PHYSIOLOGY OF MUSCLE CONTRACTION AND MOVEMENT(PART 3)

By

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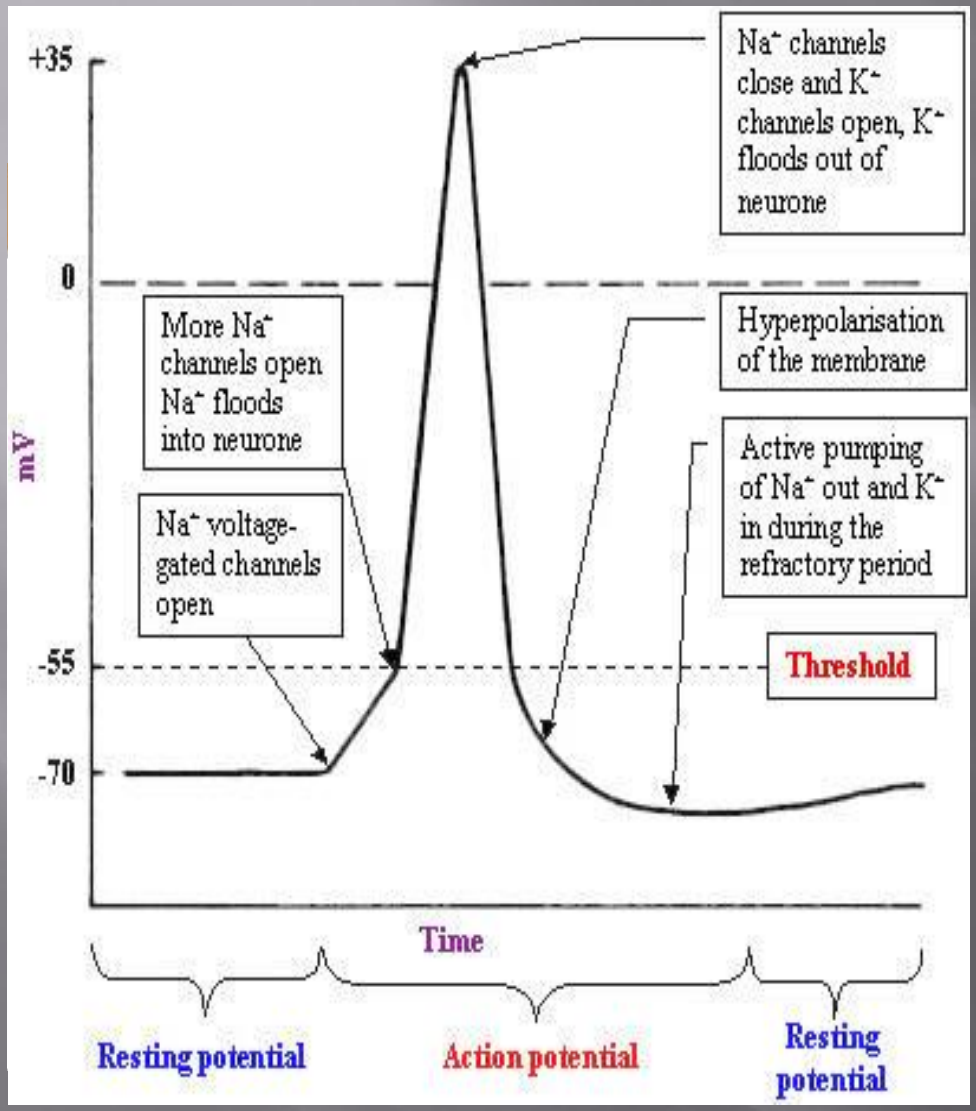
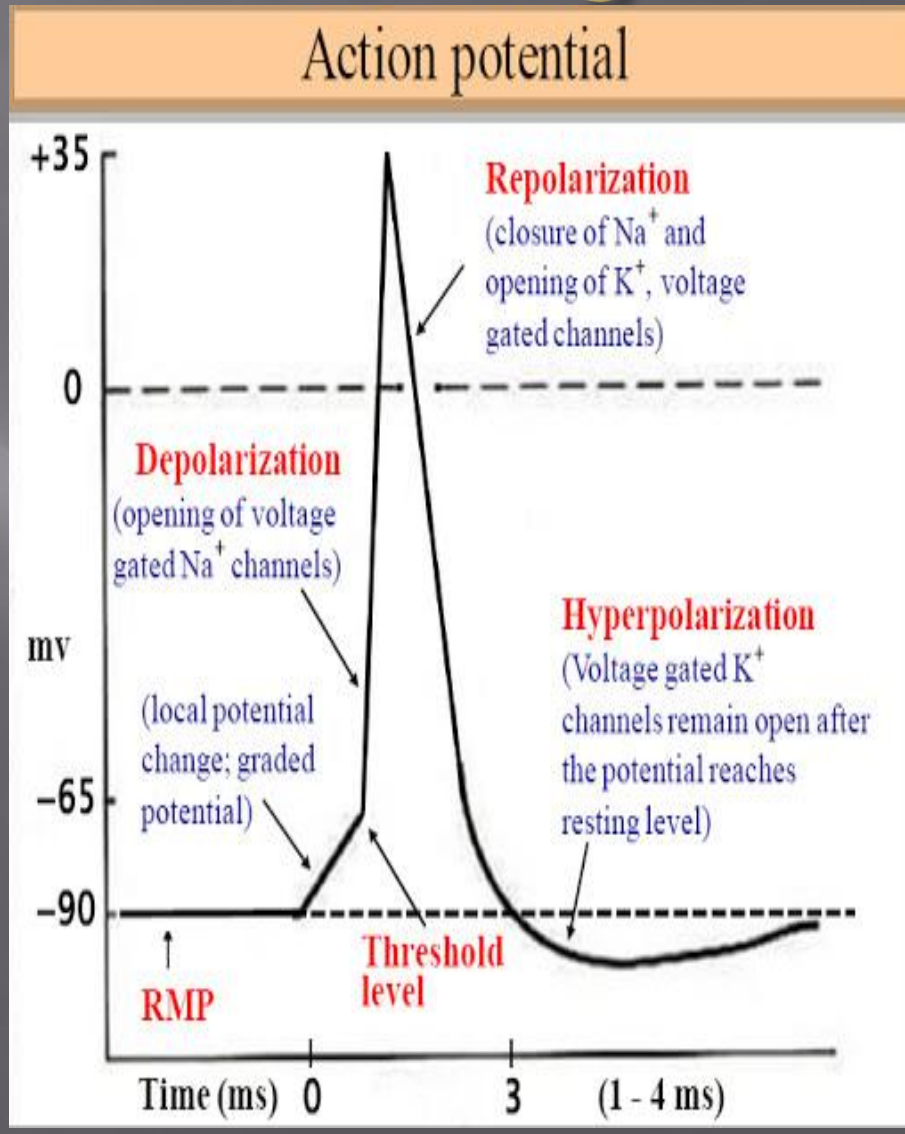
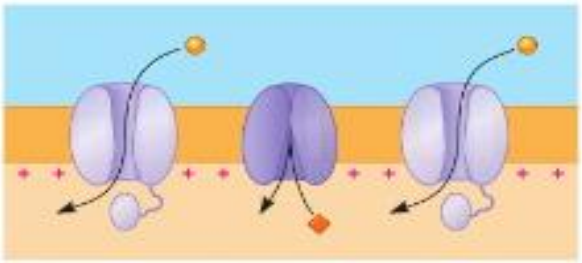
Changes Accompany With Muscle Contraction

- Electrical Changes
- Ionic Changes
- Excitability Changes
- Metabolic Changes
- Thermal Changes
- Mechanical Changes

1- Electrical And Ionic Changes

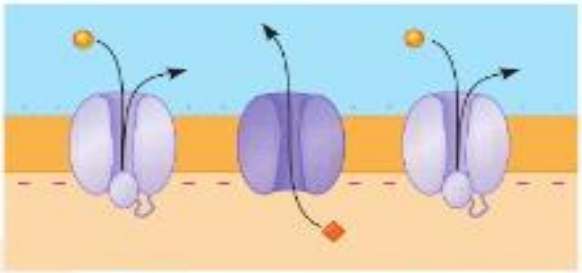




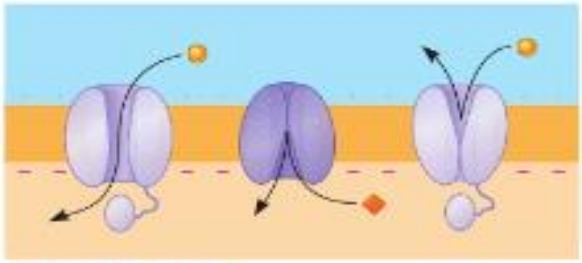


Key
Na+
K+

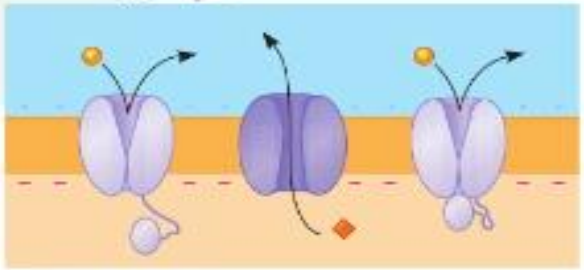
3 Rising phase of the action potential
Depolarization opens most sodium channels, while the potassium channels remain closed. Na^+ influx makes the inside of the membrane positive with respect to the outside.



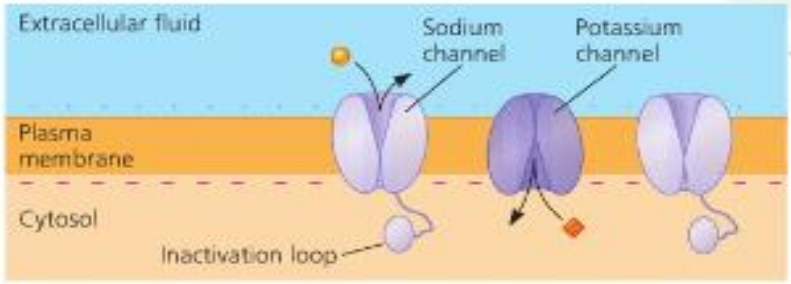
4 Falling phase of the action potential
Most sodium channels become inactivated, blocking Na^+ inflow. Most potassium channels open, permitting K^+ outflow, which makes the inside of the cell negative again.



2 Depolarization A stimulus opens some sodium channels. Na^+ inflow through those channels depolarizes the membrane. If the depolarization reaches the threshold, it triggers an action potential.



5 Undershoot The sodium channels close, but some potassium channels are still open. As these potassium channels close and the sodium channels become unblocked, the membrane returns to its resting state.



1 Resting state The gated Na^+ and K^+ channels are closed. Ungated channels (not shown) maintain the resting potential.

Comparison Between Electrical Changes (A.P) Between Muscle And Nerve

	Muscle	Nerve
RMP	-90 mv	-70 mv
Firing level	-40 mv	-55 mv
Over shoot reachs	+40 mv	+35 mv
Magnitude of spike	130 mv	105 mv
Spike lasts	5-10 mv	2 mv
Contraction	Followed by muscle contraction	No contraction

3- Excitability changes

- 1- Absolute Refractory Period(ARP)
- 2- Relative Refractory Period(RRP)
- 3- Super Normal Phase Of Excitability
- 4- Sub Normal Phase Of Excitability.

1- Absolute Refractory Period(ARP)

- It is corresponding to ascending limb of action potential until first one third of repolarization
- Excitability equal Zero (No response to any stimulus what ever its strength.

2- Relative Refractory Period(RRP):

- It is contributed with last two third of repolarization
- Excitability lower than normal but above zero (response to stimulus higher than threshold stimulus)

3- Supra Normal Phase

- It is corresponding to negative after potential
- Excitability is hyper excitable (hypo potential)
- (response to any stimulus what ever its strength even sub threshold stimulus).

2- Sub Normal Phase:

- It is contributed with positive after potential
- Excitability is hypo excitable (hyper potential)
- Excitability lower than normal but above zero (response to stimulus higher than threshold stimulus)

4- Metabolic Or Chemical Changes

Chemical composition of skeletal muscle:

1- Water 70-80%

2- Protein(contractile , Regulatory And Elasticity And Expansion Protein Is 20%.

3- Energy Producing Substance As

- A- ATP 0.33%
- B- Creatine Phosphate=0.5%
- Glycogen= 0.1-1%

4- Inorganic Ions As Na, K, Ca, Mg, Cl, Hco_3

4- Metabolic Or Chemical Changes

I- Metoblism During Rest:

- Muscle consume 25% of Basal metabolic rate of muscle during rest.

It is benefit or used for:

1- maintenance of RMP.

2- keeping electrolytes composition of muscle is constant.

3- chemical synthesis of protein and glycogen.

4- production of muscle tone.

II- Metoblism During Activity Or Muscle Contraction

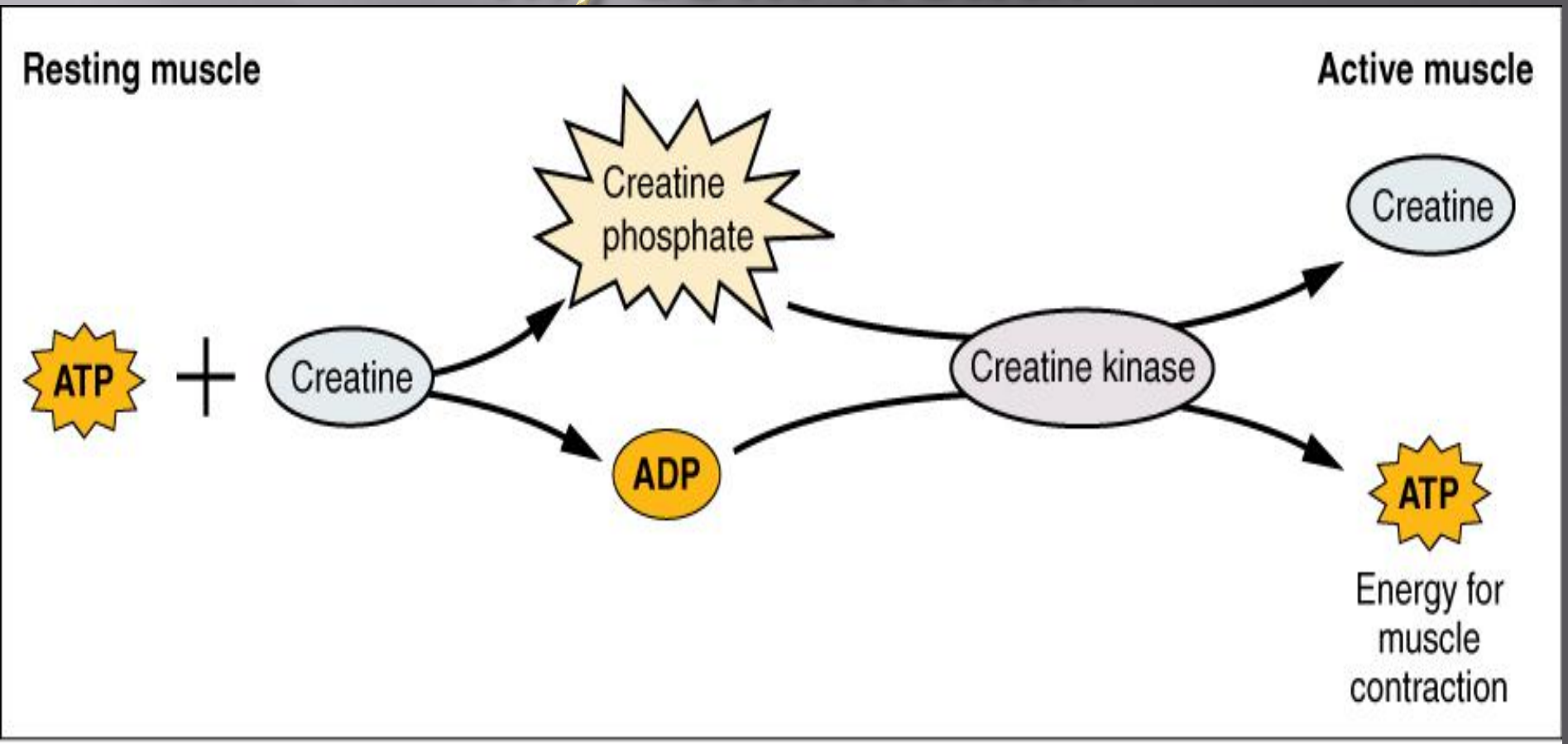
1- Breaking Of ATP To ADP:

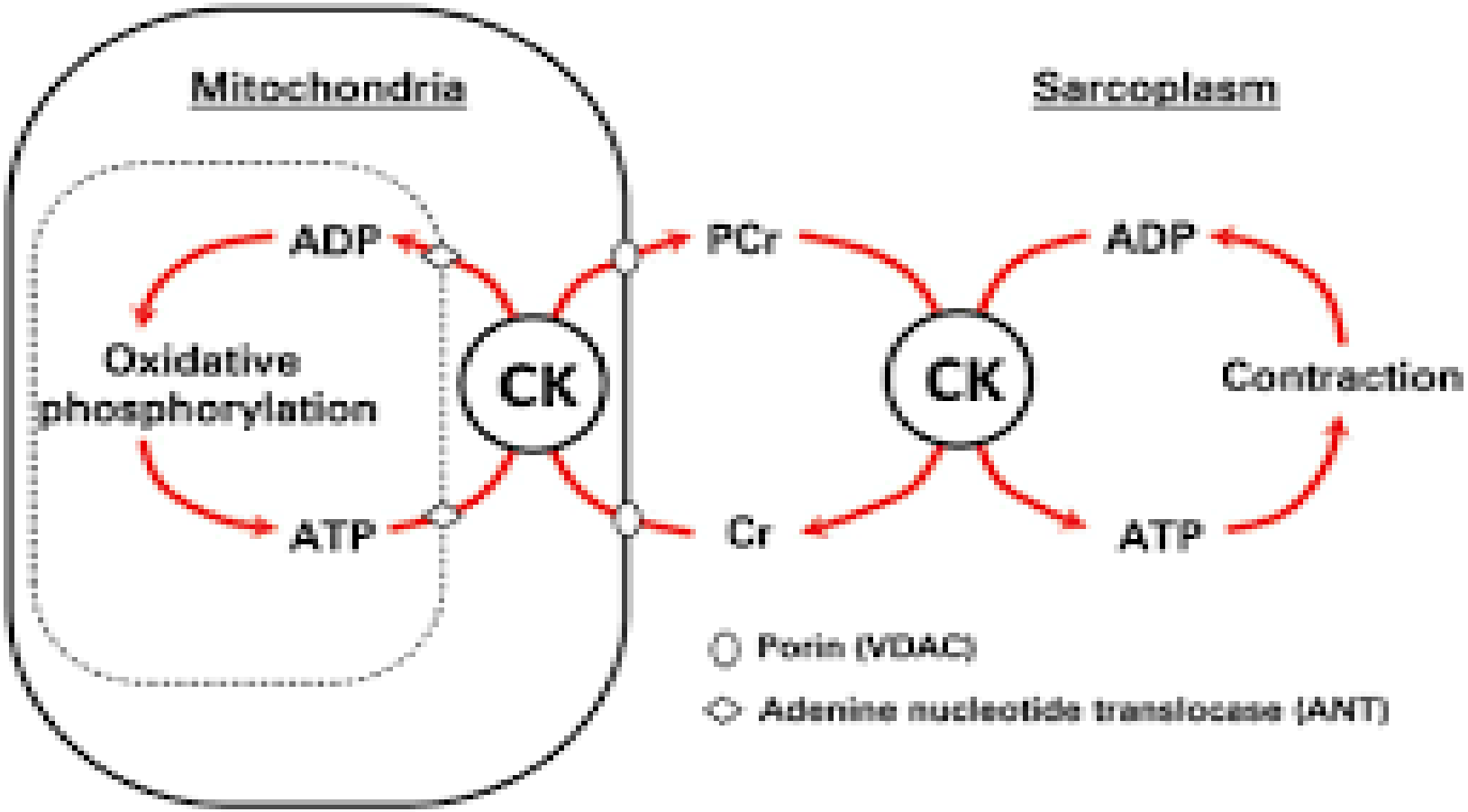
Myosin head (ATPase)

ATP → ADP+P

2- Rapid Regeneration Of ATP:

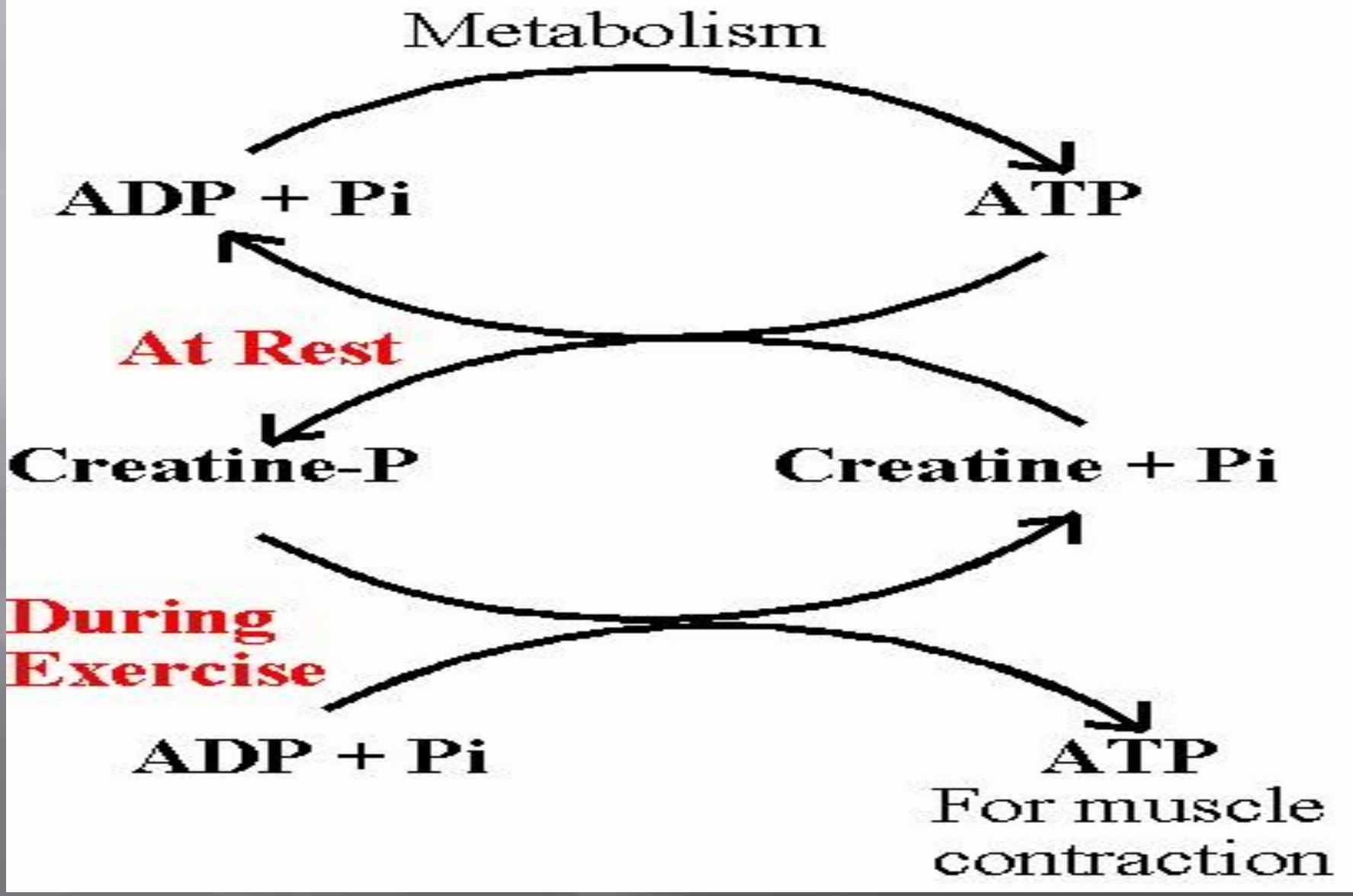
Occurs anaerobically by using creatine phosphokinase (CPK) in myosin head.



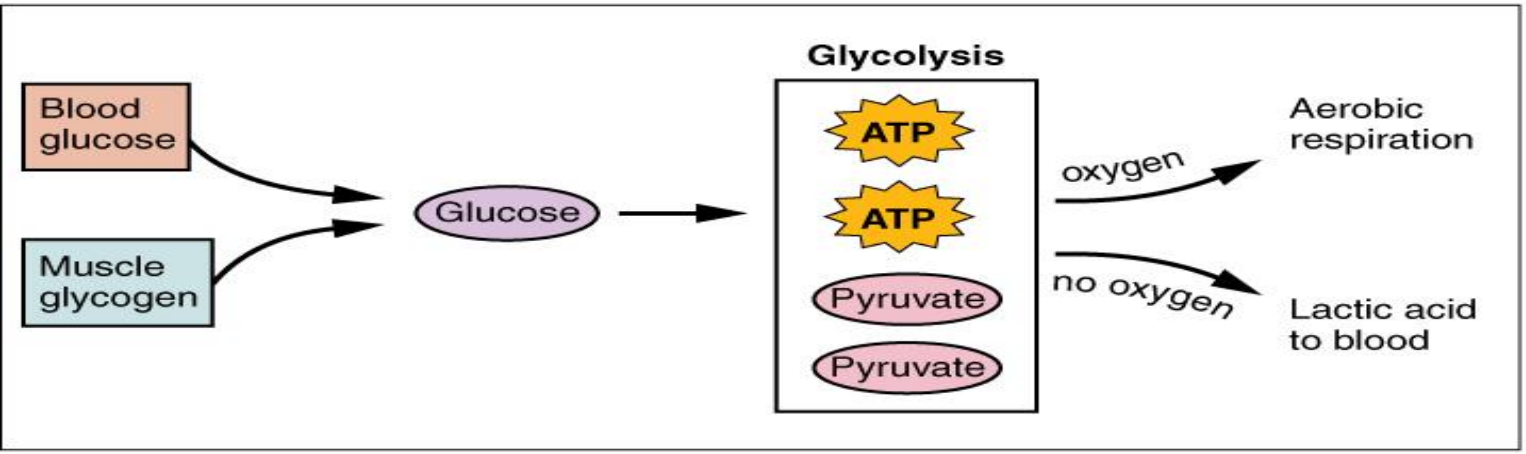


ADP: adenosine diphosphate; CK: creatinine kinase; PCr: phosphocreatine; ATP: adenosine triphosphate; Cr: free creatinine

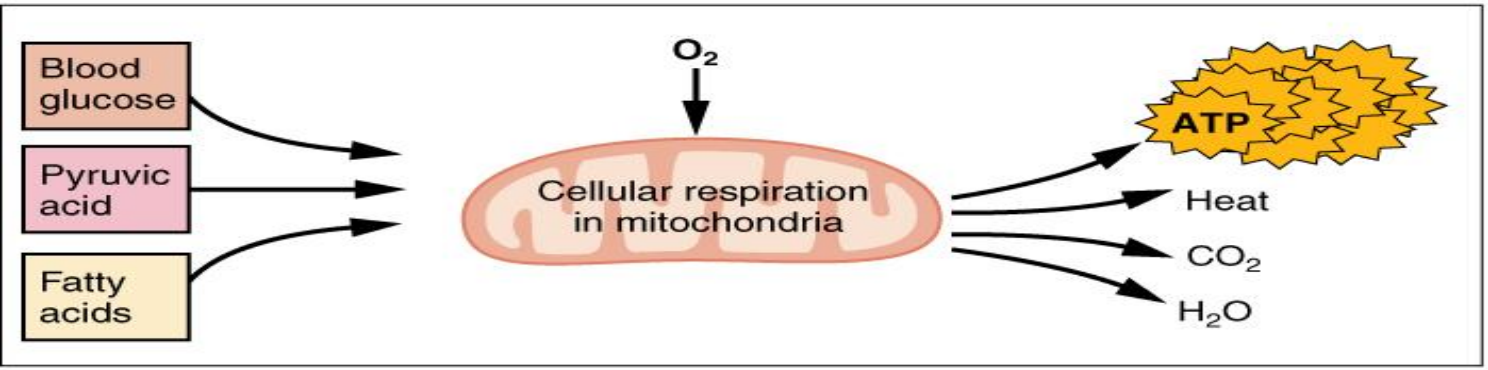
Phosphagen System



3- Slow Regeneration OF ATP:



(b)



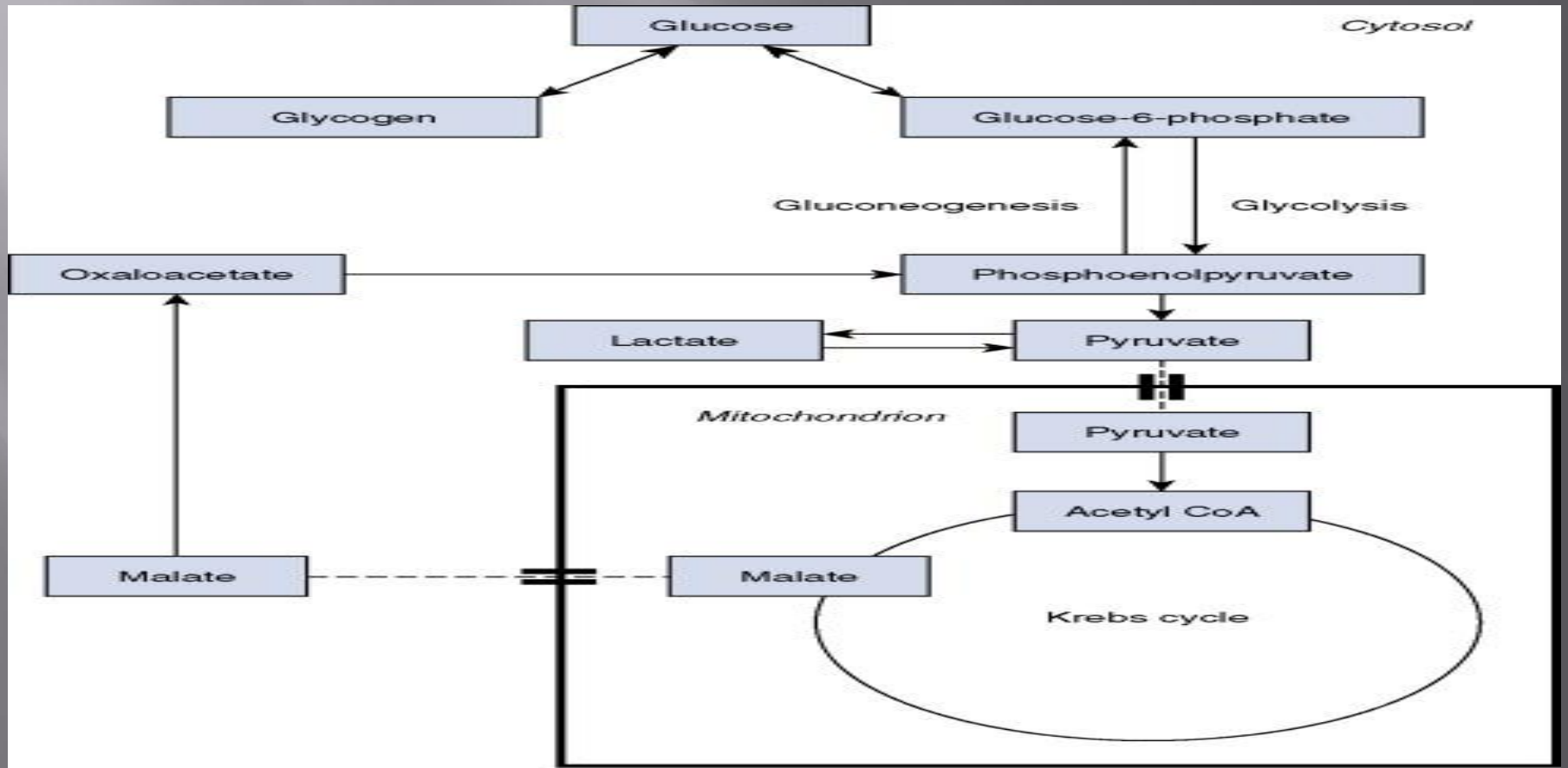
(c)

N.B : 1- anaerobic glycolysis leads to accumulation of lactic acids in muscle (inhibits enzymatic reaction in muscle contraction leads to fatigue.
2- anaerobic glycolysis is useful in muscular exercise

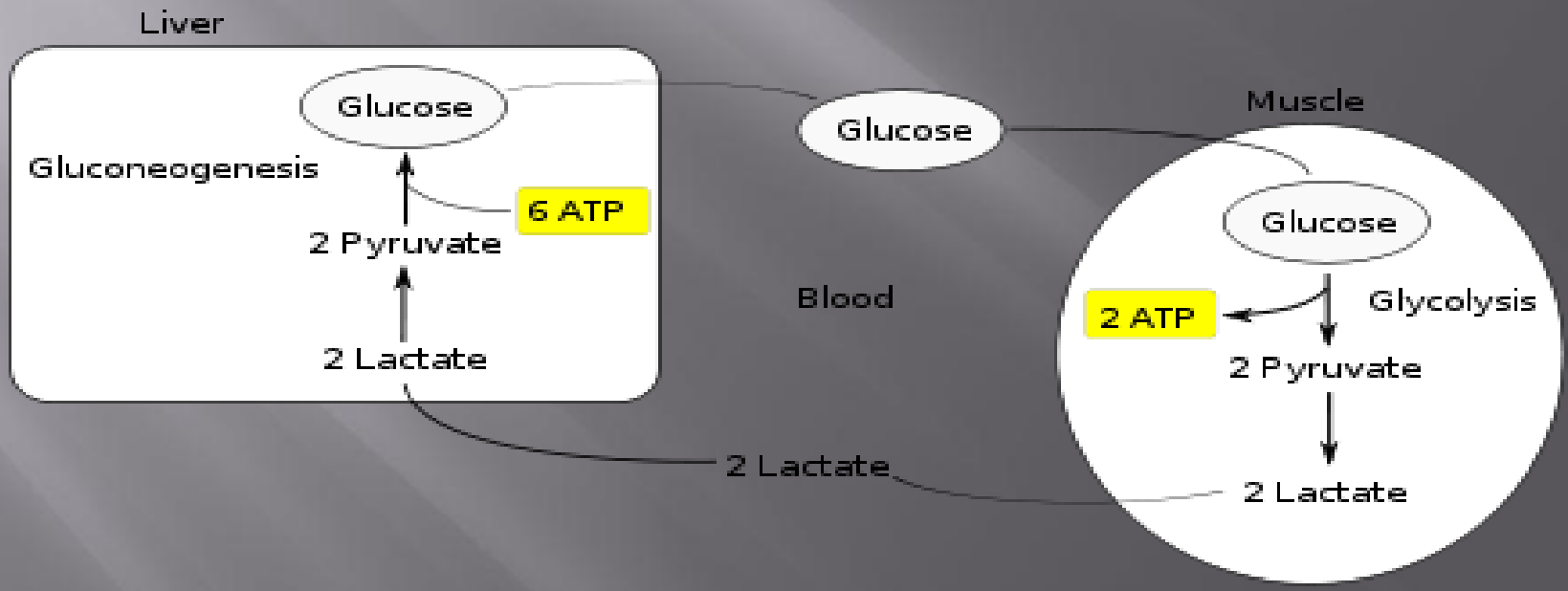
C- During Recovery

1-destruction Or Fate Of Lactic Acid

a- enters in Krebs cycle



B- Lactic Acid Is A Fuel In Cardiac Muscle
C- Resynthesize Of Glucose In Liver (Cori's Cycle)



D- oxidation of lactic acid and converted into $CO_2+H_2O+Energy$

- **Oxygen debt** : It is extra amount of oxygen used to oxidize lactic acid (accumulated during sever exercise) in recovery period above normal oxygen consumption so increase heart rate and respiratory rate until excess lactic acid has disappeared.

Thank you