



Sport and exercise nutrition



Yaseen Galali
Nutrition Department

COURSE OUTLINE!

Part 1: The science of nutrition and sport

1- Introduction to sport and exercise nutrition

2-Energy for sport and exercise

3- Digestion and absorption of macro nutrient for sport exercise

4-Dietary assessment

5-diet planning

LEARNING OUTCOMES

Upon completion of this part you will be able to:

- **compare** and **contrast** physical activity, exercise and sport
- **Describe different types** of sport and exercise, and relate these to differing physiological processes and adaptations
- Measure **exercise performance** and **intensity**
- Describe the principles of **exercise prescription**
- Describe **muscle types** and **actions**
- Explain the body's **physiological response** and **chronic adaptations to exercise**

PART 2: NUTRITION FOR EXERCISE

9-Macronutrient periodisation

10-Exercise nutrition

11-Hydration

12-sports supplement

13-changing body composition

LEARNING OUTCOME

Upon completion of this chapter you will be able to:

- Understand that an athlete's **training/competition schedule** involves changes in the **type, quantity and goals** of exercise sessions, which should be supported by changes in energy and macronutrient intake
- appreciate that different **dietary strategies** can enhance the muscle's capacity to use **different fuels** (such as fat vs carbohydrate), which may play a role in enhancing competition performance
- understand the true meaning of '**metabolic flexibility**' and some of the ways in which this concept is currently being used or misused
- be aware of an emerging theme in sports nutrition whereby nutrient support around training can be provided to promote **performance/recovery** or withdrawn to increase the training stimulus/adaptation.

PART 3: APPLIED SPORT NUTRITION

- 15-strength and power athletes
- 16-Team sport athletes
- 17-Weight category and aesthetic
- 18-Young athletes
- 19-master athletes
- 20-Paralympic athletes
- 21 Travelling athletes
- 22-Environmental and climate consideration for athletes.
- 23-Gastrointestinal disturbance in athletes.
- 24-nutrition support for injury management

LEARNING OUTCOME!

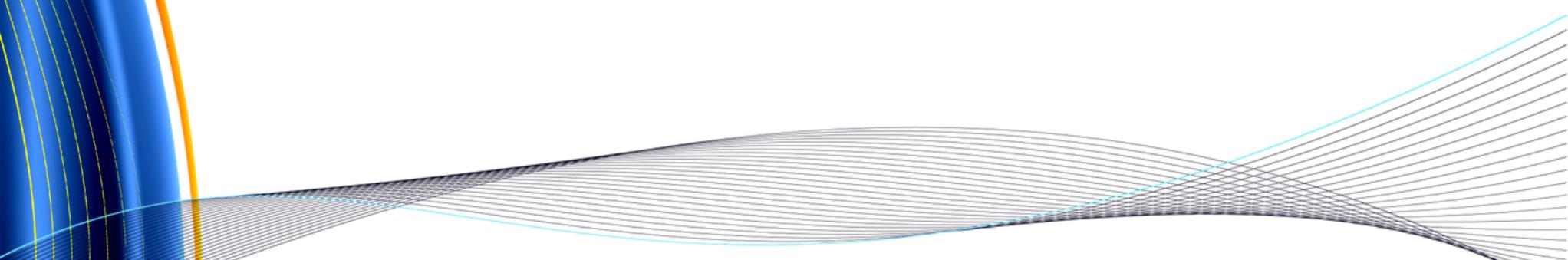
Upon completion of this chapter you will be able to:

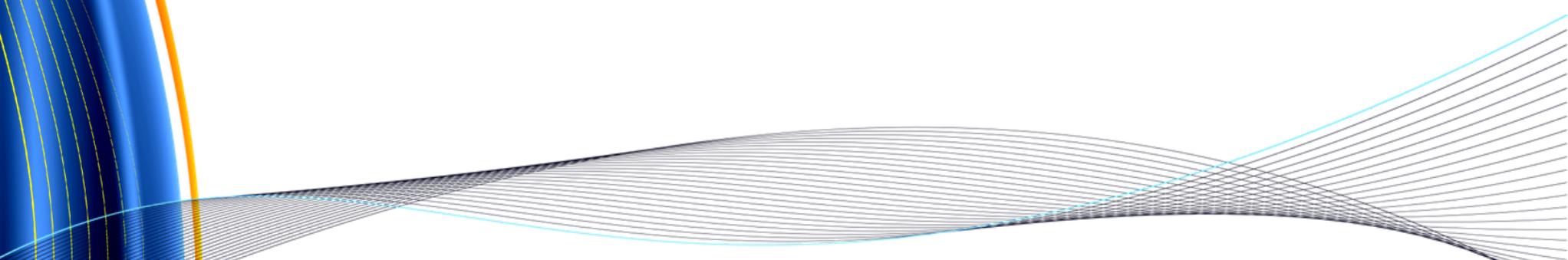
- understand the **nutrition challenges** faced by **endurance athletes** in daily training
- Describe **daily carbohydrate requirements for endurance** athletes and identify important considerations when managing individual athlete
- Assess an **athlete's daily food and fluid intake** and identify key areas to modify to optimise daily training performance, recovery and the favoured metabolic adaptations to training
- Identify important **considerations for racing** and the need to customise nutrition support across the wide variety of endurance events
- manipulate fluid intake advice according to an athlete's likely requirements.

PHYSICAL ACTIVITY, EXERCISE AND SPORT

Physical activity

- is any movement that we perform that expends energy.
- The simplest categorisation of physical activity is based on proportioning activities in daily life—namely, sleep, work and leisure

- 
- The energy expenditure during sleep is obviously **very small**, whereas the energy expenditure **during work** would depend on the type of employment.
 - A nurse who spends a lot of time **walking around** a hospital ward would expend much more energy than an office worker who spends the majority of the work day sitting down
- 

- 
- **Physical activity**
 - Any bodily movement produced by skeletal muscles that results in energy expenditure
 - **Exercise**
 - Physical activity that is planned, structured, repetitive and purposeful with the aim to improve or maintain one or more components of physical fitness.
- 

CRITERIA MUST BE MET IN ORDER FOR A SPORT TO BECOME A MEMBER OF THE ASSOCIATION OF SPORTS ASSOCIATION

- The sport proposed should include an element of competition.
- The sport should not rely on any element of 'luck' specifically integrated into the sport.
- The sport should not be judged to pose an undue risk to the health and safety of its athletes or participants.
- The sport proposed should in no way be harmful to any living creature.
- The sport should not rely on equipment that is provided by a single supplier.

TYPES OF SPORT

- Due to the large variety of sports in existence, the **Global Association of International Sports Federations** has also developed categories of sports.

Category	Examples of sports
Physical	Football, Basketball, Athletics
Mind	Chess, Draughts, eSports
Motorised	Formula One, Motorcycling
Coordination	Lawn Bowls, Billiards, Shooting
Animal-supported	Horse Racing, Equestrian, Polo

ENDURANCE-POWER CONTINUUM

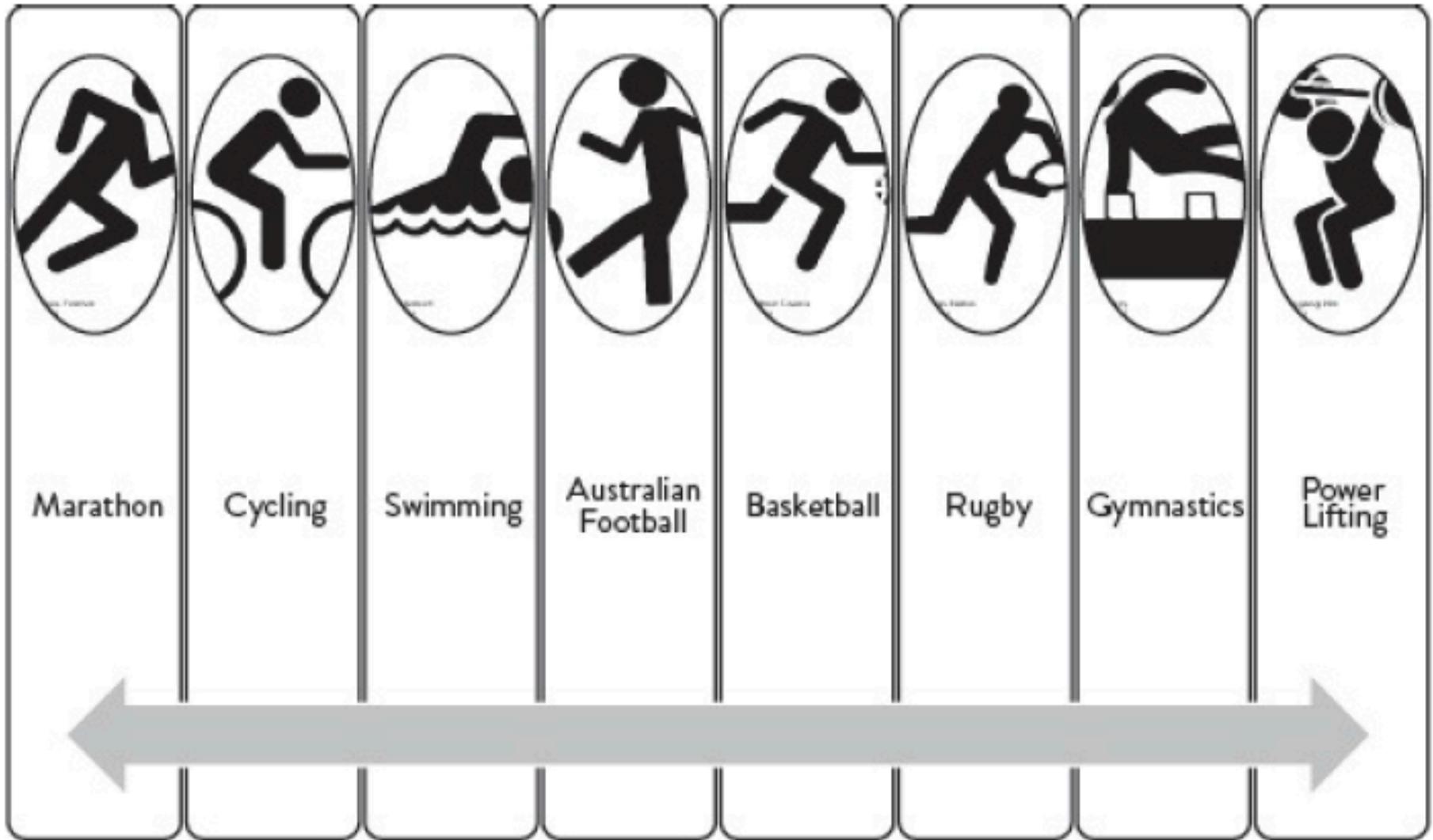
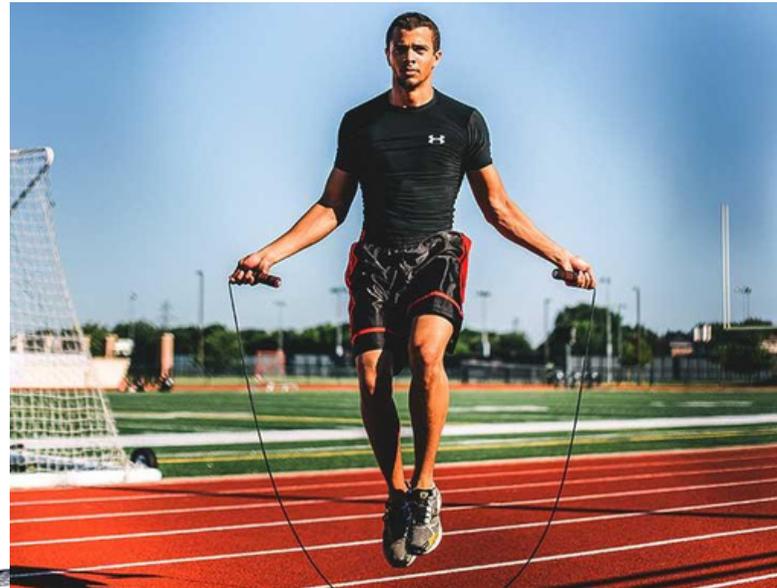


Figure 1.1. Endurance–power continuum of sport

AEROBIC

- Exercise at an intensity that is low enough to allow the body's need for oxygen (to break down macronutrients) to be matched to the oxygen supply available.



ANAEROBIC

- Exercise at an intensity where the body's demand for oxygen is greater than the oxygen supply available, therefore relying on anaerobic metabolism and the production of lactate.



EXERCISE CAN BE CATEGORISED INTO TWO MAIN TYPES

1-cardiorespiratory exercise

- Whole-body, dynamic exercise that taxes predominantly the **cardiovascular and respiratory systems**, such as running, cycling and swimming.

- **Resistance exercise**
- Exercise that predominantly involves the musculoskeletal system.



- The intensity of **cardiorespiratory** and **resistance** exercise can be expressed in either **absolute** or **relative terms**.
- **Absolute exercise intensity** refers to the total amount of energy expended (expressed in **kilojoules** or **kilocalories**).
- Absolute exercise intensity can be expressed in **metabolic equivalents** (METs), which describe exercise intensity as a **multiple of the amount of energy required by the body at rest**

- **One MET** is approximately equivalent to an oxygen uptake of **3.5** mL.kg⁻¹ · min⁻¹.
- For example:
- the oxygen consumption for **a 70 kilogram** male exercising at an absolute exercise intensity of **five METs for 30 minutes** would be calculated as:
- **Oxygen consumption** (O₂) =
- **5 × 3.5 mL · kg⁻¹ · min⁻¹ = 17.5 mL · kg⁻¹ · min⁻¹ O₂**
- **Oxygen consumption** (O₂) = **17.5 mL · kg⁻¹ · min⁻¹ × 70 kg = 1225 mL · min⁻¹ O₂**

- **Oxygen consumption (O₂) =**
 $1225 \text{ mL} \cdot \text{min}^{-1} \times 30 \text{ min} = 36750 \text{ mL O}_2$
Oxygen consumption = $36750/1000=36.750$
(L of O₂).
- From the estimated oxygen consumption we can calculate the energy expenditure during exercise, since each **litre** of oxygen yields **~5 kcal**
- Therefore, the estimated energy expenditure for the example above is:
• **Energy expenditure (kcal) =** $36.75 \text{ L O}_2 \times 5$
kcal = 183.75 kcal

	Light (<3 METs)	Moderate (3-6 METs)	Vigorous (>6 METs)
Walking	Walking slowly (2)	Walking at brisk pace (3)	Jogging (4)
Household or occupation	Dish washing (2)	Washing window (3)	Shoveling (6)
	Ironing (2)	Sweeping floor (3)	
	Making beds (2)	Vacuuming (3)	
	Work at desk (1-2)	Mowing lawn (5)	
Leisure, sports	Billiard (2-3)	Badminton (4)	Basketball (6)
	Croquet (2-3)	Dancing (3-4)	Soccer (6)
	Dart (2-3)	Golf (4)	Skiing (6)
	Fishing (2-3)	Bicycling (light) (6)	Bicycling (vigorous) (8)
	Musical instrument	Swimming (light) (6)	Swimming (vigorous) (8)
		Tennis (double) (5)	Tennis (singles) (7)

Modified from table 2, reference 25. METs: metabolic equivalents

- In comparison, **resistance exercise** may be expressed **relative to the maximum amount of mass** that a particular muscle group can lift successfully for one repetition, which is known as the one repetition maximum (1 RM), or
- by using perceptual methods such as the RPE. Exercise intensity for resistance training can then be expressed as a percentage of an individual's 1 RM.

- For example, an **athlete with a 1 RM** for the back-squat exercise of **120 kilograms** wishes to develop their muscular strength, and so should **lift ~85 per cent** of their **1 RM** in training. The mass they should lift in training can be calculated as follows:
 - $85\% \text{ 1 RM} = 0.85 \times 120 \text{ kg} = 102 \text{ kg}$



PRESCRIBING PHYSICAL ACTIVITY AND EXERCISE

- Due to the strong association between physical activity and health outcomes such as chronic disease and obesity.
- the Australian Department of Health has developed **age-specific guidelines for physical activity**. These guidelines are intended to help facilitate positive health outcomes for all
- Australians

Australia's Physical Activity Guidelines



Age Range	Guideline
 <p>Birth–5 years</p>	<p>Infants (Birth–1 Year): 30 minutes of ‘tummy time’ per day Toddlers (1–2 Years): At least 180 minutes of activity including energetic play Pre-schoolers (3–5 Years): At least 180 minutes of activity with at least 60 minutes of energetic play</p>
5–12 Years	At least 60 minutes of moderate-to-vigorous physical activity per day
13–17 Years	At least 60 minutes of moderate-to-vigorous physical activity per day
18–64 Years	150 to 300 minutes of moderate physical activity or 75 to 150 minutes of vigorous physical activity per week
Older Adults	At least 30 minutes of moderate physical activity per day

Source: Adapted from Department of Health 2017.

CHRONIC ADAPTATION OF TO EXERCISE

- Whether you are undertaking exercise for **general health**, or to **improve your competitive performance**, when exercise sessions are repeated over multiple weeks and months **chronic adaptations to exercise begin to occur**.
- These chronic adaptations occur as a result of **the specific loading and progression of exercise sessions** and can be specific aerobic, anaerobic or strength adaptations, depending on the goals of the individual

On of the example application of the frequency intensity, time and type (FITT)

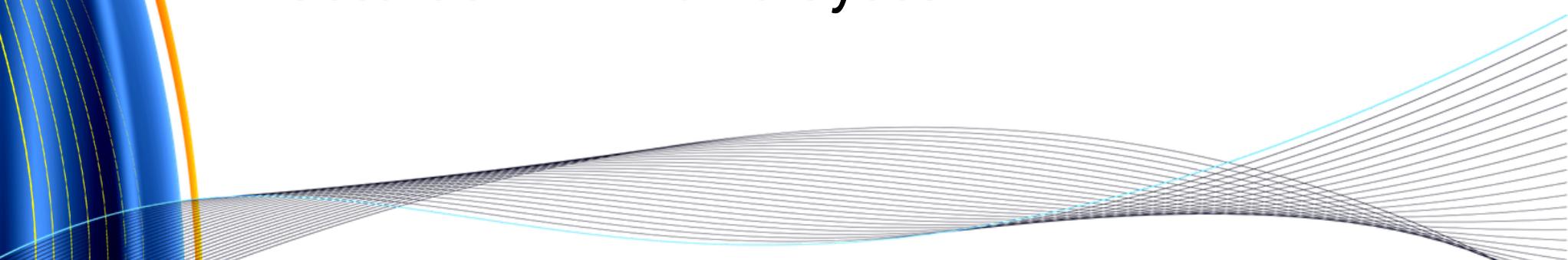
	Cardiovascular Endurance	Muscular Endurance	Muscular Strength
Frequency (How often the exercise is performed)	3–5 times per week	3–5 times per week	3 times per week
Intensity (How hard the exercise is)	60–90% max heart rate	12+ repetitions, 2–4 sets	3–7 repetitions, 3–5 sets
Time (The duration of each individual exercise session)	>30 min	30–60 min	15–60 min
Type (The kind of activity completed)	Running Swimming Bicycling Walking	Free weights Circuit training Body-weight	Free weights Resistance machines

CHRONIC ADAPTATIONS TO EXERCISE

- Adaptations that occur as a response to exercise are specific to the training stimulus applied include changes to the **cardiovascular, metabolic, respiratory and muscular systems.**
- Regular aerobic exercise, for example, enhances the ability of the body to use **fat as fuel** during exercise through increased transport of **free fatty acids, fat oxidation**
- **Oxidation**
- Part of a chemical reaction that results in the loss of electrons. During fat oxidation, triglycerides are broken down into three fatty acid chains and glycerol.

- All of these adaptations lead to an improved capacity to complete **longer duration** or **higher intensity** exercise while remaining within an aerobic state.
- Exercise and prolonged training also stimulate the release of a number of hormones, including **testosterone and growth hormone**, which promote an **anabolic** (building up' and repair of tissues) effect on the body

- These hormones increase **protein synthesis and cell growth**, leading to an increase in lean muscle mass and decreased fat mass.
- This chronic adaptation of an individual's body composition, which increases the amount of active tissue in the body, also leads to an increased **metabolic rate** for the individual.
- Growth hormone also stimulates **cartilage formation and skeletal growth**, which encourages **bone formation**

- 
- The mechanical loading of exercise, such as during foot strike while running, also **elicits the remodelling** of bone to adapt to the load under which it is placed, when the exercise stimulus is removed these **adaptations revert back**
 - Along with the more commonly discussed changes to our cardiovascular, metabolic and muscular systems, exercise also affects our immune system
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- exercise also affects our **immune system**, Following acute exercise, there is a **reduction in white blood cell numbers** and activity due to circulating hormones (catecholamines (adrenaline and dopamin), growth hormone, cortisol, testosterone) and as a result of local inflammation.
- This acute-phase response can last from two to 72 hours post-exercise depending on intensity and duration.

- The immune system can also be affected by travel and when in a team sport environment. Specific hygiene practices should be in place to reduce the duration and severity of illness, as well as to limit the spread of infection during periods of exercise



- Nutrition is also thought to play a role in maintaining immune function, through the adequate intake of specific micronutrients (for example, iron, zinc, vitamins A, E and B12) and sufficient carbohydrate availability during exercise bouts to help limit the rise in the stress hormone **cortisol**.



RECOVERING FROM EXERCISE

- In order for the body to adapt to the exercise stimulus, sufficient recovery is required.
- It is during this recovery period that the body is **able to replenish energy stores** and **repair damaged tissue to allow the body to**
- **develop** and **adapt in response to the stimulus**

- The simplest ways to recover from exercise are **to have a rest day from training** and to **get good-quality sleep**.
- Other common recovery methods include cold or contrast , **compression garments**, **foam rolling** and **massage**



Compression clothing works to boost **recovery** by narrowing your veins, forcing blood to flow faster and more effectively up to your heart, which pumps oxygen-rich blood back to your aching muscles.

Energy for Sport and exercise

Assist Prof Yaseen Galali

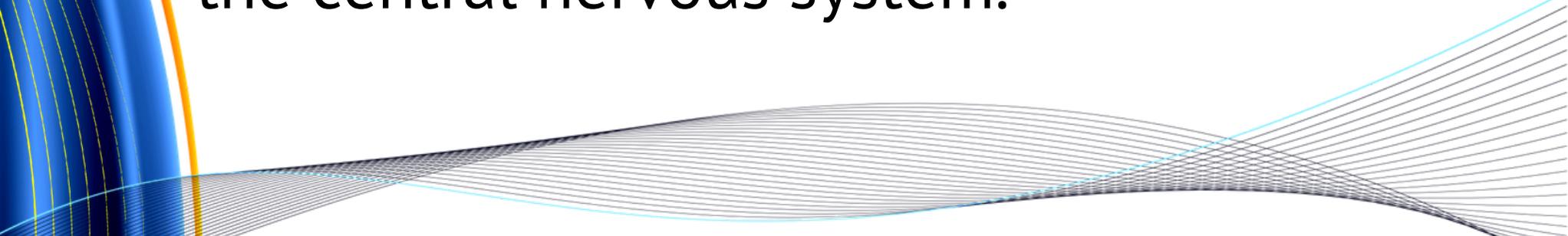
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2022

ENERGY FOR SPORT AND EXERCISE

- Our bodies require a **constant supply** of energy to fuel our working organs, including the brain, heart, lungs and muscles.
- The major energy currency within the human body is an energy-rich molecule known as **adenosine triphosphate**, or ATP.

- 
- At rest, the demand for ATP is low; however, sport and exercise can increase this demand as much as a **thousand fold**, requiring a coordinated metabolic response by the energy systems to replenish ATP levels.
 - The contribution of each energy system is determined by the interaction between the **intensity** and **the duration of exercise**, and is regulated by **metabolic processes** and the central nervous system.
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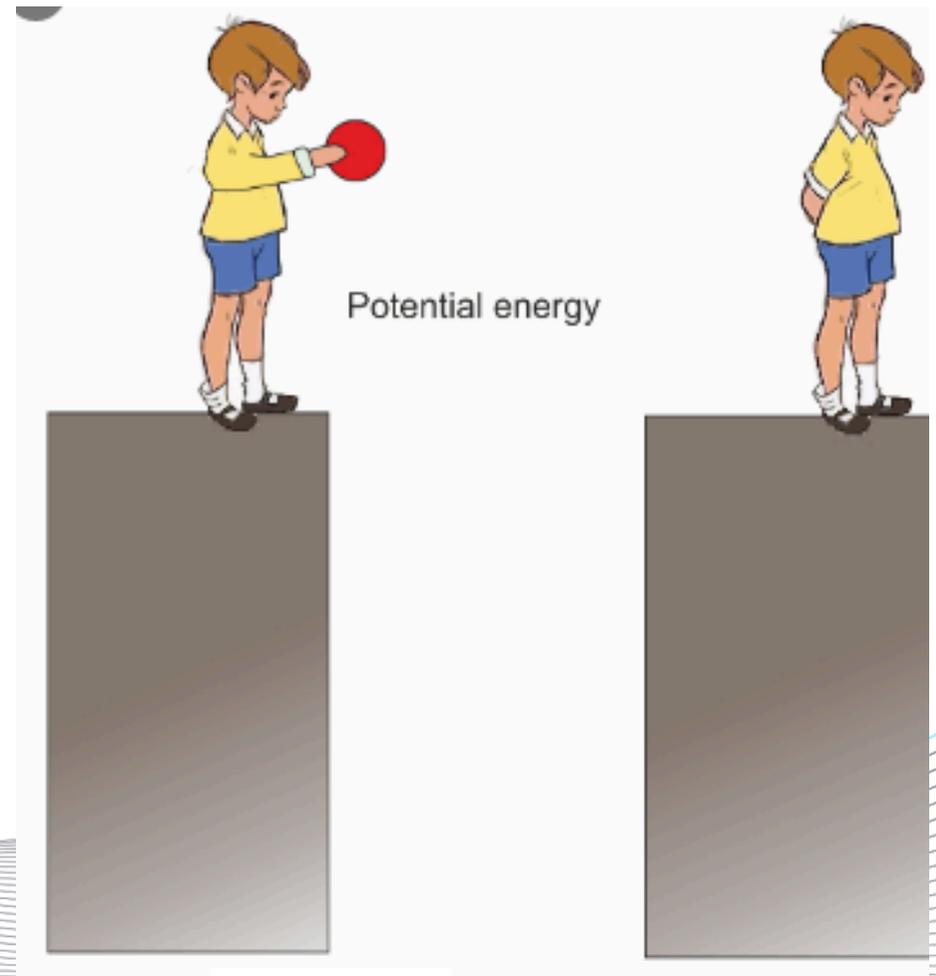
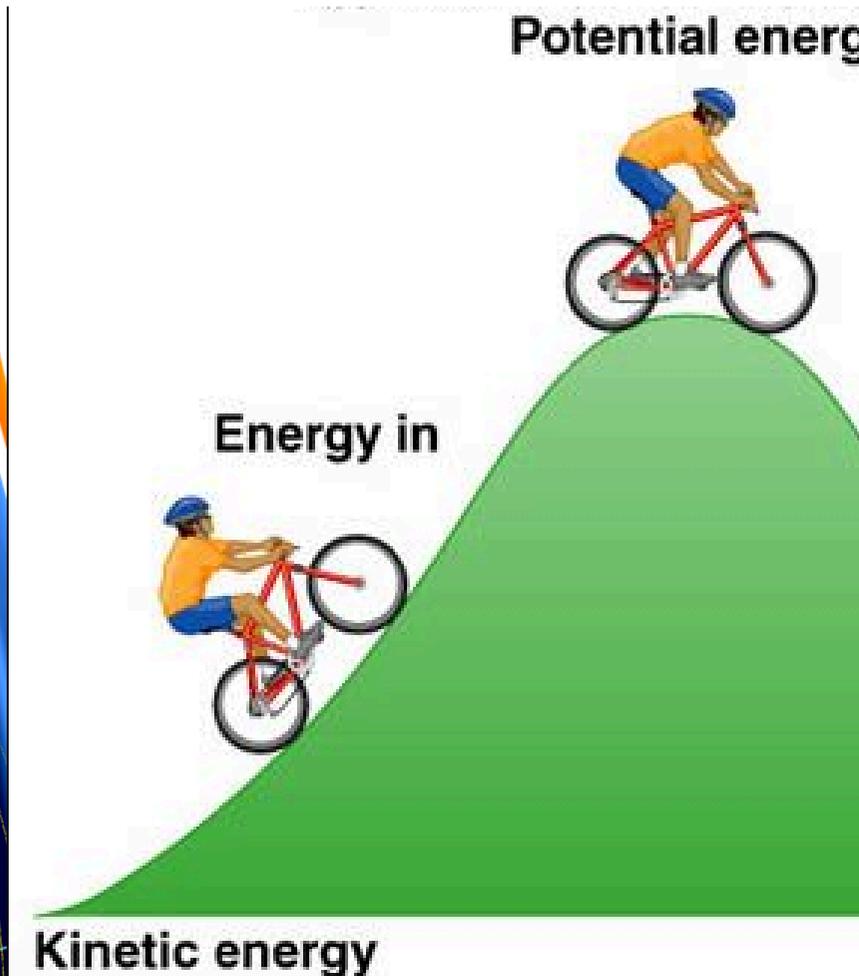
THE RELATIONSHIP BETWEEN ENERGY, WORK AND POWER

The two major forms are

- **kinetic energy:** is the energy in moving objects or mass, such as mechanical energy and electrical energy
- **potential energy:** is any form of energy that has stored potential and can be put to future use such as nuclear energy and chemical energy (ATP)

Kinetic energy is energy possessed by a body its **movement**.

Potential energy is the energy possessed by a body its **position** or state



- **Equation 1: Work done** (Newton·metres [N·m] or Joules [J]) = **Force** (N) × **Distance** (m)

For example, the greater the force required to move an object, or the further the distance of the object to be moved, the greater the work done

Equation 2: Power (Watts [W]) = Work done (J) ÷ Time (s).

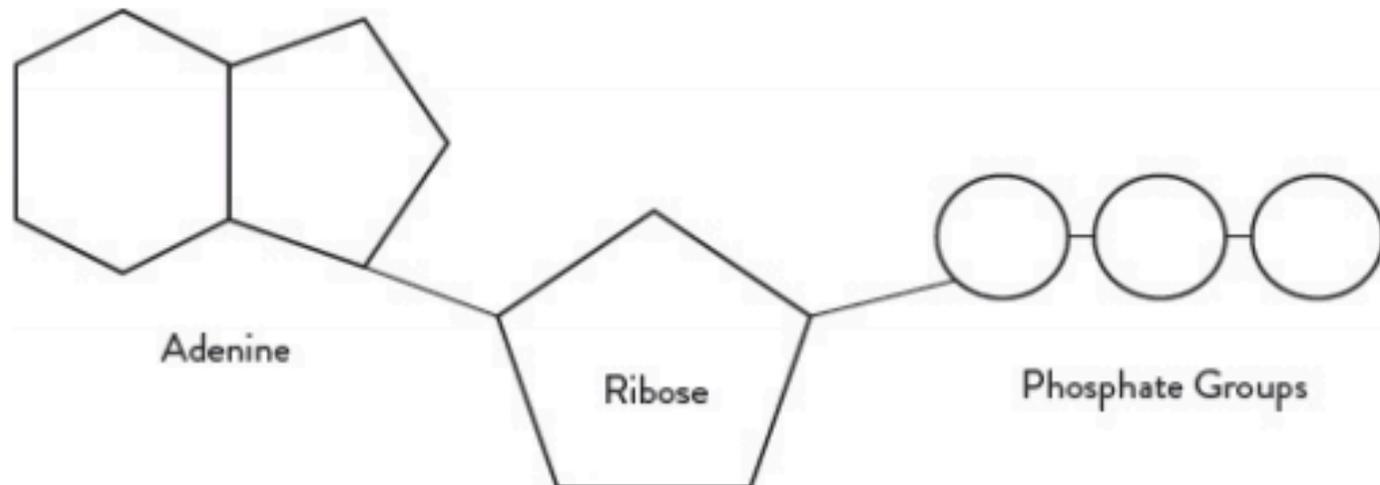
Therefore, **the faster the rate** at which work is completed, **the higher the power output.**

With sufficient training, athletes can develop **physiological adaptations** that allow them to **perform a larger amount of work in a short period of time**, thus generating higher **power outputs**

ENERGY IN THE HUMAN BODY

- Chemical energy is a form of potential energy that is stored in the bonds of atoms and molecules.
- Carbohydrates, protein, fats and alcohol are sources of energy in the diet. Under normal circumstances, **more than 95 per cent of this food energy** is digested and absorbed from the gastrointestinal tract, providing the body with its chemical energy needs

- Within the body, the major energy currency is the ATP molecule, which comprises three components: An adenine ring (as part of adenosine), ribose sugar and three phosphate groups (triphosphate)

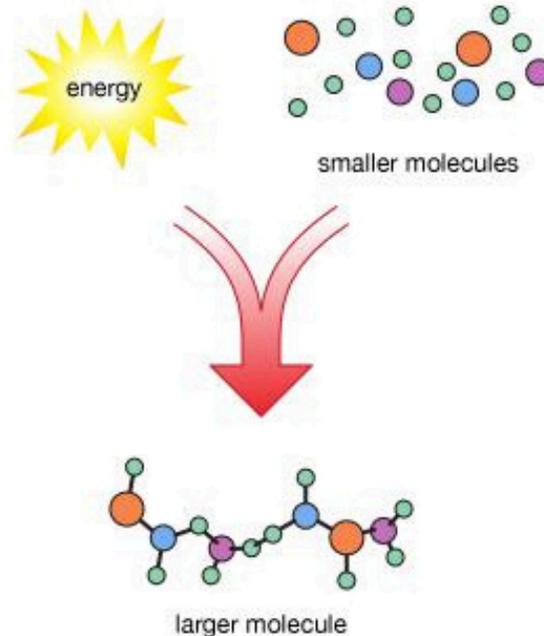


- In the presence of water, ATP can be broken down to form **adenosine diphosphate** (ADP). This process is known as **hydrolysis**. Living cells contain ten times more ATP than ADP.
- When ATP is hydrolysed to ADP, a large amount of energy is released. The release of this free energy from the high energy bonds is used to **drive energy-requiring reactions** such as **protein synthesis**.

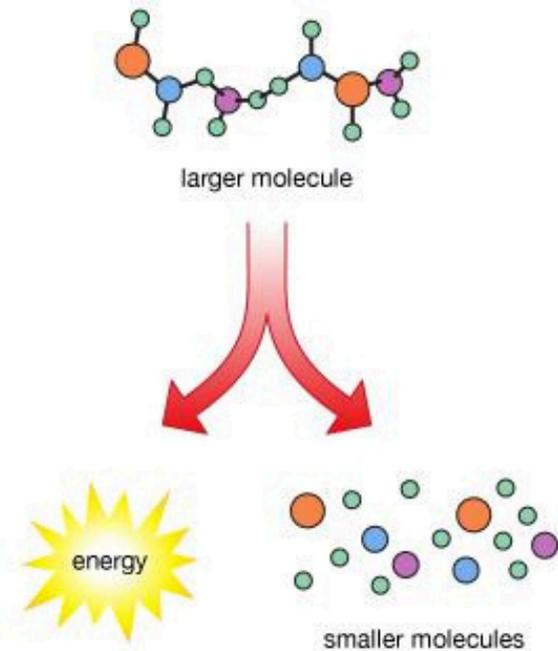
- Reactions within a cell can be classed as either catabolic or anabolic.
- **Catabolic reactions** involve breaking molecules down into their smaller components; energy is released as a by-product of these reactions.
-

Metabolism

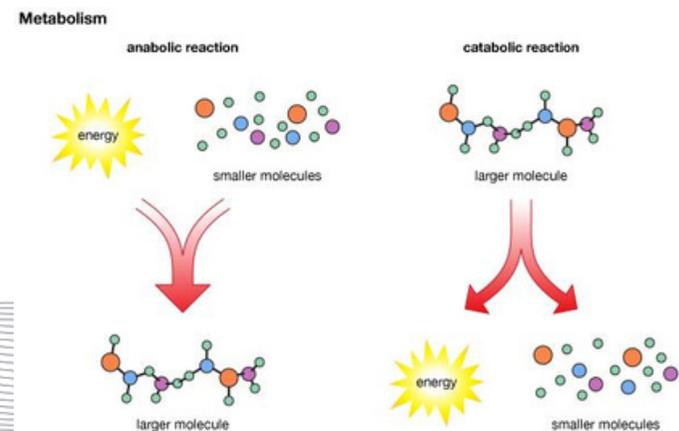
anabolic reaction



catabolic reaction



- **Anabolic reactions** involve combining simple molecules to form complex molecules, and energy in the form of ATP is required to support these reactions. Energy yielding reactions (catabolic) within a cell are typically coupled to energy requiring reactions (anabolic). The high-energy bonds of ATP thus play a central role in cell metabolism by serving as a usable storage form of free energy.
- energy.



PRODUCTION OF ENERGY: THE ROLE OF METABOLIC PATHWAYS

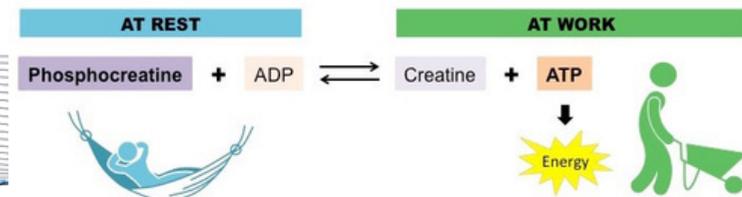
- The three main metabolic pathways for ATP resynthesis
- **(a)** the phosphagen system (**ATP-PCr, alactacid**),
- **(b)** anaerobic glycolysis (**lactic acid**) and
- **(c)** oxidative phosphorylation (**mitochondrial ATP production**).
- Both the phosphagen system and glycolysis pathway occur in the **cytoplasm** (cytosol) of the cell. Oxidative phosphorylation occurs within the mitochondria. **Mitochondria** are known as the powerhouses of the cell. They are organelles that act like a digestive system to take in nutrients, break them down and create energy-rich molecules for the cell.

1-THE PHOSPHAGEN SYSTEM

- The phosphagen system is the quickest way to resynthesise ATP, and comprises three reactions

Reactants	Products	Enzymes Used
ATP + Water (H ₂ O)	ADP + Pi + Energy	ATPase
PCr + ADP	ATP + Cr	Creatine kinase
ADP + ADP	ATP + AMP	Adenylate kinase

Phosphocreatine (PCr) donates a phosphate to ADP to produce ATP. Despite its ability to rapidly resynthesise ATP, the total capacity of this high-energy phosphate system to sustain maximal muscle contraction is about four seconds, assuming complete depletion of PCr and ATP

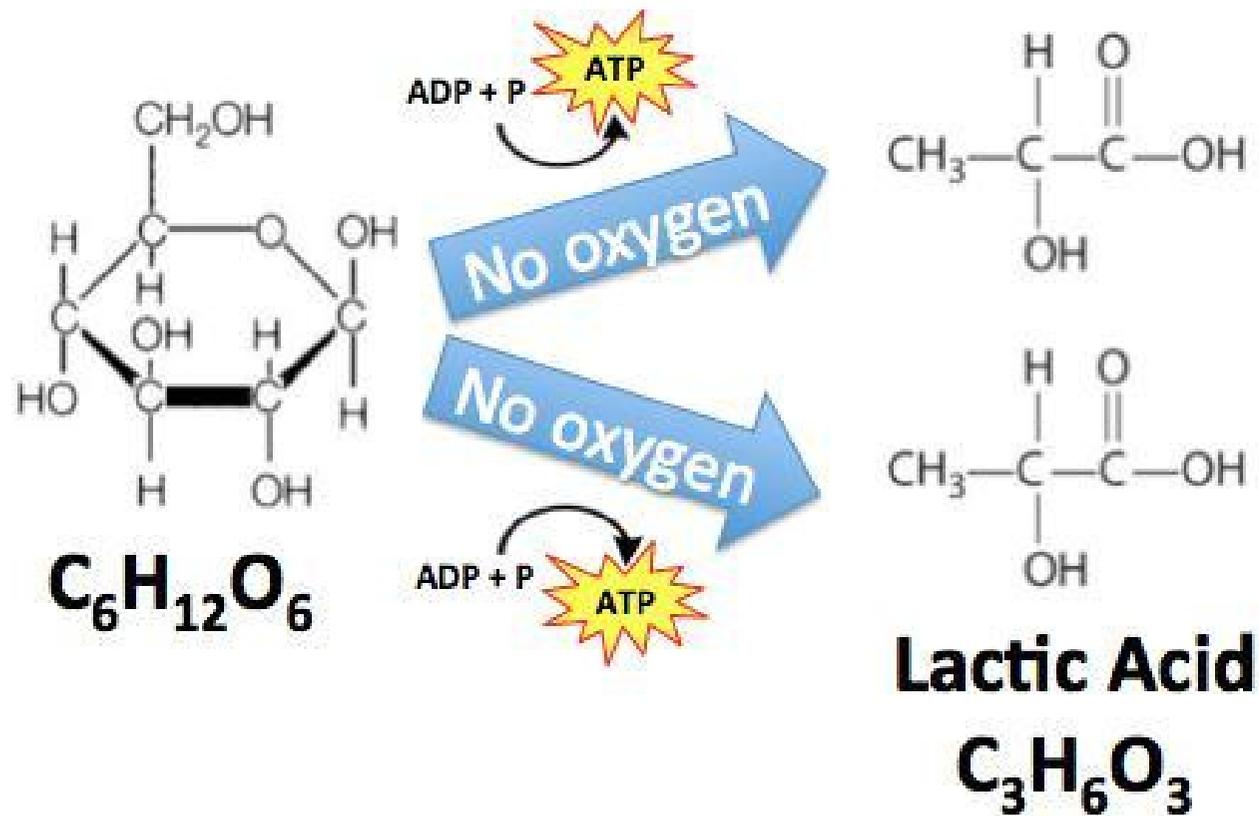


2- GLYCOLYSIS

- The complete oxidative breakdown of glucose to carbon dioxide (CO₂) and water (H₂O) is written as follows:
- $C_6H_{12} + 6O_2 \rightarrow 6 CO_2 + 6 H_2O + \text{energy}$
- **Glycolysis**
- The breakdown of glucose to form two molecules of ATP.

- The terms '**aerobic**' and '**anaerobic**' are used to describe the different conditions by which **oxidation of food molecules** especially glucose, fatty acids and proteins occur (known as respiration).
- **Aerobic respiration** occurs when adequate oxygen is present,
- **anaerobic respiration** occurs when lack of oxygen is present and the demand for ATP is high

(**Lactic acid**: A by-product of anaerobic glycolysis that contributes to fatigue of the muscle)



MITOCHONDRIAL OXIDATIVE PHOSPHORYLATION

- is the only source of ATP production that has the capacity to support prolonged exercise.
- The total yield from the complete oxidation of a glucose molecule is 38 molecules of ATP.

INTERACTION AMONG METABOLIC ENERGY SYSTEMS: INFLUENCE OF SPORT AND EXERCISE

- **The interaction and relative contribution** of the **three energy systems during** different exercise intensities and sporting activities have been of considerable interest to exercise scientists. Compare the **demands of a 100-metre sprint** to a **42.2-kilometre marathon?**



- The sprint is **fast**, with **minimal oxygen breathed** in during its ten-second duration, making the event almost exclusively **anaerobic** .
- The marathon, on the other hand, is primarily an **aerobic** event completed **in two to two-and-a-half hours at 80–85** per cent of an elite athlete's maximal capacity

- Despite the different demands of each event, **all systems (three pathways)** are activated at the start of exercise to maintain ATP levels and ensure adequate supply for maximal power output and intensity.
- **The anaerobic** (non-mitochondrial) systems, which are capable of supporting extremely high muscle force application and power outputs such as those during a 100-metre sprint, would be the predominant energy system used at these times



- During a marathon race, the anaerobic system, which is limited in its capacity, is unable to meet the energy demands required by extended periods of intense exercise.
- The aerobic energy system (oxidative metabolism) is the only system that can resynthesise ATP to meet required ene



Sprinter

Phosphagen system

8-10 seconds (100 m)



Swimmer

Glycogen-lactic acid system

1.3-1.6 minutes (400 m)



Aerobic respiration



QUANTIFYING ENERGY EXPENDITURE: APPLICATIONS IN SPORT AND EXERCISE

- Regardless of which **energy system predominates during exercise**, Measurement of an **athlete's energy expenditure** helps determine the daily energy requirements for the athlete's training and competition.
- **So, how do we measure energy expenditure?**

- We know that the rate of **energy metabolism** is directly proportional to the **amount of heat our whole body produces**. As such, the rate of metabolism can be quantified by measuring heat produced by the body. This direct measurement method is known as **direct calorimetry**

a cheaper and smaller—but still accurate—method known as **indirect calorimetry** is more widely used for measuring energy expenditure.



This involves collecting all exhaled gases into a mixing chamber, which is then processed and analysed by a metabolic cart

Indirect calorimetry

- A method of estimating energy expenditure by measuring oxygen consumption and carbohydrate production.
- CO₂ produced and O₂ consumed can also be expressed as a ratio (**CO₂/O₂**) to obtain a number that is normally between **0.7 and 1.0**. This number is known as the **respiratory exchange ratio (RER)**, and represents the composition of the mixture of lipids (fats) and carbohydrates oxidised through metabolism during submaximal exercise

Energy produced per litre of O₂ when metabolising different macronutrients

Macronutrient	kcal · L O ₂ ⁻¹
Carbohydrate	5.05
Fat	4.69
Protein	4.49

the limits of their cardiorespiratory system. An RER greater than 1.0

Oxidation of a carbohydrate molecule:^[3]



$$\text{RER} = \frac{\text{VCO}_2}{\text{VO}_2} = \frac{6 \text{ CO}_2}{6 \text{ O}_2} = 1.0$$

Oxidation of a fatty acid molecule, namely palmitic acid:^[3]



$$\text{RER} = \frac{\text{VCO}_2}{\text{VO}_2} = \frac{16 \text{ CO}_2}{23 \text{ O}_2} = 0.7$$

- **Respiratory exchange ratio (RER)**
- The ratio of **carbon dioxide** produced to **oxygen consumed**; used to indicate the relative contribution of substrates oxidized during submaximal exercise.

▶ **Caloric Equivalence of the Respiratory Exchange Ratio (RER) and % kcal From Carbohydrates and Fats**

RER	Energy	% kcal	
	kcal/L O ₂	Carbohydrates	Fats
0.71	4.69	0.0	100.0
0.75	4.74	15.6	84.4
0.80	4.80	33.4	66.6
0.85	4.86	50.7	49.3
0.90	4.92	67.5	32.5
0.95	4.99	84.0	16.0
1.00	5.05	100.0	0.0

ESTIMATING DAILY ENERGY REQUIREMENTS

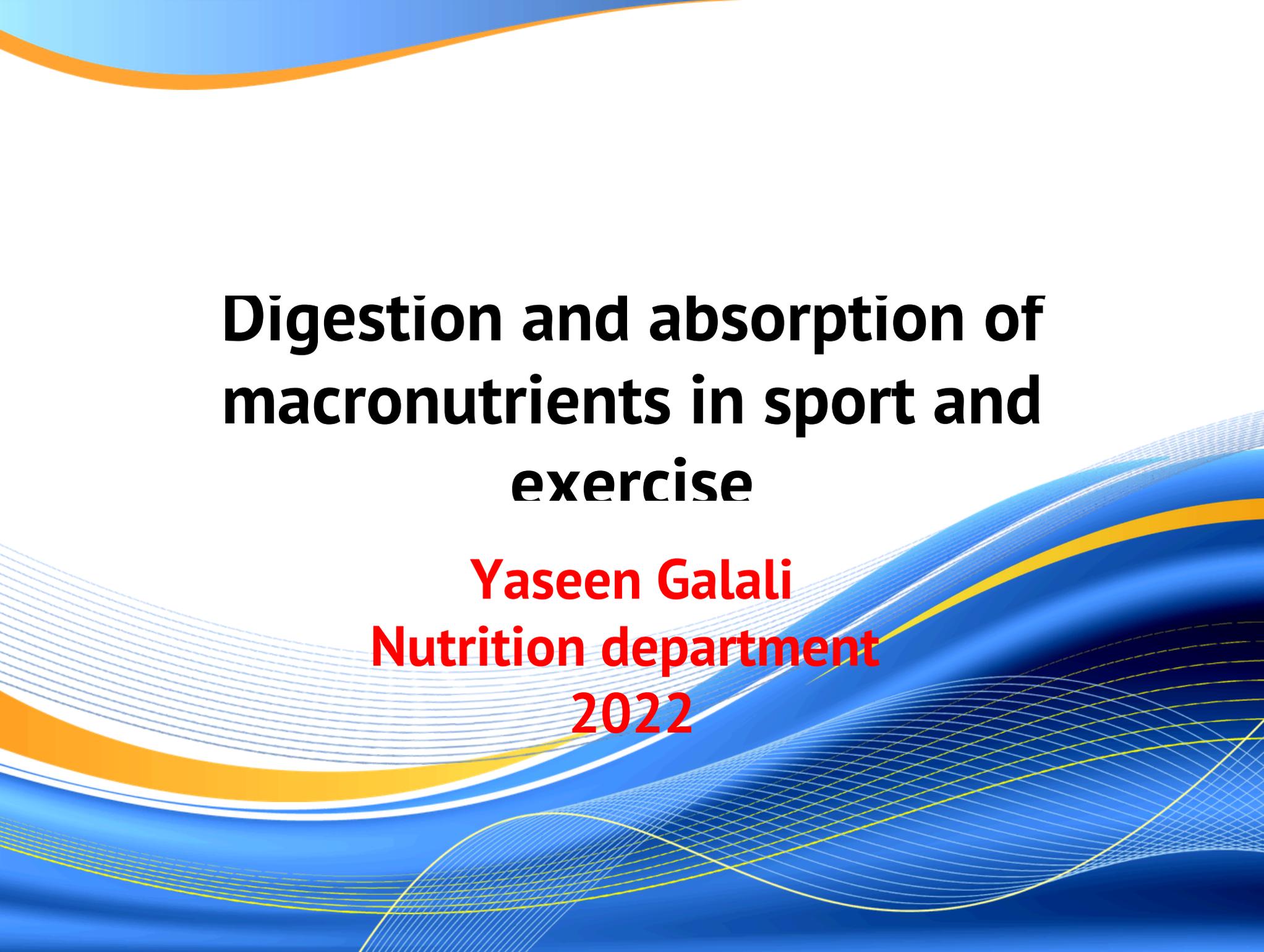
The daily energy expenditure for healthy adults can be calculated using the equations below, formulated based on adults 19–78 years of age. It is important to keep in mind that factors other than those accounted for within these equations can also influence resting energy expenditure.

These factors include climate, body composition and surface area of the body.

Equations:

- For females: resting energy expenditure (kJ/day)
 $= 9.99 \times (\text{weight in kg}) + 6.25 \times (\text{height in cm}) - 4.92 \times \text{age} - 161$
- For males: resting energy expenditure (kJ/day)
 $= 9.99 \times (\text{weight in kg}) +$
 $6.25 \times (\text{height in cm}) - 4.92 \times \text{age} + 5$

- Resting energy expenditure calculated from the above equations can be multiplied by a factor according to the individual's physical activity level (PAL) for an estimated total daily energy expenditure. These factors are
- defined as:
- **1.0–1.39**: Sedentary, activities of daily living, sitting in office
- **1.4–1.59**: Activities of daily living plus 30–60 minutes of light intensity activity (e.g. walking)
- **1.6–1.89**: Activities of daily living plus standing, carrying lightloads, 60 minutes of walking
- **1.9–2.5**: Activities of daily living plus strenuous work or highly active/ athletic lifestyle



Digestion and absorption of macronutrients in sport and exercise

Yaseen Galali
Nutrition department
2022

DIGESTION

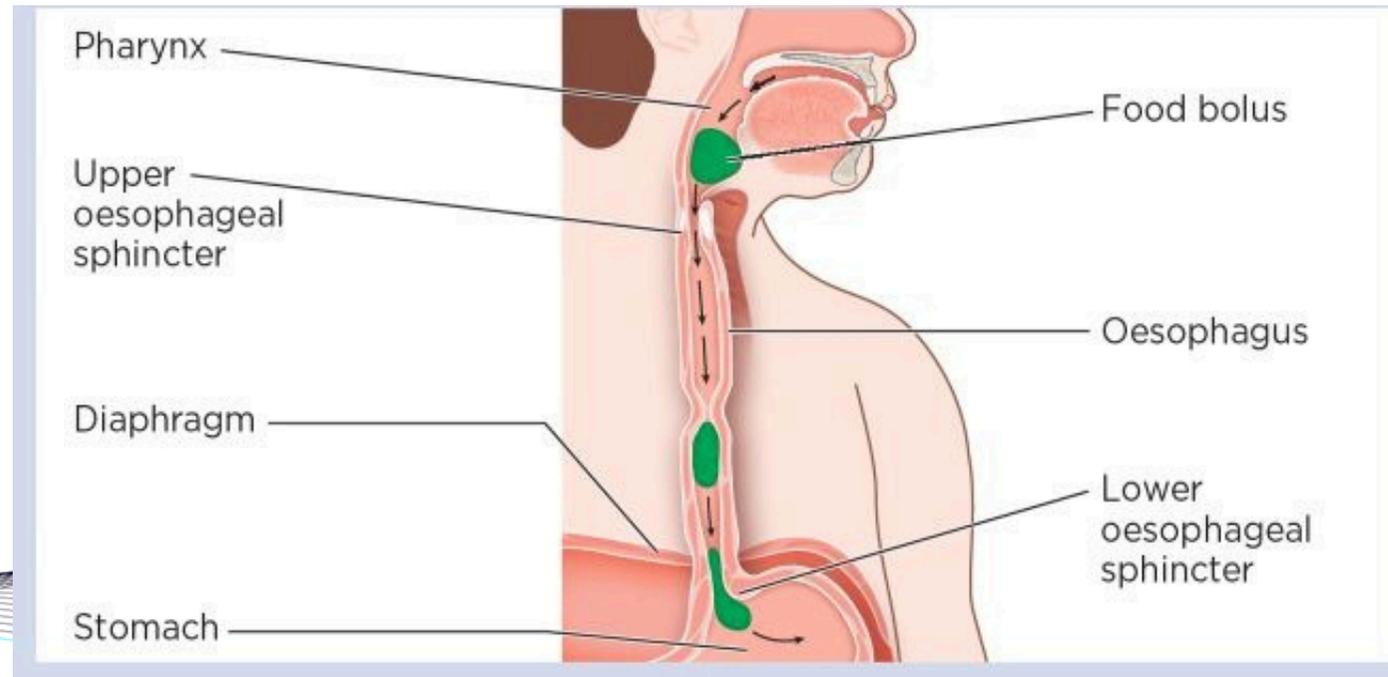
- Digestion is the process by which the body breaks down food into nutrients, which are essential for normal bodily function
- Digestion begins at the **mouth** and ends at the **anus**.
- **Food is digested mechanically (chewing) and chemically (enzymatically).**

MOUTH: THE STARTING POINT OF DIGESTION

- While digestion begins in the mouth, food is primarily broken down mechanically at this.
- **Chewing** is the first stage of digestion when food is broken down and mixed with saliva.
- **Saliva contains amylase** which breaks down starch to maltose.
- **Lingual lipase** begins the digestion of fats and is present in higher concentrations in the saliva of babies

ESOPHAGUS:

- Connecting the mouth to the stomach



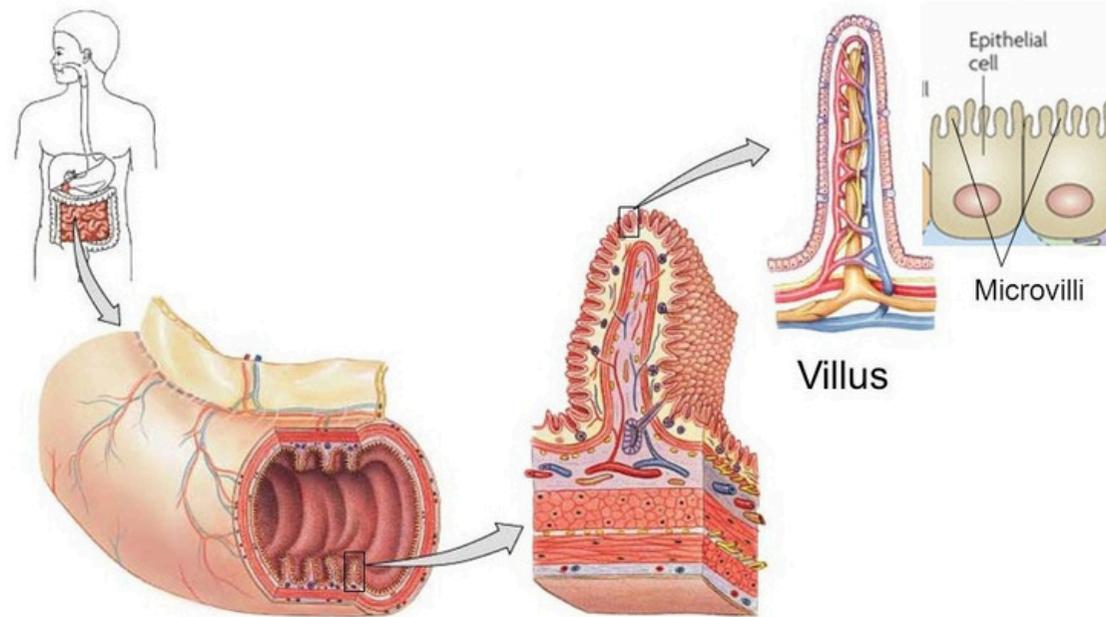
STOMACH

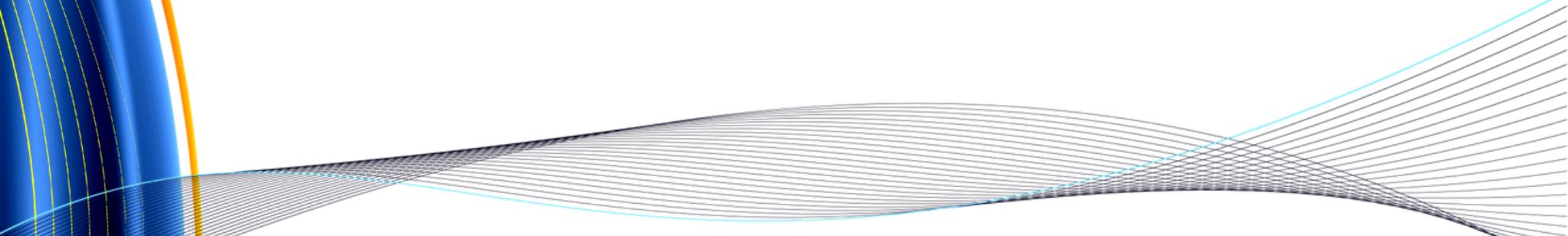
- **Where hydrochloric acid plays an important role.**
- specialized cells secrete the gastric juices needed for digestion in the stomach.
- Hydrochloric acid and **intrinsic factor**, which is needed for the absorption of **vitamin B12**, are produced at the bottom of the gastric pits

- **Hydrochloric acid is responsible for the acidic environment (pH 2) in the** stomach and is important for:
 - neutralisation of slightly alkaline salivary amylase, hence stopping starch digestion
 - **denaturation** of proteins
 - activation of inactive enzymes, notably activation of pepsinogen to pepsin
 - Releasing vitamin B12 bound to proteins in food
 - killing harmful bacteria that can cause infection or food poisoning.

SMALL INTESTINE:

- The longest part of the digestive tract.
- The small intestine is a long tube (4.5 to 7.5 metres) that comprises the duodenum, jejunum and ileum.
- the intestinal lumen is covered with finger-like projections called **villi and microvilli**.



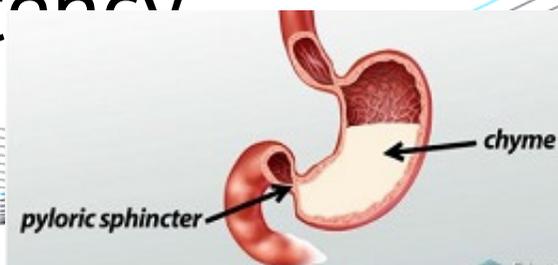
- 
- **Many enzymes** are secreted in there where macromolecules are broken down.
 - **The pancreas** produces and secretes many enzymes used for the digestion of all three macromolecules.
- 

Region of digestive tract	Substrate	Enzyme	Secreted by	End-product
Mouth	Starch	Salivary amylase (α amylase)	Salivary glands	Shorter polysaccharide chains and Dextrins
	Fat	Lingual lipase (minor contribution to fat digestion in adults)	Salivary glands	Diglycerides and fatty acids
Stomach	Protein	Pepsinogen Activated to pepsin by HCl	Parietal cells of stomach	Polypeptides
Small intestine	Starch	Pancreatic amylase	Pancreas	Maltose
	Sucrose	Sucrose	Small intestine	Glucose and Fructose

	Maltose	Maltose	Small intestine	Glucose
Small intestine	Lactose	Lactase	intestine	Glucose and
	Fat	Pancreatic lipase	Pancreas	Fatty acids and glycerol
	Polypeptides	Activated to trypsin	Pancreas	Dipeptides and amino
	Polypeptides	Activated to chymotrypsin by	Pancreas	dipeptides and

MOVEMENT OF CHYME ALONG THE SMALL INTESTINE

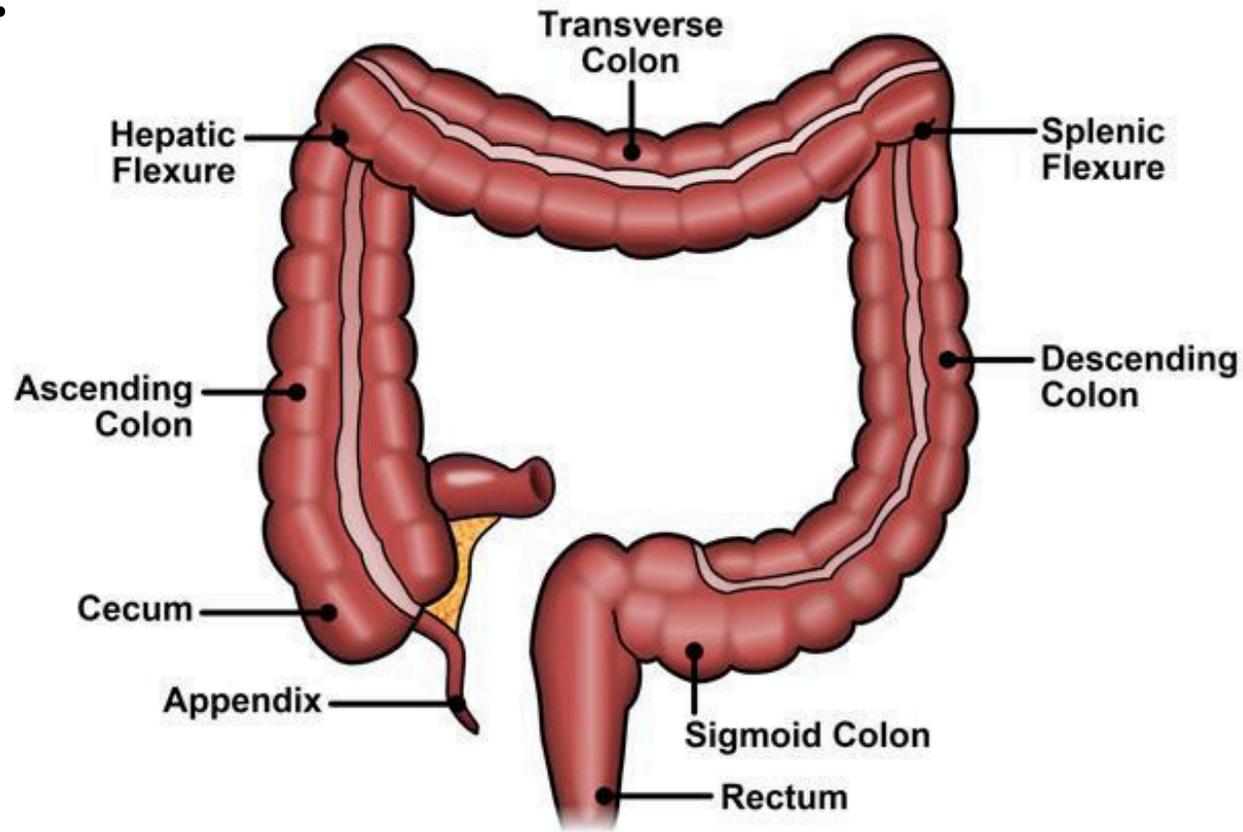
- Upon leaving the stomach, **the acidic chyme** enters the duodenum via the pyloric sphincter. Upon sensing the acid, **the sphincter closes until** the pH rises and it relaxes again to allow the chyme to enter the duodenum.
- Here **the pancreatic juices neutralise stomach acid** and the digestion of macronutrients continues. The frequency of opening of the pyloric sphincter is governed by stomach content, volume and chyme consistency.



- **For example:**
- Gastric emptying is slower after a high-fat meal (hence high-fat chyme).
- • Gastric emptying is faster after a large meal. The stretching and expansion of the stomach drives the opening frequency of this sphincter.
- • Liquids pass through the small opening of the pyloric sphincter more easily than solid chyme.

COLON (LARGE INTESTINE)

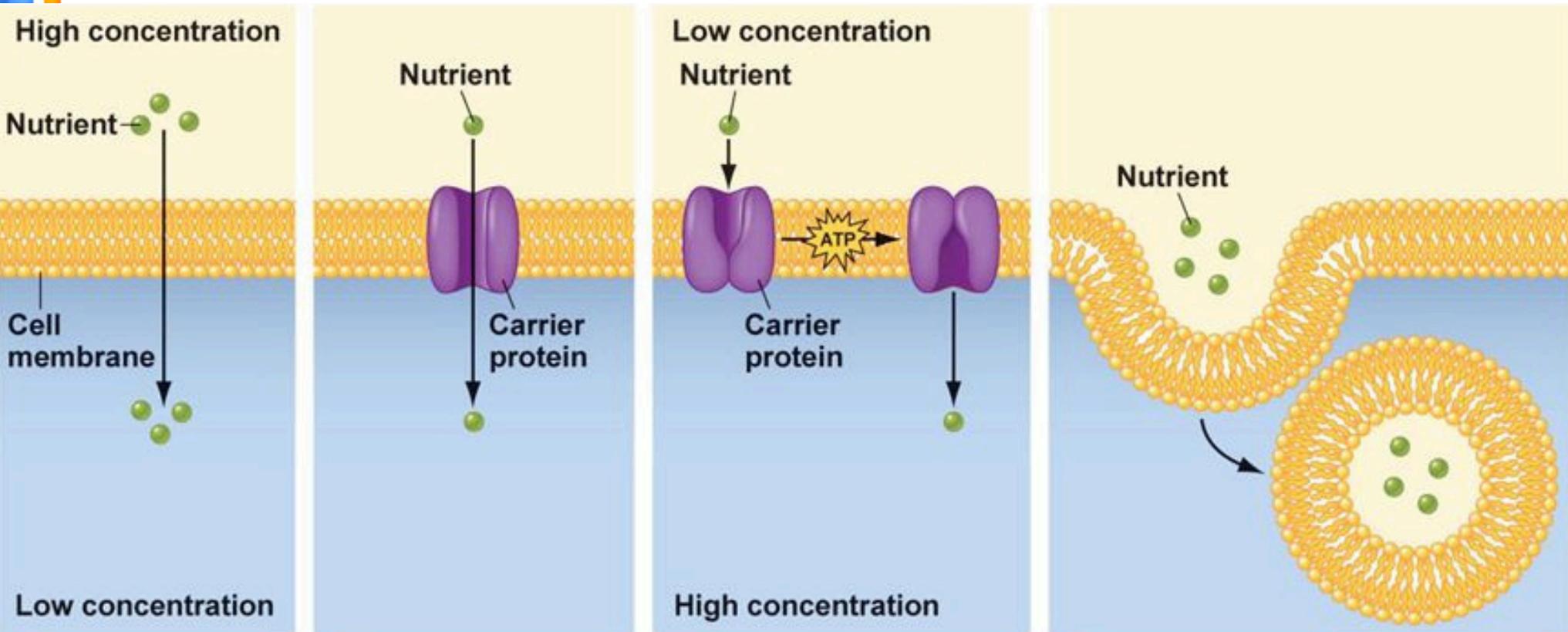
- The colon is larger in diameter than the small intestine and comprises five regions.



- The colon is **larger in diameter** than the **small intestine** and comprises five regions.
- The colon serves to absorb water and some minerals from intestinal content, to sustain fermentation of intestinal content by gut bacteria and to form stools.
- **Transit time** in the colon can range from 12 to 70 hours, during which colon content changes from liquefied form to semi-solid form due to absorption of water and digestive secretions.
- **Stools** are generally composed of **undigested food, some undigested nutrients, some water, sloughed intestinal cells, bacteria** and **indigestible fibre**.

ABSORPTION

- The majority of nutrients are absorbed into the enterocytes of small intestine.



a Passive diffusion: Nutrients pass through the cell membrane.

b Facilitated diffusion: Requires a specific carrier but no energy is needed to cross the membrane.

c Active transport: Requires both a carrier protein and energy to cross the cell membrane.

d Endocytosis: Whole molecules are engulfed by the cell membrane.

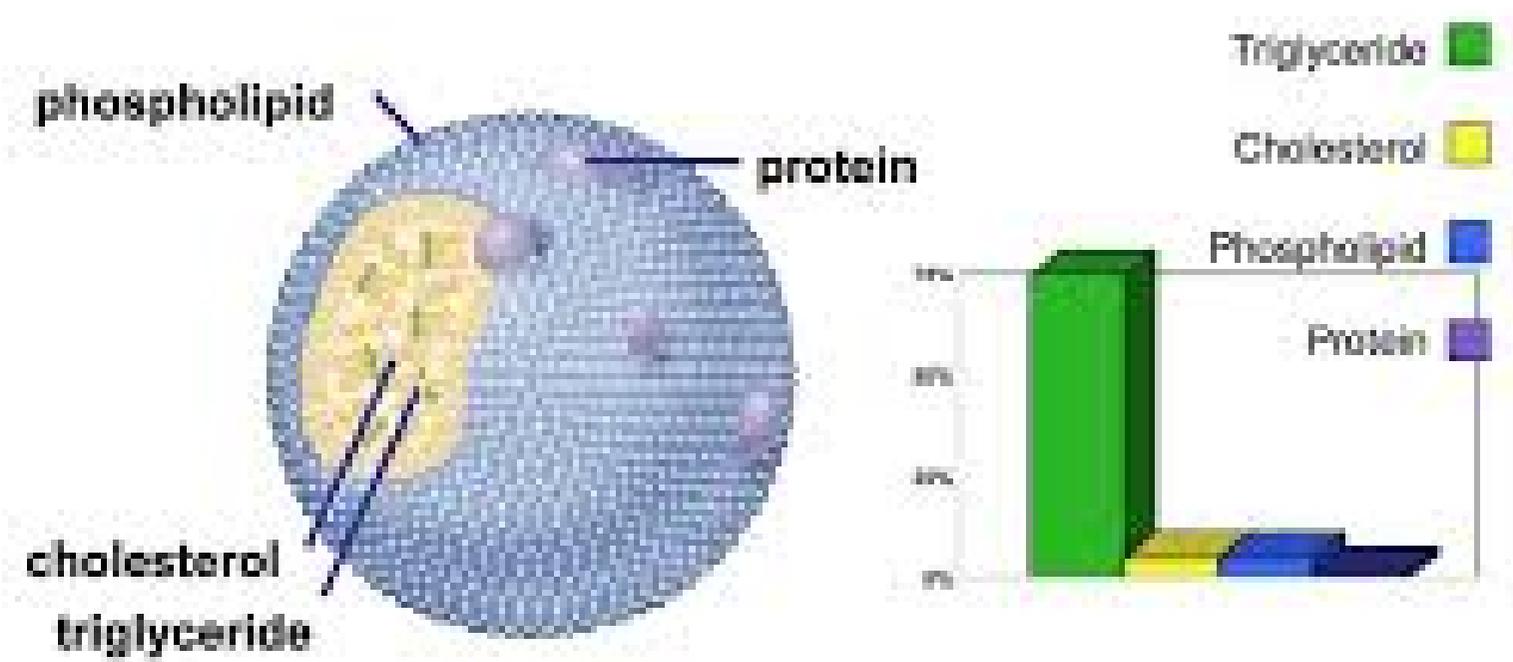
- **Passive diffusion** is when small molecules, such as water and small lipids, are freely absorbed into the enterocytes across the concentration gradient.
- **Facilitated diffusion** occurs when a specific carrier is needed to transport nutrients (for example, water-soluble vitamins) through the enterocyte cell membrane.
- **Active transport** uses energy to transport some nutrients, against the concentration gradient.
- From one side of the enterocyte cell membrane to the other.

1- **Amino acids** are absorbed through active transport,

2- **Glucose** which is absorbed via the transporter sodium-glucose linked transporter.

3- **The water-soluble** nutrients and small lipids are absorbed through the enterocytes, they enter the bloodstream and are transported to the liver for further metabolism and distribution to other parts of the body

- Once the **water-soluble nutrients** and **small lipids** are absorbed through the **enterocytes**, they enter the bloodstream and are transported to the liver for further metabolism and distribution to other parts of the body.
- **Larger lipids** and **fat-soluble vitamins** are not water-soluble, and hence cannot be transported easily in blood. Instead, **they are first absorbed into the enterocytes**, where they are packaged with some proteins to form chylomicrons. These are then released into the lymphatic vessels for transport around the body.



Macronutrients

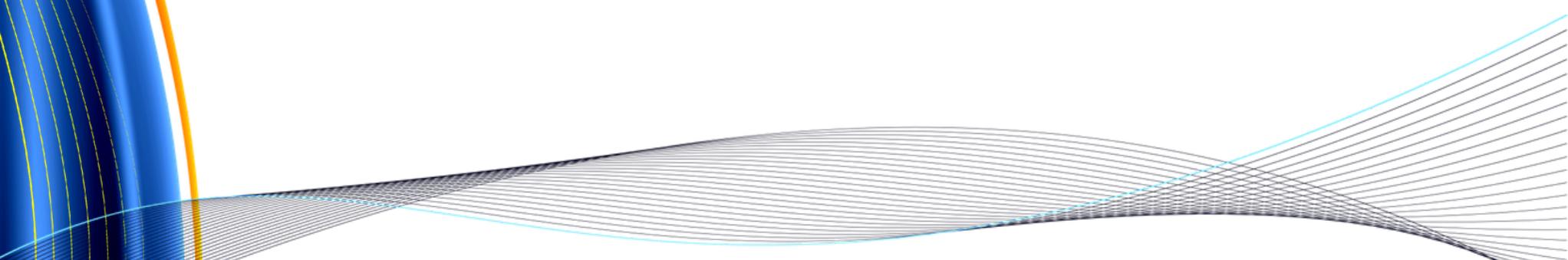
Yaseen Galali
Nutrition department
2022

MACRONUTRIENTS

- Carbohydrates
- A normal diet, where approximately half (45-55%) of the daily calories come from carbohydrates, provides enough for most moderately active people. For example, a person weighing 70 kg needs about 210-350 g carbohydrates per day



Sugars are Of particular concern for the athlete is the **quantity of sports drinks** they may consume to enhance **exercise performance**, in terms of both general and dental health. Even, if they are 'rinsing and spitting', the sugar will stay in contact with their teeth for a period of time and can have a direct impact on the development of dental cavities.



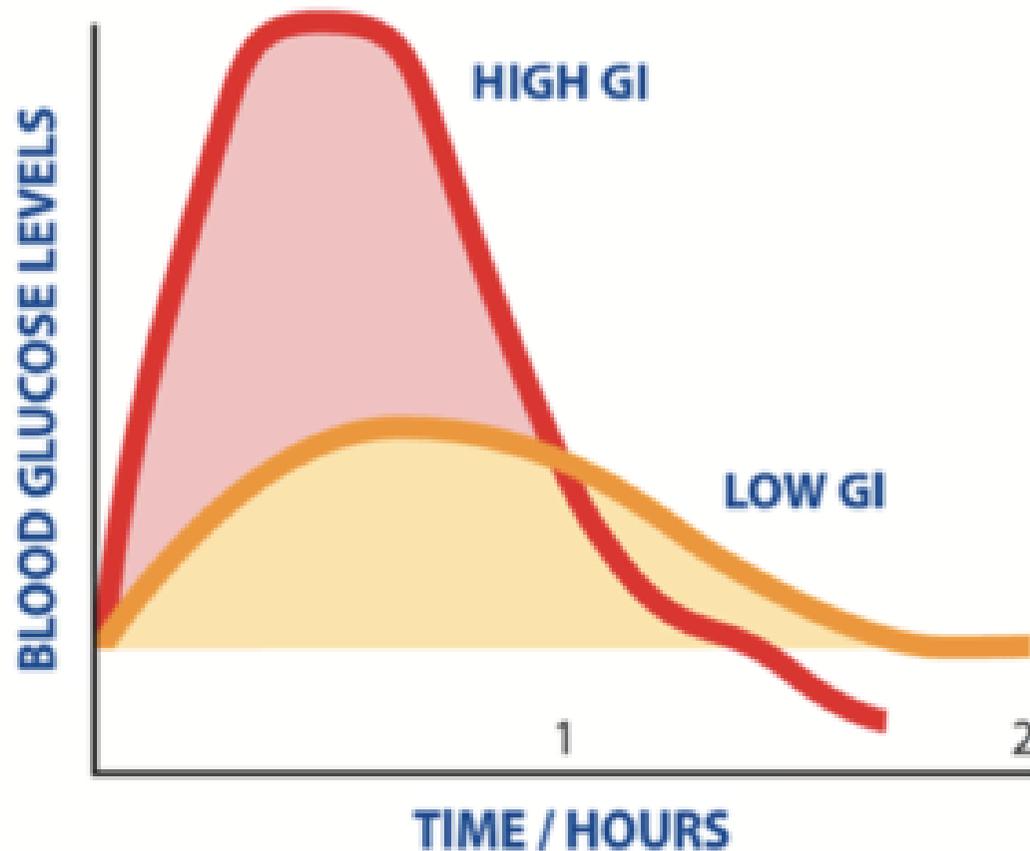
- **Very active people**, who perform high **intensity exercise** regularly (e.g. 2-3 hours intense exercise per day, 5-6 times per week), will need to consume extra energy and increase carbohydrate intake to **55-65% of total daily calories**.
- The exact amount needed increases with the amount and the intensity of exercise

- **Carbohydrate loading** is useful for athletes taking part in events lasting more **than 90 mins** to maximise energy stores before their event. This involves eating **10-12 g of carbohydrate per kg** body weight, per day, for **1.5-2 days** before the event, while also resting from training.
- For a person weighing 70 kg, this translates **to 700-840 g** carbohydrate per day (contributing 2,800-3,350 kcal)

GLYCEMIC INDEX AND SPORT NUTRITION

- The glycaemic response is defined by the length of time it takes for glucose to be absorbed from foods that have been consumed.
- Regardless of whether the foods contain disaccharides or polysaccharides. A low glycaemic response indicates that the glucose is slowly absorbed over a longer period of time,

- A high glycaemic response indicates that the glucose is absorbed more quickly and that there is a sharp immediate rise in blood glucose levels



The amount of carbohydrate in the reference and test food must be the same.

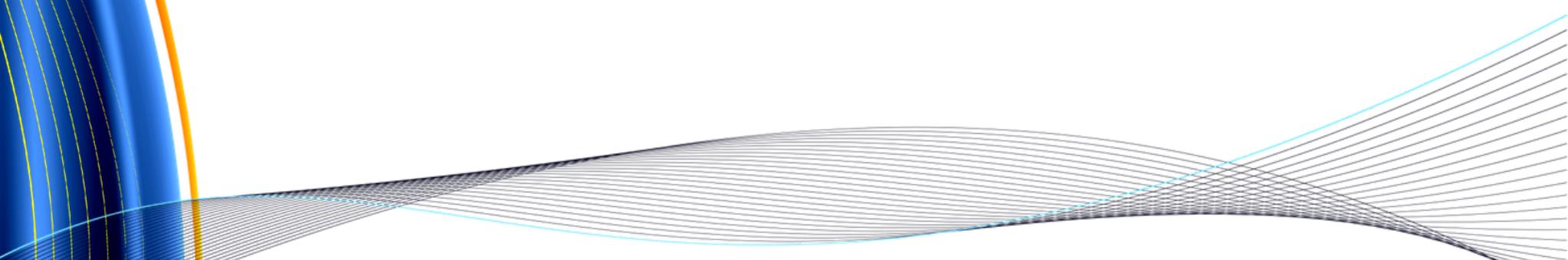
FACTORS INFLUENCING GI

- Fat content (delays gastric emptying)
- Acid content (delays gastric emptying)
- Protein content (delays gastric emptying)
- Amount and types of fibre (soluble fibre has lower glycaemic index than insoluble fibre)
- Type of starch (depending on the structure of the molecule, which affects the rate of enzyme digestion)
- Level of processing (wholegrain bread has a lower glycaemic index than wholemeal bread)
- Sugar type (fructose and lactose have lower glycaemic index than glucose).

Low Glycemic Foods 0 - 54 GO! Ideal To Consume	Moderate Glycemic Foods 55 - 69 Use With Caution	High Glycemic Foods 70+ STOP - Try To Avoid
<p>Most non starchy vegetable <15 Peanuts <15 Low-fat yogurt, no sugar<15 Tomatoes 15 Cherries 22 Peas 22 Plum 24 Grapefruit 25 Pearled barley 25 Peach 28 Can peaches, natural juice 30 Soy milk 30 Baby lima beans 32 Fat-free milk 32 Low-fat yogurt, with sugar 33 Apple 36 Pear 36 Whole wheat spaghetti 37 Tomato soup 38 Carrots, cooked 39 Apple juice 41 All-Bran 42 Canned chickpeas 42 Custard 43 Grapes 43 Orange 43 Canned lentil soup 44 Macaroni 45 Pineapple juice 46 Banana bread 47 Long-grain rice 47 Bulgur 48</p>	<p>Canned kidney beans 52 Kiwifruit 52 Orange juice 52 Banana 53 Potato chips 54 Special K 54 Sweet potato 54 Brown Rice 54 Linguine 55 Oatmeal cookies 55 Popcorn 55 Sweet corn 55 Muesli 5 White rice 56 Pita bread 57 Blueberry muffin 59 Bran muffin 60 Hamburger bun 61 Ice cream 61 Canned apricots, light syrup 64 Macaroni and cheese 64 Raisins 64 Couscous 65 Quick-cooking porridge 65 Rye crisp-bread 65 Table sugar (sucrose) 65 Instant porridge 66 Pineapple 66 Taco shells 68 Whole wheat bread 68</p>	<p>Bagel 72 Corn chips 72 Watermelon 72 Honey 73 Mashed potatoes 73 Cheerios 74 Puffed wheat 74 Doughnuts 75 French fries 76 Vanilla wafers 77 White bread 79 Jelly beans 80 Pretzels 81 Rice cakes 82 Mashed potatoes, instant 83 Cornflakes 84 Baked potato 85 Rice, instant 91 French bread 95 Parsnips 97 Dates 100</p>

- **GI to promote satiety** and confer health benefits, for the athlete, knowledge of the GI of foods is also important for implementing nutrition plans to optimize performance.



- 
- Meals before exercise focus on consuming low-GI foods to enable a sustained release of glucose in the blood.
 - However, during and after exercise, high-GI foods are preferred to promote a quicker glycaemic response, allowing the absorbed glucose to be utilized for performance and to replace lost glucose respectively.
- 

- The impact of **hyperglycaemia** (high blood glucose levels) on cells and tissues in the body is also cause for concern.
- An indirect impact of eating large amounts of added sugars is that they may replace other **nutrient-rich foods** and result in **nutrient deficiencies**.

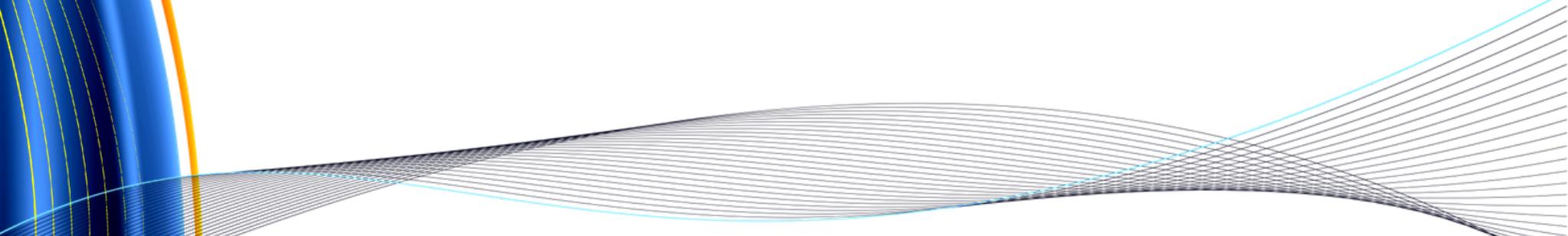


- Foods such as lollies, cakes, biscuits, doughnuts, muffins and chocolate, and drinks such as sports drinks, soft drinks and fruit drinks, all have high amounts of added sugar with few other nutrients in them, so they are referred to as **nutrient-poor**.





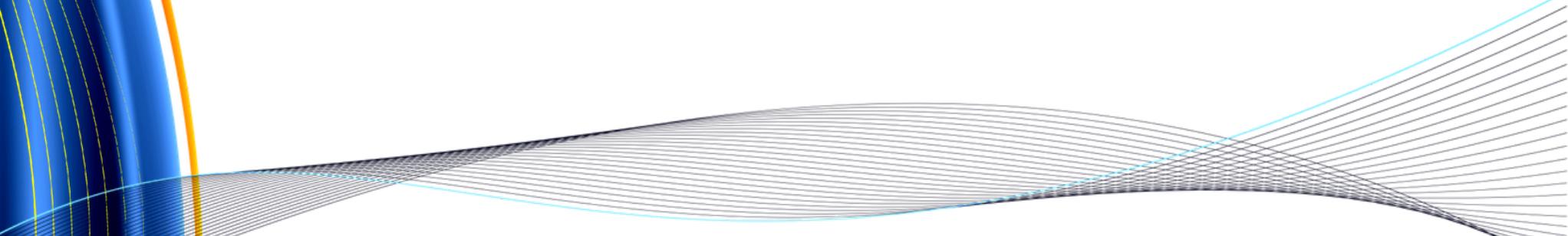
Weight	Sedentary Individual (g/kg body weight/day)	Endurance Athletes (g/kg body weight/day)	Strength Athletes (g/kg body weight/day)
55kg (120 lbs)	44	66-77	66-94
70kg (154 lbs)	56	84-98	84-119
90kg (198 lbs)	72	108-126	108-153



FAT

- Active people need a moderate amount of fat (about 30% of daily calories).
- which can easily be achieved by including oily fish (like salmon), vegetable oils or spreads, nuts, seeds and avocado in the diet



- 
- Current dietary guidelines recommend that
 - **10% of fat intake should come from monounsaturated sources,**
 - **10% from polyunsaturated sources,**
and
 - **no more than 10% from saturated fat**
- 

ALCOHOL

- however, it is not necessary to include when planning diets and nutritional intakes for people, including athletes, due to the negative health and performance effects.
- alcohol refers to compounds containing a hydroxyl group ($-OH$), which include methanol, ethanol, isopropyl alcohol, glycerol, butanol and pentanol. However, for most people the term 'alcohol' is used to describe alcoholic beverages containing ethanol

- Ethanol is a **depressant of the brain** and nerve tissues and affects a number of neurochemical processes. leading to an increased risk of suffering mental health problems
- Importantly, if consumed as part of **after-game celebrations**, alcohol can limit athletes' ability **to adhere** to **nutrition recovery plans**



Micronutrients and antioxidants

Yaseen Galali
Nutrition Department

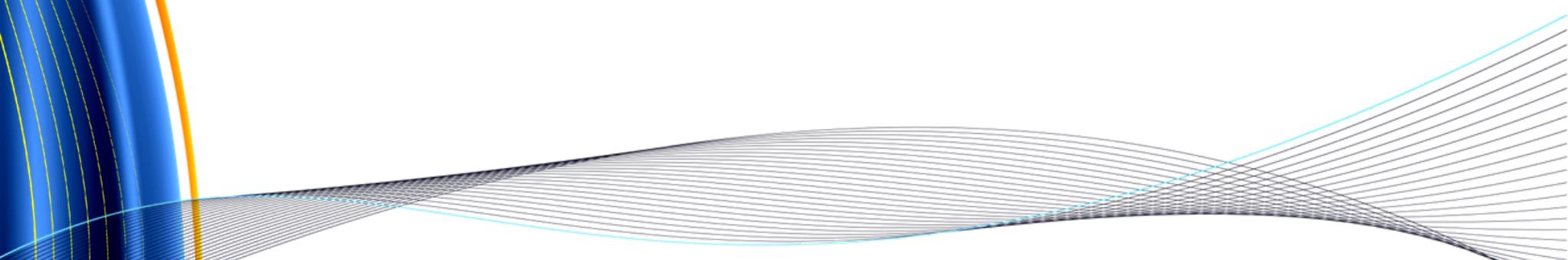
1. SODIUM

- **Maintains fluid balance**
- **Maintains blood volume**
- **Helps muscles contract**

Sodium is an electrolyte, a name for minerals that help to maintain fluid balance in your cells. When you sweat or when you're dehydrated, you lose electrolytes, and you lose more sodium than any of them. **A liter of sweat has about 900 milligrams of sodium, 200 milligrams of potassium, 15 milligrams of calcium and 13 milligrams of magnesium**

- Because you lose so much sodium, sodium should take a priority in your recovery and rehydration.
- Your blood thickens when it's dehydrated, **Salt helps to increase blood volume so you have a better cardiovascular system, better stamina, better endurance, and better recovery from training.**
- **sweaty workouts can result in up to 7 grams of lost sodium an hour**, it's wise to balance your workout with extra sodium when it makes sense.



- 
- The RDA for sodium is 2.4 g/d (roughly the equivalent of 1 tsp of table salt)
 - most athletes will have an excess of **4 to 6 g/d of sodium**. This is sufficient for most athletes; **however, it may be inadequate in those with large sweat sodium losses**
- 

2. MAGNESIUM

- **Helps with sleep quality**
- **Helps with stress management**
- **Plays role in energy metabolism**

Magnesium is useful in multiple energy and blood cell production processes, so important for endurance and recovery,” “For athletes particularly, it’s shed in sweat and urine, and **low levels can cause you to get tired more quickly and experience muscle cramps.**

RDA

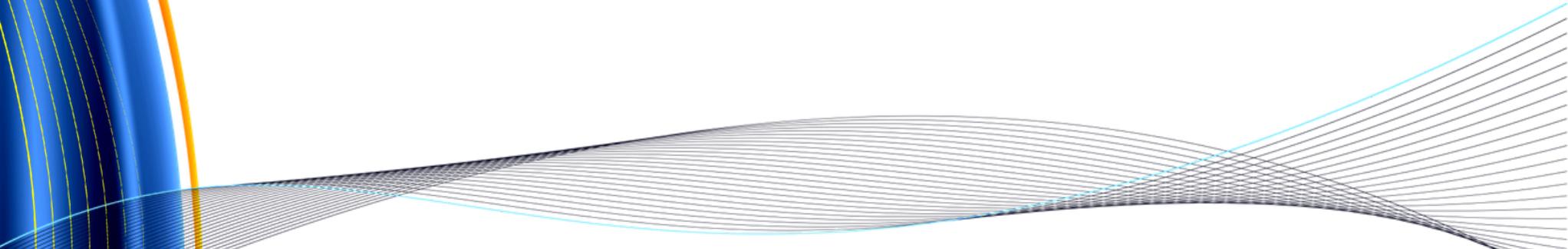
400mg for men

300mg for women

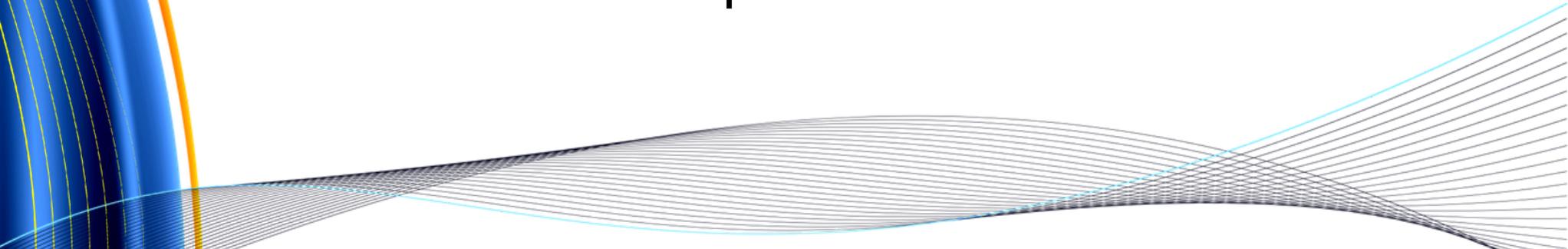
3. CALCIUM

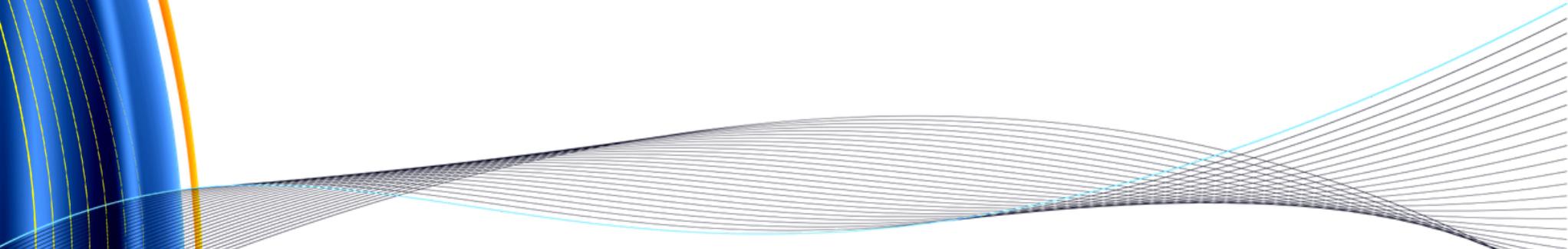
- **Contributes to bone strength**
- **May help with testosterone**
- **Increases fat excretion**
- Calcium is a structural component of bone. It combines with phosphorus to form hydroxyapatite, a hard, crystalline structure that gives bones their strength



- 
- Adequate calcium intake has also been linked to healthy testosterone levels and, according to a meta analysis of *twenty-nine* randomized controlled trials, **it probably helps you excrete fat and thereby improve body composition.**
 - That's something most athletes can get behind.
- 

- **CALCIUM** This may be the most important nutrient for an athlete. In a survey of more than 10,000 male and female athletes ages 7 to 50, fewer than half consumed 1,000 mg of calcium daily. **The recommended dietary intake** ranges from 1,000 to 1,500 mg/day depending on age and gender.

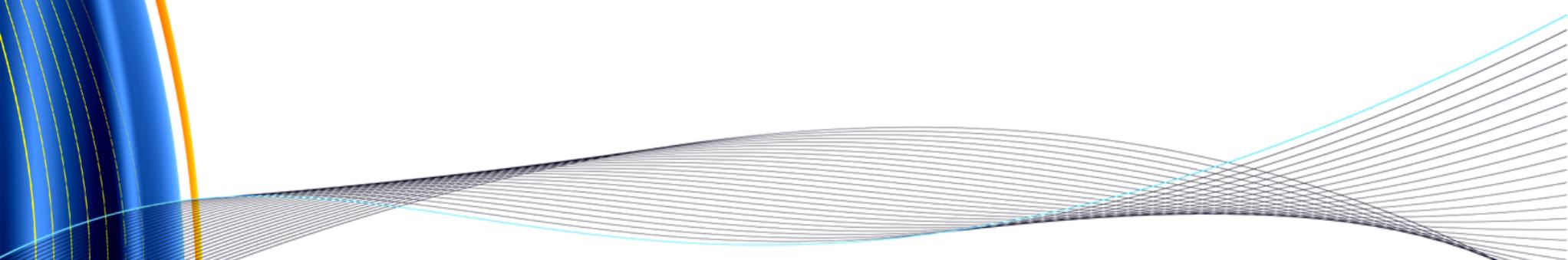
- 
- For female athletes, calcium intake is of particular concern. Excessive training—more than seven hours per week—may **cause hormonal declines in young girls that can stop menstruation**. This hormonal decline also compromises bone formation, possibly leading to **premature, irreversible osteoporosis**. Recent research shows that male endurance athletes of all ages experience testosterone deficits that also can cause osteoporosis.
- 

- 
- **adequate intake can lead to better V02 max, grip strength, leg power, and gait speed.**
 - **Plant sources of calcium include** cherries, broccoli and spinach.
- 

4-IRON

- Iron is a structural component of **haemoglobin**, a protein in red blood cells that is responsible for the transport of oxygen to tissues.
- Iron is also a cofactor for enzymes that participate in the electron transport chain, a series of reactions that are needed for the synthesis of ATP



- 
- Given its role in energy production and cell metabolism, it is clear that iron is an essential **nutrient for athletes, especially endurance** athletes.
 - The iron needs of athletes can be more than recommendations for the general population
- 

- 
- Haem iron, is easily absorbed, is found in animal sources particularly in lean red meat.
 - Non-haem iron is found in plant-based sources, such as cereal grains, nuts and certain green vegetables and is not as easily absorbed as haem iron.
 - Vitamin C helps the absorption of iron from plant sources so, if you're vegetarian, be mindful of the relationship. Top up your iron by tucking into a delicious
- 

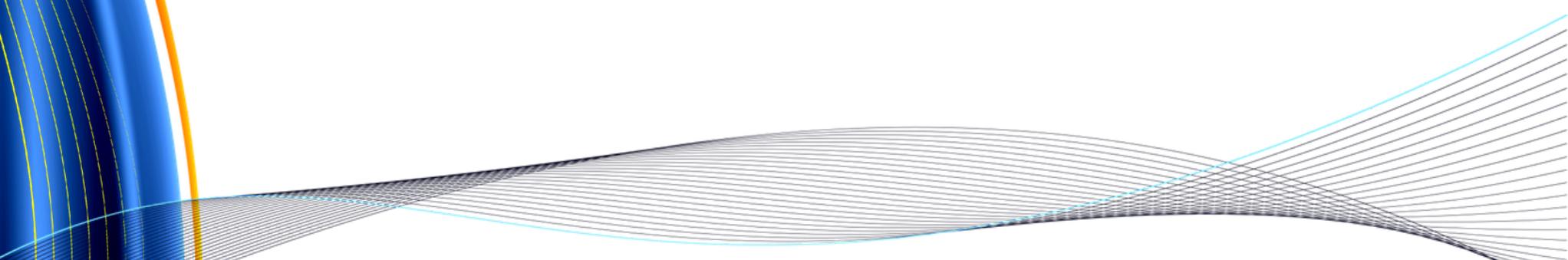
WHY ARE ATHLETES AT RISK FOR IRON DEFICIENCY?

- **Athletes need more iron** than the general population. Iron is lost through sweat, skin, urine, the gastrointestinal (GI) tract, and menstruation.
- Exercise, particularly **high intensity and endurance types**, increases iron losses by as much as 70% when compared to sedentary populations.
- Athletes lose more iron due to heavy sweating
- Red blood cells also break down more quickly in those who exercise.
- The mechanical force of a foot strike during endurance running, for example, can increase the destruction of red blood cells in the feet, leading to a shorter red blood cell life span.

- **Athletes who are at particular risk of iron deficiency include:**
- 1-athletes on energy restricted diets
- 2-adolescent athletes (periods of rapid growth increase iron needs)
- 3-vegetarian athletes (plant sources of iron are poorly absorbed)
- • female athletes who are menstruating (iron is excreted through blood loss)



- • athletes who undertake altitude training (increased production of red blood cells requires iron, along with other nutrients such as B12 and folate)
- endurance athletes, especially runners (pounding the pavement destroys red blood cells, often described as ‘foot strike **haemolysis**’)
- • athletes who are injured (iron is needed for wound healing)
- • athletes who donate blood.

- 
- Avoid eating food containing tannins (coffee, tea and wine) and calcium when taking iron (**chelating**)
 - The recommended dietary allowance (RDA) for iron ranges from 10 to 15 mg/day
- 

5. VITAMIN K

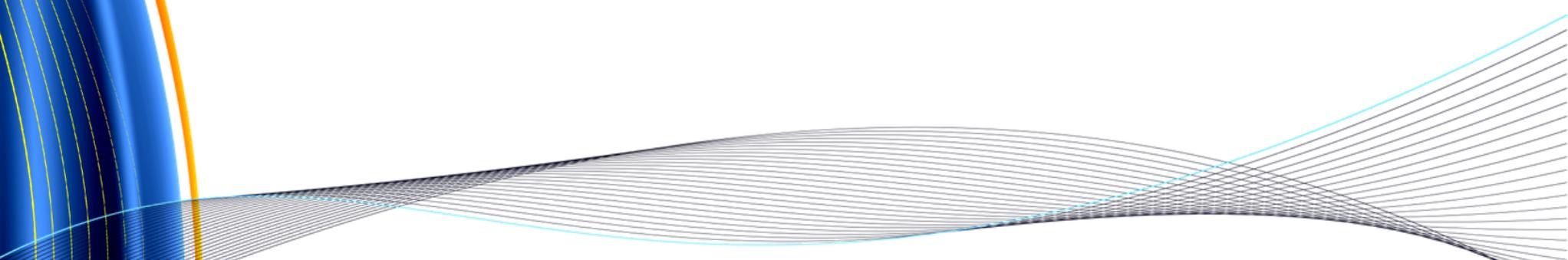
Contributes to bone health
Contributes to heart health



it was only discovered in the 1920s – and research on it has been relatively scarce until recently. But it turns out that **Vitamin K may play an important role in bone health (calcium and Vitamin D)**: it may help proteins bind with calcium and make sure more calcium gets deposited in bones and less of it winds up in soft tissues.

TYPES OF VITAMIN K

- There are three forms of vitamin K: vitamin **K₁** or phylloquinone (plant origin) , vitamin **K₂** or menaquinone (probiotic bacteria in colon) , and vitamin **K₃** or menadione.
- **Women aged 19** to older than 70 years, as well as pregnant and lactating women, require 90 µg/d of vitamin K.
- **Men aged 19** to older than 70 years require 120 µg/d of vitamin K

- 
- In this way **it strengthens bones but it also reduces arterial stiffness**, so it could improve heart health, too.
 - **Vitamin K1, which is found in leafy greens, seems to help with blood clotting while K2 is more closely associated with bone health.** K2 is tougher to get: it's in fermented products, and some animal fats like yolks and chicken thighs. If you're convinced by the science, K2 makes the most sense for supplementing.
- 

6. VITAMIN D

- Linked to better mood
- May support healthy testosterone
- Contributes to bone strength.
- **For athletes, there's also a pretty strong link between adequate Vitamin D and adequate testosterone** – which is pretty important for building muscle.
- One randomized controlled trial published in *Hormone and Metabolic Research* found that a year of supplementing with about 3,333 IU (about three times the recommended intake) saw an average increase of 20 percent in testosterone levels.

7-POTASSIUM

- This mineral, present in intracellular fluid, is responsible for regulating total body water and stabilizing controlled and automatic muscle contractions. It is also lost through sweat and urine.
- In a study of athletes running 40 minutes at 70 degrees Fahrenheit, potassium loss was estimated at 435 mg/hour. The rate of potassium loss is approximately 200 mg/kg of weight lost during exercise

- 
- For postactivity replacement, athletes should take about 435 mg/hour of exercise or 200 mg/kg of weight loss.
 - Supplementing with potassium during training does increase markers of recovery, primarily serum lactate and muscle hydration, but does not aid performance
- 

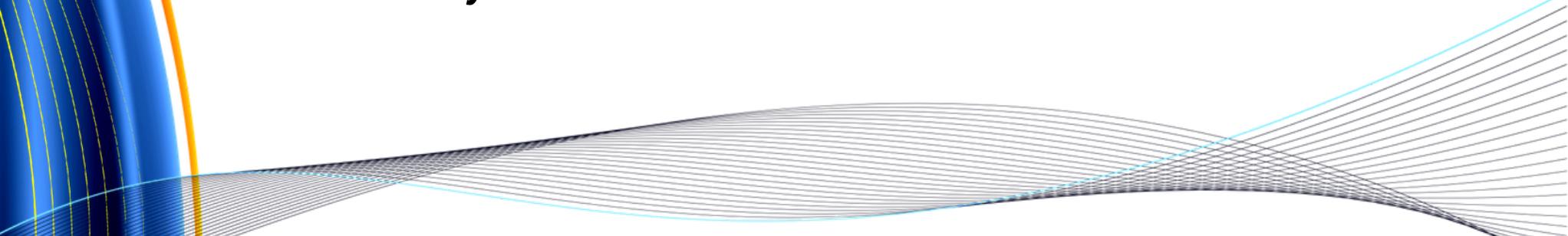
8- ZINC

- This mineral aids in post-exertion tissue repair and in the conversion of food to fuel.
- Both male and female athletes have lower serum zinc levels compared with sedentary individuals. Studies correlate endurance exercise with periods of compromised immunity—zinc depletion may be one reason

- Those who train without days off lose zinc even more quickly. In a study of cyclists, researchers looked at zinc excretion via sweat. Half of the group underwent intense training for two months. Half underwent moderate training with two to three days off per week. Both groups were studied before and after. The exercising group showed increased zinc excretion while the control group showed no increase.
- The researchers believe altered zinc metabolism coupled with increased zinc excretion and stress levels lead to fatigue and decreased endurance.
- **Athletes should take 30 to 60mg zinc daily.**

9- SELENIUM

- **Prevents cell damage**
- **Mitigates oxidative stress**
- **May help with hormonal health**
- “Selenium, along with Vitamin E, can help to prevent cell damage.
- There’s some evidence that physical activity increases your selenium requirements, but in any case, active individuals may want to be particularly mindful of their intake, especially because there’s research that suggests it helps repair cells

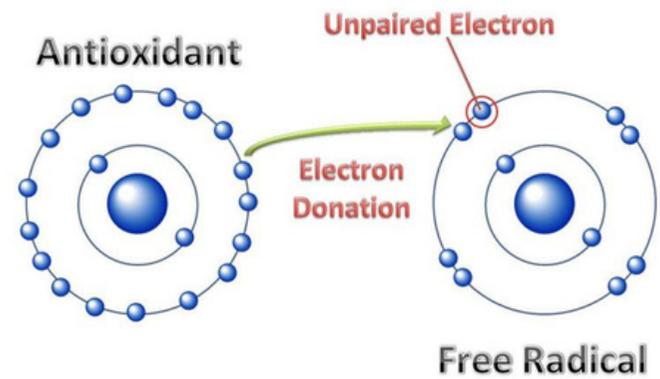
- 
- This essential mineral helps to reduce cell damage because it's an especially powerful antioxidant, so it helps to mitigate oxidative stress.
 - For athletes, the main benefits are the potential impact on recovery by way of lower cell damage and the possibility that selenium, especially when paired with adequate zinc intake, may help to maintain healthy testosterone levels
- 

SUMMARY OF FUNCTIONAL ROLES OF MICRONUTRIENTS RELATED TO

<p>athletic performance Energy, macronutrient metabolism and macronutrient synthesis</p>	<p>Muscle contraction</p>	<p>Fluid balance</p>	<p>Bone health</p>	<p>Blood health</p>	<p>Immune function</p>
<p>Thiamin (B1) Riboflavin (B2) Niacin (B3) Pantothenic acid (B5) Biotin Pyridoxine(B6) Iodine Chromium Iron Zinc Magnesium</p>	<p>Magnesium Sodium</p>	<p>Sodium Potassium Chloride Phosphorus</p>	<p>Vitamin D Vitamin K Calcium Phosphorus Magnesium</p>	<p>Vitamin B12 Vitamin K Iron Folate</p>	<p>Vitamin C Iron Zinc</p>

EXERCISE OXIDATIVE STRESS AND ANTIOXIDANTS

- Free radicals, including reactive oxygen species, are molecules with one or more unpaired electron.

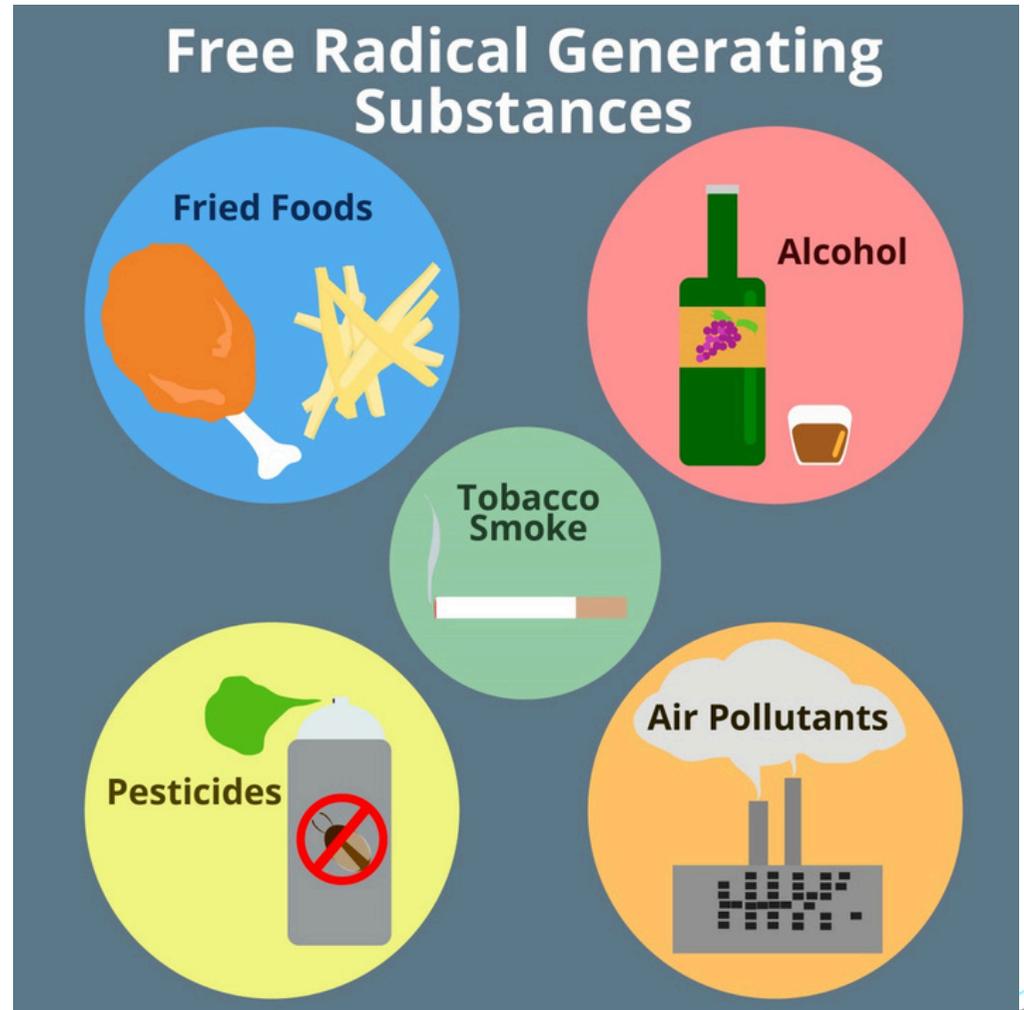


WHERE DO WE GET?

- Cells contain small structures called mitochondria, which work to generate energy in the form of adenosine triphosphate (ATP).
- Mitochondria combine oxygen and glucose to produce carbon dioxide, water, and ATP. Free radicals arise as byproducts of this metabolic process.

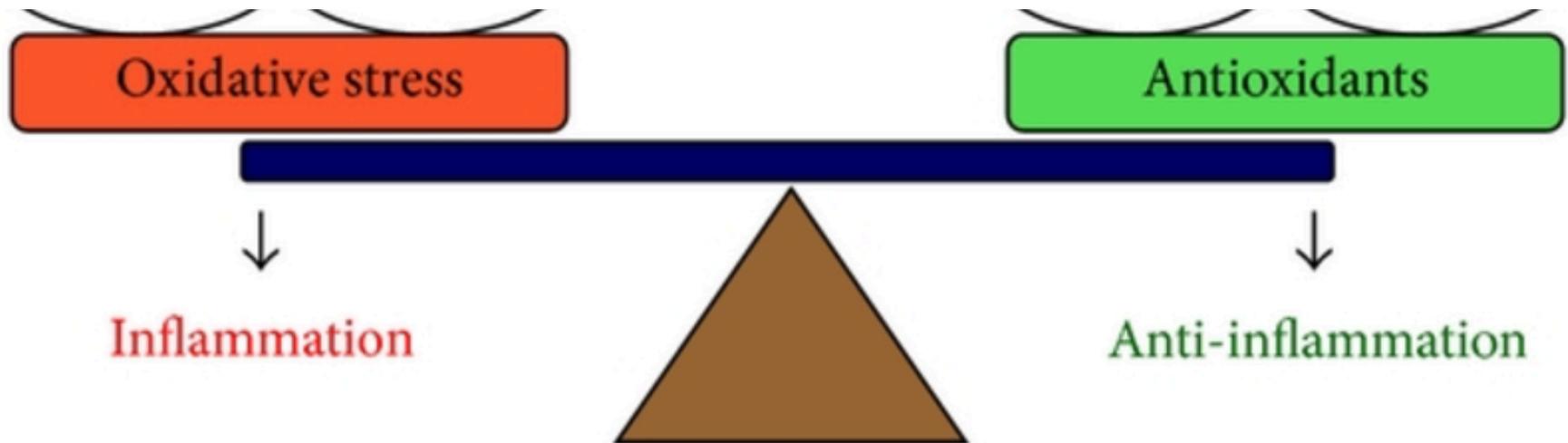
OTHER FACTORS FOR FREE RADICALS

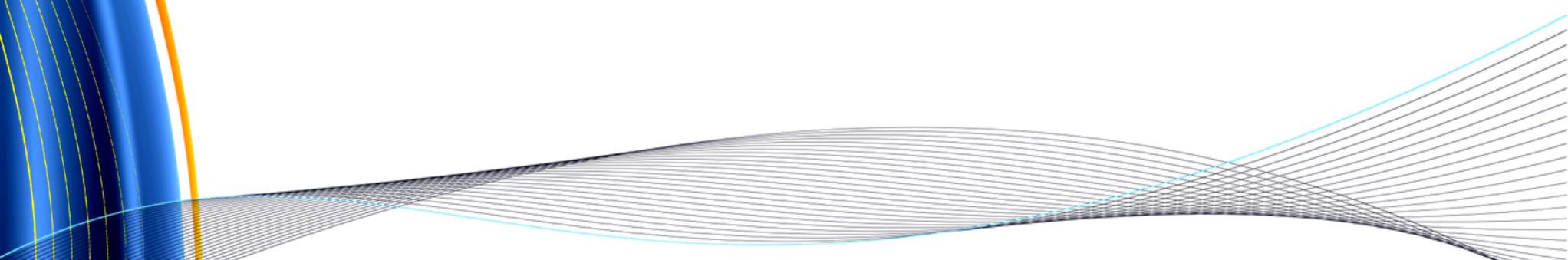
- **Smoking**
- **Air pollution**
- **Pesticides**
- **Diet**
- **Alcohol**
- **Radiation and UV light**



OXIDASE STRESS

- Oxidative stress can occur when there is an imbalance of **free radicals** and antioxidants in the body.



- 
- The body's cells produce **free radicals** during normal metabolic processes. However, cells also produce **antioxidants** that neutralize these free radicals. In general, the body is able to maintain a balance between antioxidants and free radicals.
- 

- The effects of oxidative stress vary and are not always harmful. For example, **oxidative stress that results from physical activity may have beneficial, regulatory effects on the body.**
- Exercise increases free radical formation, which can cause temporary oxidative stress in the muscles. However, the free radicals formed during physical activity regulate tissue growth and stimulate the production of antioxidants.

SOURCES OF ANTIOXIDANTS

Like free radicals, antioxidants come from several different sources.

- Cells naturally produce antioxidants such as **glutathione**.

A person's diet is also an important source of antioxidants. Foods such as fruits and vegetables provide many essential antioxidants in the form of vitamins and minerals that the body cannot create on its own.

Types of anti-oxidants

Antioxidants are of two types

- **Primary / Enzymatic / natural**

- superoxide dismutase
- catalase
- glutathione peroxidase
- glutathion reductase

- **Secondary / Non enzymatic / synthetic / dietary supplements**

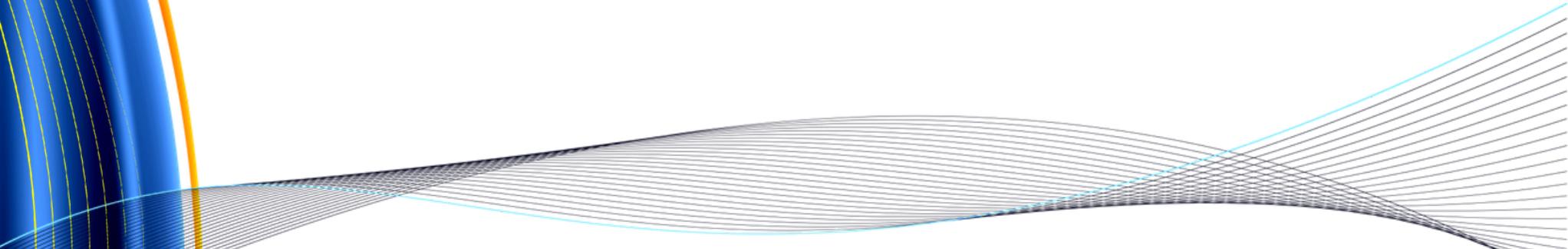
- vitamin C
- vitamin E
- selenium
- zinc
- taurine , hypotaurine
- glutathion
- beta carotene , carotene

Introduction to diet plan

Yaseen Galali
Cihan university-Erbil

INTRODUCTION TO DIET PLAN

- One of the main roles of nutrition professionals working with athletes and active people is to help them develop and implement
- we will describe the steps involved in planning diets for individual athletes and for teams, and consider a range of factors that
 - influence an athlete's nutrition plan
 - their nutrition plans

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- We will also consider strategies to use when working with athletes to increase engagement and participation in the diet-planning process.
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ATHLETES

- Developing a nutrition plan is a **complex task**. There are a number of factors that may influence dietary intake; these are described in more detail below. To help simplify the process, the following steps may be used as a guide to follow when developing a nutrition plan.



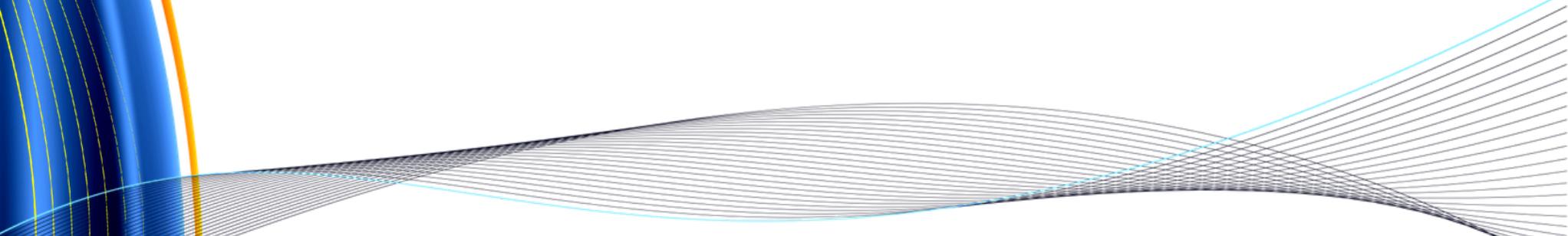
STEP 1: COLLECT INFORMATION

- Identify **baseline physiological requirements**. How much energy and nutrients are required at rest?
- Identify additional requirements related to training and competition. How much extra energy is needed to support training sessions and competition events? Should this energy be focused on any specific macronutrients?

- Determine when training, competition and recreational activity will take place. It is important to be able to time meals to **effectively fuel training, competition and recovery.**
- Identify any dietary requirements related to **allergies, intolerances, religious or cultural beliefs, or personal values. Are there any foods that the athlete cannot consume?**
- Assess current **body composition** and evaluate this against any required standards or goals. What information is currently available? Take additional measurements if trained to do so and relevant to the athlete's goals.



- Identify any factors that may influence access to food. Does the athlete have access to fresh food outlets? Can they afford to buy this food? Do they have facilities for food storage, preparation and cooking, and do they have the skills to do so?
- Identify social influences on dietary intake. Where does the athlete eat, and who do they eat with? Do they prepare their own meals? Are they cooking for other members of their household? How is their day scheduled? Do they have time to cook?

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- Identify any nutrition-related health concerns. Does the athlete have any health issues that require input from a dietitian or other health professional?
 - Identify any team requirements, restrictions or habits regarding food, beverages and supplements. What type of sport do they play? What is their goal?
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- position and what does it involve? **How long do games/events run for? Will the athlete play for the entire game?** Will they have access to food or fluid while they are playing or during breaks? Does the team or club eat meals together or provide food or supplements for athletes?
- **Collect and assess information about the athlete's usual diet and supplement use.** What do they eat currently (what, when and how much)? Are they happy with this? What would they like to change and why?

STEP 2: IDENTIFY PRIORITY AREAS

- Ask the client what is important to them.
- Common goals include increasing lean (muscle) mass, reducing fat mass, or providing strategic fueling suggestions to maximize performance in training or competition.
- There will be other important aspects to consider—for example, the athlete focused on fuelling a training session may also be interested in recovery strategies

- But- these do not all need to be addressed at the first appointment. Depending on the athlete's situation, you may also ask for input from a coach or trainer to help identify nutrition goals.

STEP 3: DEVELOP A PLAN

- Put together a specific plan with detailed recommendations for when to eat,
- what to eat and how much to eat. Athletes will often like the structure of a rigid plan,
- but it is helpful to provide some **flexibility** to allow for changes in circumstances, preferences and access to foods.
- A flexible plan that includes options will also help to teach the athlete about the components of their dietary plan and enable them to make appropriate choices on their own.

STEP 4: TRIAL THE PLAN

- Nutrition plans **must be tailored to the individual** athlete.
- As much as we can try to develop helpful nutrition solutions for athletes based on what we know about their needs and what we know about food, the only way to determine with any certainty whether a plan will be tolerated by an athlete and help to achieve their nutrition-related goals is to trial the nutrition plan.
- Ask the athlete to trial the plan at least once or twice before your next consultation with them.
- Nutrition plans that will be used in competition should be trialed in training as much as possible, to familiarize the athlete with the plan and to help train the gut.

STEP 5: ASSESS THE PLAN

- Once the athlete has had some experience with the nutrition plan, it is important to meet and review how well the plan was tolerated and accepted by the athlete, and whether it is helping to achieve their nutrition-related goals.
- it cause any gastrointestinal discomfort?
- Did the athlete like the foods.
- Were the foods easy to access and prepare?
- Were foods planned for use during competition or training easy to consume during the activity?
- Were there any changes noted in performance at training, or in energy or mood through the day?
- Were there any barriers encountered in implementing the plan?

STEP 6: REVISE THE PLAN

- Based on the feedback provided by the athlete, make modifications to the plan. The new plan should also be trialed, assessed and revised as needed.
- Following these steps should help you collect all of the information you require to work with an athlete to develop a nutrition plan

EXAMPLE:

- **TIMING OF TRAINING/COMPETITION/ACTIVITY**
- Trains after work (5 p.m.) during the week, and in the mid-morning on weekends.
- **BODY COMPOSITION**
- **BMI** = $57 \text{ kg} / (1.68 \text{ m})^2 = 20.2 \text{ kg/m}^2$ (considered to be within healthy range)
- More detailed anthropometric measurements have not been performed. In recreational athletes of healthy BMI with no personal concerns about their body composition, there is no need to perform detailed anthropometric measurements.

- **DIETARY REQUIREMENTS**

Nil allergies or intolerances.

- **PERSONAL PREFERENCES, LIKES AND DISLIKES**

Prefers dairy, eggs and vegetable sources of protein to meat.

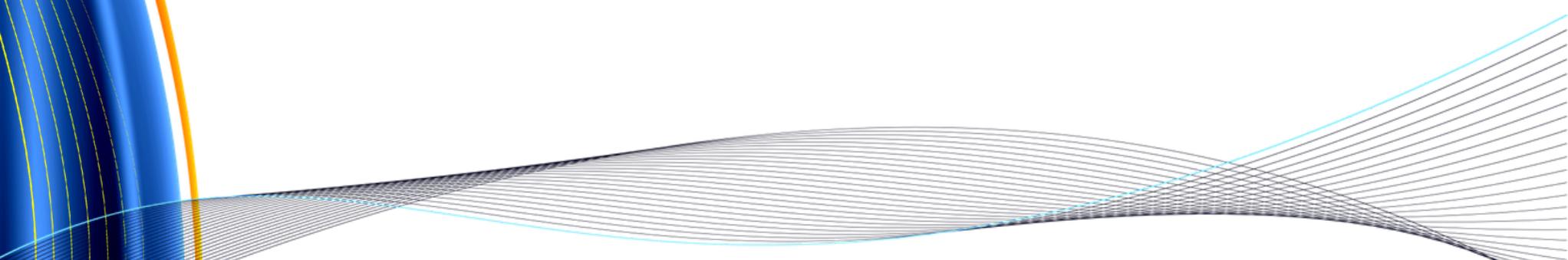
- **FACTORS INFLUENCING ACCESS TO FOOD**

- Works full time; is able to access shops on evenings and weekends.
- Shares a kitchen with one roommate.

- **SOCIAL INFLUENCES**
- Usually eats alone; occasionally eats dinner with her roommate. Eats lunch at her desk during the week. Works 8.30 a.m.–4.30 p.m. in an office close to home. Enjoys cooking, but not baking.
- **NUTRITION-RELATED HEALTH CONCERNS**
Nil



- **TEAM REQUIREMENTS, RESTRICTIONS OR HABITS**

- Long weekly training runs will require a source of carbohydrate, electrolytes and fluid while training. Race-day nutrition strategies should be practised in training.
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- **USUAL DIET**

- **Breakfast (7 a.m.):** 1 cup of cereal with skim milk and a glass of orange juice
- **Morning snack (9 a.m.):** 2 slices of wholemeal toast with peanut butter and coffee with skim milk
- **Lunch (12 p.m.):** 2 cups of salad using leftover vegetables from dinner plus 2 eggs, a small tin of tuna or crumbled feta with olive oil and vinegar to dress the salad plus an apple or pear
- **Afternoon snack (2.30 p.m.):** chocolate bar or similar from the vending machine
- **Dinner (7 p.m.):** pasta or rice with lentils, chickpeas or beans and vegetables, and fruit with ice cream or custard for dessert

CALCULATING ENERGY REQUIREMENT STEP ONE

- Calculate your basal metabolic rate (BMR), the minimal number of calories your body needs just for daily survival. Use this formula:
- $BMR = 66 + (6.23 \times \text{weight in pounds}) + (12.7 \times \text{height in inches}) - (6.8 \times \text{age in years})$
- **1 inch=2.54**
- **1 Kg=0.453**

- Example: If **Jenica** weigh 220 pounds, 6' tall, and 20 years old, your calculations would look like this:
- $BMR = 66 + (6.23 \times 220) + (12.7 \times 72) - (6.8 \times 20)$. *That's 2214 calories per day.*

STEP TWO

- Calculate your Energy Expended for Physical Activity (EEPA), which is all the calories you expend in a day. You can figure this out with this formula:
- $EEPA = BMR \times Activity\ Level = 2214 \times 1.9 = 4206$

1.200	sedentary (little or no exercise due to injury or illness)
1.375	lightly active (about 30 minutes training, moderate 1 to 3 days/week)
1.550	moderately active (moderate 45 minutes, 3 to 5 days/week)
1.725	very active (1 hour, 6 to 7 days a week)
1.900	1.900+ = extra active (very hard training including weight lifting 2-3 days/week)

Most athletes are between **1.550 and 1.9**, depending on the their training. For athletes training at very high **levels (3 hours or more per day)**, calorie needs may exceed recommendations.

STEP THREE

- Calculate your Specific Dynamic Action of Food (SDA) by multiplying the total of BMR and EEPA in step two by 10%.
- *Example: Your SDA equals $4206 \times 0.1 = 420$ calories*

STEP FOUR

- Add the total from step two to the total from step 3 to get the overall number of calories you need daily to maintain your present weight.
- **Total Calorie Needs: $4206 + 420 = 4626$ calories**

ANOTHER METHOD

Example A athlete weight (220 pound) train for three hours

1-For basal requirement(Need)

- weight (pound) X 10 = $220 \times 10 = 2200$

2-Then for basic activity

Multiply by 10% to 30%

= 2200×1.2 to 1.3

= 2,640 – 2,860 calories

3- Then add **100 calorie for 10 min exercise**

If runs for three hours (30 minutes)

= 300 calorie

Total = $300 + 2,640 - 2,860 = 2940 - 3,160$ calories

per day

PROPOSED PLAN

7 a.m.	2 poached eggs on 2 slices of sourdough bread with 1 tomato and 6 mushrooms, grilled with 1 tsp olive oil 200 mL of orange juice
10 a.m.	2 slices of whole meal toast with 2 tbsp peanut butter 250 mL coffee with skim milk
1 p.m.	1 cup of salad vegetables plus 95 g tuna, salmon or sardines and 30 g feta or ricotta cheese and 1 cup leftover cooked starchy vegetables with 1 tsp olive oil and 2 tsp vinegar and a dinner roll One piece of fruit
4 p.m.	1 cup of cereal (not a high-fibre option) with ½ cup skim milk
5 p.m.	Training
6 p.m.	3 pieces of fruit with a 20 g slice of cheese
7p .m.	1 cup cooked wholemeal pasta or brown rice with ½ cup cooked lentils, chickpeas or beans, ¾ cup tomato-based sauce, ½ cup cooked starchy vegetables (e.g. potato, sweet potato, corn) and ½ cup green vegetables (e.g. broccoli, green beans, spinach)
9p .m.	300 mL yoghurt or custard with 1/2 cup nuts and 1 cup berries

- This plan provides more than 3000 145 g protein, 95 g fat and 350 g carbohydrate per day.
- Did you notice that this plan contains many **elements from the athletes usual diet?**
- We have moved the order and timing of some of the foods,
- **But** it is helpful to include as many foods as possible that are already familiar to and known to be tolerated by the athlete

- You may also note that the total energy provided by the nutrition plan is not exactly what we calculated Janice's requirements to be.
- Remember that estimates of energy requirements are just that—estimates. It is more important to note Janice's usual intake and any changes in weight or body composition with dietary changes to inform finetuning of the nutrition plan.
- Estimated energy requirements are more likely to be used when an athlete requires a more substantial change to their diet,
- or when you have limited background information available to inform your plan

- Janice will now trial this plan on two training days and keep track of her experience in a
- She will record what she eats and when, as well as her energy levels and any gastrointestinal discomfort. After these two trial days, you meet with Janice to discuss her experience.
- Janice reports no concerns except that she felt hungry during training.
- Together, you adjust her lunch and pre-training snack to include more low-GI sources of carbohydrate, and you ask her to return with feedback after her next training day.



Time	Food consumed	Mood and energy levels	Gastrointestinal symptoms
4 p.m.	1 cup cornflakes ½ cup milk	Energetic	Nil

