



## **Body 2: Muscles**

# **Basics About Skeletal Muscle**

Skeletal muscles are composed of muscle cells, connective tissue, blood vessels and the nerves, which activate muscle fibres.

Muscle cells (fibres) can be as long as the length of the muscle and are about the diameter of a human hair. Each cell contains hundreds of myofibrils (contractile units) made up of the proteins actin and myosin. The cytoplasm of the muscle cell (sarcooplasm) is where glycogen, fat particles, metabolic enzymes and mitochondria are found.

The sarcomere is the smallest contractile unit of the myofibril. This is where actin and myosin protein filaments are organized parallel to each other. When a muscle is activated, actin and myosin slide past each other due to the action of cross bridges between them (like small cords, pulling one strand of protein to the other). This is the sliding filament theory of muscle action.

In order to work, muscle fibres must be activated by a motor neuron (nerve).

The motor neuron and the muscle fibres it activates are referred to as a motor unit.

Activation of a motor unit is referred to as a twitch.

Motor units have different twitch times and metabolic capabilities which have led to the following classifications:

- Slow twitch (type 1): develop force more slowly; highly oxidative, endurance fibres; low power
- Fast twitch (type 2): develop force quickly; low oxidative anaerobic, high-power fibres

Muscle is a contractile tissue capable of working (producing tension) while:

- Shortening (isotonic concentric muscle action)
  - Lengthening (isotonic eccentric muscle action)
  - Holding a fixed length (isometric muscle action).



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### **Aquafitness and Skeletal Muscle**

Muscle actions performed against the resistance of water (not using propulsion against gravity or buoyant devices) are isotonic concentric muscle actions.

The landing phase of a chest deep, propulsive movement involves isotonic eccentric muscle action. The muscles (especially gastrocnemius and soleus) lengthen while working, as the participant lands on the pool bottom.

Eccentric muscle action is most likely to produce delayed onset muscle soreness (DOMS). This is especially evident in land based weight workouts that emphasize the lowering phase of the weighted movement.

Since very little eccentric muscle work is done in a basic aquafitness class, even poorly conditioned participants are unlikely to experience substantial DOMS during the 24 to 48 hours following class. "Aquafitness is 'all gain, no pain!'"