

Excess Post-Exercise Oxygen Consumption (EPOC)

- EPOC is the total volume of oxygen that is consumed after exercise which enables the body to fully recover and return to its pre-exercise state.
- It includes the **oxygen debt** which is oxygen that is used to restore muscle ATP and PC, and remove lactic acid.
- It also includes the oxygen required to keep breathing and heart rates elevated, and the oxygen restored to muscle myoglobin.

Oxygen Debt

An oxygen debt will occur...

... when the body has exercised anaerobically, either at the start of any exercise before the aerobic system kicks in, during intense exercise lasting up to 3 mins, or when the anaerobic threshold has been exceeded.

The **oxygen debt** is used to compensate for the **oxygen deficit** - the amount of extra oxygen that would have been required to complete the exercise aerobically.

As aerobic respiration does not happen for the first 3 mins of exercise, a deficit will always occur.

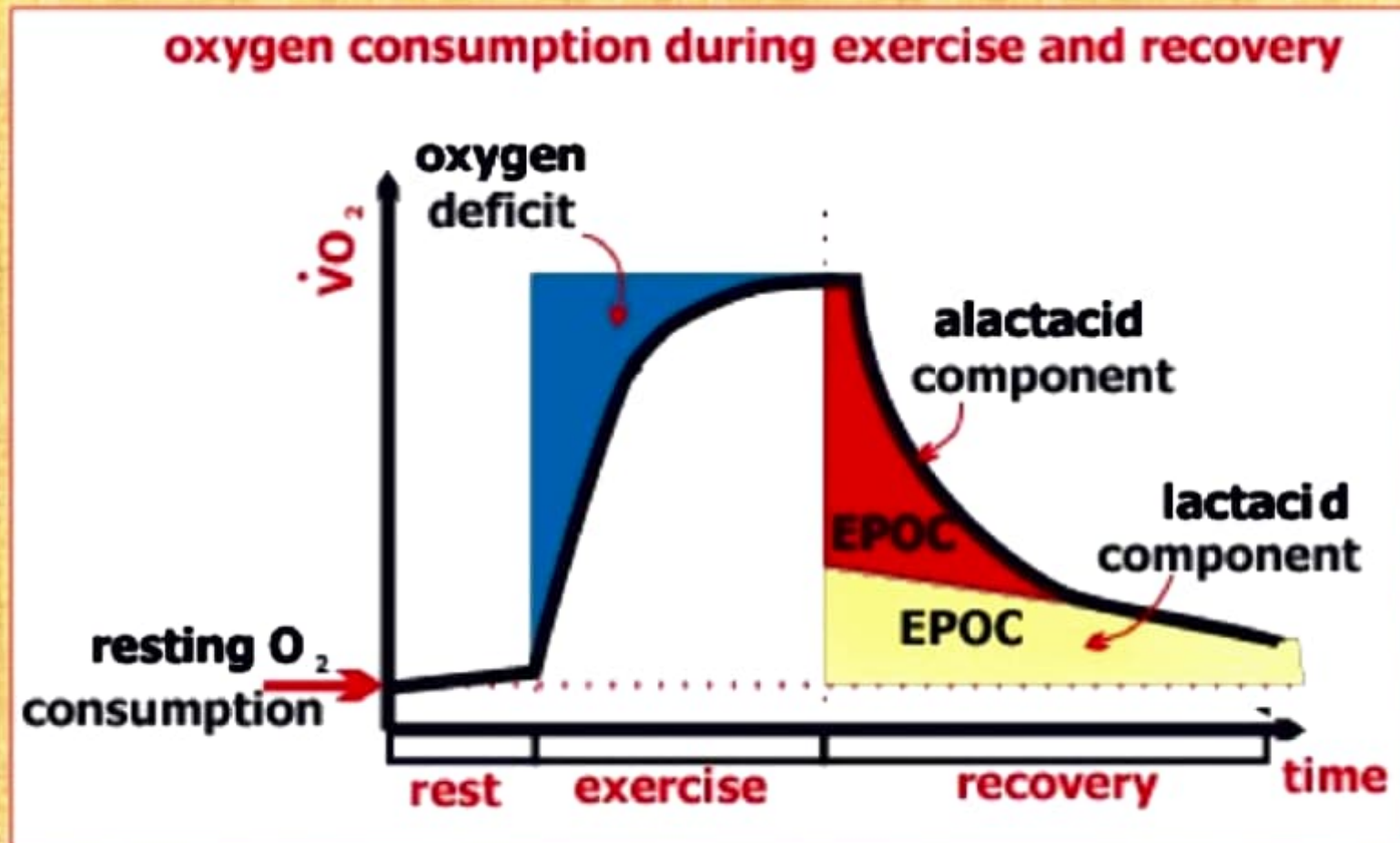
It does not necessarily follow that EPOC will equal deficit, as extra oxygen is required post exercise to:

- Supply oxygen to re-saturate muscle myoglobin stores
- Supply energy for the increased cardiac and respiratory rates that remain elevated during the recovery phase

Consequently the amount of oxygen consumed during the EPOC is greater than that which might have been consumed during the oxygen deficit.

The excess post-exercise oxygen consumption (EPOC) has two components:

1. The fast replenishment stage (alactacid debt)
2. The slow replenishment stage (lactacid debt)



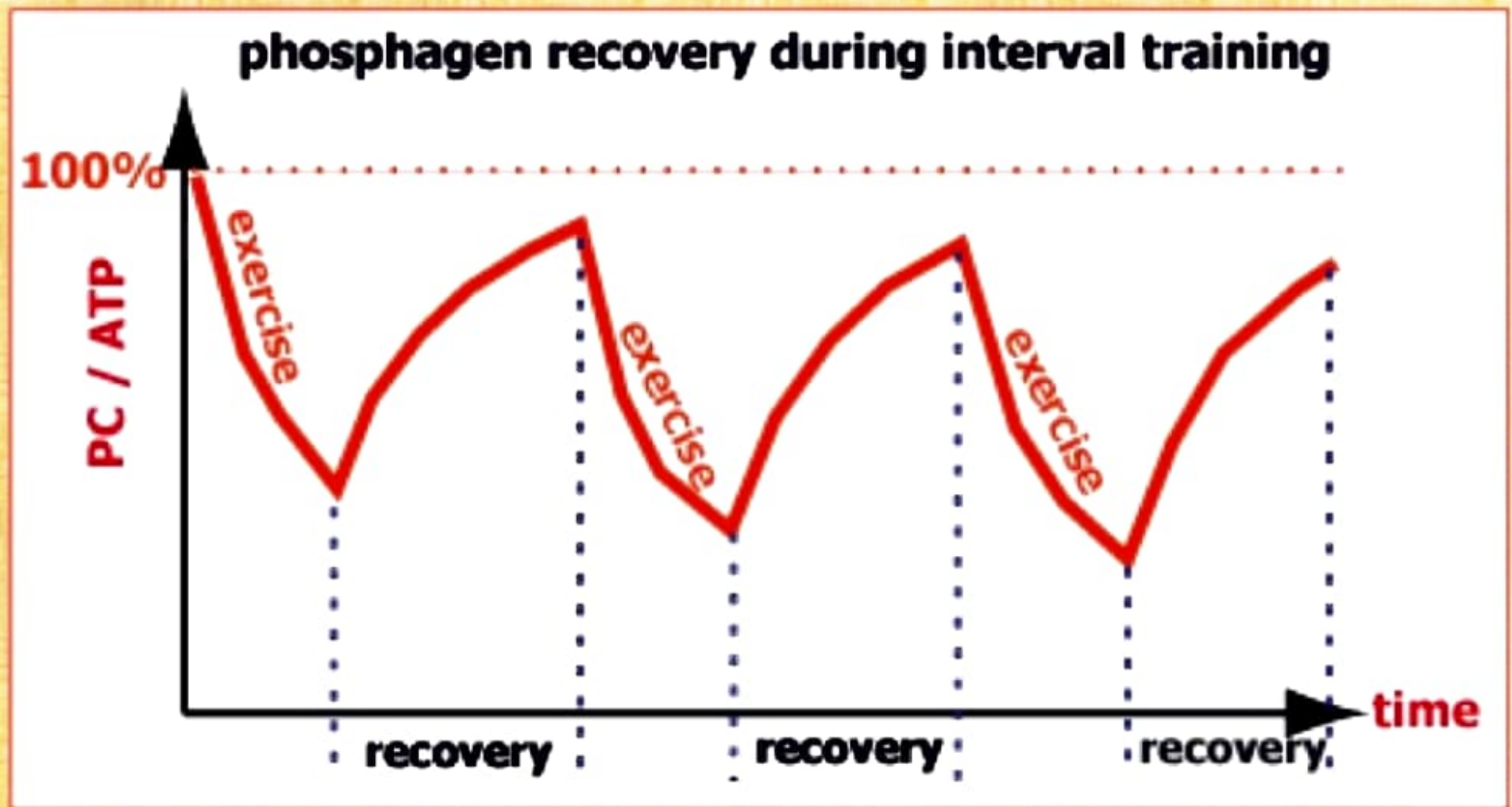


The fast replenishment stage



- This is the first component of the oxygen debt that is replenished and requires up to 4 litres of oxygen.
- Within this component, the very first amount of oxygen consumed is used to resaturate myoglobin with oxygen.
- The rest of the oxygen is required to produce sufficient energy from aerobic respiration to restore the muscle ATP and phosphocreatine stores
- It takes a short amount of time (2-3 mins) for this to be replenished
- This means that after a short (<10s) bout of intense work, the body will be sufficiently recovered after 3 mins to repeat the exercise

Interval training plays on this quick replenishment of phosphagens



Training can increase muscle PCr and ATP stores.

The Slow replenishment stage (Lactacid Debt)

- Can take up to 2 hours and require 5-10 litres of oxygen which is used to do 4 main things:

- 1. Maintain the elevated heart and respiratory rates

- 2. Remove lactic acid from the muscles

- Most (65%) LA is converted into pyruvate and oxidised into CO_2 and H_2O through aerobic respiration - this requires oxygen!

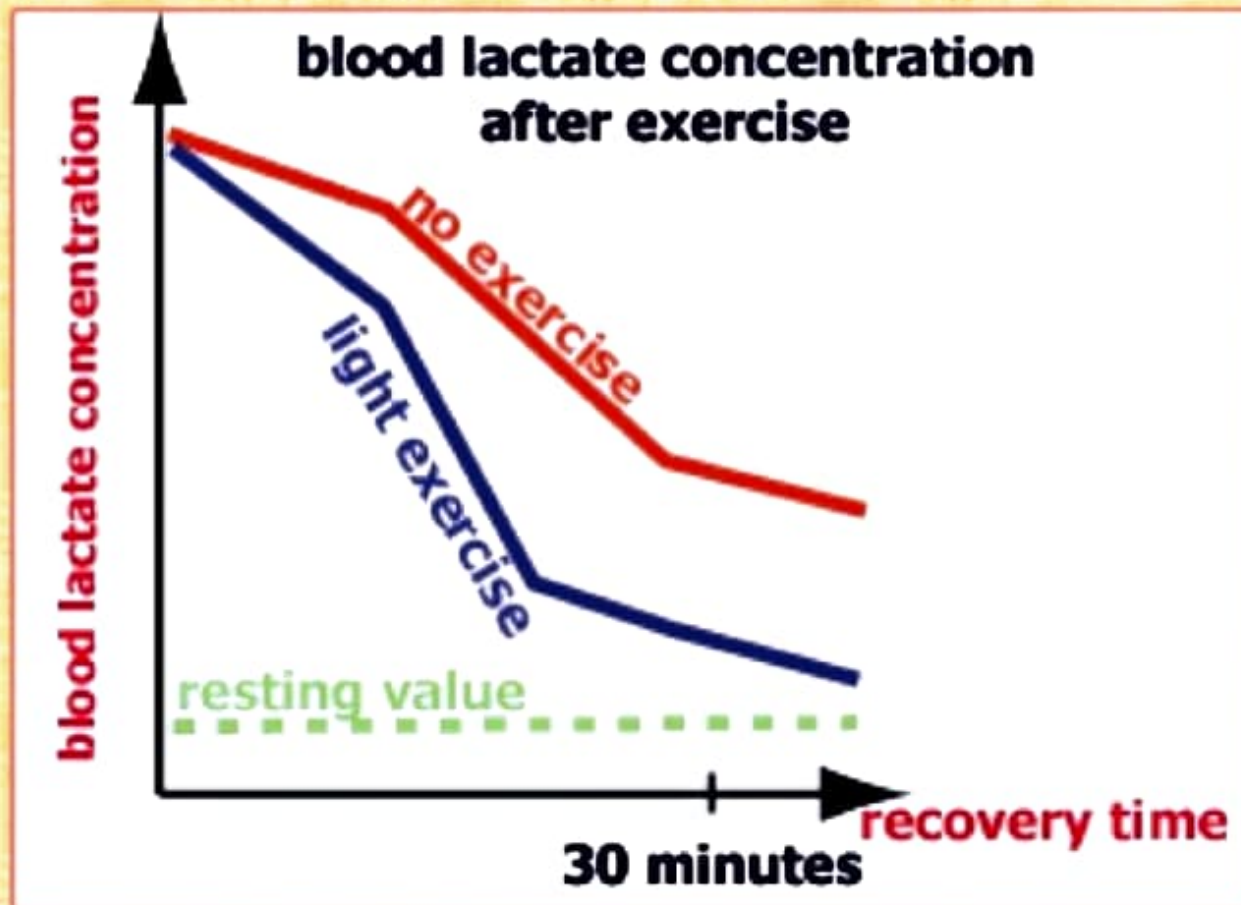
- Typically this process of lactic acid removal takes approx 1 hour, but it can be accelerated by a cool down which ensures a rapid and continuous supply of oxygen to the muscles



EFFECT OF COOL-DOWN ON LACTIC ACID REMOVAL

REMOVAL OF LACTIC ACID FOLLOWING EXERCISE

- cool-down continues to provide oxygen to skeletal muscle
- which therefore enhances oxidation of lactic acid
- and ensures that less lactic acid remains in tissue
- and there is less muscle soreness



The Slow replenishment stage (Lactacid Debt)

- 3. Replenish muscle glycogen stores:

- This depends on the type of exercise performed and the amount and timing of carbohydrate consumption following exercise

- Continuous endurance activity: little glycogen replenishment immediately after exercise, and can take up to 48 hours

- High intensity short duration exercise: significant muscle glycogen replenished within 30-60mins and all within 24hrs

- Due to conversion of LA back into glycogen via **cori cycle**

- Replenishment occurs much more rapidly if a high carbs meal (200-300g) is consumed within 45-60mins after exercise - the **carbohydrate window**

The Slow replenishment stage (Lactacid Debt)

- 4. Meet the increased metabolic demands associated with an elevated body temperature
 - A 10°C rise in body temperature doubles the rate of metabolic reactions
 - Body temp doesn't change this much, but metabolism does speed up meaning more oxygen is required!