

# 1.2.a – Diet, Nutrition & Performance

## **Learning objectives**

To describe the components of a balanced diet.

To explain how energy balance might change dependant on sport or training requirements.

To explain the use of ergogenic aids specifically pharmacological and physiological aids.

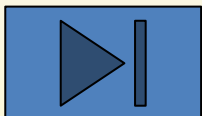
To understand the importance of nutritional aids including, hydration, electrolyte balance, caffeine, creatine, glycogen loading, bicarbonate and nitrates.



# Diet and nutrition



*Watch me*



**How does the nutritional requirements change for different athletes?**



# Diet and nutrition

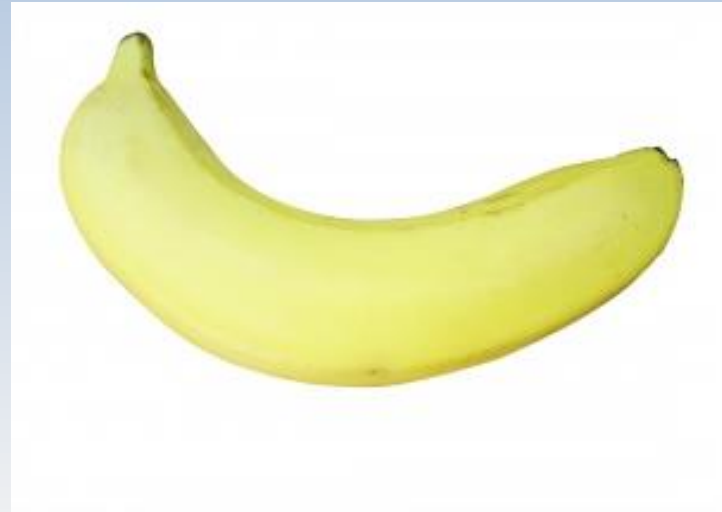
A balanced diet is essential for health as well as to cope with the physical demands of sport. An average male should consume 2500 calories per day while females should aim for 1900.



**Think. Pair. Share – What should be included in a balanced diet?**

# Diet and nutrition

**1. Carbohydrates** – this macronutrient is the ‘fuel’ for energy production, cell division and active transport.

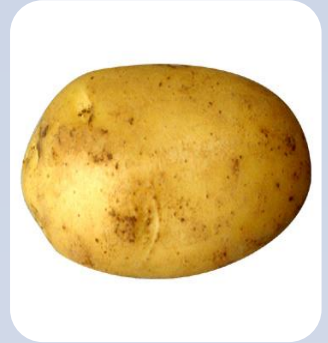
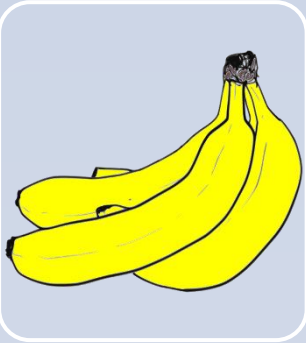


Carbohydrates can be consumed in the form of starches which are stored in the form of Glycogen and through sugars which circulate in the blood stream as glucose.



# Diet and nutrition

Other sources of carbohydrate:



Fruit

Bread

Rice

Pasta

Potatoes



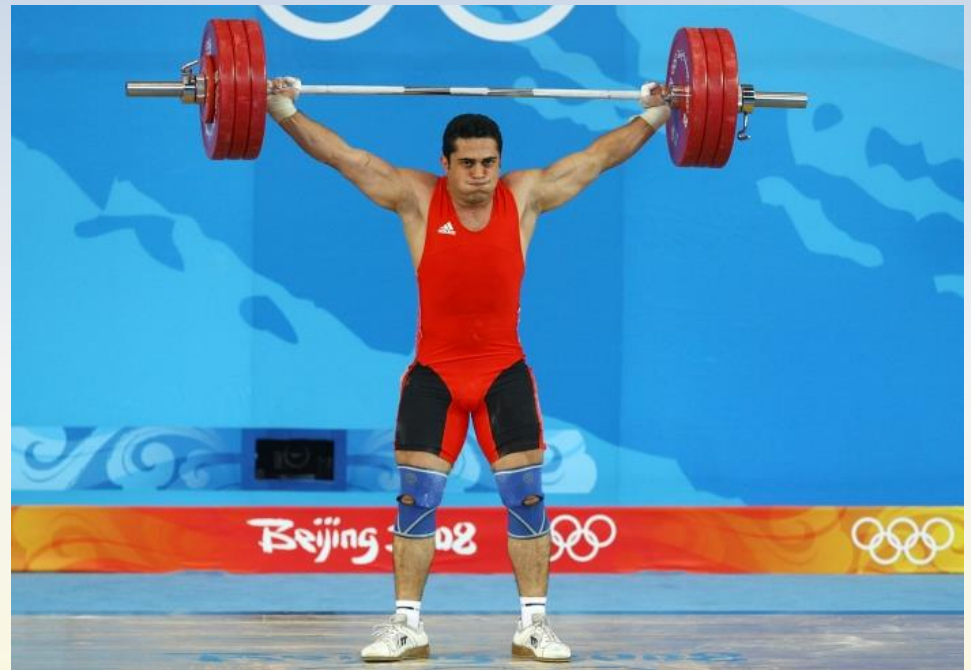


# Diet and nutrition

**2. Protein** – This essential nutrient promotes the growth and repair of muscles. Protein consists of **amino acids**. They are also used to generate energy only when the body has exhausted glycogen and fat stores.

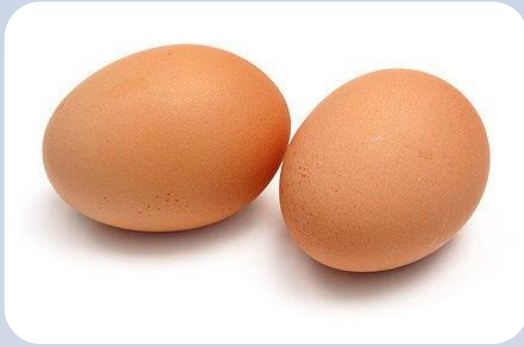
Proteins are especially important for sportspeople who need to build up large, powerful muscles.

Performers in sports like weightlifting, rugby and sprinting need a **high protein diets**.



# Diet and nutrition

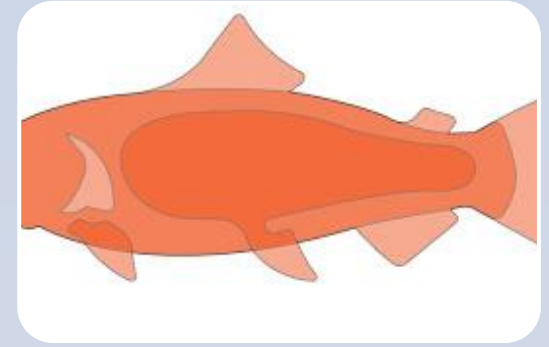
Other sources of protein:



Eggs



Chicken



Fish



# Diet and nutrition

Proteins are also needed by performers who are recovering from injury in order to repair damaged tissue.

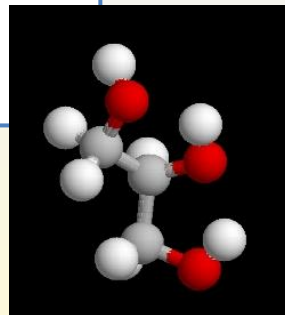




# Diet and nutrition

**3. Fats** – These are also used for energy, but only when stores of carbohydrate run low. Fat provides very slowly released energy. This is important for endurance activities. The longer you work the more fat is used.

Fats are made from glycerol and fatty acids. Each glycerol molecule is attached to three fatty acid molecules.



# Diet and nutrition

Fats are stored in the muscle as triglycerides and transported as fatty acids. Sources of fats include:



Saturated fats –  
This includes  
butter, cheese  
and bacon.



Unsaturated fats  
such as avocado,  
oily fish and soya  
beans will boost  
delivery of oxygen  
and improve  
recovery rates. .



# Diet and nutrition

**4. Minerals** – these are essential in small quantities to maintain healthy bodily functions. In particular minerals increase the efficiency of carrying oxygen to muscles.

Minerals can be found in:

- Calcium in milk aid bone development
- Iron in meat help form haemoglobin and the immune system.
- Phosphorous are key to bone health and energy production.



# Diet and nutrition

**5. Vitamins** – these generally contribute to the general health of an athlete. Vitamins are either fat-soluble (Vitamin A, D, E & K) and are stored in the body or water-soluble (Vitamin C and B) which require regular intake.



Vitamins are needed to:

- Resisting infection and disease
- Regulate chemical reactions in the body.



# Other nutrients in a balanced diet

**6. Fibre** – This is important for the normal functioning of the large intestine.

Fibre is found in wholemeal bread and pasta, nuts, seeds, fruit and vegetables.



**7. Water** - The human body is 75% water. We need regular intake to replace the water lost through urine, sweating and breathing.

When exercising the body loses even more water which can cause dehydration.





# Energy Balance

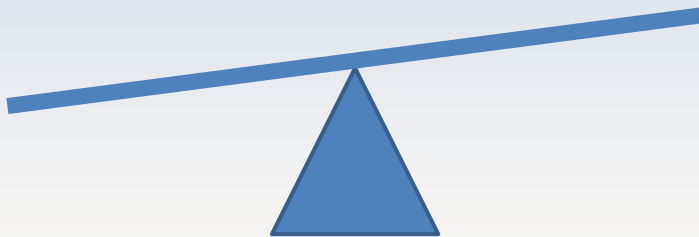
**Energy balance** is the relationship between energy intake and expenditure.

## Calories out

- Exercise
- Daily activity
- Resting metabolic rate

## Calories in

- Carbohydrate
- Fat
- Protein



If intake is lower than expenditure then weight will be lost. This must be carefully monitored in an athletes programme to ensure muscle mass is not reduced.



# Energy Balance

Basal Metabolic Rate (BMR) is the body's basic energy needs. It is the lowest form of energy requirement to maintain the body systems.

Each sport has a different energy requirement depending on:

- **Length of game**
- **Intensity of activity**
- **Level of opposition**



# Energy Balance

Table of energy requirements in different sports:

Activity:	Energy used per hour	Activity:	Energy used per hour
Rugby	1130KJ	Walking	380KJ
Squash	1254KJ	Golf	560KJ
Jogging	1320KJ	Badminton	710KJ
Cycling	1380KJ	Tennis	1000KJ
Swimming	1500KJ		

**Think. Pair. Share – Study the table above and discuss what it shows.**



# Ergogenic aids

**Substances, products or training regimes** that improve performance are referred to as **ergogenic aids**. There are both legal and illegal methods of achieving this and must be governed carefully.

In recent years, the World Anti-Doping Agency (WADA) have introduced an Athlete Biological Passport which profiles an athlete's blood and urine readings to detect changes and irregular patterns.



# Pharmacological aids

## Anabolic steroids



- This category of synthetic hormone resembles testosterone (MALE HORMONE) Anabolic steroids promote muscle growth and repair after stress and provide an ability to train harder due to improve recovery.
- **Side effects:** Irritability, aggressiveness, acne, females develop male features as well as liver & heart damage.

**Athletes that might use this category of drug:**

Athletics power events *i.e.* 100m, Shot Putt





# Pharmacological aids

## Erythropoietin (EPO):



- This is a naturally occurring hormone in the body but can be synthesised in a laboratory. **EPO** is responsible for the production of red blood cells. Increasing the red blood count will increase oxygen transport and improve aerobic capacity. EPO is difficult to detect due to the naturally occurring levels circulating in the body at any one time.
- **Side effects:** Blood thickening (hyper-viscosity) and blood clots as well as associated cardiovascular problems.

### **Athletes that might use this category of drug:**

Cycling, marathon runners (endurance athletes)



# Pharmacological aids

## Human Growth Hormone (HGH)



- This occurs naturally in the body and is responsible for promoting muscle growth. It is associated with a range of sports involving power and explosive strength. It can be difficult to detect due to it occurring naturally in the body.
- **Side effects:** Heart and nerve diseases, glucose intolerance and bone and organ growth deformities.



# Performance Enhancing Drugs – In the news

Lance Armstrong won numerous Tour De France events from 1999 to 2006 but in 2015 admitted using banned substances EPO, HGH and Anabolic Steroids.



# Physiological aids

**Physiological aids** are used to increase the rate of adaptation in the body. **Blood doping** is illegal while others such as **intermittent hypoxic training (HIT)** and **cooling aids** are used frequently.



# Physiological aids

## Blood doping:

This is an illegal way of increasing red blood cells in the body. A volume of blood is removed from the body prior to competition. The body then naturally replenishes the lost blood.

A few hours before competition the athlete has the blood removed injected back into the body. This increases the total red blood count and therefore increasing the bodies oxygen carrying capacity.





# Physiological aids

This method can be difficult to detect through blood tests as it is the athlete's own blood. Blood doping can dramatically increase blood thickness and increase the chances of blood clots and heart failure.



Despite the associated risks cyclists in the Tour De France have used this method for years.

Studies have shown an increase of 1 litre of blood prior to a race can increase  $VO_2$  max by as much as 10-15%.



# Physiological aids

## Intermittent hypoxic training (IHT):

This is a training method where athletes will live at sea level and train under conditions where the partial pressure of oxygen has been decreased (hypoxic). This is cheaper than altitude training as travel costs and the disruption to training routines are negated.

IHT can increase **red blood cell** and **haemoglobin** volume, **oxygen-carrying capacity** and **delay OBLA**.

It is also proved to **increase** the number of **mitochondria** in any given space and the body's **buffering capacity**. (resistance to **pH change in the body**)



# Physiological aids

Endurance athletes as well as games players can benefit from IHT and can be used to acclimatise prior to a tournament or competition held as a venue above sea level.



# Physiological aids

**Cooling aids:** This is a range of products used **pre, post** and **during** an event.



**Pre-event** – ice vests and cold wraps can be used prior to a race to reduce core body temperature. This can delay the onset of fatigue through reducing overheating, sweating and dehydration.



**Injury treatment** – ice packs can be used to treat injuries and reduce pain and swelling. RICE (Rice, Ice, Compression & Elevation) procedure should be followed.



**Post-event** – ice baths are a common method of reducing exercise-induced muscle damage and delaying Delay Onset Muscle Soreness (DOMS) Ice baths constrict blood vessel removing waste and lactic acid from muscles.



# Nutritional aids

Nutritional awareness and the use of supplements are key for elite athletes to meet the required balance between health, training and performance.

A supplement is anything that can be added to an athlete's diet. Supplements are often used to increase energy stores, which in turn enhance athletic performance.



**Think. Pair. Share – What sport supplements do you know of?**





# Nutritional aids

The **amount of food, composition of meals** and the **timing** of these meals are an important part of an athlete's training programme.

## Pre-race meal:

3-4 hours before an event endurance athletes will eat a complex carbohydrate meal. This type of carbohydrate has a low glycaemic index which fills glycogen stores. *i.e. porridge or beans.*



# Nutritional aids

1 hour before the event, a smaller meal of simple/high glycaemic index foods will top up glycogen stores and maintain blood glucose levels. *i.e. energy bar.*

Too much glucose prior to an event can leave an athlete feeling dizzy and fatigued. This is known as **hypoglycaemia**.



# Nutritional aids

## During the event:

For event lasting more than an hour it is recommended that they consume small amounts of simple carbohydrates but at regular intervals. Tennis players will often use glucose gels, tablets or bananas in breaks in play.

## After the event:

Post exercise recovery can be aided with moderate/fast digesting carbohydrates consumed within 30 minutes of completion. This should be repeated at 2 hour intervals for up to 6 hours.



# Nutritional aids

This nutritional balance is altered for athletes in strength based events. A weightlifter will adjust their programme in the following way:

- Eat 5-7 smaller meals a day.
- Increase the amount of protein content to assist muscle growth and repair. *i.e. tuna*
- Limited fat intake
- Consume more complex carbohydrates to release energy slowly and control blood sugar levels.



# Nutritional aids

## Hydration and electrolyte balance

Water is extremely important in the human body. It transports nutrients, hormones and waste products around the body. It plays an important part in regulating body temperature.

During exercise, energy is required and some of that energy is released as heat. Sweating prevents the athlete from overheating. However, this cooling process means that water is lost.





## Nutritional aids

Once the body starts to lose water during exercise, blood volume decreases. The heart has to work harder to move blood around the body and less oxygen is available to the working muscles. It is therefore important when exercising to drink early and often.

The balance of the **electrolytes** in our bodies is important for the normal functioning of cells and organs and to limit the onset of fatigue and cramping.



# Nutritional aids

We need to replace the electrolytes to keep the concentrations of body fluids constant. Sports drinks typically contain sodium chloride and sugar.



**Isotonic** sports drinks such as Lucozade Sport are preferred by middle-distance to long-distance runners and games players as they replace lost fluids and give a carbohydrate boost.



# Nutritional aids

Hypertonic drinks contain a higher concentration of glucose and are usually consumed post-exercise to aid recovery. This will be used by athletes who have exercised for a long period of time.

## Hypertonic drink

### ingredients:

- 400 ml of orange or blackcurrant squash
- 1 litre of water
- A pinch of salt.



# Nutritional aids

**Hypotonic drinks** replace lost fluids but do not give a carbohydrate boost. These are used regularly by jockeys and gymnasts who need to keep their weight down.

## Hypotonic drink ingredients:

You can make your own quite easily using 100 ml of orange or blackcurrant squash, 1 litre of water and a pinch of salt.



# Nutritional aids

## Glycogen loading:

Glycogen loading is a method of maximising glycogen stores. It is often used by long-distance runners and is popularly known as 'carbo-loading'.



Before an important competition, a performer depletes their glycogen stores. This is followed by 3 days of a diet high in carbohydrates and very light training. This increases the stores of glycogen in the muscle and therefore energy for performance.





# Nutritional aids

## Creatine:

Creatine is a supplement used to increase the amount of phosphocreatine stored in the muscles. It allows the ATP-PC system to operate for longer and can help to improve recovery times.

Creatine monohydrate is easily accessible and comes in a powder form. This increase in phosphocreatine allows athletes to perform at a higher intensity for longer.



# Nutritional aids

Athletes in explosive events such as sprints, jumps and throws are likely to experience the most benefit from creatine supplements.



Possible side effects include muscle cramps, bloating, gastrointestinal problems and liver damage.



# Nutritional aids

## Bicarbonate:

The concept behind drinking a solution of sodium bicarbonate is that it reduces the acidity in the muscle cells. This delays fatigue and allows the performer to continue exercising at high intensity for longer.

**Sodium bicarbonate** increases the **buffering capacity** of the blood and therefore neutralises the effects of lactic acid.



**Think. Pair. Share – What athletes might use Sodium Bicarbonate?**



# Nutritional aids

Athletes who use the lactate anaerobic system in their events, such as 400 m runners and swimmers, produce a lot of acidity and will therefore benefit from a sodium bicarbonate buffer.

Side effects can include:

- Vomiting
- Unpleasant taste
- Cramps
- Diarrhoea
- A feeling of being bloated.



# Nutritional aids

## Caffeine:

Caffeine is a stimulant, so it can increase mental alertness and reduce fatigue. It is also thought to improve the mobilisation of fatty acids in the body and thus sparing glycogen stores.

It is taken as a supplement by endurance performers who predominantly use the aerobic system for long-duration exercise.





# Nutritional aids

Caffeine is legal but has been recently placed on a monitoring programme amongst testers to detect misuse patterns in sport.



The drawbacks of caffeine are the increased risk of dehydration, irritability, insomnia and anxiety.



# Nutritional aids

## Nitrates:

These inorganic compounds are ingested by eating root vegetables. *i.e. leafy green vegetables*. They are stored in the body until during exercise when they are converted in nitric oxide which plays a role in vascular and metabolic control.

Nitrates can dilate blood vessels, reduce blood pressure and increase blood flow to tissues.



# Apply it!

What has stuck with you?

Explain the components of a balanced diet.

Describe the use of anabolic steroids and EPO in sport.

**Diet and nutrition**

Explain how blood doping works and the side effects.

What is meant by nutritional aids and name 2 that are used in sport?





# Practise it!

## Exam questions

2. Compare erythropoietin (EPO) and human growth hormone (HGH) as ergogenic aids to performance. [5]





# Practise it!

## Exam questions

3. Table 2 shows the weekly breakdown of a hockey player's diet.

Table 2

Component of diet	Weekly intake
Carbohydrates	50%
Fats	40%
Proteins	10%
Vitamins and minerals	Well below recommended guidelines
Fruit and vegetables	Below recommended guidelines

Evaluate the potential impact of this diet on the player's health and physical performance. Recommend changes that should be made to the intake of carbohydrates, fats and proteins. [5]



# Practise it!

## Marks Scheme:

1. (i) (7 days before event) - significantly reduce carbohydrate intake/high protein diet. (7-3 days before event) - train at high intensity each day. (depletion) - ... this causes severe glycogen depletion in muscles. (3 days before event) - taper training / rest. (3 days before event) - Eat high carbohydrate diet.

(ii) Effective in terms of:

- increased stores of glycogen (in both muscles and liver) / can double overall stores of glycogen.
- which delays fatigue / hitting the wall

But can cause:

- weight gain (caused by) / water retention
- (during depletion phase) muscle stiffness / fatigue
- (during depletion phase) irritability / poor quality training



# Practise it!

## Marks Scheme:

2.

EPO	HGH
Illegal Aerobic benefit Increased RBC / haemoglobin / increased O <sub>2</sub> transport to muscles Increased aerobic capacity / cardiovascular fitness / endurance Increased blood viscosity / CHD / strokes Used by anaerobic athletes to improve training / speed up recovery	Illegal Anaerobic benefit Muscle hypertrophy/increased muscle mass Increased strength / speed / power Abnormal organ growth / agromegaly / cancers Used by aerobic athletes to increase strength endurance / speed / power



# Practise it!

## Marks Scheme:

### 3. Evaluation of impact:

(carbs) 50% too low which means less energy available/increased fatigue. (fats) 40% too high which means increased risk of obesity/CHD/diabetes. (proteins) 10% too low which means loss of muscle mass/decreased

immunity/increased fatigue. (vits/mins) Low levels mean detrimental effect on body functions/decreased

immunity/(mental or physical) fatigue. (fruit/veg) Low intake may mean lack of vitamins and minerals (credit effects listed above)/lack of fibre/digestive problems/weight gain.

### Possible changes:

(carb change) Increase carbohydrate intake to 55-65%. (fats

change) Reduce fats intake to 25-30%. (protein change) Increase protein intake to 15%.

