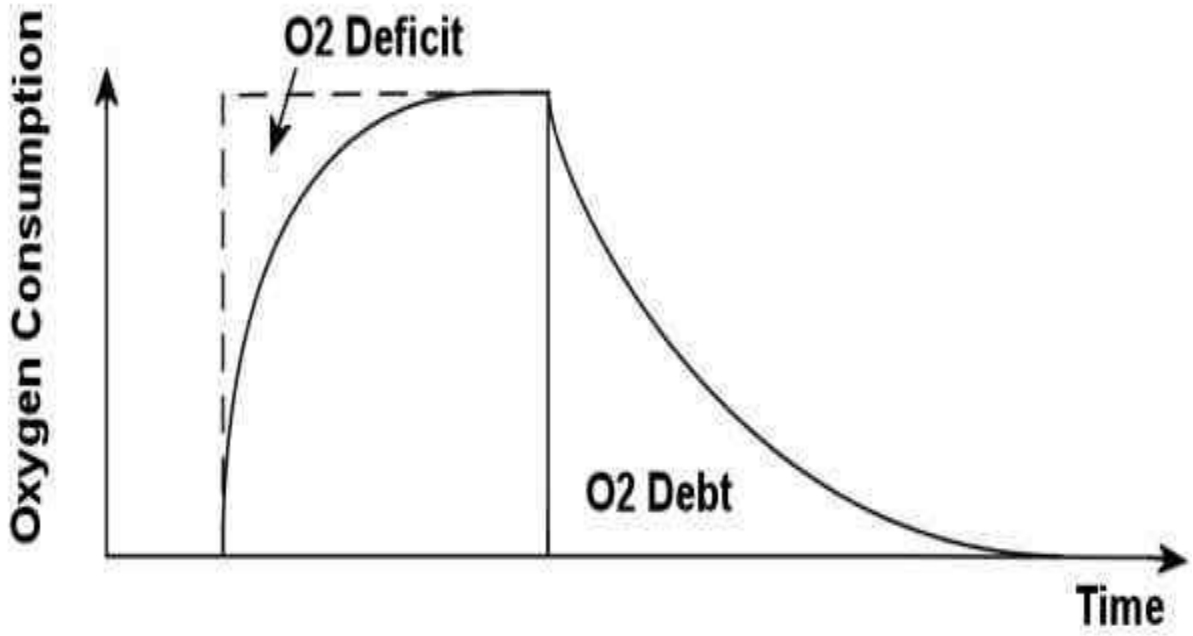
Oxygen Debt



- During muscular exercise, blood vessels in muscles dilate and blood flow is increased in order to increase the available oxygen supply.

- when muscular exercise is very great, oxygen cannot be supplied to muscle fibers fast enough, and the aerobic breakdown of pyruvic acid cannot produce all the ATP required for further muscle contraction.

- During such periods, additional ATP is generated by anaerobic glycolysis. In the process, most of the pyruvic acid produced is converted to **lactic acid.**

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- <u>After exercise has stopped, extra oxygen is required to</u>

1- metabolize lactic acid

2- to replenish ATP, phosphocreatine, and glycogen

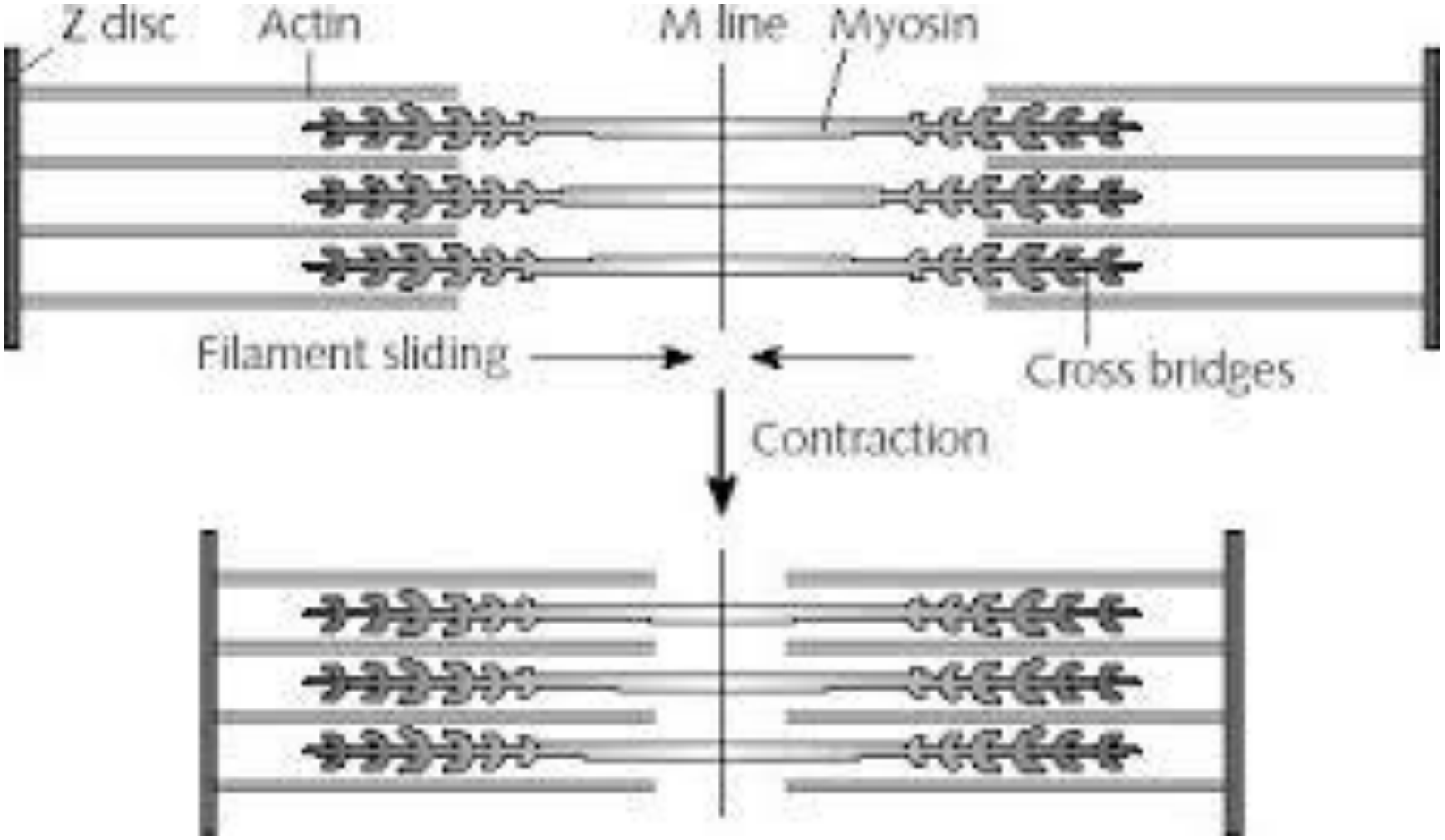
3-to pay back any oxygen that has been borrowed from hemoglobin, myoglobin .

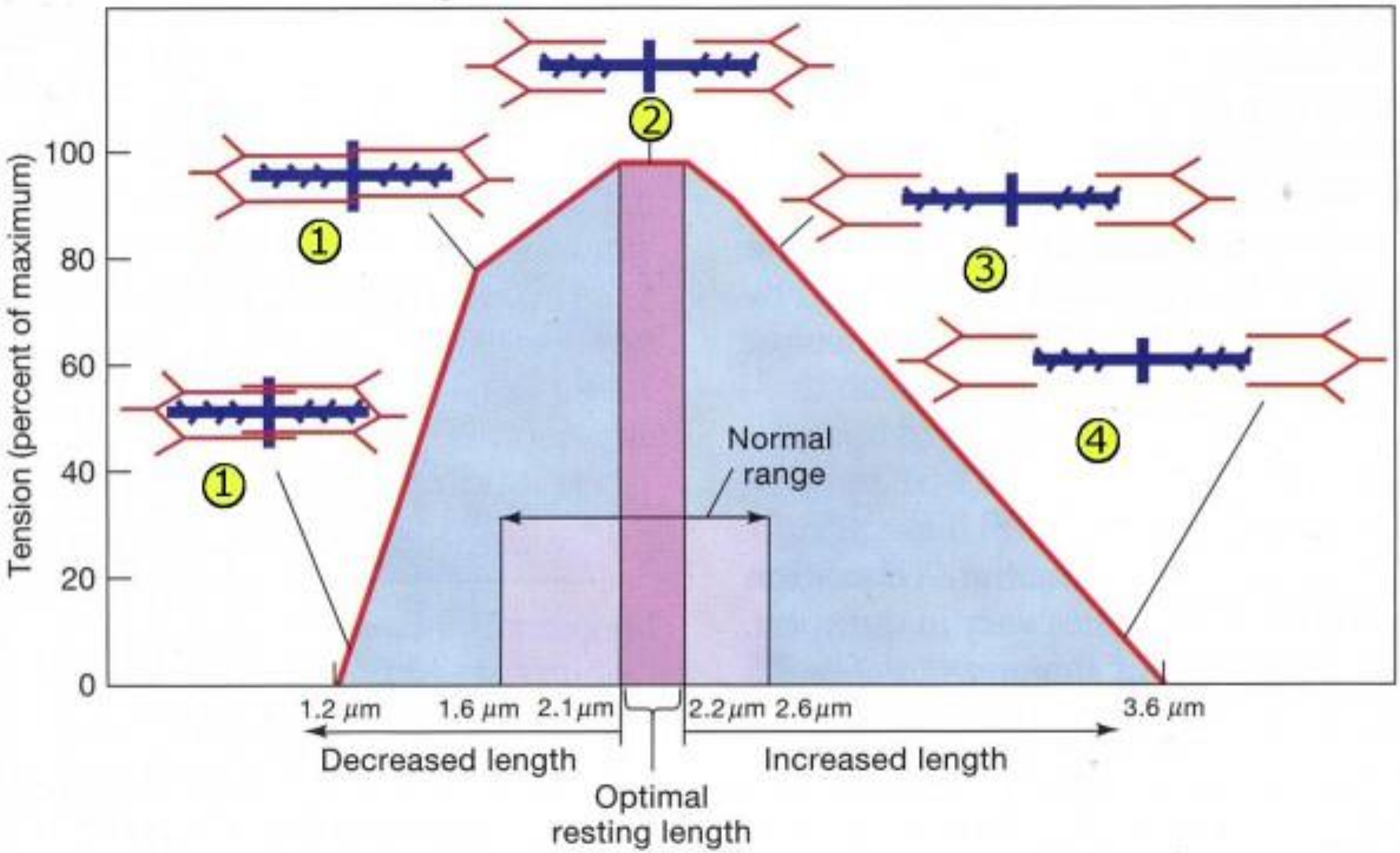
The additional oxygen that must be taken into the body after exercise to restore all systems to their normal states is called **oxygen debt**

Length-tension relationship

The relation ship between initial length of muscle fiber and active tension produced during contraction.

Active Tension in muscles is composed of the forces generated by many cross-bridge formations. It is the pulling of the actins by myosin heads towards each other that exerts this tension. muscle fibers are composed of many sarcomere units. Maximal tension is readily produced in the body as the central nervous system maintains resting muscle length near the optimum. It does so by maintaining a muscle tone. The myofilaments are also elastic. They maintain enough overlap for muscular contraction.

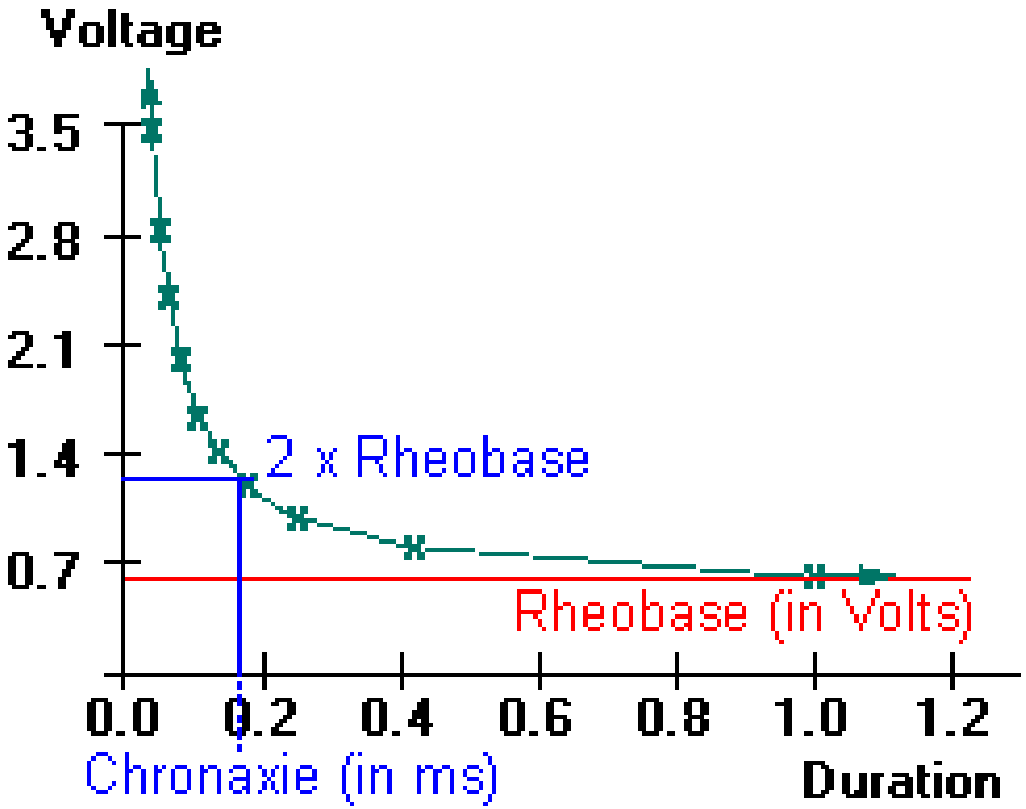

Z disc
Actin
M line
Myosin
Filament sliding
Cross bridges
Contraction


Tension (percent of maximum)
100
80
60
40
20
0
1
2
3
4
1
Normal range
1.2 μm
1.6 μm
2.1 μm
2.2 μm
2.6 μm
3.6 μm
Decreased length
Increased length
Optimal resting length

- **At 1** the sarcomere is **overly contracted** at rest. There is a high degree of overlap between the thin and thick filaments. Muscle contraction causes actin filaments to slide over one another and the ends of myosin filaments.
- **At 2** Maximum tension is produced when sarcomeres are about 2.1 to 2.2 µm long,. This is the **optimal resting length** for producing the maximal tension.
- **At 3**, By increasing the muscle length beyond the optimum, the actin filaments become **pulled away** from the myosin filaments and from each other. At there is little interaction between the filaments. Very few cross-bridges can form. Less tension is produced.
- **At 4** When the filaments are pulled too far from one another, they no longer interact and cross-bridges fail to form. **No tension results.**

Strength duration curve

relationship between the strength of stimulus and time needed for production response



1- **Rheobase:** The minimal stimulus applied for muscle or nerve for certain time to produce response.

2-Utilizing time -

Time needed by rheobase to produce response

3-Chronaxie

Time needed by 2 rheobase to give response

Physiological significance

1 -measurement of tissue excitability

2- compare between excitability among various tissue