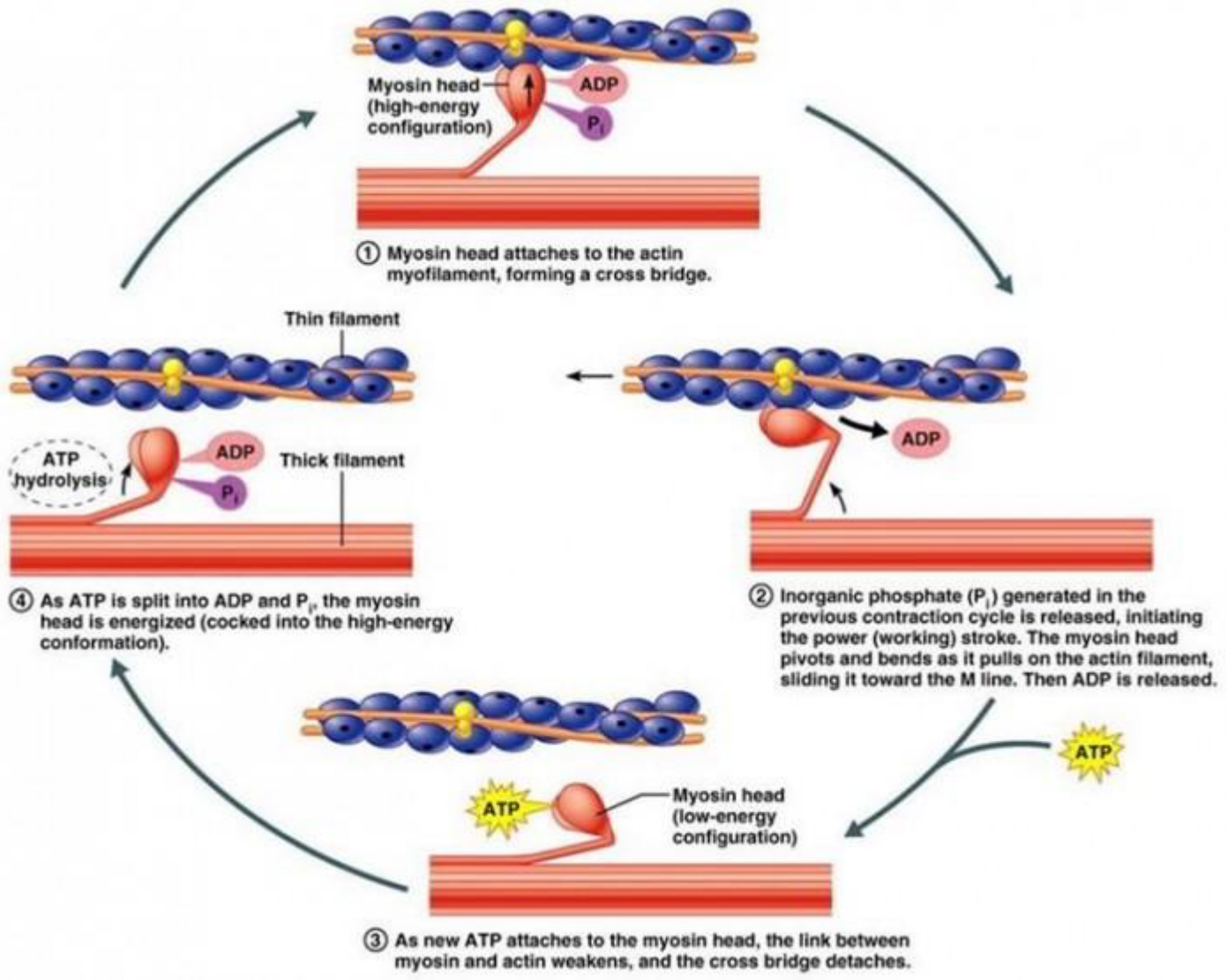
The Physiology of Skeletal Muscle Contraction

Sliding filament theory: The *sliding filament theory* explains the finding that sarcomeres shorten but the filaments remain the same length when skeletal muscle contracts. The thin actin filaments slide past the thick myosin filaments, increasing the overlap of the filaments when contraction takes place. The movement of filaments occurs as chemical cross-bridges are formed and broken, moving the actin filaments towards the centre of the sarcomere during contraction. As the sarcomeres shorten, so does the skeletal muscle involved. When the muscle relaxes the cross-bridges break, the filaments slide apart and the sarcomeres return to their original length. A muscle consists of a large number of muscle fibres. In addition to the sarcolemma mentioned previously, each fibre is enclosed in and attached to fine fibrous connective tissue called *endomysium*. Small bundles of fibres are enclosed in *perimysium*, and the whole muscle in *epimysium*. The fibrous tissue enclosing the fibres, the bundles and the whole muscle extends beyond the muscle fibres to become the *tendon*, which attaches the muscle to bone or skin.



In summary the sliding filament theory of muscle contraction can be broken down into four distinct stages, these are:-

1. Muscle activation: The motor nerve stimulates an action potential (impulse) to pass down a neuron to the neuromuscular junction. This stimulates the sarcoplasmic reticulum to release calcium into the muscle cell.

2. Muscle contraction: Calcium floods into the muscle cell binding with troponin allowing actin and myosin to bind. The actin and myosin cross bridges bind and contract using ATP as energy (ATP is an energy compound that all cells use to fuel their activity – this is discussed in greater detail in the energy system folder here at ptdirect).

3. Recharging: ATP is re-synthesised (re-manufactured) allowing actin and myosin to maintain their strong binding state

4. Relaxation: Relaxation occurs when stimulation of the nerve stops. Calcium is then pumped back into the sarcoplasmic reticulum breaking the link between actin and myosin. Actin and myosin return to their unbound state causing the muscle to relax. Alternatively relaxation (failure) will also occur when ATP is no longer available.