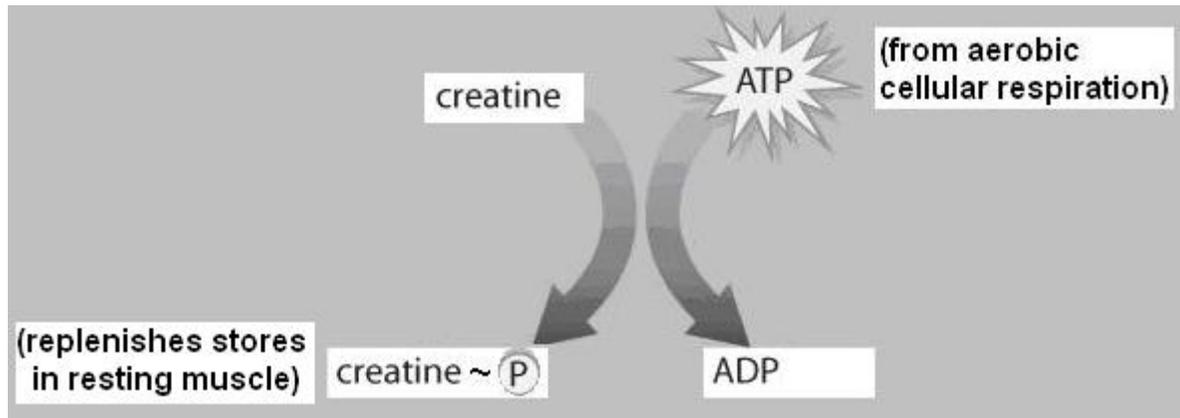


During strenuous exercise, when demand for the energy from ATP exceeds the supply available from aerobic respiration, oxygen deficit (debt) occurs. Oxygen debt can be defined as the difference between the amount of oxygen theoretically needed for the exercise and the amount actually consumed. This difference is the amount of oxygen needed to replenish the supplies of creatine phosphate plus the amount needed to eliminate the lactate produced by fermentation.

Breathing rate and depth remains elevated for some time after strenuous exercise. Cardiac output is also elevated. As both of these responses occur, the extra oxygen entering the cells replenishes creatine phosphate and eliminates lactate.

Replenishing the pool of creatine phosphate happens quite rapidly, right within the muscle fibre. High levels of aerobic cellular respiration (for which high breathing and heart rates supply adequate oxygen) occurs, and the ATP produced provides high energy phosphates to create creatine phosphate, as shown below.

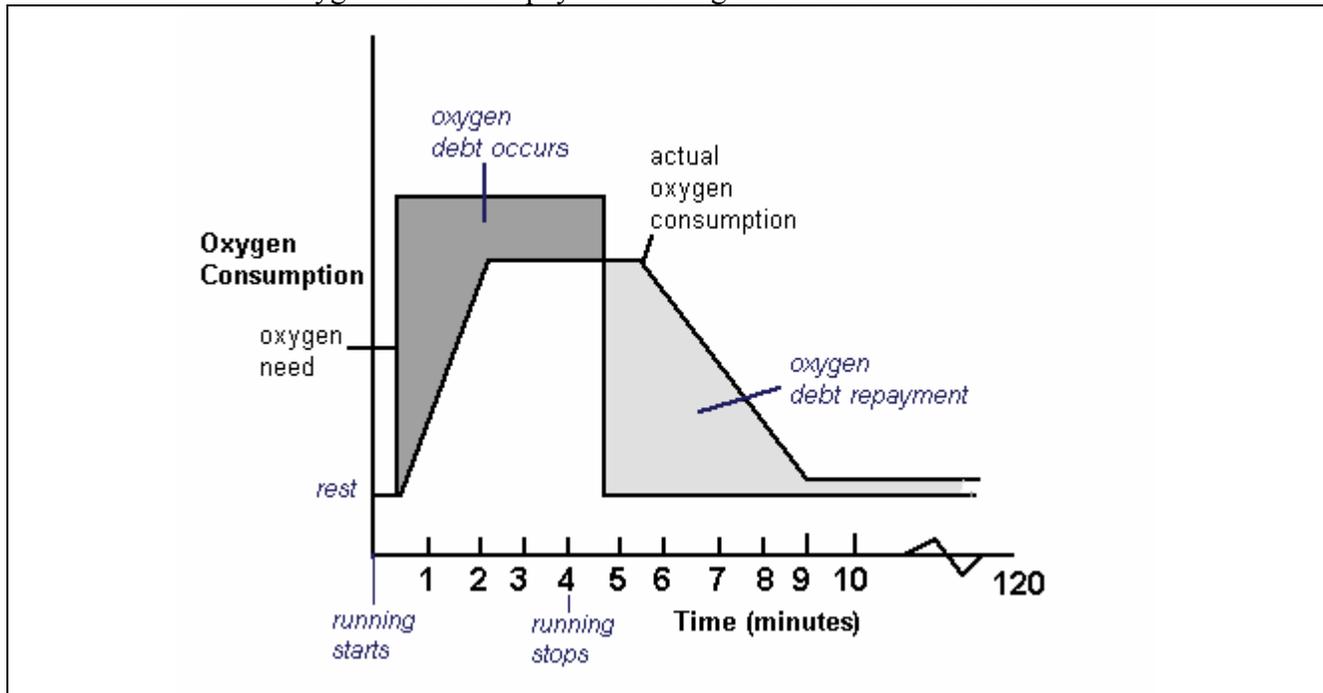


Elimination of lactate can take several hours of slightly increased oxygen consumption. During this time, lactate is carried in the blood from the muscle fibres to the liver, where it is synthesized into glycogen, using ATP from aerobic cellular respiration. Much later, muscle glycogen is restored using glucose from the liver.

The formation and the elimination of an oxygen debt may be represented in graphical form as shown on the following page. Study the graph and answer the questions that follow.

Oxygen Debt

Oxygen debt and repayment during and after a 4-minute dash



1. Why does oxygen need increase immediately when running starts, while actual oxygen consumption increases gradually?

2. What happens in muscle tissue as oxygen debt occurs?

3. Why does oxygen need decrease sharply when running stops?

4. Actual oxygen consumption is higher than oxygen need for many minutes after running stops. Why?
