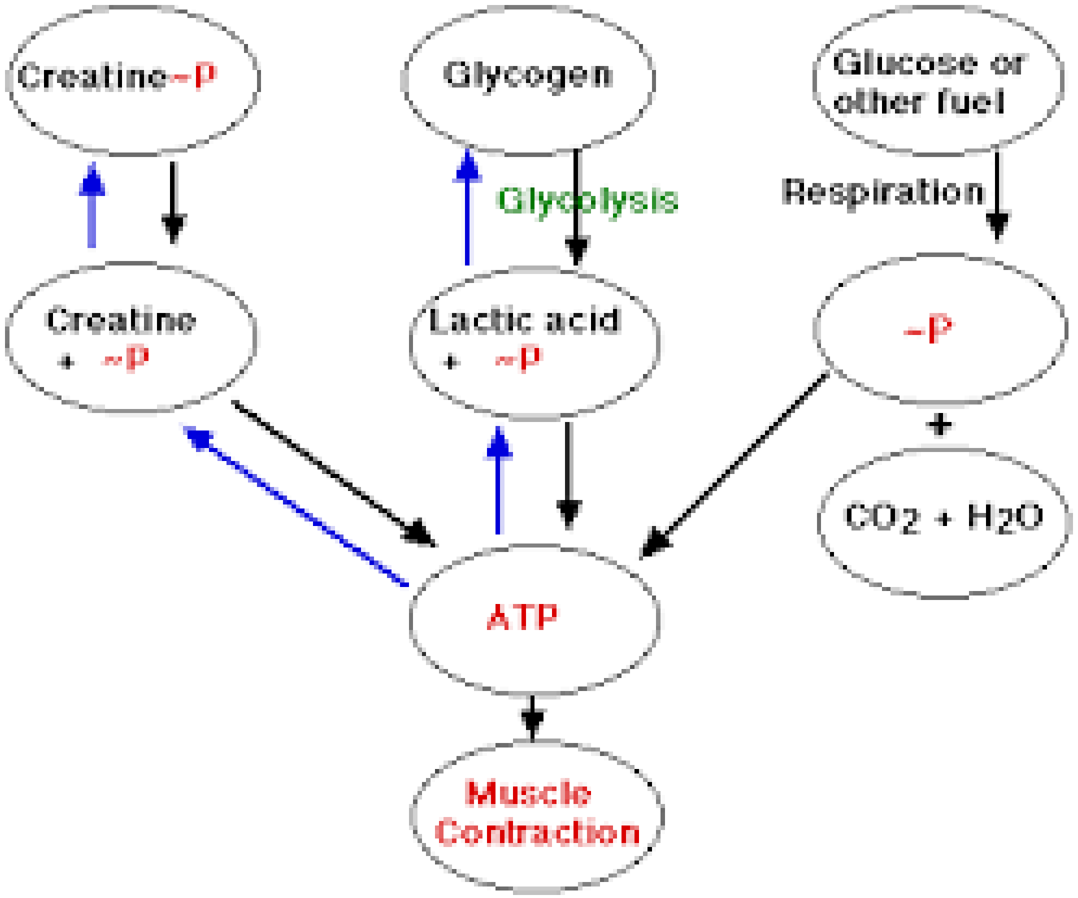
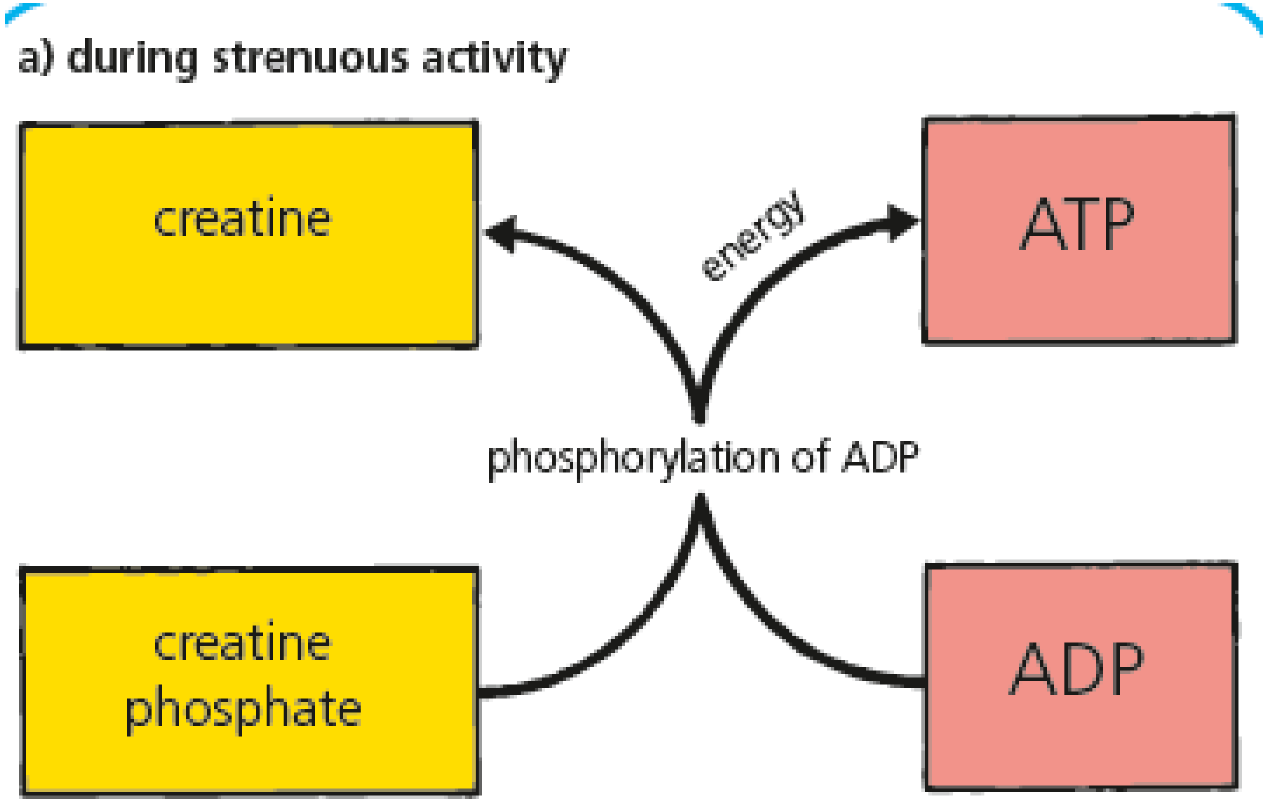
Energy systems in muscle cells



L.I. Energy systems in muscle cells

I can describe the role of creatine phosphate

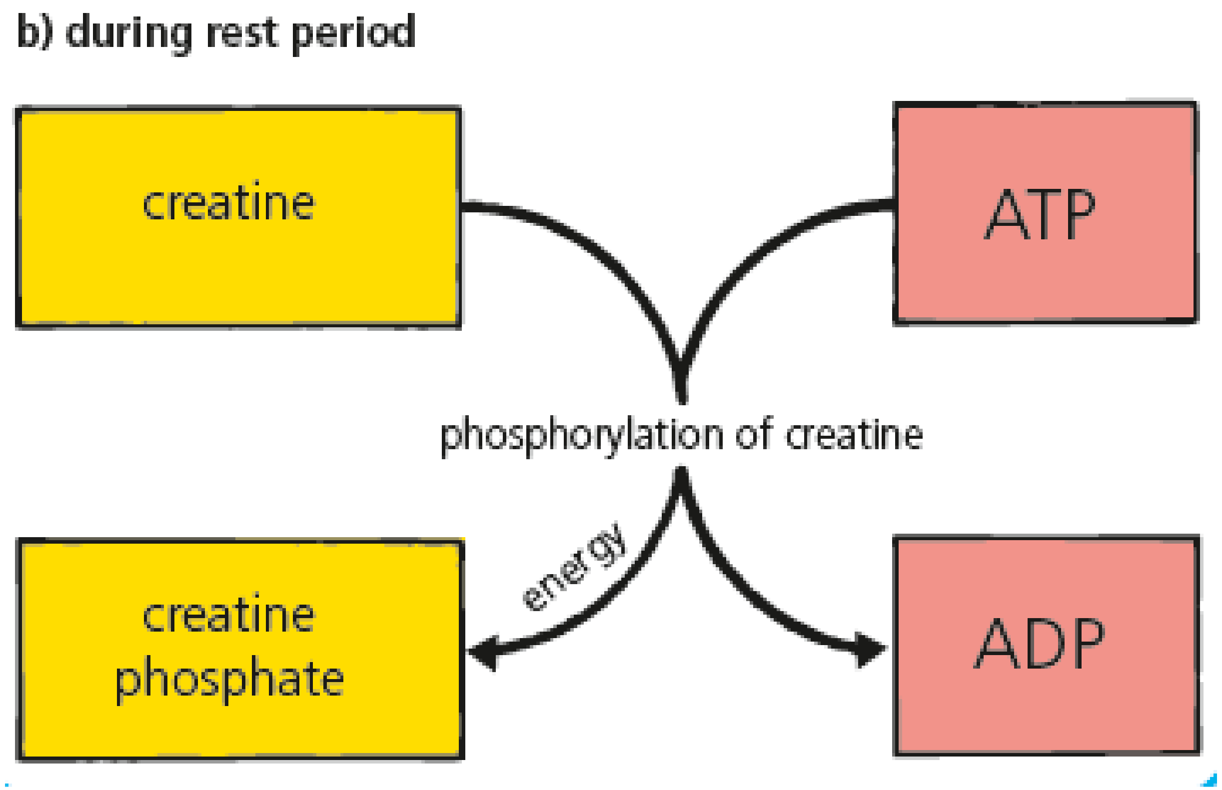
During strenuous muscle activity the cell rapidly breaks down its reserves of ATP to release energy. Muscle cells have an additional source of energy in **creatine phosphate** which can replenish ATP pools for around 10 seconds.



L.I. Energy systems in muscle cells

I can describe the role of creatine phosphate

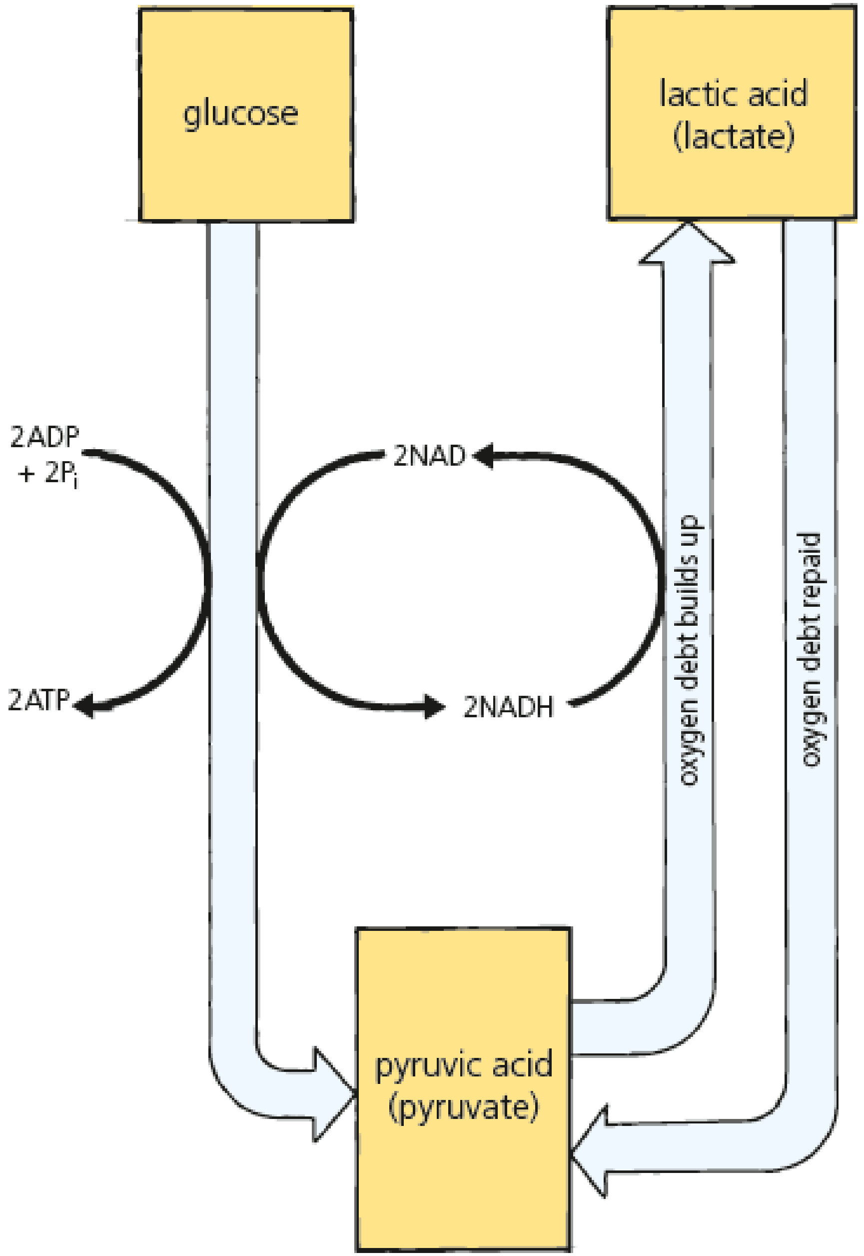
When muscle energy demands are low, Creatine phosphate is regenerated using ATP from cellular respiration.
It is a high energy reserve.



L.I. Energy systems in muscle cells

I can describe lactic acid metabolism

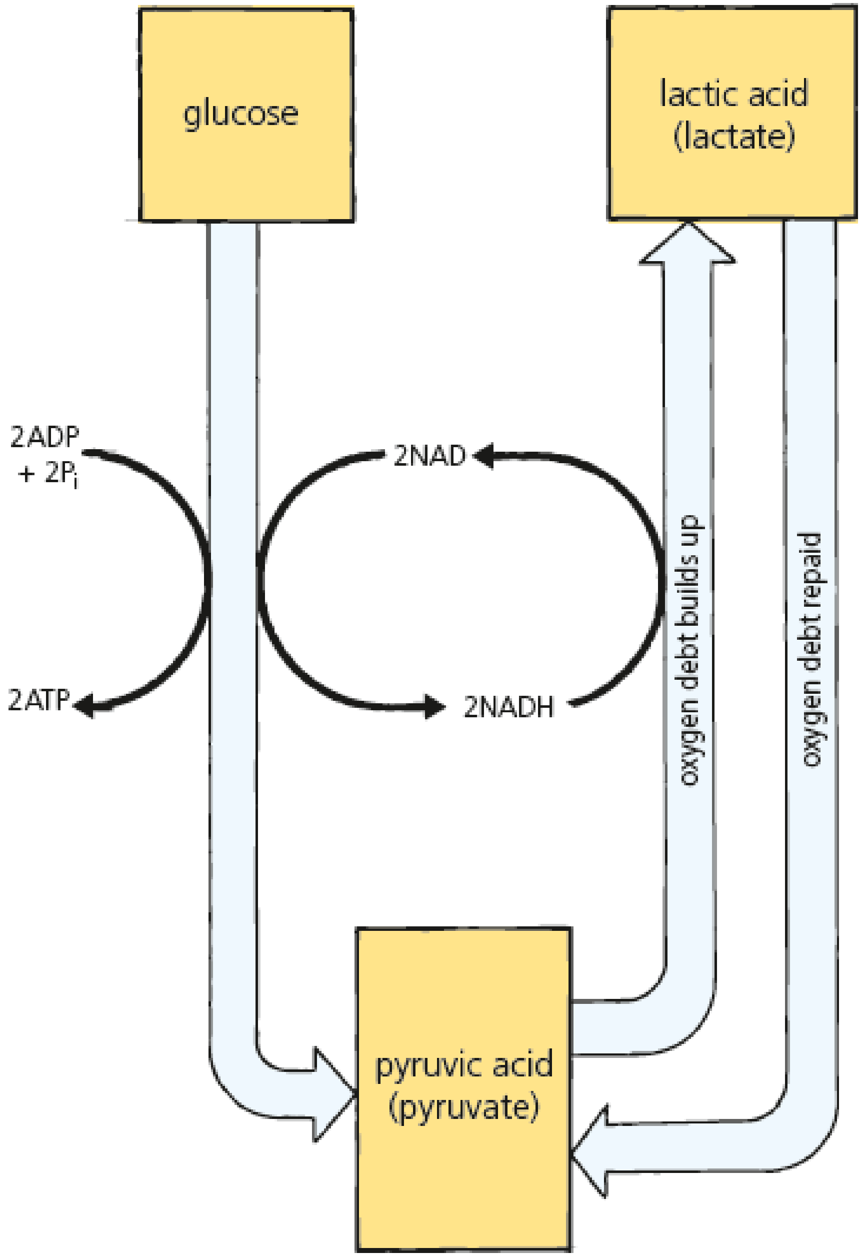
- During vigorous exercise, the muscle cells do not get sufficient oxygen to support the electron transport chain. Pyruvate is converted to **lactic acid.**
- Hydrogen from the NADH produced during glycolysis to pyruvic acid is used to produce lactic acid.
- This generates the NAD needed to maintain ATP production through glycolysis.



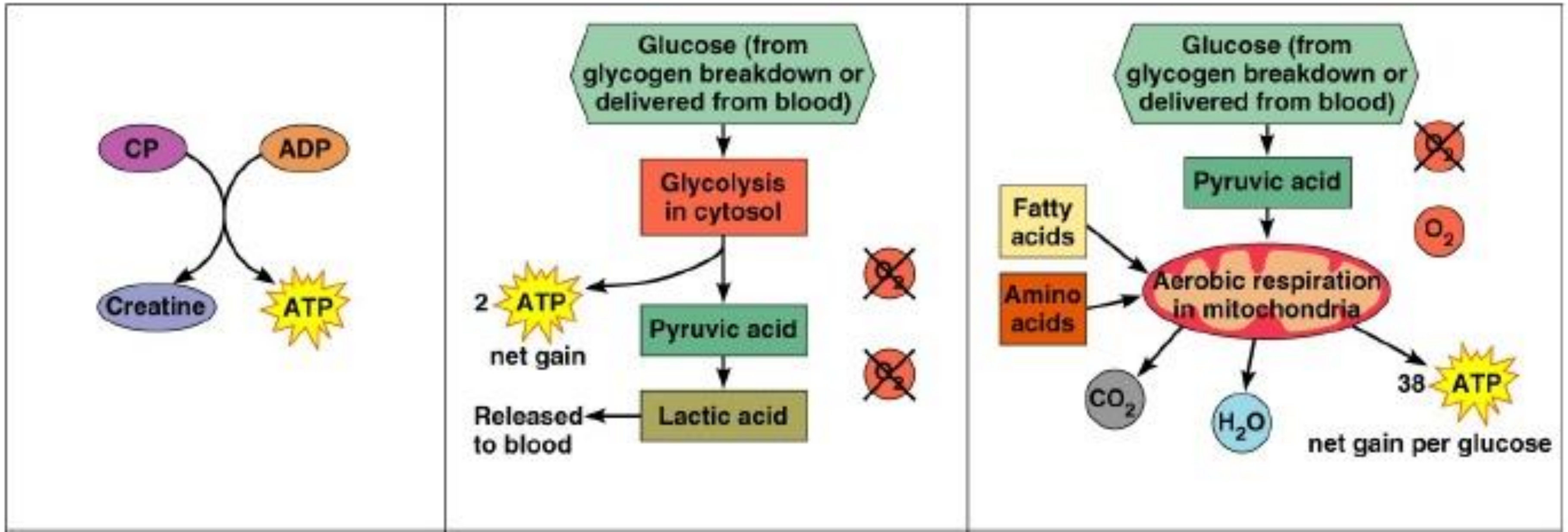
L.I. Energy systems in muscle cells

I can describe lactic acid metabolism

- Lactic acid accumulates in muscle causing **fatigue.**
- **Oxygen debt** repaid when exercise is complete allows respiration to provide the energy to convert lactic acid back to pyruvic acid.
- Only 2ATP produced per molecule of glucose.



Muscle Metabolism: Energy for Contraction



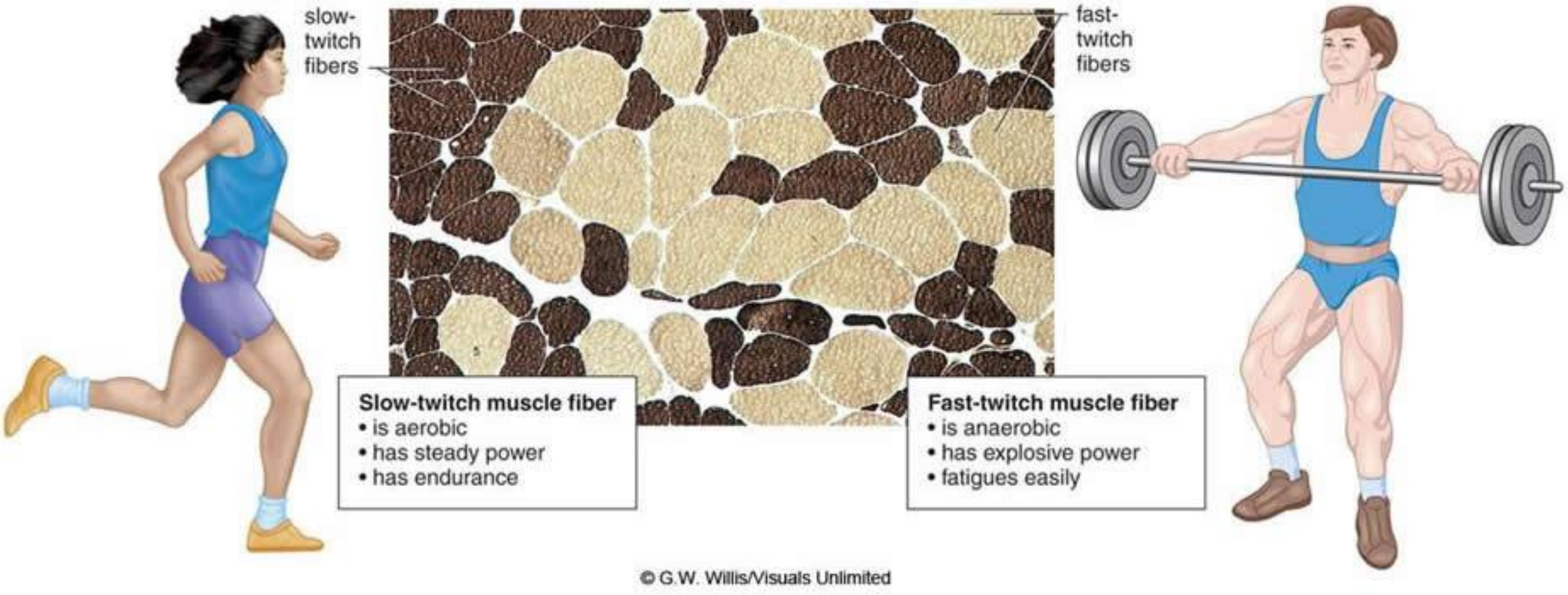
(a) Direct phosphorylation [coupled reaction of creatine phosphate (CP) and ADP]	(b) Anaerobic mechanism (glycolysis and lactic acid formation)	(c) Aerobic mechanism (aerobic cellular respiration)
Energy source: CP	Energy source: glucose	Energy source: glucose; pyruvic acid; free fatty acids from adipose tissue; amino acids from protein catabolism
Oxygen use: None Products: 1 ATP per CP, creatine Duration of energy provision: 15 s.	Oxygen use: None Products: 2 ATP per glucose, lactic acid Duration of energy provision: 30–60 s.	Oxygen use: Required Products: 38 ATP per glucose, CO_2, H_2O Duration of energy provision: Hours

Figure 9.20

L.I. Energy systems in muscle cells

I can describe skeletal muscle fibres

- There are two types of skeletal muscle fibres – **slow twitch** and **fast twitch**



L.I. Energy systems in muscle cells

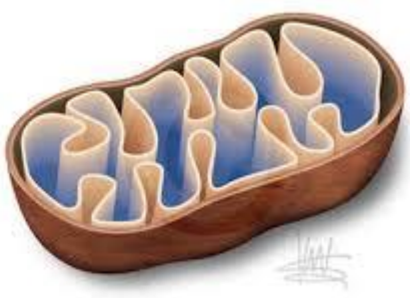
I can describe skeletal muscle fibres

- **Slow twitch (type1):**
- **Contract more slowly**
- can **sustain contractions for longer**
- good for **endurance activities**

L.I. Energy systems in muscle cells

I can describe skeletal muscle fibres

Slow twitch (type1) muscle fibres:



- rely on **aerobic respiration** to generate ATP
- have **many mitochondria**,
- a **large blood supply**
- high concentration of the oxygen storing protein **myoglobin**.

- The major storage fuel of slow twitch muscle fibres is **fats**.

L.I. Energy systems in muscle cells

I can describe skeletal muscle fibres

Fast twitch (type1) muscle fibres:

- **contract more quickly, over short periods,**
- good for **bursts of activity**

L.I. Energy systems in muscle cells

I can describe skeletal muscle fibres

Fast twitch (type1) muscle fibres:

- **generate ATP through glycolysis only**
- and have **fewer mitochondria** and **lower blood supply** than slow twitch muscle fibres.
-
- The major storage fuels of fast twitch muscle fibres are **glycogen** and **creatine phosphate**.