Let's Excel Together

CANADIAN ACADEMY OF SPORTS NUTRITION

Lecture 6:

Energy Systems in The Body

(Part 1)

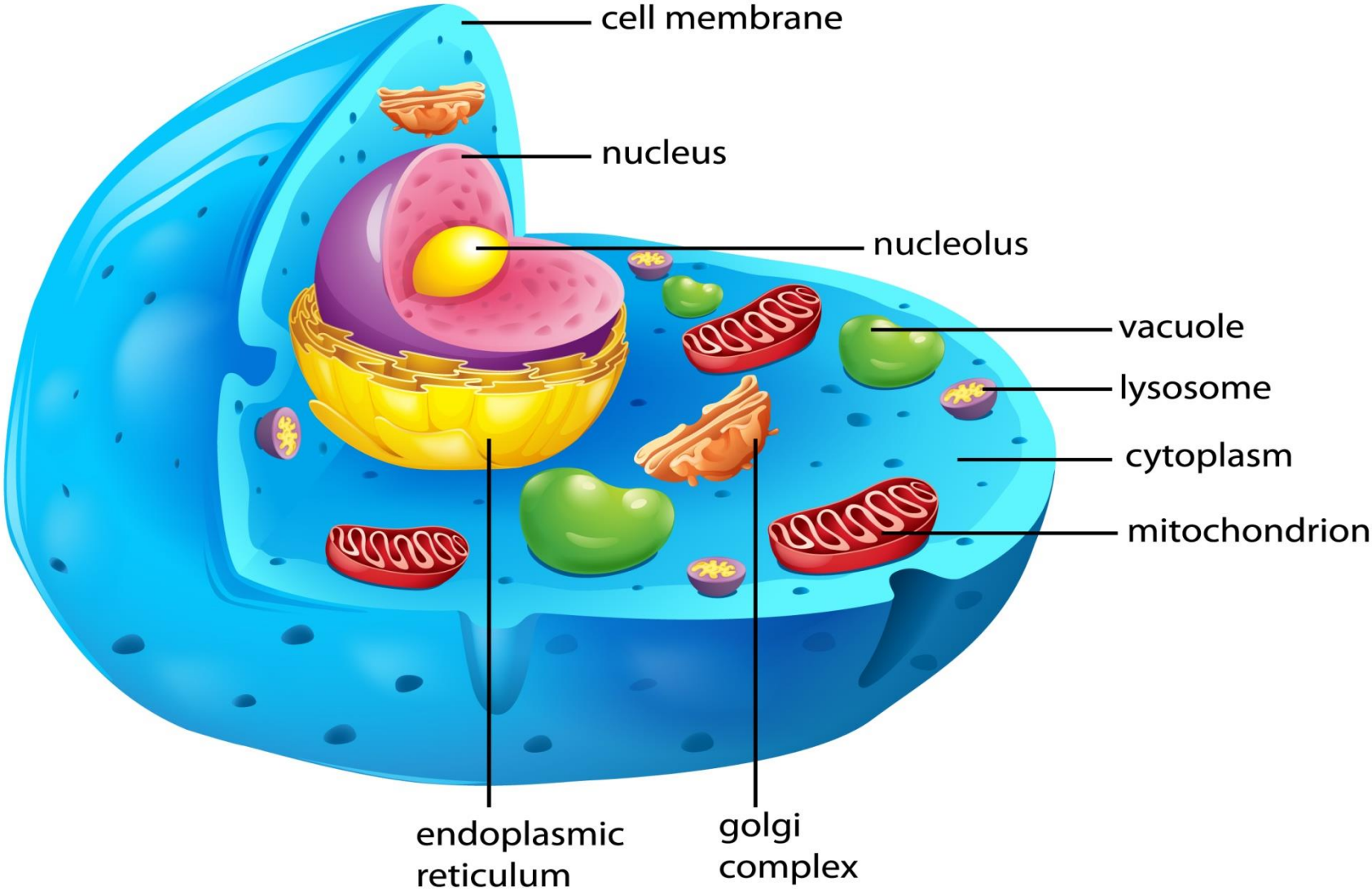
Copyright Protection:

The human body needs a continuous supply of energy to function optimally, and any physical activity demands more energy production.

The energy stored in chemical bonds of carbohydrates, proteins, and fats is released as ATP (adenosine triphosphate) through complicated yet precise cascade chemical reactions.

Which organ in a cell is responsible for producing energy?

Anatomy of an Animal Cell



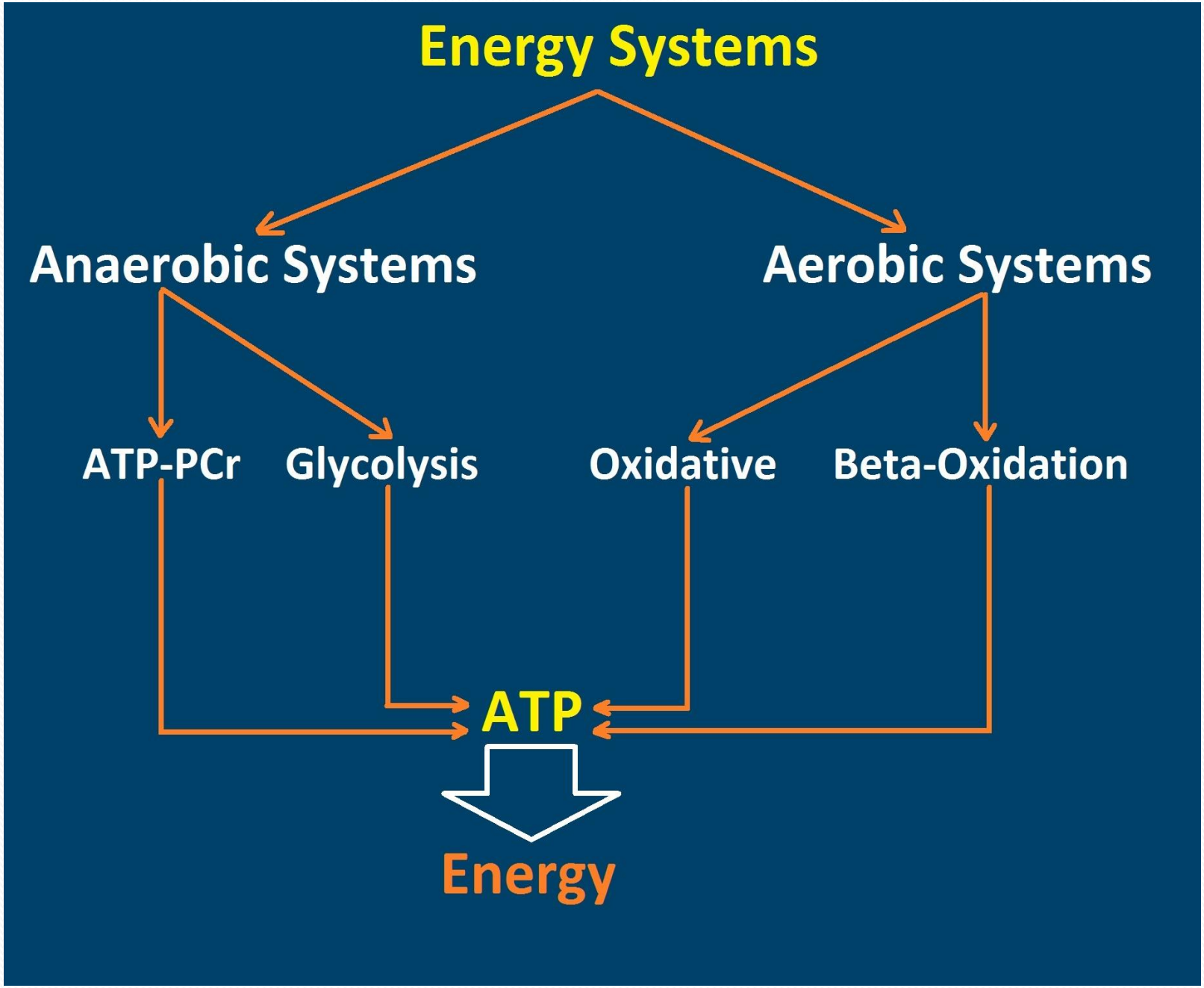
What is ATP (adenosine triphosphate)?

- **ATP is an energy carrier in the body that contains energy within its phosphate bonds.**
- **After breaking down, it releases the energy required for the body to be utilized by every single cells.**
- **The final outcome of the energy systems in the body is to produce ATP.**

The Energy Systems in Human:

- **The energy systems in human are anaerobic and aerobic systems.**

- **The anaerobic systems do not need oxygen to produce ATP, while the aerobic systems do need oxygen to do so.**

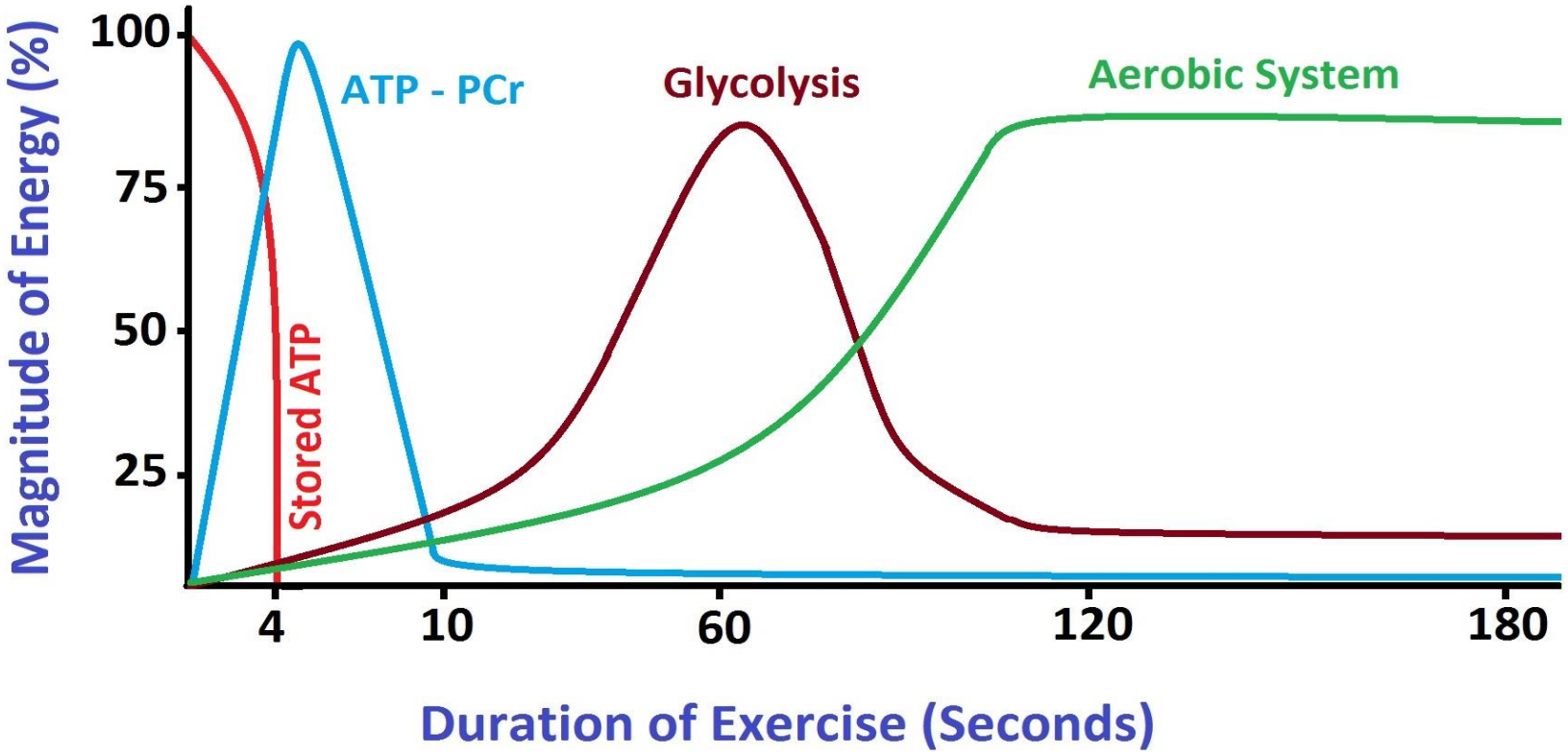

Energy Systems
Anaerobic Systems
Aerobic Systems
ATP-PCr
Glycolysis
Oxidative
Beta-Oxidation
ATP
Energy

Overlapping Energy Systems:

- **All energy systems work together at any one time.**
- **Depending on intensity and duration of an exercise or a sport, one of the systems is usually dominant.**
- **In fact, there is always an overlap among the systems with one being the primary source of energy and the others being the secondary.**

- **The energy system which is the primary source of energy for a specific sport or exercise is called the "Dominant Energy System", and the secondary energy systems are called the "Non – Dominant Energy Systems".**

Overlapping Energy Systems



- **For example, during a 100 meters dash event or lifting a heavy weight, ATP – PCr is the dominant energy system and glycolysis is the non – dominant energy system.**

- **During a 200 meters dash or a 100 meters backstroke swimming, glycolysis is the dominant energy system and ATP – PCr and aerobic systems are the non – dominant energy systems.**

Sports	ATP - CP	Glycolysis	Aerobic
Archery	95%	5%	0%
100 m dash	95%	5%	0%
200 m dash	25%	65%	10%
Marathon	0%	0%	100%
Football	25%	40%	35%
Ice Hockey	30%	60%	10%
Swimming (800 m, freestyle)	0%	35%	65%

Energy Systems in Different Sports:

- **See "Athletic Events" in our website.**

Why You Need to Know Dominant Energy Systems in Sports?

- **The answer is: To provide better guidance for an optimal manipulation of the energy system.**

- **For examples:**

1) Weight lifter……Creatine Monohydarte

2) Ice Hockey Player……Beta – Alanine

3) Half Marathon Runner……L – Carnitine

ATP – PCr System:

- Also called as **immediate energy system, phosphagen system,** and **alactic anaerobic system**.

- ATP – PCr system is the main energy provider for a high intensity exercise of short duration up to **10 seconds**, for example lifting a weight, swinging a golf club, doing a push – up, and throwing a hammer.

- **ATP is the primary energy currency of the body and when hydrolyzed, it releases a lot of energy that results in muscle contraction and protein synthesis.**

ATP + Water ⟶ ADP + Phosphate + Energy

The body has a limited storage of ATP, about 100 grams at any time under a normal resting condition.

The stored amounts of ATP and PCr are used up within approximately 10 seconds of an intense exercise or an explosive movement.

- ATP + Water ⟶ ADP + Phosphate + Energy

- ADP + PCr ⟶ ATP + creatine + energy

ADP + PCr ⟶ ATP + creatine + energy

water

Energy

- PCr in the muscles comes from three sources:

1) PCr made from creatine in the liver

2) PCr made from creatine in the muscles

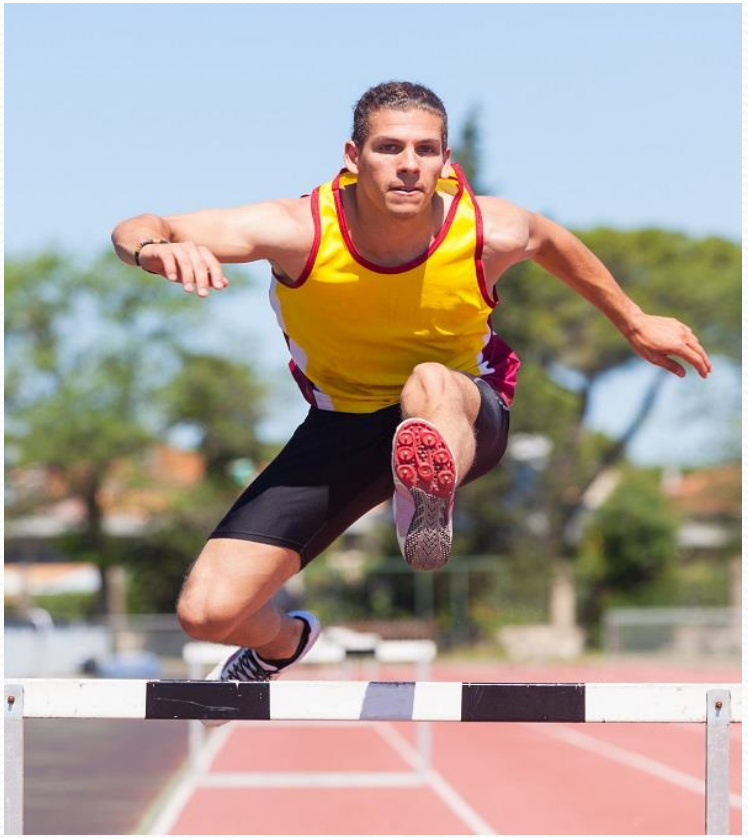
3) PCr made from ATP in the muscles.

Sports with Dominating ATP – PCr System:

a) Archery.

b) Athletics:

- 100 m dash.
- 100 m hurdles, women.
- 110 m hurdles, men.
- 4x100 m relay.
- Discus throw, Hammer throw, Javelin throw, Shot put, Pole vault, High jump, Long jump, and Triple jump.



c) Baseball.

d) Basketball.

e) Cricket.

f) Curling.

g) Diving.

h) Fencing.

i) Golf.

j) Gymnastics:

- Artistic gymnastics.

- Rhythmic gymnastics.

k) Hockey (field).

l) Judo.

m) Lacrosse.

n) Rugby (union, and league).

o) Sailing.

p) Shooting.

q) Skiing:

- Ski jumping (all events).
- Nordic skiing (individual, ski jumping 70 m).
- Freestyle skiing (aerials).

r) Softball.

s) Table tennis.

t) Volleyball.

u) Weightlifting.

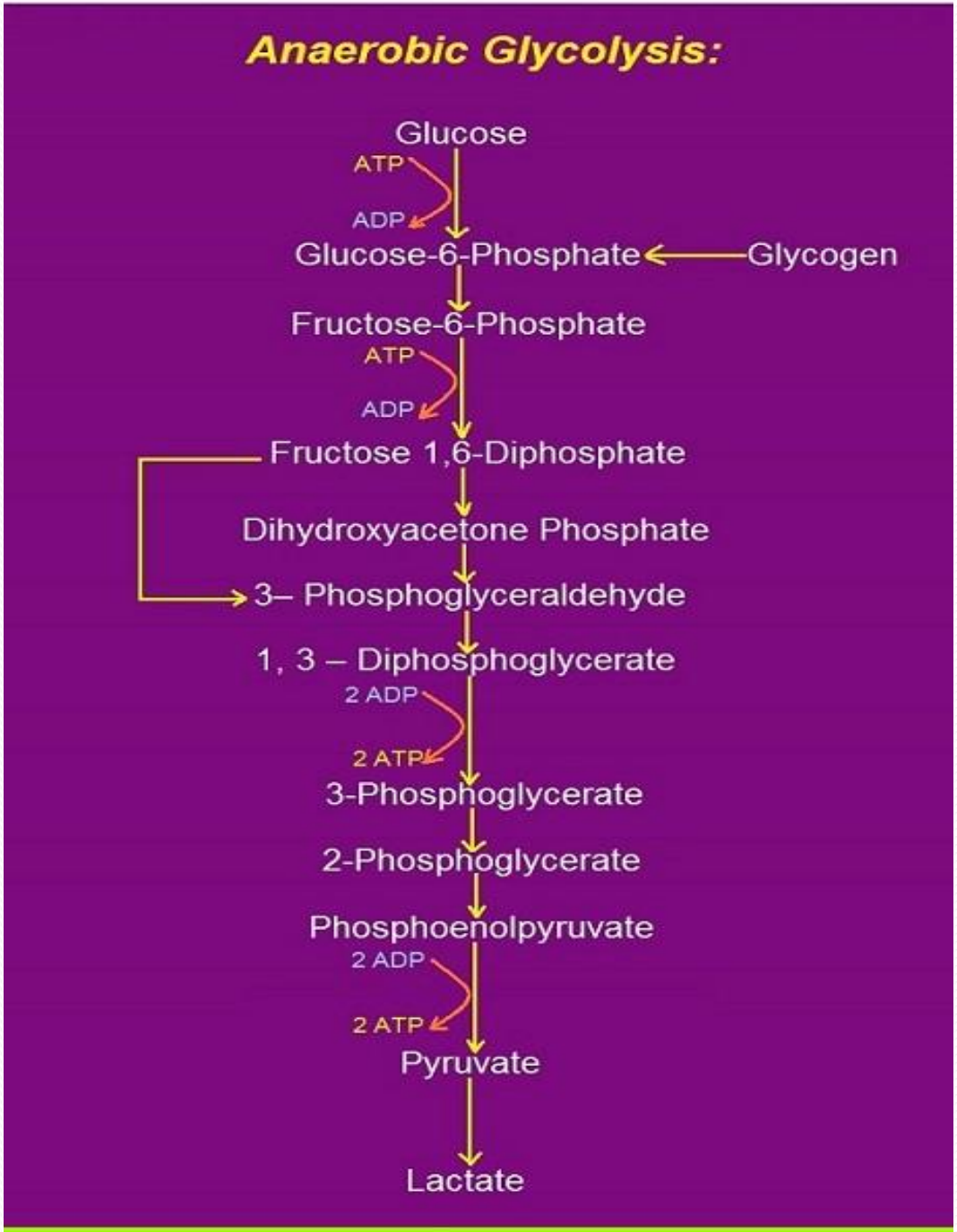
Anaerobic Glycolysis:

- **It is also called "short – term energy system" and "lactic acid system". It is the main provider of ATP during intense exercise that lasts 10 – 120 seconds.**

- **As an exercise continues more than 10 seconds, the anaerobic glycolytic system takes charge of providing ATP.**

- **This system uses glucose in the blood or glycogen to form ATP rapidly without oxygen.**

- **If glucose is used, it generates 2 ATP, while if glycogen is used, it forms 3 ATP.**



- **The end product of this energy system is lactic acid.**

- **As lactic acid accumulates, the production of ATP via anaerobic glycolysis starts declining. This system provides ATP for up to 2 – 3 minutes.**

- **If exercise continues beyond 2 – 3 minutes, either the intensity of exercise should be decreased or the body would switch to aerobic systems to use oxygen to produce ATP.**

Sports with Dominating Anaerobic Glycolysis System:

a) Athletics:

- 200 m dash.

- 400 m dash.

- 800 m dash.

- 400 m hurdles.

- 4 x 400 m relay.

b) Badminton.

c) Canoe/Kayak:

- Slalom events (all events).

- Sprint, women`s events (all events).

- Sprint, men`s events (C-1 200 m canoe single, K-1 200 kayak single, and K-2 200 kayak double).

d) Cycling, BMX events.

e) Football (soccer).

f) Gymnastics:

- acrobatic events (all events).

g) Handball.

h) Hockey (ice).

i) Luge.

j) Rugby 7.

k) Skating:

- Speed skating

(1500 m, 1000 m, 500 m).

- Short track speed skating

(1500 m, 1000 m, 500 m).

l) Skiing:

- Alpine skiing (all events).

- Freestyle skiing (half-pipe, moguls, slope style).

- Snowboarding (half-pipe, giant parallel slalom, parallel slalom, slope style, snowboard cross).

- Cross – country skiing (sprint, 1.5 km).

m) Swimming:

- Freestyle swimming (50 m, 100 m, 4x100 m relay).

- Backstroke swimming (100 m).

- Breaststroke swimming (100 m).

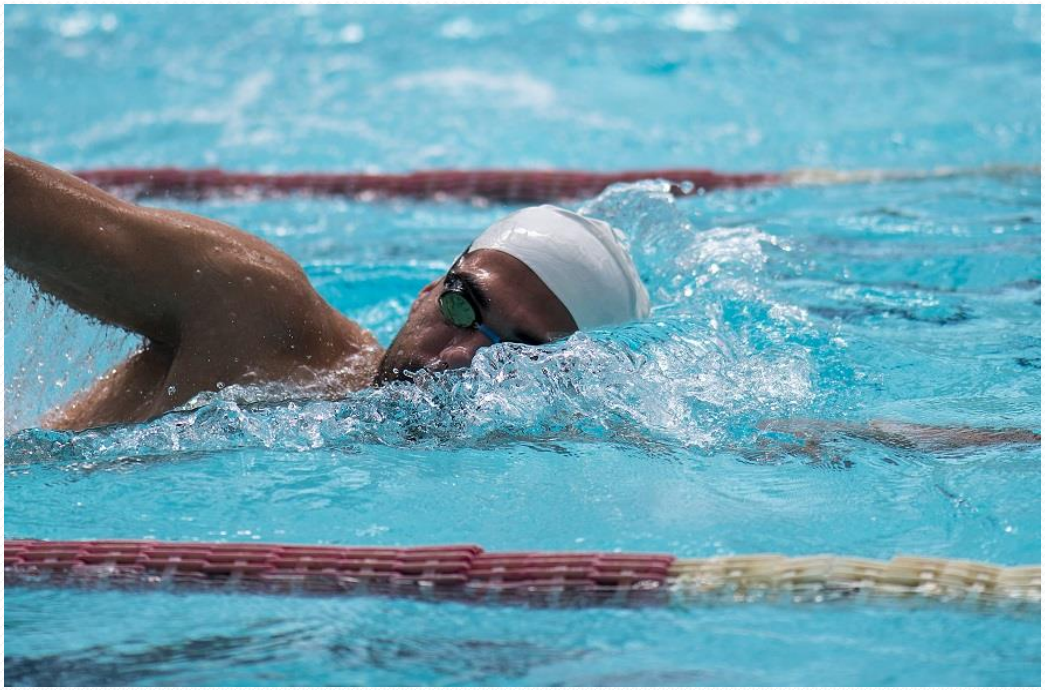
- Medley swimming (4x100 m relay).

n) Taekwondo.

o) Tennis.

p) Water polo.

q) Wrestling.



Homework:

- **1) Describe how ATP – PCr system works and name at least 5 sports in which the ATP – PCr system is dominating.**

- **2) Describe briefly how Glycolysis system works and name at least 5 sports in which this system is dominating.**