

# BIO TEAM 429

بسم الله الرحمن الرحيم

## MUSCULOSKELETAL BLOCK ATP METABOLISM

إعداد الطالبات

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## TYPES OF MUSCLE FIBERS:

*There are 2 types of fibers in muscles:*

Red	slow; red due to the presence of myoglobin that is used as O <sub>2</sub> reserve, or to the presence of the heme-containing cytochromes.	e.g. <b>muscles of distance runners</b>
White	fast	e.g. <b>muscles of sprinters</b>

\*الطيور المهاجرة تتميز بامتلاك عضلات حمراء...ليه؟!  
 لانها محتاجه طاقه كافيه عشان تطير ببطء وثبات لمسافات طويله ☺  
 \*طيب الطيور اللي ما تطير زي الدجاج..؟!  
 هذا النوع من الطيور يمتلك عضلات بيضاء...ليه؟! ☺

- حركة العضلات سريعه << حركة العين
- لانها تفتقر الى ال mitochondria و myoglobin و cytochrome
- تخرج الطاقه من عمليات anerobic

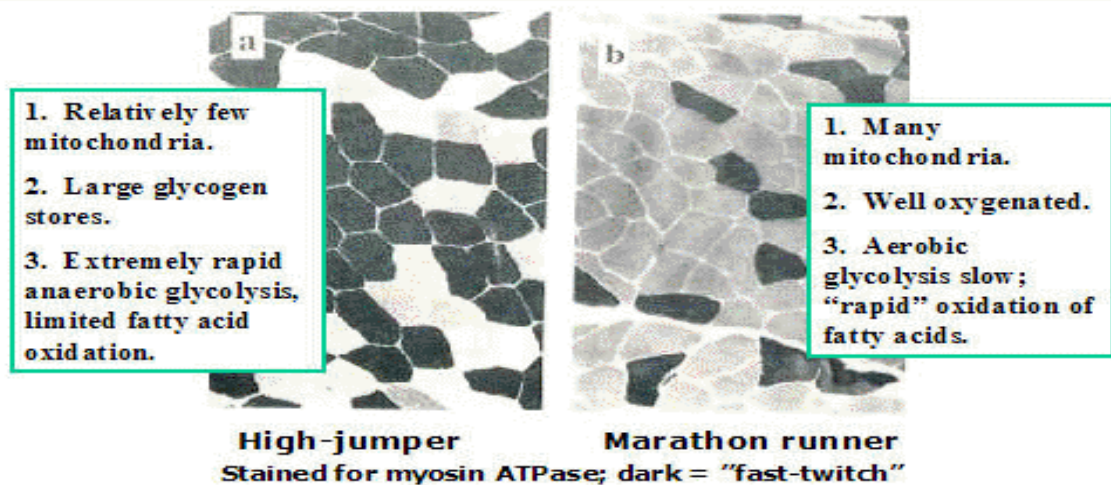
**NB:** fiber color is an imperfect indicator of muscle physiology: muscles of sprinters & of distance-runner have the same color.

The proportions of both fibers: vary from one type of muscle to the other.

**During the course of appropriate physical training:**

The proportions of the 2 fiber types can change  
 the expression of functional muscle proteins can change

## Quadriceps Fiber Composition in Athletes



Modified from: K. N. Frayn, *Metabolic Regulation, a Human Perspective*, 2 ed. page 106

Muscle of sprinters:  
Fast-twitch fibers

Muscle of distance runners:

## ENERGY METABOLISM IN THE WHITE AND RED MUSCLE FIBERS:

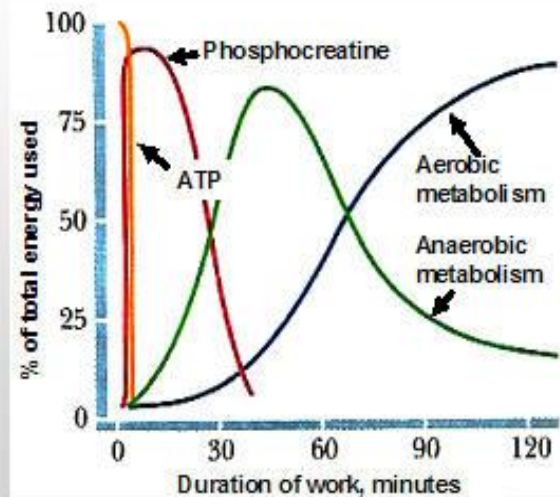
**Red**  
 (type I fibers = slow-twitch)

- Suitable for **prolonged** effort
- e.g. the flight muscles of migratory birds (ducks & geese): needs continuous energy supply, dark breast meat.
- Mainly **aerobic** metabolism → depends on an adequate supply of  $O_2$
- The main (but not the only) sources of ATP production:
  - **Fatty Acid  $\beta$ -oxidation**
  - TCA cycle
  - Respiratory chain oxidative phosphorylation

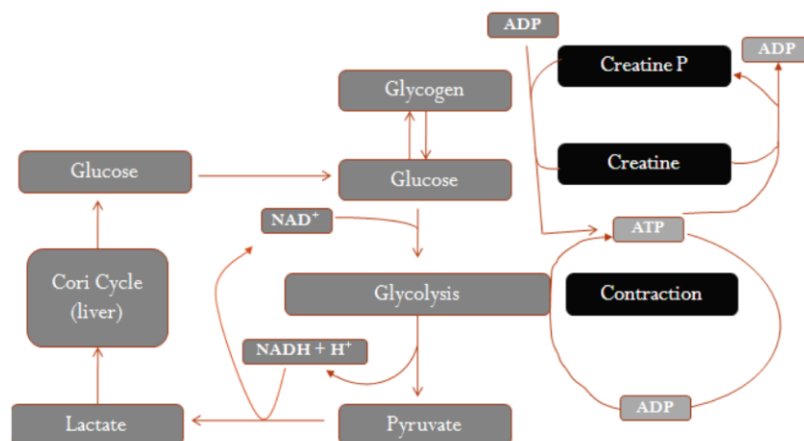
**White**  
 (type II fibers = fast-twitch)

- Suited for fast (e.g. eye muscles), strong (e.g. weightlifting) contractions
- e.g. the flight muscles of chicken & turkeys, used only for short spurts, white breast meat
- Nearly devoid of mitochondria
- Able to form sufficient ATP even when there is little  $O_2$  available
- Mainly obtain their ATP from anaerobic glycolysis
- They have supplies of glycogen → quick release of Glc-1-P when needed

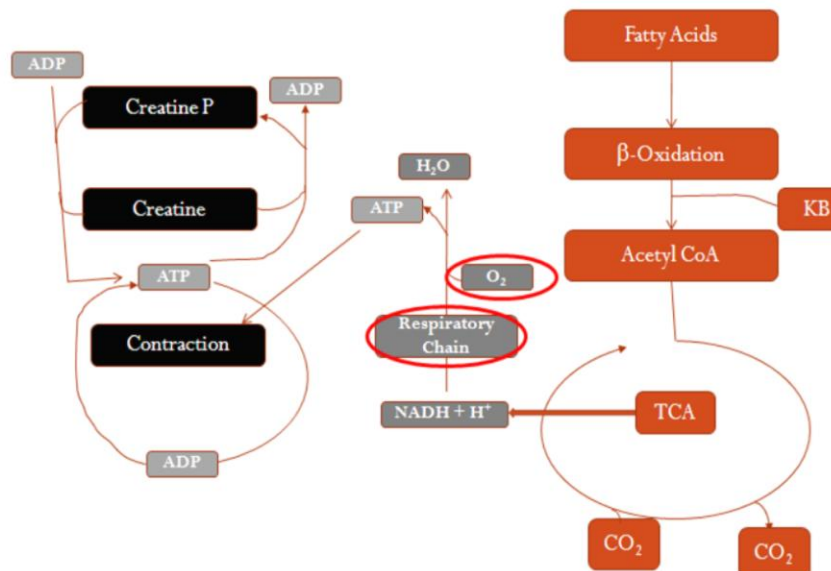
### Energy Sources in Working Muscles



### Energy Metabolism in white (Fast) fibers, anaerobic

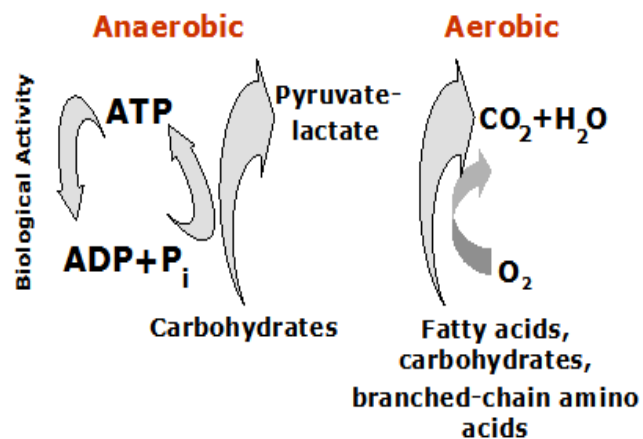


### Energy Metabolism in red (slow) fibers, aerobic



### Energy Sources in Working Muscle

The main source in white muscle fibers



طيب وش راح يصير لما تزيد نسبة lactic acid ؟

لما تزيد نسبة ال lactic acid بالعضله راح تمر بشي اسمه ال cori cycle

Lactic acid    blood → liver → glucogenesis → glucos →  
muscle → lactic acid

😊 وترجع مره ثانيه ال cori cycle

## HOW TO METABOLIZE LACTATE PRODUCED DURING ANAEROBIC GLYCOLYSIS IN WHITE MUSCLE FIBERS?

### Cori's Cycle:

- White muscle fibers mainly obtain ATP from anaerobic glycolysis → lactate (& in smaller quantities pyruvate)
- Lactate is released into the blood and transported to the liver
- In liver, lactate (& pyruvate) are utilized by gluconeogenesis pathway (ATP requiring process) → glucose synthesis
- Glucose then can return via the blood to the muscles to be utilized as an energy source again.

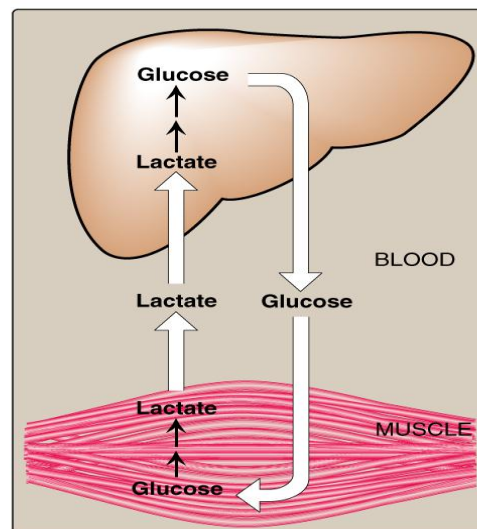


Figure 10.2  
The Cori cycle.

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## RECALL THAT THE GLYCOGEN STORE HAS DIFFERENT FUNCTIONS IN LIVER AND MUSCLE:

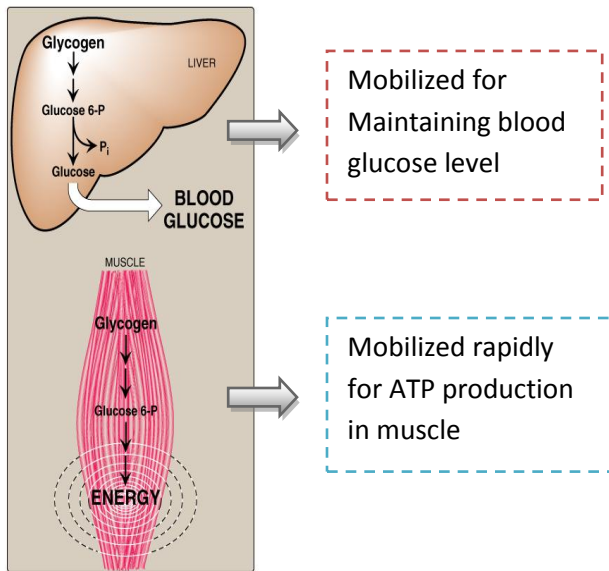


Figure 11.2  
Functions of muscle and liver glycogen.  
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## GLUCOSE-ALANINE CYCLE IN SKELETAL MUSCLE:

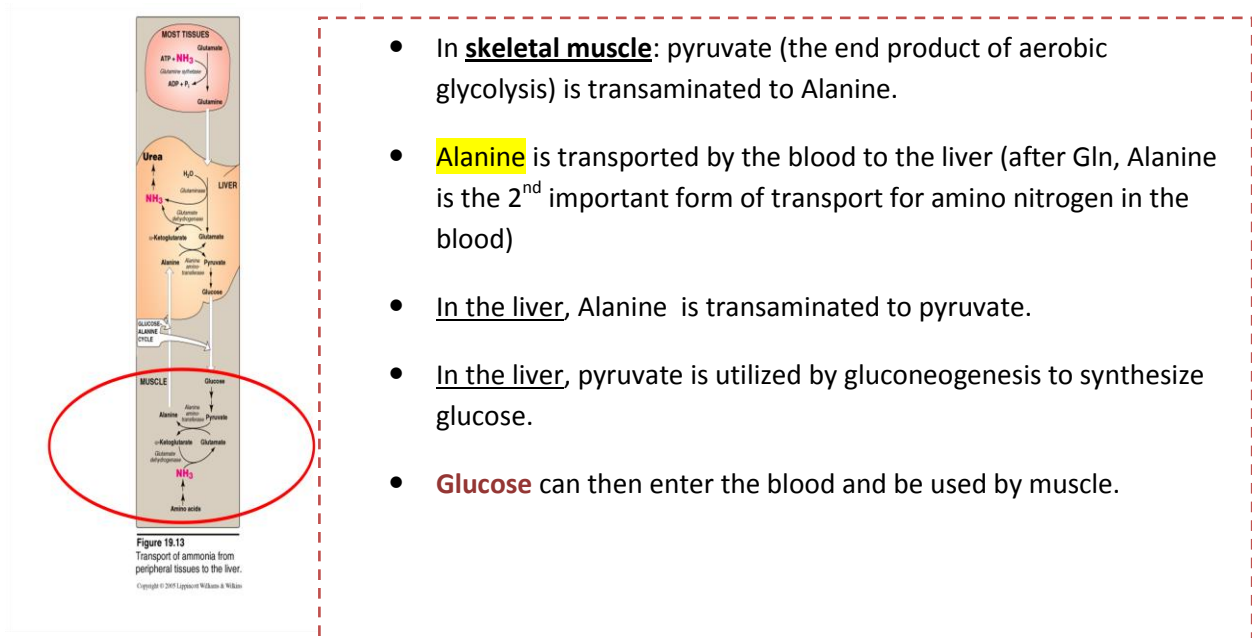


Figure 18.13  
Transport of ammonia from peripheral tissues to the liver.  
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