Physiology Team

MEDICAL COLLAGE 433

Physical and Psychological Factors Affecting Sport Performance

Color Index

Red = important

Purple = Addition

Orange = Explanation

@PhysiologyTeam

Pht433@gmail.com

Contact us: pht433@gmail.com

Objectives

1- Muscle metabolic systems in exercise:
-Adenosine triphosphate
-Phosphocreatine
-Creatine system
-Glycogen
-lactic acid & aerobic system
2-Recovery of the muscle metabolic systems after exercise& Oxygen debt& Recovery of muscle glycogen
3-Nutrients used during muscle activity
4-Effect of smoking on pulmonary ventilation in exercise
5-Effect of heart disease and old age on athletic performance
6-Body fluids and salt in exercise
7-Drugs and athletes
8-Body fitness prolongs life

Contact us: pht433@gmail.com

Metabolic systems*

- 1- Phosphocreatine creatine system
- 2- glycogen lactic acid system
- 3- aerobic system

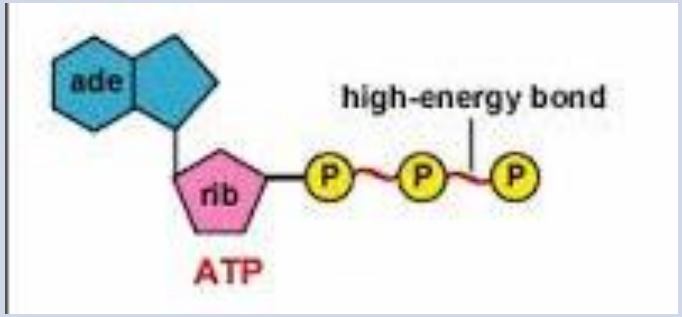
* These metabolic systems help in understanding the limits of physical exercise

Phosphagen energy system
- It is the combined amount of the cell's ATP + CP
-Maximal muscle power for 8-10 seconds
- Useful for maximal short bursts of mucle power

** **Most muscle cells have 2-4 times as much CP as ATP**

*** **½ as fast as the PHOSPHAGEN system**

Contact us: pht433@gmail.com

1- Adenosine triphosphate system	2- Creatine phosphate** system	3- Glycogen-lactic acid system (Anaerobic)
		During glycolysis : glycogen of the muscle split into glucose without use of O2, each glucose split into: Pyruvic acid + energy to form ATP (x4)
The last two phosphate bonds store high energy (7300 calories each)	The high energy phosphate bond has 10300 calories/mole	Can form ATP 2.5 times(anaerobically) faster than aerobic mechanism.
Breaking one bond converts ATP -> ADP, removal of one more bond ADP -> AMP	It provides enough energy to reconstruct the high energy bond of ATP	Can provide large ATP for short to moderate periods of contraction***
All ATP in muscle is sufficient for 3 seconds of muscle power	Energy of muscle CP is instantaneously available for contraction just as stored energy of ATP	1.3-1.6 minutes of maximal muscle activity (endurance time)
It is essential to form new ATP continuously even during performance of short athletic event	Energy transfer from CP -> ATP occurs in a fraction of a second	2.5 moles of ATP per minute

Metabolism of Glucose

2 stages

2- Aerobic:

- In the mitochondria
- Sufficient oxygen
- More ATP produced

1- Anaerobic:

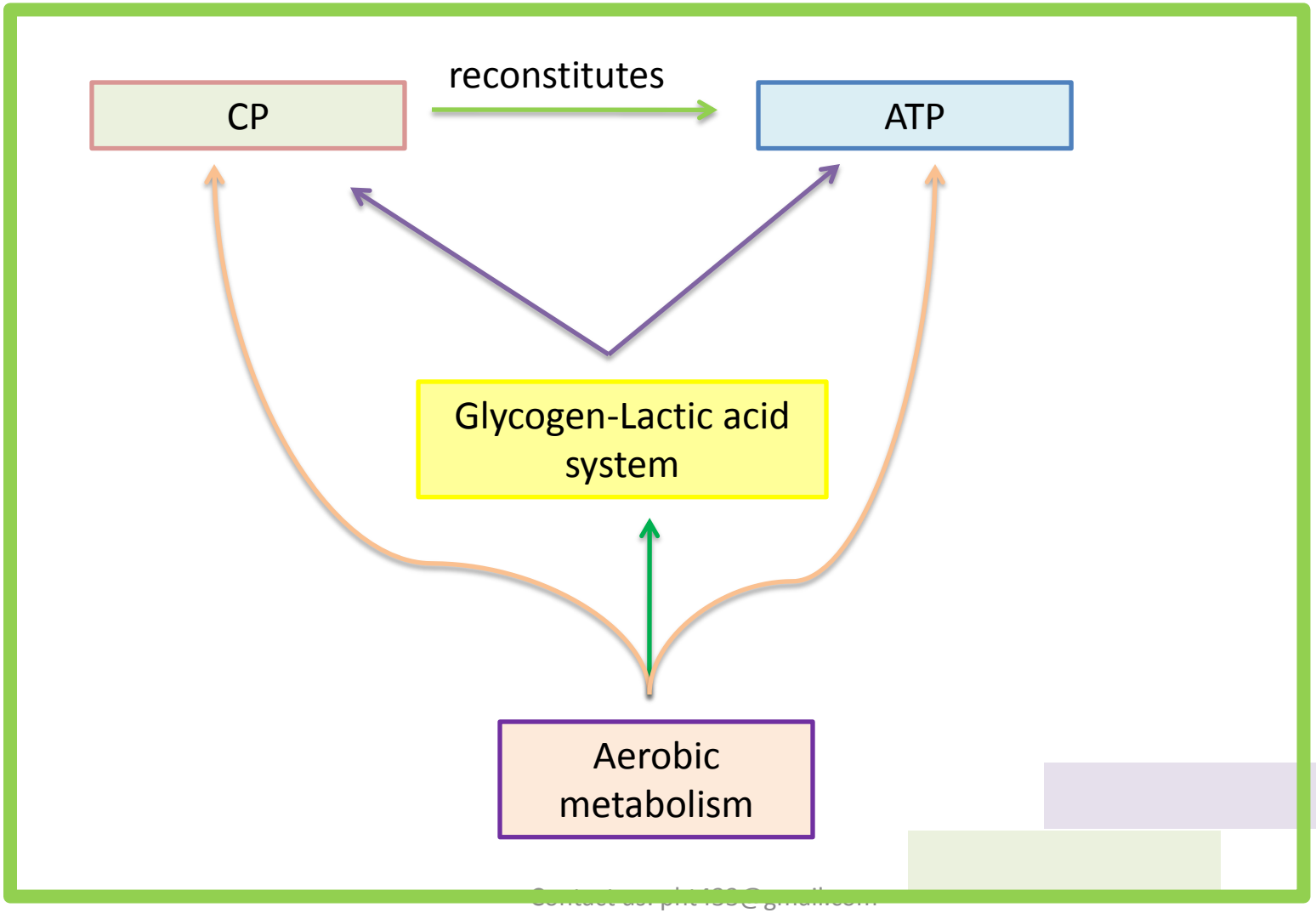
- In the cytoplasm
- Each glucose molecule is split into 2 pyruvic acids and 4 ATP molecules produced

In case of the Glycogen-lactic acid system: glucose is released from glycogen by glycogenolysis without oxygen then undergoes the anaerobic stage of glucose metabolism

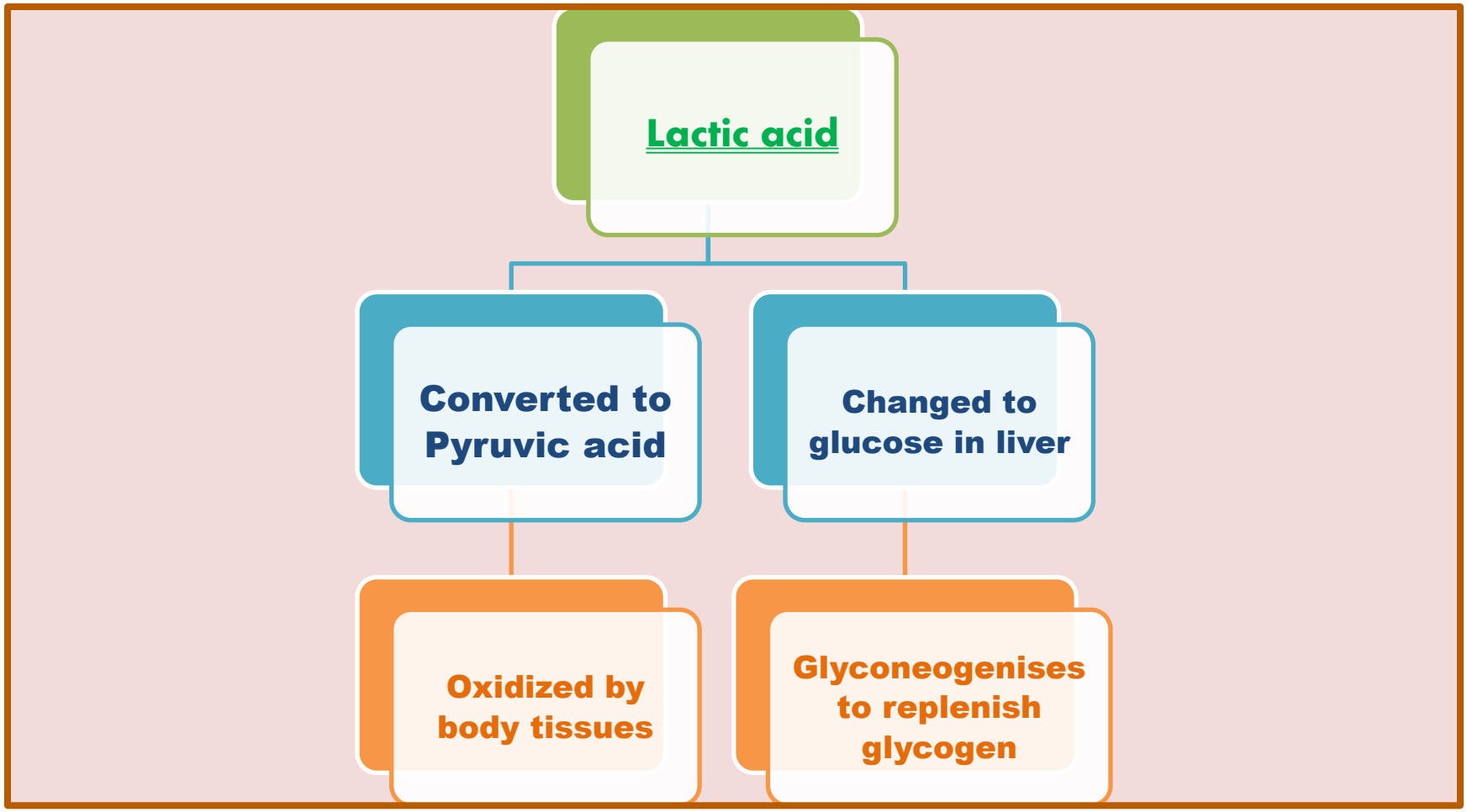
Contact us: pht433@gma

System	Endurance time	Moles of ATP per minute
Aerobic system	unlimited	1
Phosphagen	8-10 seconds	4
Glycogen-lactic acid	1.3-1.6 minutes	2.5

Recovery of Muscle after exercise

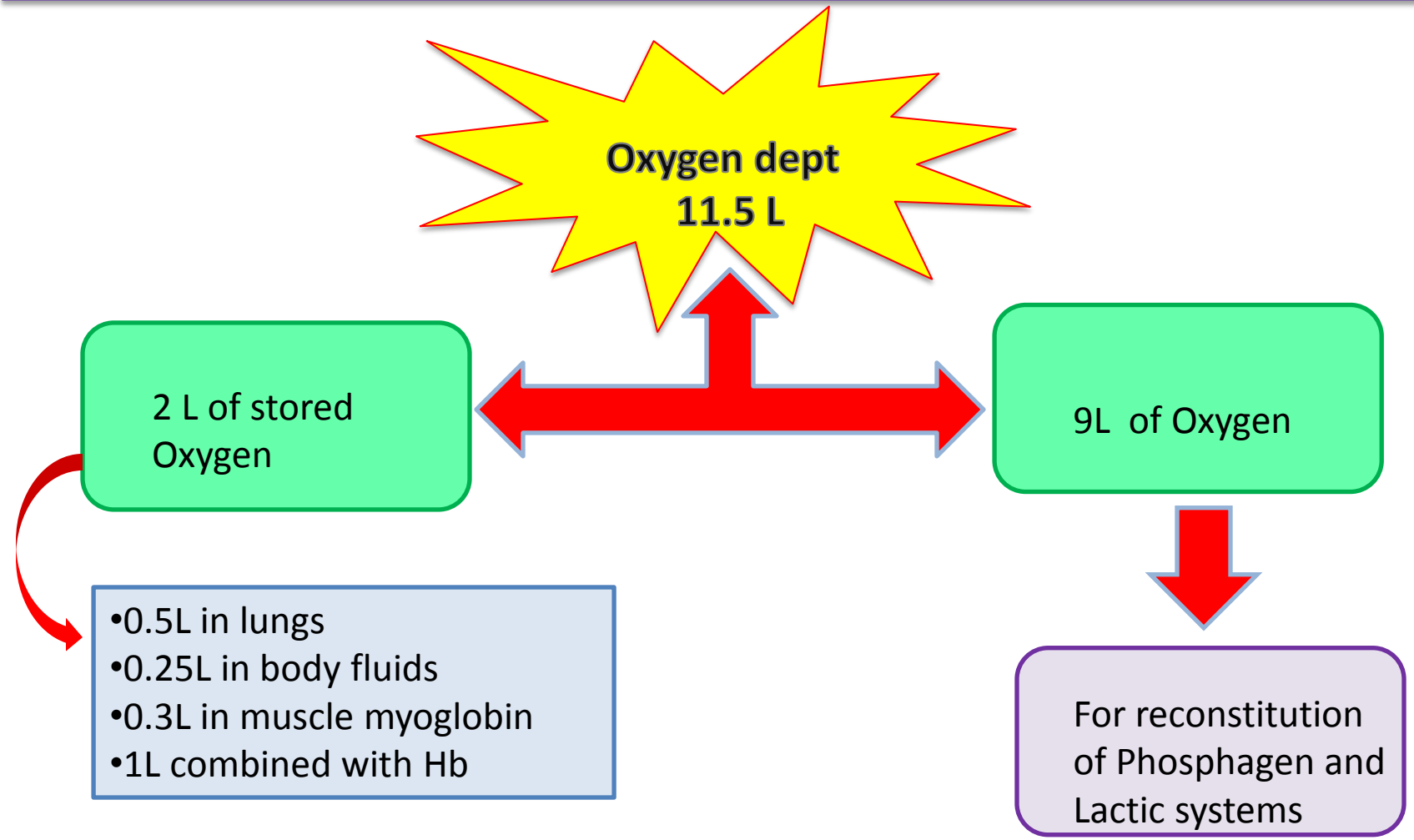


Reconstitution of Lactic acid



Contact us: pht433@gmail.com

Recovery of aerobic system after exercise

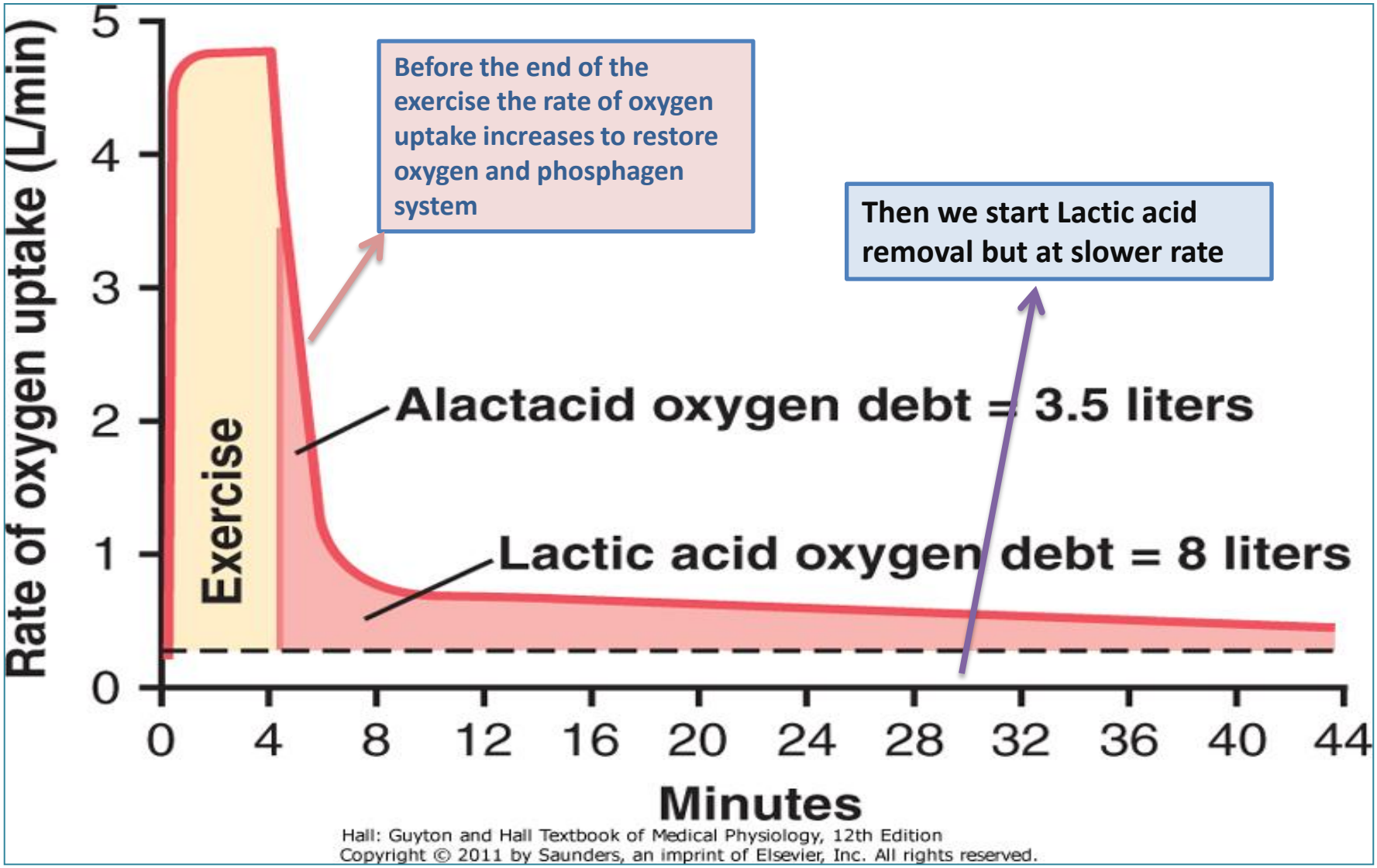


Cont.

At first O2 uptake is high & fast to replenish stored O2 & phosphagen system (this is called alactacid O2 dept = 3.5 L)

- The later portion of O2 dept takes 40 minutes for lactic acid system removal, it is of lower level breathing , it is called (lactic acid O2 dept =8 L)

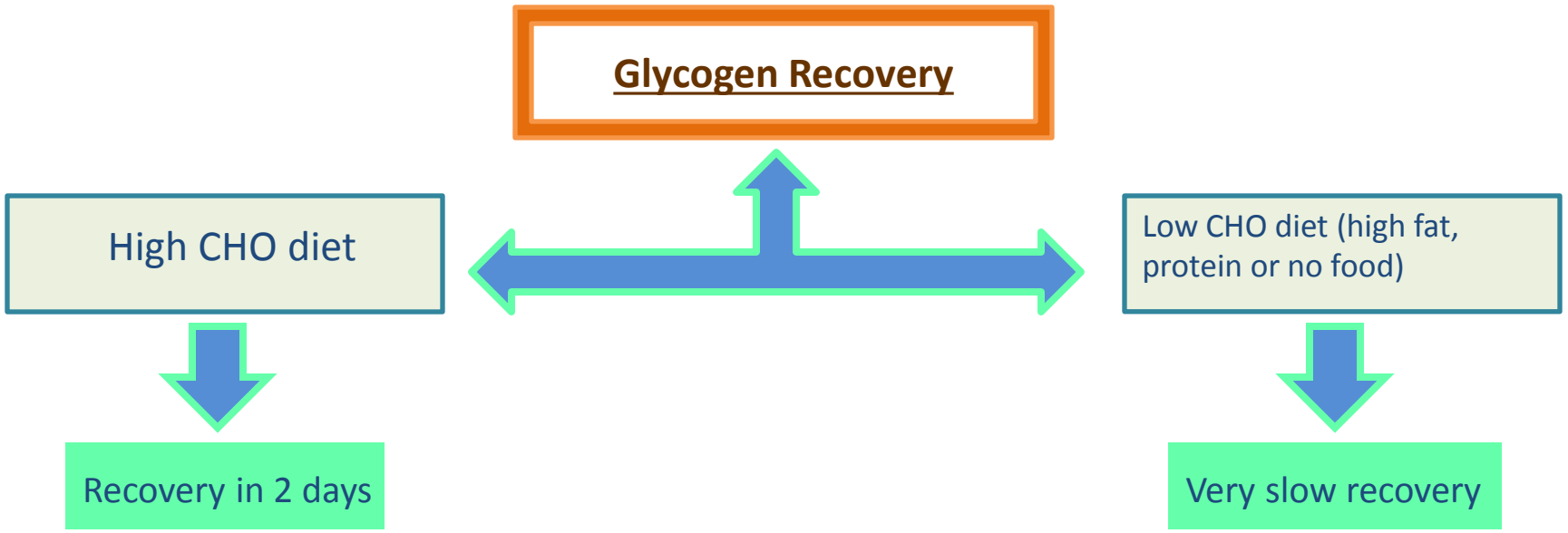
Oxygen Dept



Recovery of muscle glycogen

- **When exercising our body uses the glycogen stores in order to supply us with energy.**

But glycogen needs days to be replenished again



NB: **The athlete should try to have high carbohydrate diet and should avoid intense exercises at least 48 hours before the competition because we know that glycogen is the main source of energy, so it should not be depleted**

Nutrients used during muscle activity

- **During early stages of exercise& intense muscle activity → body use CHO of muscle glycogen and blood glucose ,also fats as Fatty Acid & very little amino acids**

- **In endurance → muscle glycogen is depleted& muscle depend on fats.**
- **CHO energy comes from muscle and liver glycogen**
- **Glucose solution given to athletes to drink during athletic event supply 30-40% of energy required during prolonged event as marathon race.**

Contact us: pht433@gmail.com

Effects of smoking on pulmonary ventilation in exercise

- **1-Nicotine causes:**
  - ** constriction of terminal bronchioles
  - **increases resistance of airflow into & out lung
  - ** paralyses the cilia on respiratory epithelial cell surface
- **Chronic smokers :** may develop **Emphysema** (obstruction of bronchiols+chronic bronchitis+destruction of alveoli)

  → so slight exercise cause respiratory pain.

- **2-Smoke irritation causes:**
  - **increased fluid secretion into bronchial tree
  - **swelling of epithelial layer

Effects of heart disease and old age on athletic performance

- **Cardiac diseases :**

  **Reduce cardiac output(C.O)

  **Reduce muscle power

Cardiac output: مقدار الدم الذي يضخه القلب في النبضة الواحدة

- **Athletic performance is related to age as well:**

  → Because as we grow older :

  **C.O decreases

  **Breathing capacity (ventilation rate) decreases

  **Muscle mass and power decreases

Contact us: pht433@gmail.com

Effects of body fluids and salts in excercise

Loss of large amounts of sweat during endurance athlete activity:

**reduce performance, (-5-10%) loss of weight.

**causes nausea, cramps and serious effects

Incase of losing too much sweat → we take:

**Sodium tablets (because we mainly loose NaCl when sweating)

**Fruit juice containing sodium and potassium

Potassium loss increases the secretion of aldosteron which may cause NaCl retention

Drugs and athletes

Drugs that ***increase*** athlete's performance

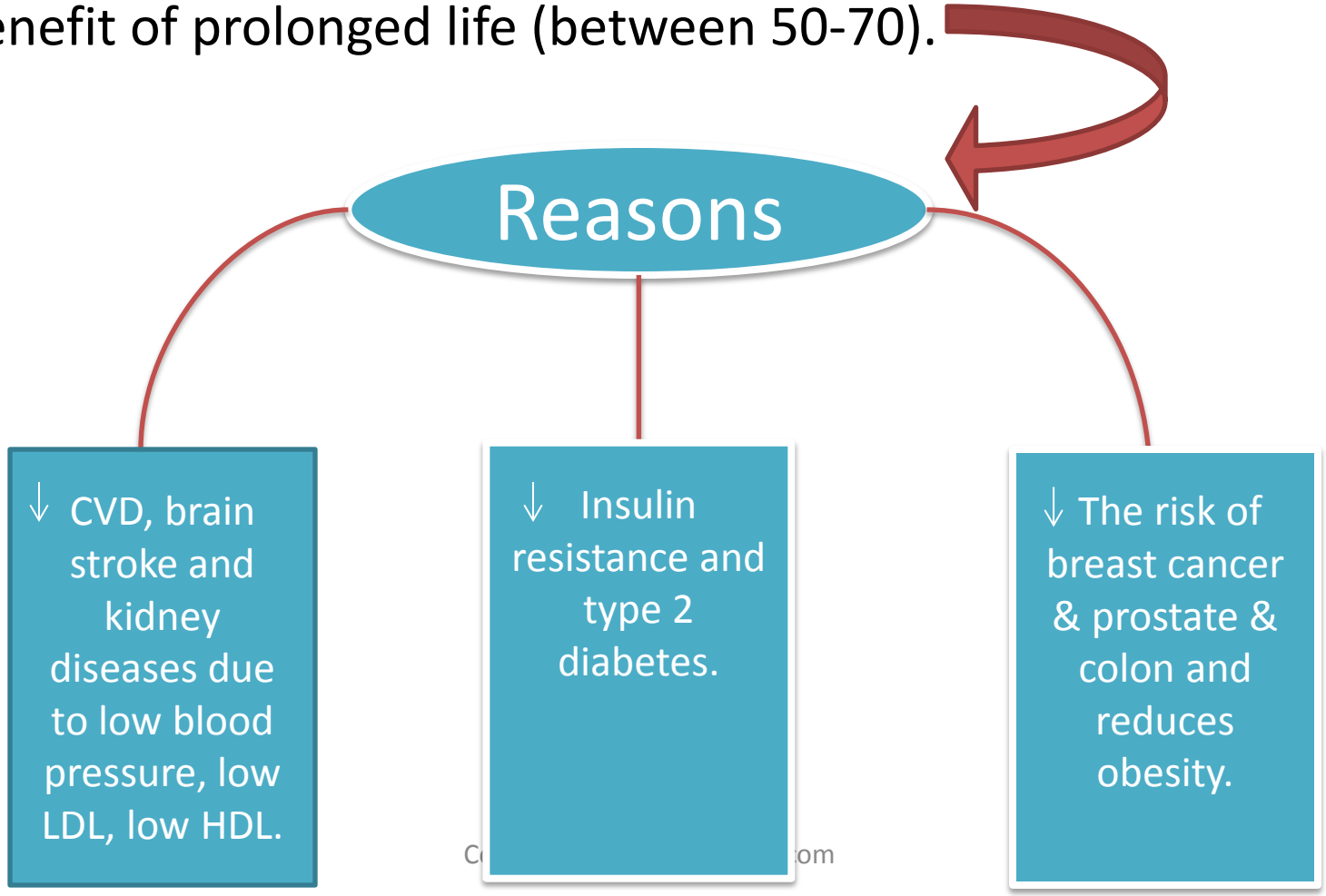
- Caffeine
- Steroids
- Male sex hormones = androgens = testosterone
- Amphetamine
- Cocaine

Increase the risk of heart attacks due to hypertension, in males it will decrease the testicular function and in women it will develop facial hair.

Reactions of these drugs with epinephrine and norepinephrine cause death.

Body fitness prolong life

- Body fitness, exercise and weight control have additional benefit of prolonged life (between 50-70).



Questions:

- Q1) In phosphgen energy system maximal muscle power is last for:
- **A)** 3-5 sec **B)** 5-7sec **C)** 8-10sec **D)** 12-15sec
- Q2) in the glycogen-lactic acid system the number of ATP molecule produce per minute is :
- **A)** 4 **B)** 2.5 **C)** 1 **D)** 12
- Q3) how many litters of oxygen is storage in the lung :
- **A)** .5 L **B).**25L **C).**3L **D)**1L
- Q4 lactic acid O2 dept take :
- **A)** 40 MINS **B)**30MINS **C)**50MINS **D)**60MINS
- Q5) which of these drug can interact with epinephrine – nor epinephrine causing death:
- **A)** caffeine **B)**make sex hormone **C)** amphetamine **D)** steroid

ANSWEARS : 1) C 2)B 3)A 4)A 5)C