



Factors in Athletic Performance

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- **Important**
- Further Explanation

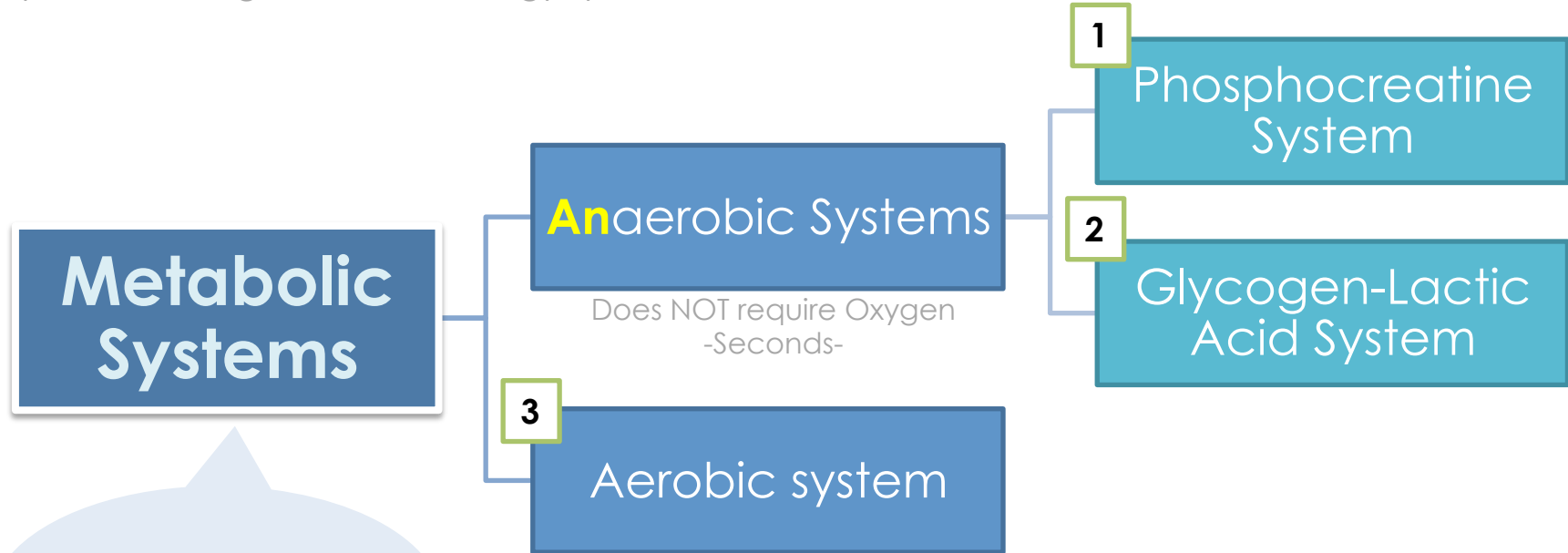
During exercise our body is working to supply energy to our muscles..

Where does energy come from?

There are 3 energy sources that our body uses for exercise: carbs, proteins and fats.

How does our body converts them to energy?

By the following metabolic Energy systems:



Anaerobic Systems

Does NOT require Oxygen
-Seconds-

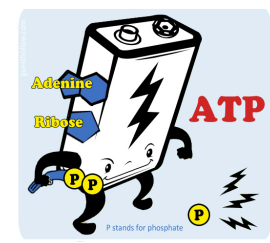
Aerobic system

Require Oxygen
-Prolonged-

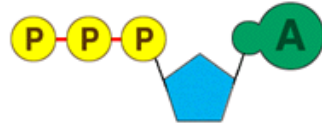
Exceedingly important in understanding the limits of physical activity

First we should know the main form of energy in our body which is :

Adenosine Triphosphate (ATP)



* Adenosine-PO₃ ~ PO₃ ~ PO₃.



*Each one of the last 2 high-energy phosphate bonds store **7300 calories**, which are used to energize the muscle contractile process. which is a very little amount!

*Removal of one bond converts ATP to ADP then removal of one more forms AMP.

* All ATP in muscle is sufficient for only **3 seconds** of muscle power (enough for one-half of a 50-meter dash).

* It is essential to form new ATP continuously even during performance of short athletic events.

Anaerobic system

1

Phosphocreatine System (Creatine-Phosphate system)

Contain high energy phosphate bond has 10300 calories/mole.

CP provide enough energy to
Reconstruct high-energy bond of ATP.

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

Energy transfer from CP to ATP occurs within a
Small fraction of a second.

Therefore, energy of muscle CP is available for contraction just as stored energy of ATP.

Phosphagen Energy System

Formed of combined amounts of cell **ATP+ CP**

Phosphagen Energy System provide maximal muscle power for **8-10 seconds** (enough for 100 meter run).
Which is still not enough!

Phosphagen Energy System is used for maximal short bursts of muscle power.

YouTube Helpful video

http://www.youtube.com/watch?v=jjSmiff4_w0&channel=KINprof

Anaerobic system

2

Glycogen-Lactic Acid System (Glycolysis)

During glycolysis glycogen of the muscle split into glucose *without use of O₂*.

Then each glucose split into
"2 pyruvic acid + energy to form 4 ATP "

Then pyruvic acid in the mitochondria in presence of O₂ will form more ATP (oxidative stage)

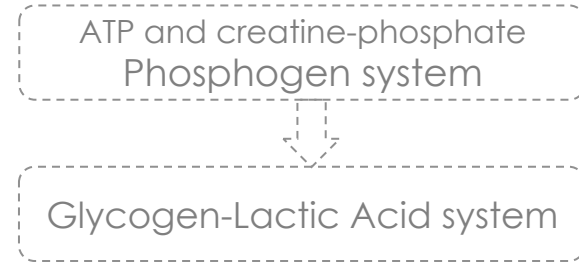
But When there is insufficient O₂ most of pyruvic acid converts into lactic acid, diffuse to blood stream.

Glycogen-lactic acid system can form ATP molecules (Anaerobically) **2.5 times** as rapidly as can oxidative mechanism of mitochondria.

Anaerobic Glycolysis can provide large ATP amounts needed for short-moderate periods of muscle contraction
($\frac{1}{2}$ as rapid as Phosphagen system)

Glycogen -lactic acid system provide
1.3-1.6 minutes of maximal muscle activity

Just a recap so far we know that the following is the sequence of systems our body use during exercise:



You Tube Helpful video

<http://www.youtube.com/watch?v=PU3yd5NkLkY>

Aerobic system

3

Aerobic process

Oxidation of foodstuffs glucose, Amino acids and fatty acids.

In the **mitochondria**

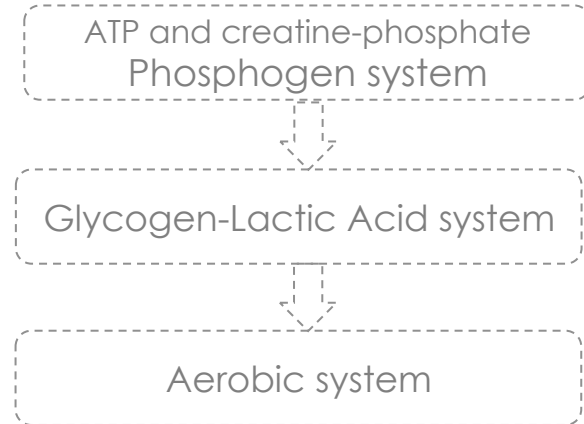
Presence of **oxygen**

Produces energy that converts AMP to ADP to ATP.

Large amount of energy which is enough for prolonged time of exercise.

The most important system that our body mainly depends on.

Just a recap the following is the sequence of systems our body use during exercise:



All the process as a whole will give us:

System	Moles of ATP/min	Endurance time
Phosphagen system	4 moles	8-10 seconds.
Glycogen-lactic acid system	2.5 moles	1.3-1.6 minutes.
Aerobic system	1 moles	Unlimited time as long as nutrients last

Note:

Both the anaerobic and aerobic systems are working at the beginning of exercise. The anaerobic system is providing most of the energy at first. BUT as the duration of exercise increases the aerobic system kicks in and becomes the main supplier of energy to our body.

Recovery of muscle metabolic systems after exercise

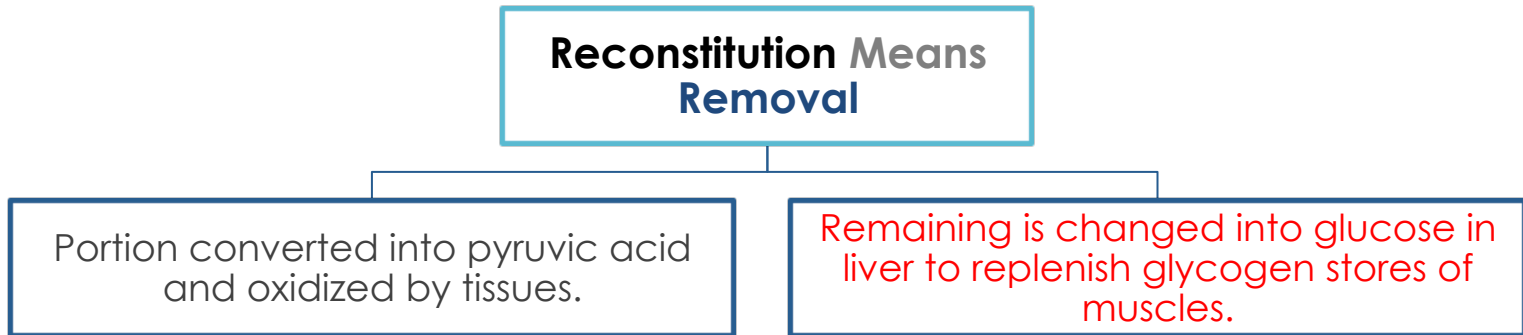
*Energy from CP reconstitute ATP.

*Energy from glycogen-lactic acid system reconstitute both CP&ATP.

*Energy from oxidative metabolism of aerobic system reconstitute all other systems:-
Glycogen-lactic acid system, CP & ATP

How to restore the amount of ATPs that has been used during exercise...?

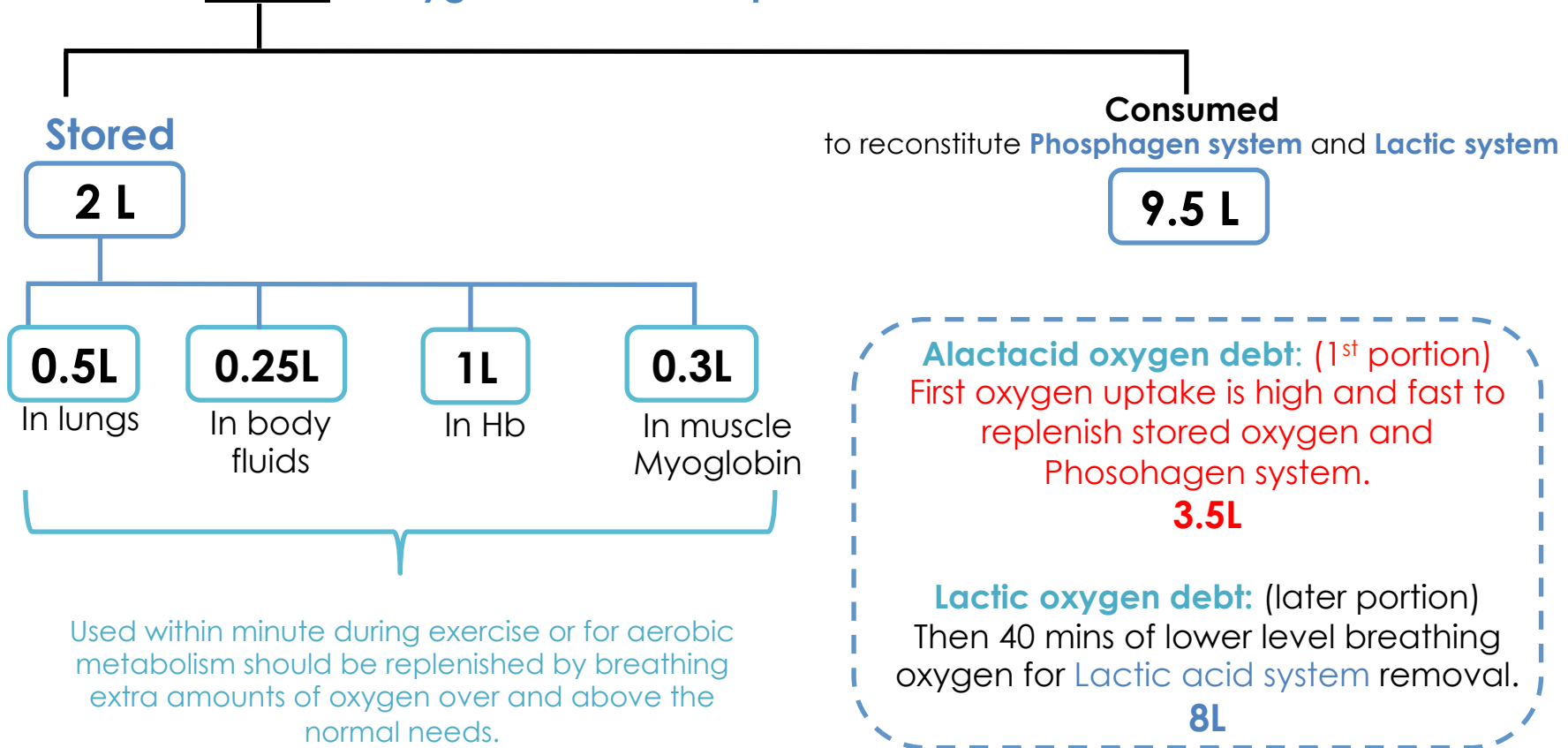
-Lactic acid causes fatigue so it is removed in **(Lactic Acid System)**



Recovery of Aerobic system after exercise

Oxygen debt :

*There is 11.5 L of oxygen should be repaid after exercise is over.



Recovery of muscle glycogen :-

- *Depletion of glycogen stores by heavy exercise needs days to be replenished.
- *On high Carbohydrates diet, recovery occurs in 2 days.
- *On high fat, high protein or on no food all show very little recovery.

Message

- *Athlete should have high CHO diet before exercise.
- *Not to participate in exhausting exercise during 48 hours preceding the event.

Physical & Physiological Factors Affecting Athletics' Performance

Body fluids and salts



Nutrients



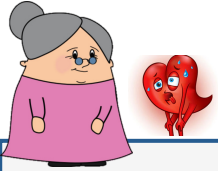
Smoking



Disease



Heart disease and old age



Physical & Physiological Factors Affecting Athletics' Performance

Sleep



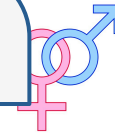
Drugs and athletes



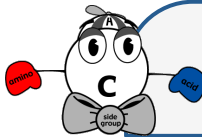
Oxygen availability



Gender



Glucose availability



Age



Nutrients used during muscle activity

During **early stages of exercise and intense muscle activity** : body uses **CHO** of muscle glycogen and blood glucose ,also fats as fatty acid and acetoacetic acid very little amino acids.

In **endurance athletic** (last longer than 4-5 hours and during exhaustion muscle) glycogen is depleted and 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.



Smoking on pulmonary ventilation in exercise

- **Nicotine causes:**

1. Constriction of terminal bronchioles.
2. Increases resistance of airflow into and out lung.
3. Paralyse the cilia on respiratory epithelial cell surface.

- **Smoke irritation causes:**

- 1- increased fluid secretion into bronchial tree.
- 2- swelling of epithelial layer.

All lead to fluid and waste accumulation and level of performance reduced.

Chronic smokers may develop **Emphysema** (obstruction of bronchioles+chronic bronchitis+destruction of alveoli) so slight exercise cause respiratory pain.

Body fluids and Salts in exercise

Exercise for 1 hour during endurance athletic event causes 5-10 pounds of weight loss in hot humid atmosphere due to sweat loss to remove metabolic waste heat , if sweating is intense may cause **Dehydration**.

Dehydration leads to :

1. constant rise in body temperature.
2. Increase in heart rate
3. Decreased stroke volume and cardiac output
- 4- Loss of enough sweat.

Loss of enough sweat during endurance athlete activity:

1. Reduce performance.
2. (5-10%) loss of weight .
3. Lead to **cramps**, **nausea** and serious effects .

In case of losing too much sweat we take :

1. Sodium tablets *because we lose NaCl when sweating.
2. supplemental fluids contain potassium and sodium in form of fruit juice.

*Potassium loss results increased secretion of **aldosterone** then loss of potassium in the urine, and sweat.

Heart disease and Old age

* Cardiac disease:

1. Reduce cardiac output (C.O)
2. Reduce muscle power.

(C.O) : The volume of blood pumped by the heart per minute .

Patient with CHF can not climb the bed. (Congestive Heart Failure)

* Old age :

1. There is 50% decrease in C.O between 18-80 years.
2. Decrease in breathing capacity.
3. Decrease muscle mass and power.

Drugs and Athletes

1. **Caffeine** increase athletes performance.

2. **Anabolic steroids and androgens** (e.g., Testosterone) :

These are used by some athletes (of both sexes) to **increase their muscle mass**, allow the athlete to train harder and thereby enhance their physical performance . Their use in sport competitions is **illegal**.

They have **harmful side-effects** such as

- Raised blood pressure .
- They increase risk of heart attacks due to hypertension.
- In males male sex hormones decrease testicular functions and decrease natural testosterone
- In women develop facial hair,stoppage of menses,ruddy skin and bass voice.

Drugs and Athletes

3- Stimulants

1. Increase reaction speed (i.e., decrease reaction-time).
2. Reduce perception of pain.
3. Raise aggression.
4. Highly addictive .

Side-effects :

1. high blood pressure.
2. cardiac problems.
3. Strokes and liver disease .

4- Narcotic analgesics

These are **pain killers** which athletes use to mask pain from an injury or overtraining .

They are also highly addictive and cause withdrawal symptoms when the athlete stops using them.

5- amphetamine and cocaine

Improve performance but **overuse** reduce performance .

They are psychic stimuli-reaction of these drugs with **Epinephrene and Norepinephrene** secreted during exercise cause death by ventricular fibrillation

<h2>Glucose availability</h2>	<ul style="list-style-type: none"> - Plasma glucose is maintained by an equal rate of glucose appearance (<u>entry into the blood</u>) and glucose disposal (<u>removal from the blood</u>). -In the healthy individual, rate of appearance and disposal are essentially <u>equal</u> during exercise of moderate intensity and duration; However, prolonged , intense exercise can result in (<u>a fall in blood glucose level and the onset of fatigue</u>) -During exercise , rate of glucose appearance depends mainly on the <u>liver (glycogenolysis & gluconeogenesis)</u> , and to a lesser extent, on absorption from the gut.
<h2>Oxygen availability</h2>	<p>depends upon..</p> <ol style="list-style-type: none"> 1. Cardiac output (the quantity of blood distributed by the heart) , 2. The ability of the lung to oxygenate the blood , 3. Arterio-venous (a-v) oxygen difference (i.e., the ability of the exercising muscle to take up oxygen from blood).
<h2>Age</h2>	<p>youth are better in sport performance than elderly</p>
<h2>Gender</h2>	<p><u>men</u> can perform better than <u>women</u> because of the <u>body build, physical ability and menstruation for women.</u></p>
<h2>Sleep</h2>	<p>- Lack of sleep makes the athlete nervous and irritable.</p>
<h2>Disease</h2>	<ul style="list-style-type: none"> - Musculoskeletal disease (sprain, disk etc) - general disease (bronchial asthma, cold etc)

Sprain > Ligament
Strain > Muscles

Body fitness prolongs life 😊

Multiple studies have shown that body fitness, exercise and weight control have additional benefit of prolonged life (50-70) or even more.

Reduce:

Cardiovascular diseases (CVD), heart attacks, brain stroke and kidney disease

Due to: low blood pressure, blood cholesterol and LDL, high HDL

Reduce:

-Insulin resistance and type 2 diabetes.

-The risk of cancer (breast, prostate and colon)

-Obesity



LDL: low-density lipoprotein
HDL: high density lipoprotein

Sport Psychology

(Study of **Psychological Factors** that affect *participation* and *performance* in sports)

Personality Type

Other Factors

Introverts

"precision, self-motivation, low arousal level, individual performances"

Extroverts

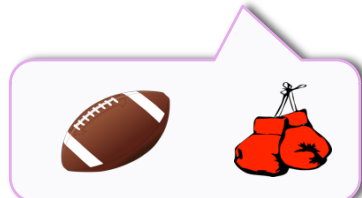
"exciting, team sports, high arousal level, large/simple skills"

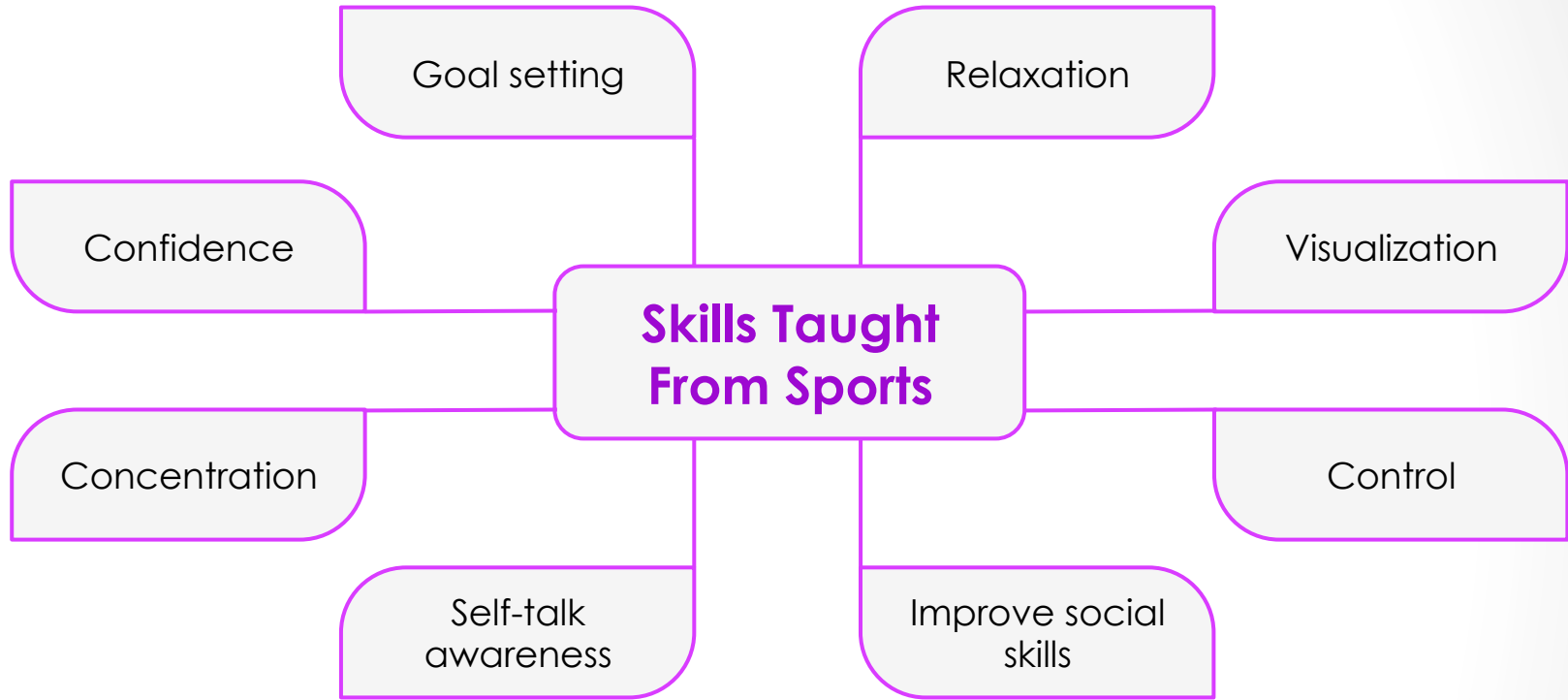
Aggression

"useful or harmful"

Depression/Lack of Motivation

"harmful"





-Sports played for *fun*, staying in *good physical condition* (exercising), or as source of *entertainment* (professional sport).

Overtraining Syndrome

(A chronic, exhausting, body-weakening condition)

- Occurs when the athlete, (while stale with impaired effectiveness), is pushed/forced to continue training at high intensity, (e.g. by a coach).

Signs

1. Decreased concentration.
2. Irritability and increased anger.
3. Slowed mental function.
4. Diminished self-esteem.

Symptoms

1. Fatigue and tiredness.
2. Reduced levels of performance.
3. Decreased ability to recover.
4. Inability to exceed former.

Disadvantageous Stages

Overtraining

Staleness

Overreaching

Burnout

Injury/
Withdrawal



MCQs

1-Which one of the following arrangements is true if we arrange them gradually from the fastest to the slowest :

- A. Phosphagen system > aerobic > anaerobic
- B. Anaerobic > Phosphagen system > Aerobic
- C. Phosphagen system > Anaerobic > Aerobic

2-The recovery of muscle glycogen is :

- A. Rapid and doesn't affected by the individual diet
- B. Slow and affected by the individual diet
- C. Slow and doesn't affected by the individual diet

3-Which one of the following is NOT true :

- A. Nicotine decreases the resistance of airflow into and out of lung .
- B. Smoking can cause swelling of epithelial linings .
- C. Smoking can led to fluid accumulations in the bronchi

4-In a healthy individual the relationship between glucose appearance and glucose disposal is :

- A. The glucose appearance greater than glucose disposal
- B. The glucose appearance lesser than glucose disposal
- C. The glucose appearance equals glucose disposal

5-During exercise the rate of glucose appearance mainly depend on :

- A. Glycolysis vs glycogenolysis
- B. Glycogenolysis and gluconeogenesis
- C. Glycogenesis and glycolysis

Answers:

- 1.C
- 2.B
- 3.A
- 4.C
- 5.B

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