected by a pronated forearm, becomes the prime mover.

### ANTAGONIST C'

Muscles which potentially or actually oppose or resist a certain movement are called *antagonists*. In the lower illustrations, triceps is the antagonist in the act of elbow flexion, even though it is being stretched and is not contracted in the case illustrated.

### FIXATOR D

*Fixator* muscles stabilize the more proximal joints during weightbearing functions of the more distal joints. Here the trapezius muscle contracts to stabilize (immobilize) the scapula, creating a rigid platform (the scapula) for operation of the weightbearing, ipsilateral limb.

### NEUTRALIZER (SYNERGIST) E

In undertaking a desired and specific movement, undesired movements are resisted by *neutralizers* (*synergists*). During flexion of the elbow with a pronated forearm, pronators of the forearm (pronator quadratus, pronator teres) contract to resist or neutralize supination of the forearm. In this action, the pronators are synergistic with the desired movement.

Globally integrated and harmonious muscle functioning makes possible painless, rhythmic, and dynamic movements, best revealed in such activities as dance, sports, and exercise. Joints affected by tense or weak interacting muscles, induced by mechanically disadvantaged posture/gait, can be subject to painful and limited movements.

