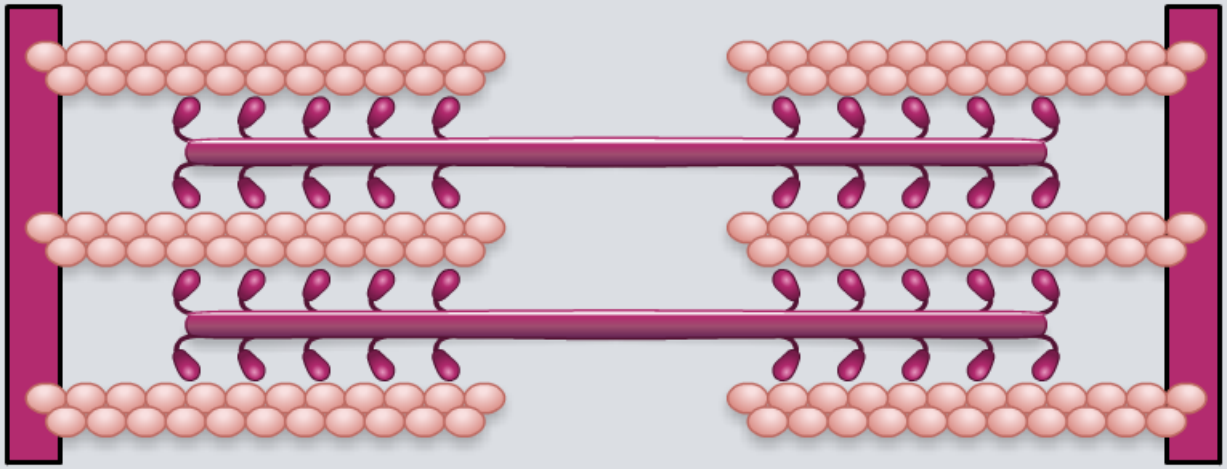
Sliding Filament Theory

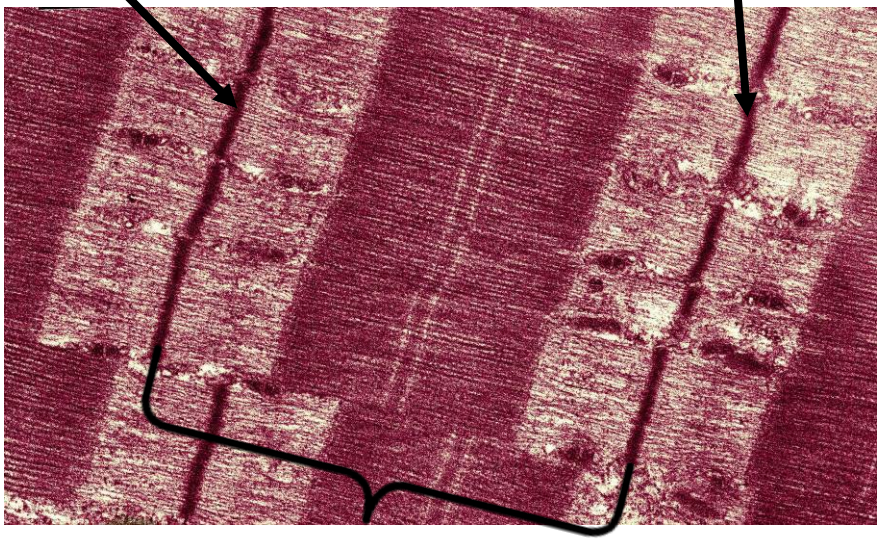


The structure of skeletal muscle

Observing myofibrils

In the 1950s, two independent research groups were studying muscle function.

The first, led by Professor Jean Hanson, studied **myofibrils**. She observed that some of the myofibril bands change length as the muscle contracts.



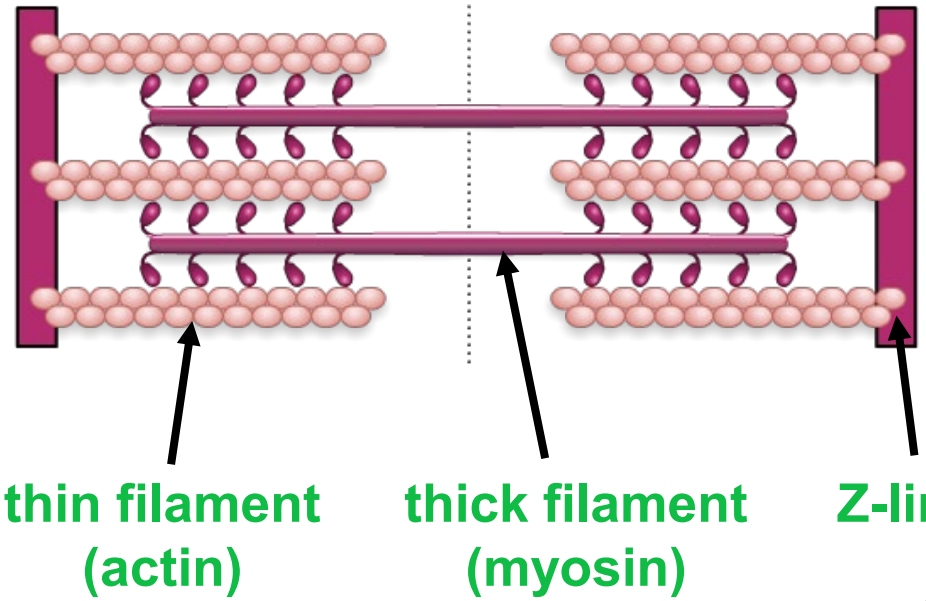
Contraction of the **sarcomere**, a region of myofibril that lies between two **Z-lines**, causes muscle contraction. The sarcomeres contract by reducing the size of the lighter bands found at either end of the sarcomere.

The sarcomere

The second group, led by Professor Hugh Huxley, used X-rays to investigate the structure of myofibrils.

Huxley found that myofibrils contained two different types of filaments: thin filaments made predominantly of **actin**, and thick filaments made of **myosin**.

These filaments are arranged in an interlocking pattern within the sarcomere, producing the characteristic banding pattern of the myofibrils.



The structure of the sarcomere

Understanding the sarcomere's bands

The sarcomere – structure to function

Hansen and Huxley realized that the interlocking structure of the thick and thin filaments allows them to slide past one another. This reduces the length of the sarcomere.

At the same time the banding pattern of the sarcomere changes; light bands, formed by actin, shrink as the filaments become more interlocked.

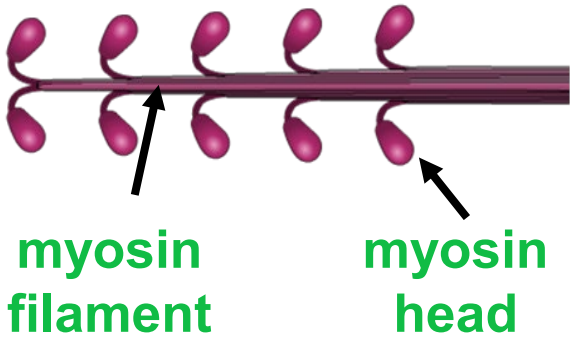
In 1954 Hansen and Huxley published their work explaining muscle contraction using their **sliding filament theory**.

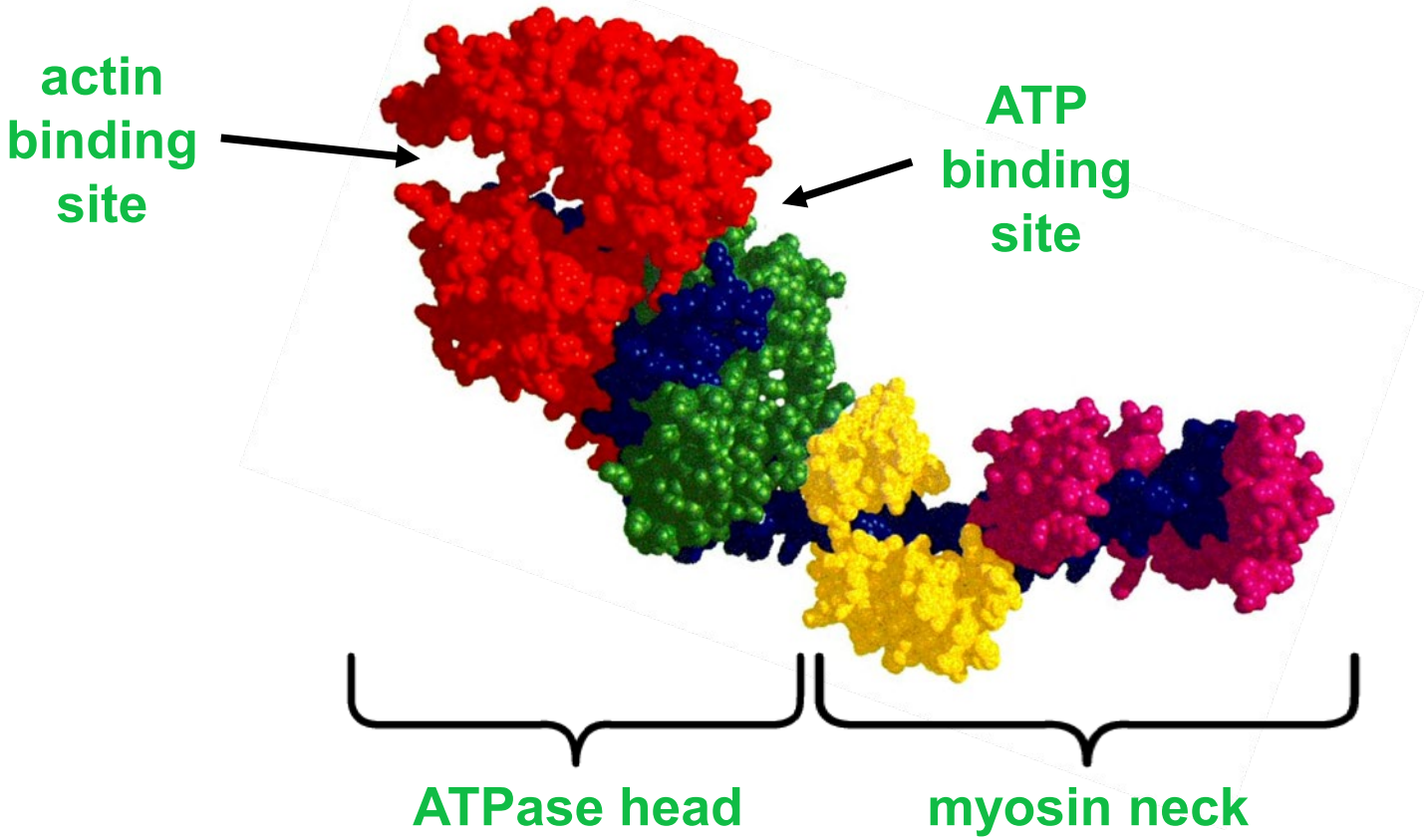
The sliding filament theory

How does the sarcomere change?

The structure of myosin

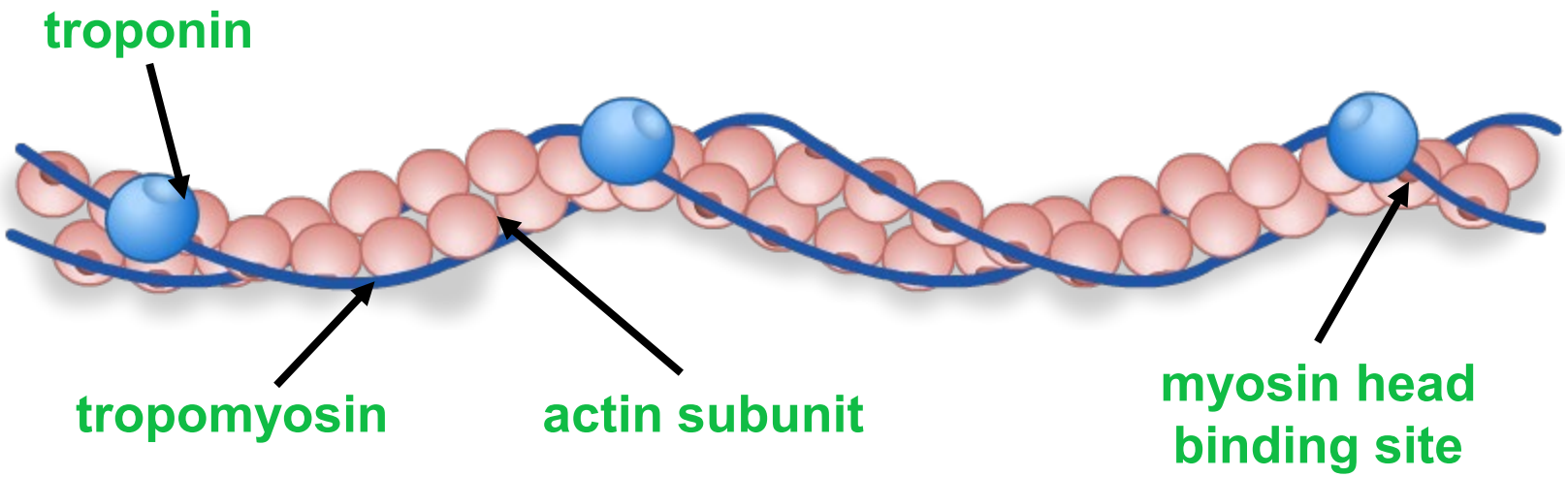
The myosin filament is formed from a number of myosin proteins wound together. Each ends in a myosin head, which contains an **ATPase**.





The structure of actin

The actin filament is formed from a helix of actin subunits. Each contains a binding site for the myosin heads.



Two other proteins are attached to the actin fiber:

- **tropomyosin** is wound around the actin
- **troponin** molecules are bound to tropomyosin and contain calcium ion binding sites.

What controls the sliding filaments?

Summary – muscle contraction