



O R I G Y M

***Level 3 Certificate
In Personal Training***

**MODULE 5:
UNDERSTANDING MOVEMENT, APPLYING NUTRITION FOR ENERGY
DEVELOPMENT AND PROGRAMME PLANNING**

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Energy Systems

MODULE 5:

UNDERSTANDING MOVEMENT, APPLYING NUTRITION FOR ENERGY DEVELOPMENT AND PROGRAMME PLANNING

Introduction

The human body is, at its most basic level, a machine and like any machine, it needs a supply of energy work. As a car needs petrol or a light bulb needs electricity, your body needs a substance called Adenosine Triphosphate which is known as ATP for short.

ATP is the universal fuel for everything that happens in your body; from lifting weights to running to reading to sleeping – ATP is what powers your body.

ATP is made up of one adenosine molecule and three phosphate molecules. These molecules are held together by high energy bonds which, when broken, release energy for us to use. The result of this reaction is ADP (adenosine diphosphate) + energy + one lone molecule of phosphate.

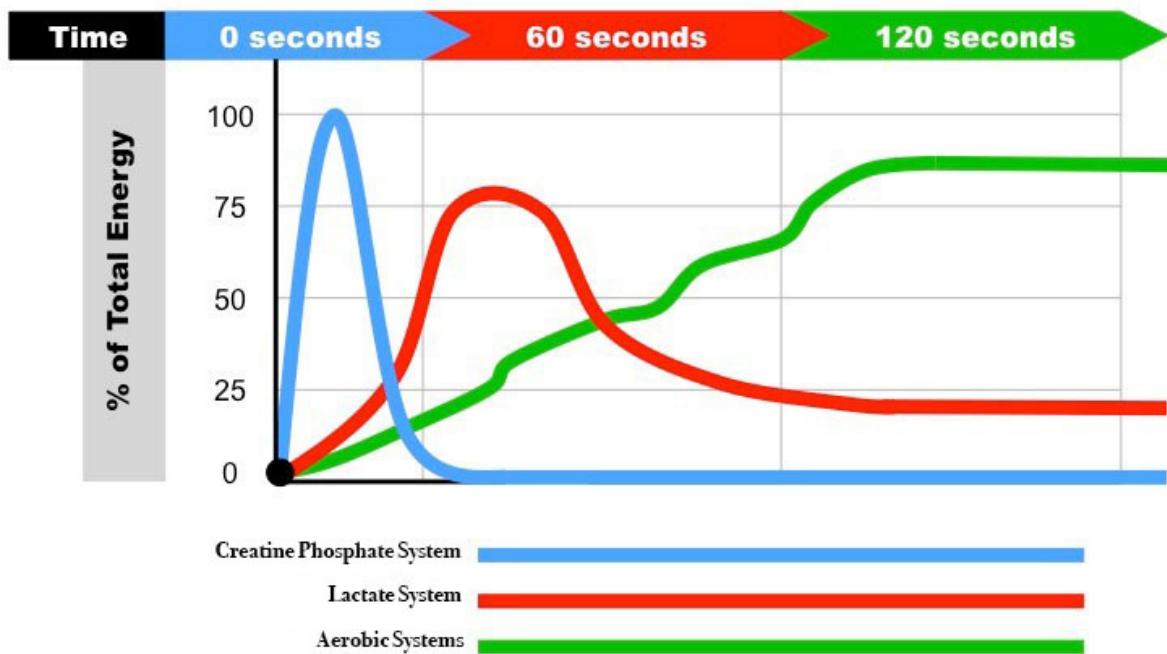
We only have a very limited supply of ATP stored in our bodies; about enough for 1-2 seconds of activity, however, humans convert food into ATP to ensure that we always have plenty of energy. In addition to food, ATP can be manufactured from fat stored around your body and the carbohydrate reserves in your muscles and liver called glycogen.

$$\text{Food} + \text{O}_2 + \text{digestion} = \text{energy (ATP)} + \text{muscular contractions} + \text{CO}_2 + \text{H}_2\text{O} + \text{heat}$$

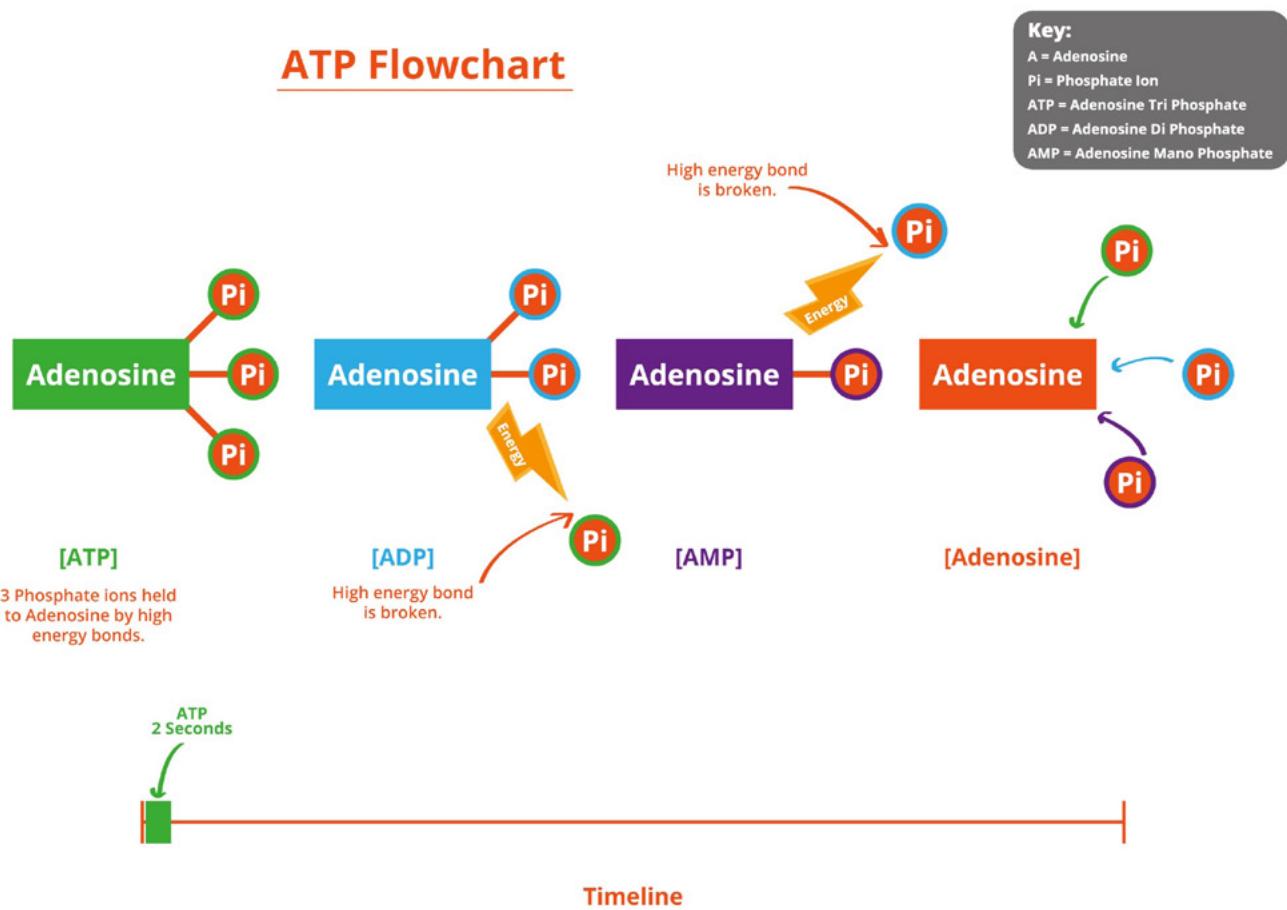
Humans use three primary systems for creating ATP or regenerating ADP back into ATP for use by the body. There are two anaerobic energy systems that operate without oxygen and one that requires an abundance of oxygen.

The Three Energy Systems

1. **Creatine phosphate system:** also known as the CP system, the phosphocreatine system or the anaerobic lactate system
2. **Lactate system:** also known as the lactic acid system or the anaerobic glycolysis system
3. **Aerobic system:** also known as the oxidative system



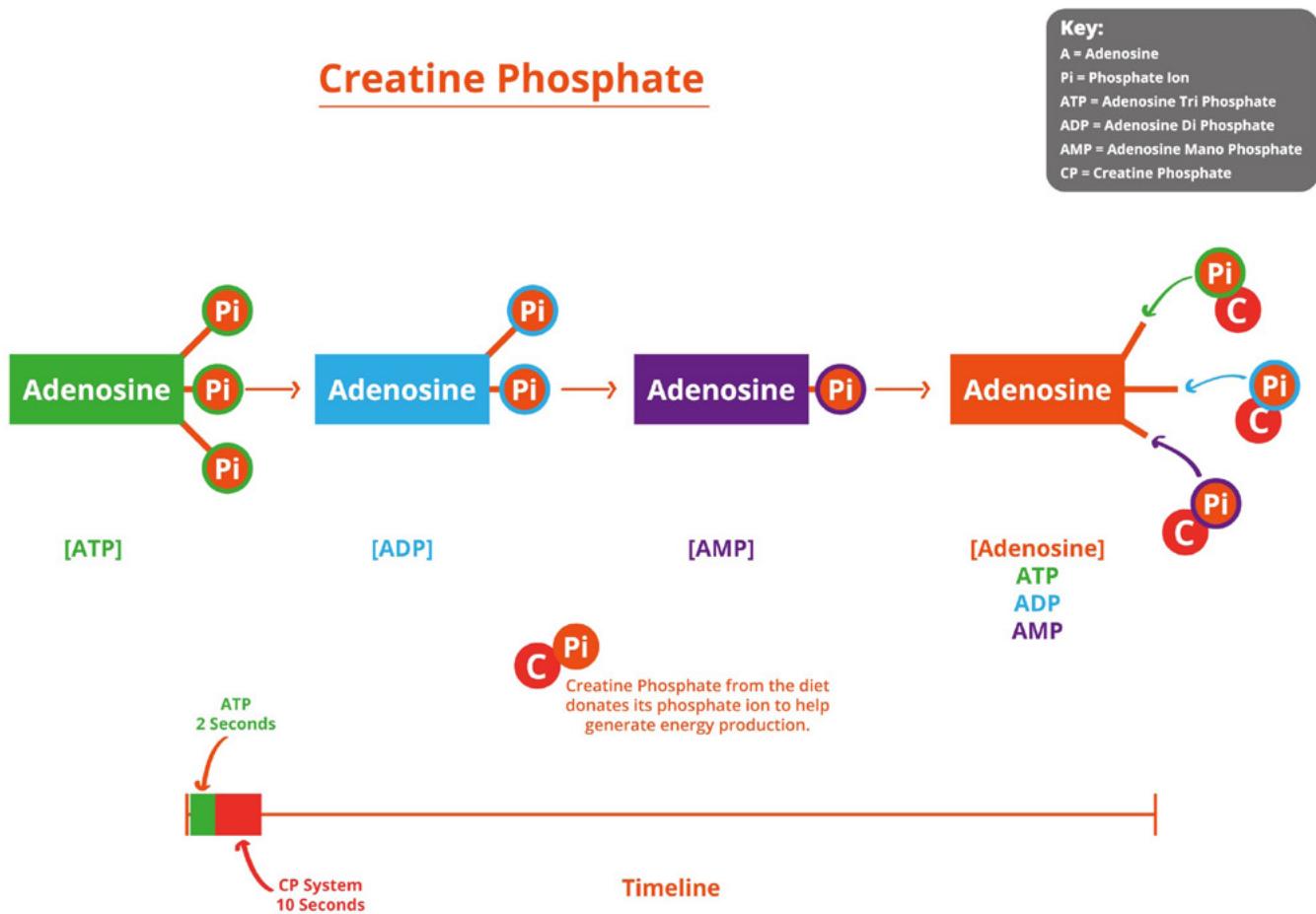
The breakdown of ATP to release energy



Creatine Phosphate Training Adaptations

There is little doubt that activities emphasising the CP system, such as heavy weight lifting and sprinting have a significant training effect; namely increased muscle mass and a pre-dominance of fast-twitch muscle fibres (Jones and Round, 1991) As well as a significant increase in muscular stores of anaerobic fuel sources i.e. ATP, creatine phosphate and glycogen.

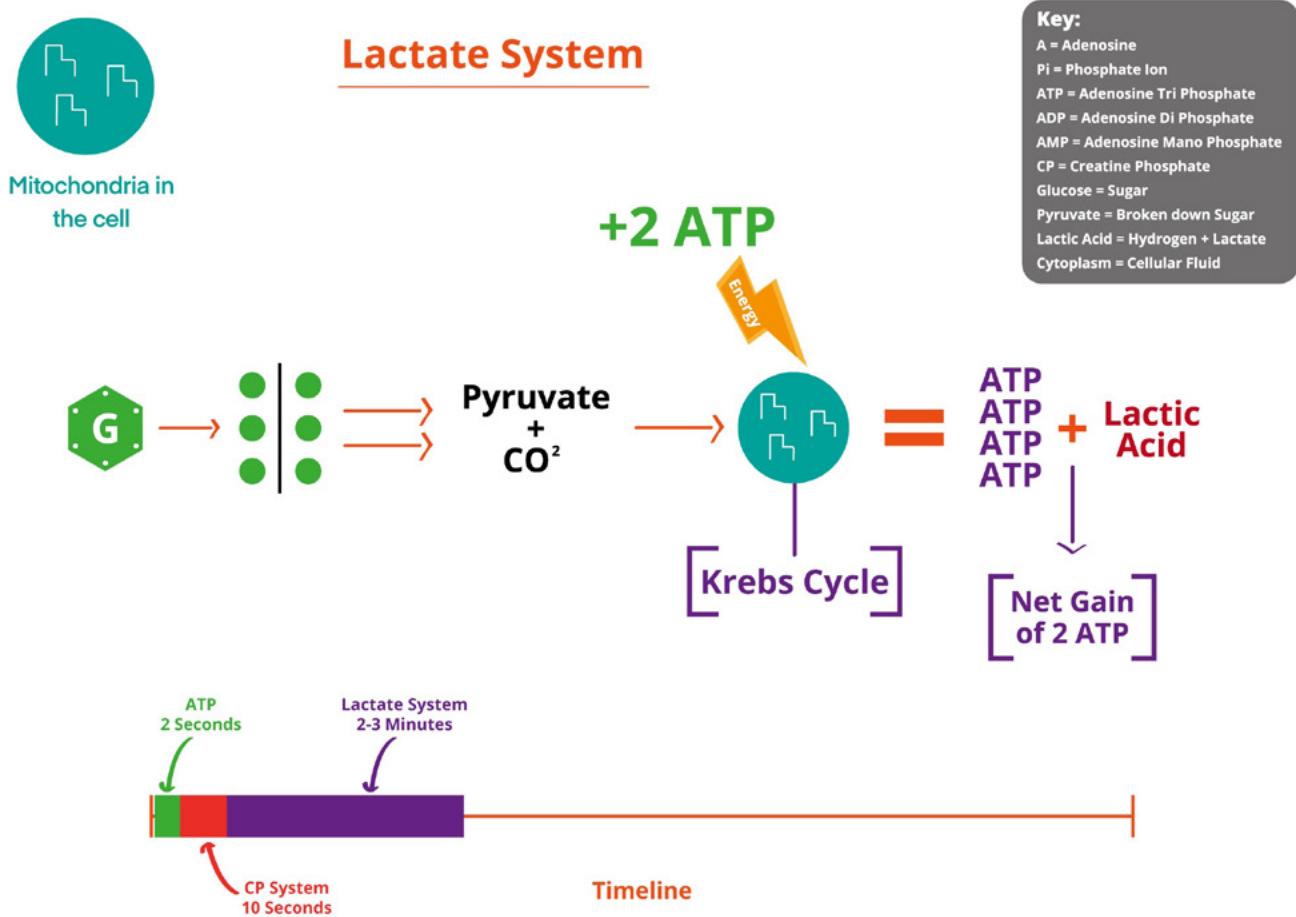
Debate continues, however, as to whether this form of training improves the ability of enzymes within these muscles to generate greater amounts of ATP. To date, there is little research to support this idea. In summary, the principle adaptations associated with training the PC system would appear to be increased muscle size (fast-twitch) and improved activation of the muscle by the nervous system.



Training and the Lactate System

Changes in this system are related to improvements in the cardio-respiratory system and are difficult to describe. Muscles that receive and utilise more oxygen, for example, are going to produce less lactic acid at any given exercise intensity.

It would also appear that regular anaerobic training improves tolerance to the build-up of fatiguing waste products. As of yet, however, researchers can only speculate as to whether this is due to physiological adaptations or is simply the result of motivational changes.



Aerobic System (Oxidative System)

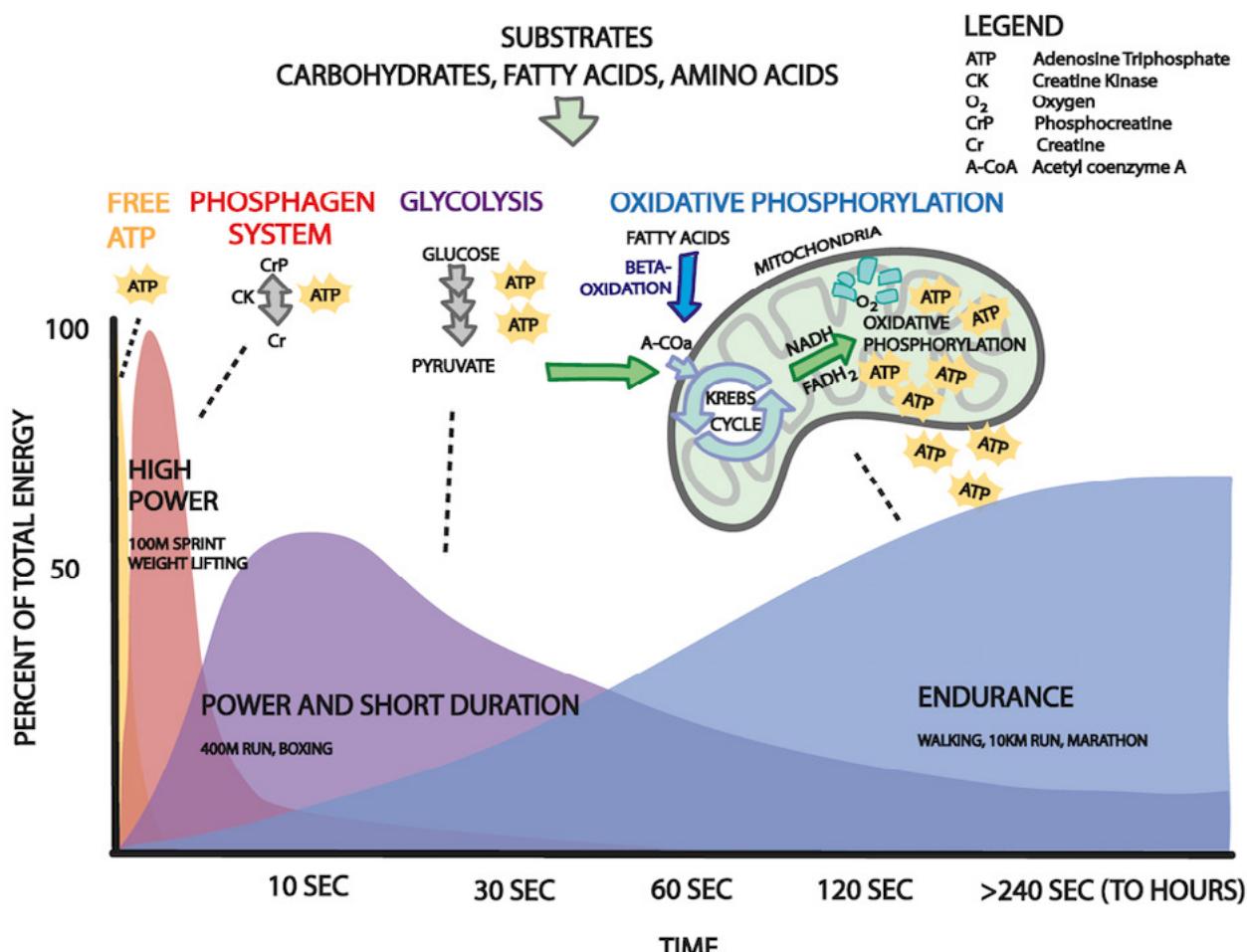
Meaning "with oxygen", the aerobic or oxidative system produces ATP from the complete breakdown of carbohydrate and fat. The lower the intensity, the more fat is used and the higher the intensity, the more carbohydrate is used. Because both fat and carbohydrate are "burnt" to produce ATP, it is often said that fat burns in the flame of carbohydrate. The aerobic system can only provide meaningful amounts of ATP when oxygen is abundant i.e. at low to moderate levels of intensity such as while at rest or while walking or jogging.

- **Carbon dioxide**
- **Water**
- **Heat**

Different fuel sources produce different amounts of energy. The complete breakdown of one carbohydrate-derived glucose molecule yields 262 kcal (a thousandth of a calorie) while the complete breakdown of one fat-derived molecule of fatty acid will yield 3360 kcals.

However, and despite fat providing much more energy per molecule, carbohydrate is the preferred source of ATP in the body because it is released much more quickly.

All ATP, irrespective of which of the three energy systems is responsible, is produced in cells called mitochondria. Aerobic energy production occurs in the organelles of the mitochondria while anaerobic energy production occurs in the cytoplasm surrounding the mitochondria. Mitochondria are best thought of as cellular power stations and the larger or greater the number of mitochondria present, the higher the potential for energy production.



Oxygen Uptake

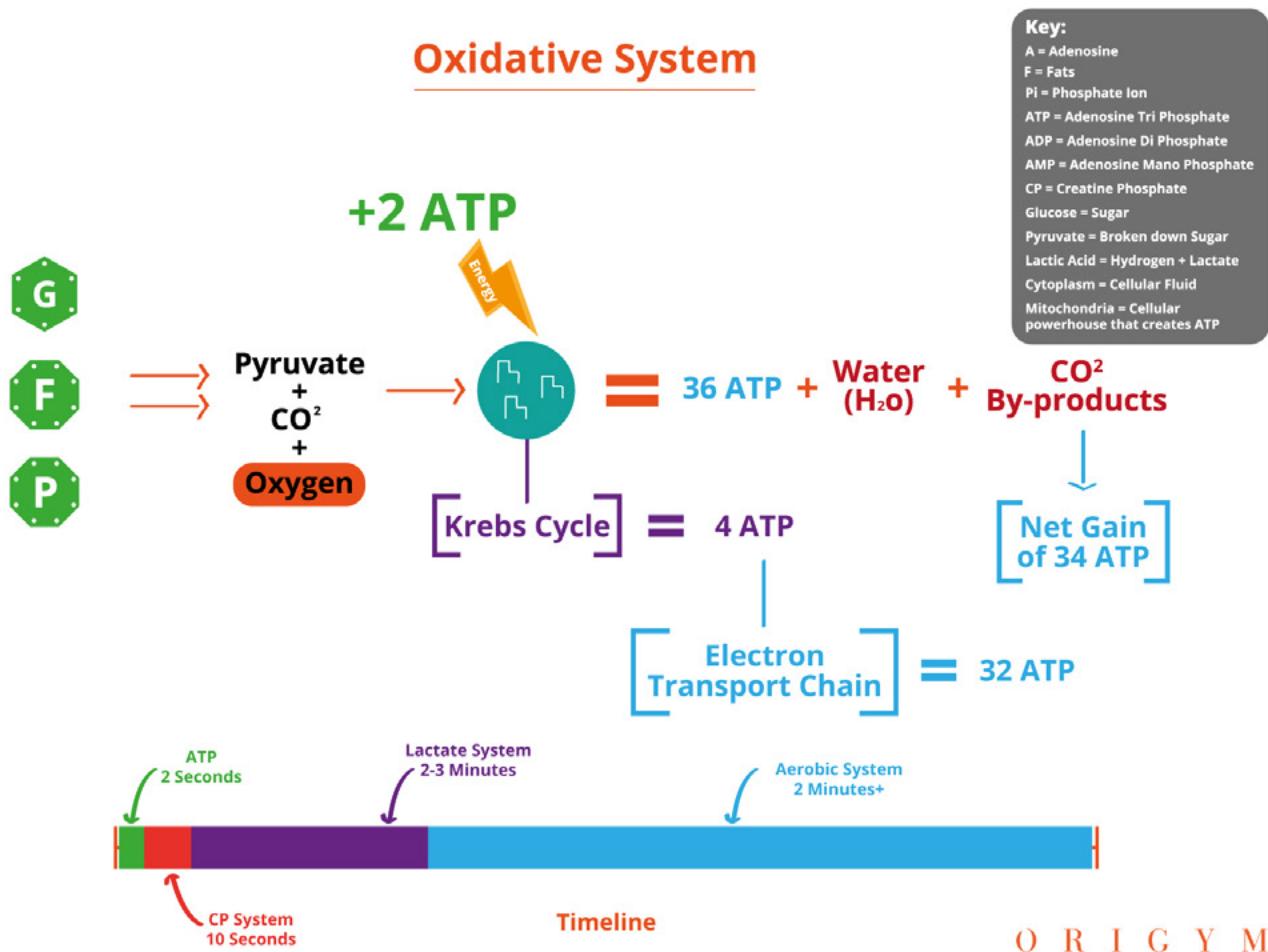
During aerobic activity and during the recovery from anaerobic activity, the cells of the body require oxygen. The aerobic system is essentially the “go-to” energy system as once the anaerobic activity has stopped, the aerobic system is always the system to which your body returns. The use of oxygen by the cells is called oxygen (or O₂) uptake or consumption.

At rest, oxygen consumption is approximately 3.5 millilitres per kilogram of body weight per minute (ml/kg/min). This value is also known as one metabolic equivalent or one MET for short. As activity intensity increases, so do does oxygen uptake which is mirrored by an increase in heart and breathing rate.

The maximum amount of oxygen that a person can take in, transport and utilise during exercise is called the VO₂ max and is a commonly assessed measure used to identify an exerciser's fitness level as well as predict their performance. The greater the potential for oxygen uptake, the higher the VO₂ max, the higher the fitness level of the test subject would be.

However, the person with the highest VO₂ max score may not necessarily be the winner of an event or race as things like strategy, lactic acid tolerance, mental toughness, recovery, nutritional status and motivational state all play a part in physical performance.

The physiology of the Aerobic (Oxidative) System



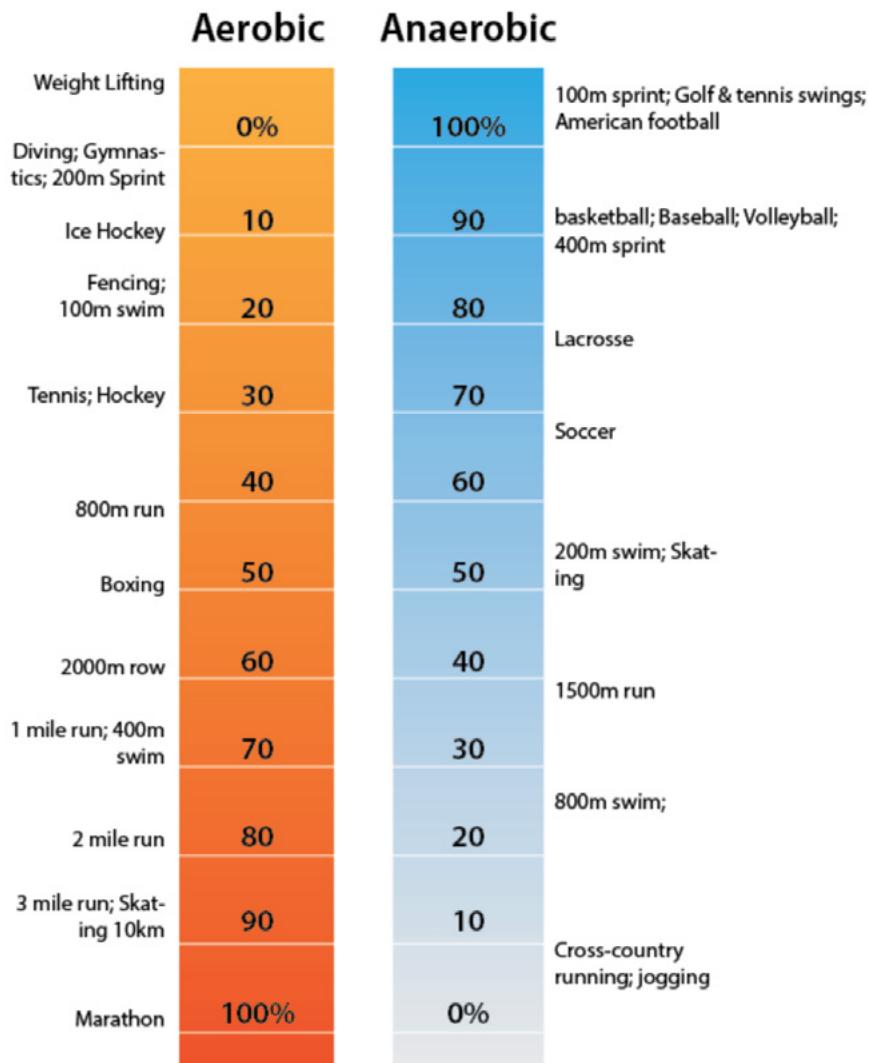
Interaction Between Energy Systems

Although the energy systems are presented separately here, it is important to underline that there is considerable overlap between them. In fact, at any one time, all three systems could be providing the body with energy. However, the relative contribution of each is determined by the intensity of the activity.

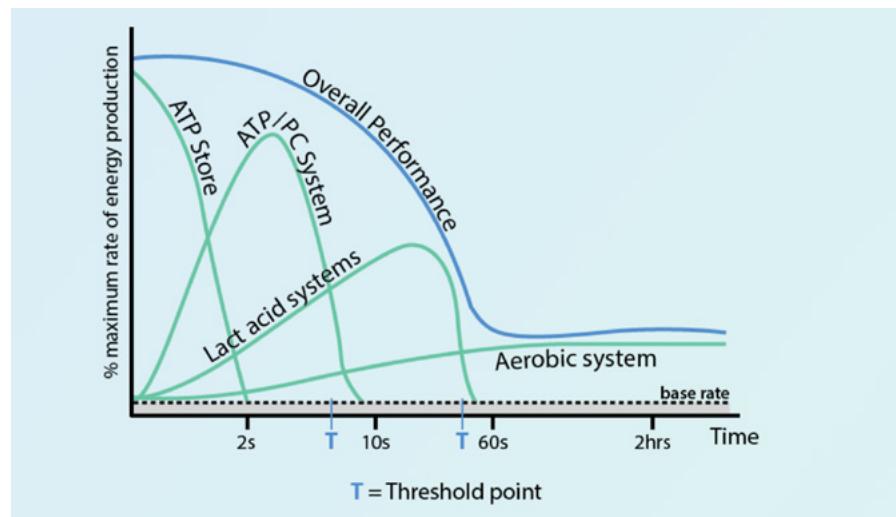
The Energy Continuum

While it should be remembered that at no point do we use one of the three energy systems in isolation, it is possible to identify which system is most dominant in any given activity. This is useful when designing sports-specific exercise programs for athletes.

The Energy Continuum



Energy System	Fuel	By-Product	Lasts
ATP	N/A	N/A	Up to 3 Seconds
CP System	Creatine Phosphate	N/A	Up to 10 Seconds
Lactate System	Carbohydrates (glycogen/glucose)	Lactic Acid	Up to 3 Minutes
Aerobic (Oxidative) System	Carbohydrates (glycogen/glucose) Fat Protein	Carbon Dioxide Water	From 3 Minutes



In Summary

- The energy systems work together to replenish ATP.
- The 3 energy systems are the Creatine Phosphate, Lactate and Aerobic.
- The energy systems all work together at the same time to keep replenishing ATP. At no point, will only one energy system will be used, but there is often a predominant system.
- The predominant energy system used during exercise will depend on the intensity and duration of the activity and the individual's levels of fitness.
- ATP-PC system is predominantly used during maximum intensity activities lasting no longer than 10 seconds.
- Anaerobic Glycolysis system is predominantly used for high-intensity activities lasting approximately 1 minute.
- The aerobic system is predominantly used during medium to low-intensity activity.
- The predominant energy system being used at rest is the aerobic system.
- The predominant energy system used during exercise will depend on the intensity and duration of the activity and the individual's levels of fitness.
- ATP-PC system is predominantly used during maximum intensity activities lasting no longer than 10 seconds.
- Anaerobic Glycolysis system is predominantly used for high intensity activities lasting approximately 1 minute.
- The aerobic system is predominantly used during medium to low intensity activity.
- The predominant energy system being used at rest is the aerobic system.

Energy Systems and Training Adaptations

Provided the right training stimulus is used, the energy systems show a variety of differing adaptations which ultimately equate to improvements in exercise performance. Many of these adaptations are not fully understood, even today, so for the purpose of simplicity only the principle ones will be discussed below.

Aerobic Training Adaptations

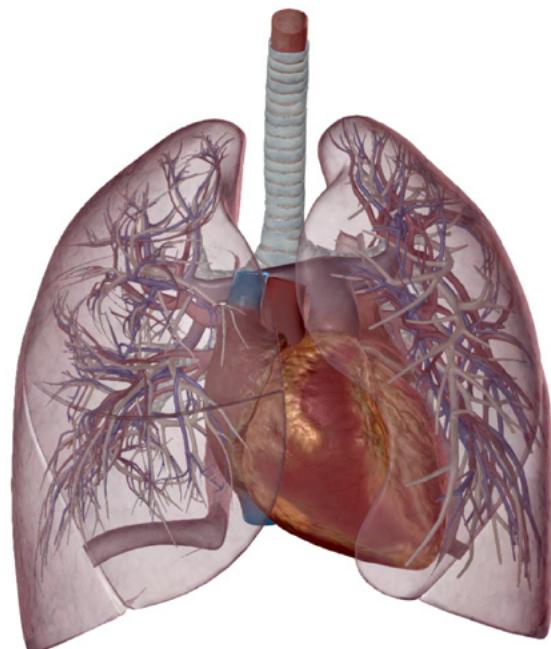
It was discussed earlier that the main limit on aerobic energy production is the ability to take in, transport and utilise oxygen (these will be referred to as pulmonary, cardiovascular and muscular changes respectively).

Aerobic training has been shown to enhance all three of these areas:

PULMONARY CHANGES

Evidence suggests that the principle adaptations associated with the pulmonary system are improvements in the efficiency of the respiratory muscles. This is indicated by an increase in maximal breathing rate and tidal volume (breathing quicker and deeper at maximal intensities).

It is also suggested that more efficient respiratory muscles are likely to use less oxygen, produce fewer waste products and thus potentially increase oxygen availability to other working muscles (McArdle et al, 2001).

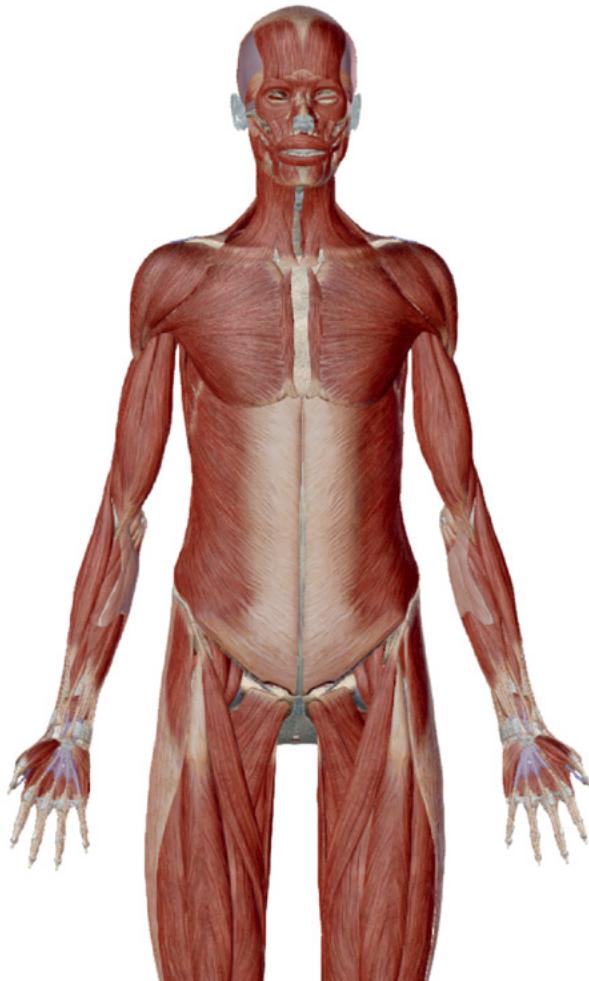
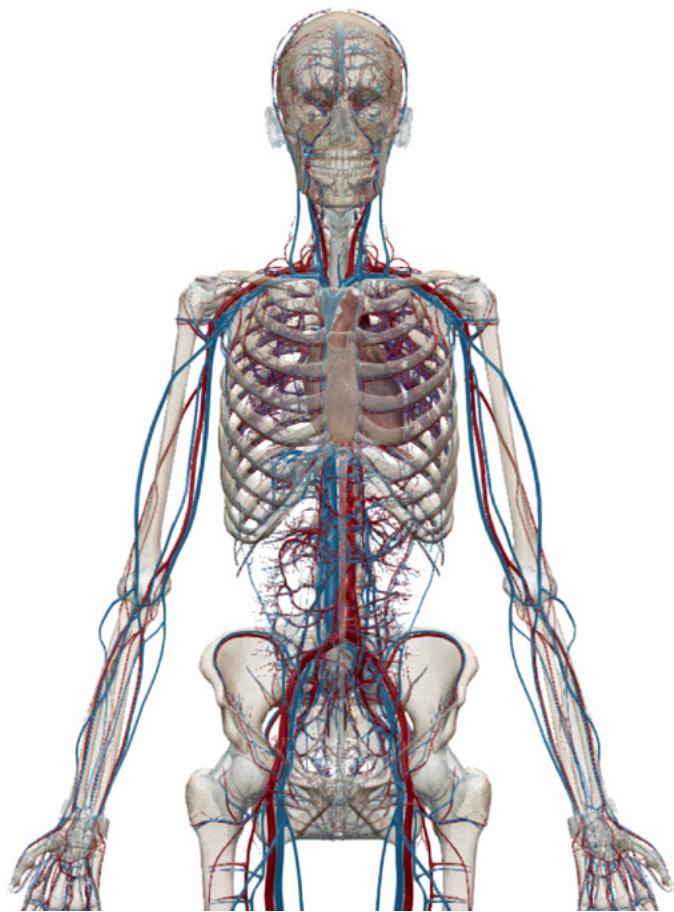


CARDIOVASCULAR CHANGES

There are a number of training adaptations associated with the cardiovascular system. Firstly, the heart of a trained individual shows significant hypertrophy and improvements in coronary blood flow, thus allowing a greater capacity for work.

The most significant coronary adaptation appears to be an increased stroke volume. This is indicated by a lower resting heart rate and a greater cardiac output at maximal heart rates. These improvements are complimented by an increase in blood plasma volume which may also contribute to the increased stroke volume, and oxygen transport (McArdle et al, 2001).

The larger cardiac output of the heart facilitates a greater flow of blood to the working tissues. However, changes in the control of blood distribution, increased arterial diameter and capillary density also serve to maximise blood flow to the muscles.



MUSCULAR CHANGES

Improved blood supply to the active muscles is matched by a greater ability of these muscles to extract and utilise oxygen from the blood. In this respect, one of the key adaptations within the muscles is an increase in size and number of mitochondria. Mitochondria are the structures within the muscle cells, where aerobic ATP production takes place, thus bigger and more numerous mitochondria mean greater ATP production.

Furthermore, within the mitochondria, there are significant increases in the volume of aerobic enzymes, which increases the muscles ability to metabolise (breakdown) fat and carbohydrate.

National Food and Nutritional Government Guidelines

MODULE 5:

UNDERSTANDING MOVEMENT, APPLYING NUTRITION FOR ENERGY DEVELOPMENT AND PROGRAMME PLANNING

The UK Eatwell Guide



IN THIS SECTION YOU WILL LEARN THE FOLLOWING:

- Explain key healthy eating advice that underpins a healthy diet
- Describe the nutritional principles and key features of the National food model/guide
- Identify the 8 healthy eating tips laid out by National Food Model Guide for the UK
- Explain the advantages and disadvantages of the National Food Model Guides
- Distinguish between evidence-based knowledge versus the unsubstantiated marketing claims of suppliers

US Department of Agriculture (USDA) Food Pyramid

(USA Only)

For many years, various governments around the world have used a food pyramid model to help us decide what to eat. These models, which vary slightly from country to country, provide a graphic representation of what we should eat and in what quantities. Easy to understand and simple to follow, food pyramid models are designed to make it obvious which foods you should be eating more of (the ones in the lower tiers) and which foods you should be eating less of (the ones in the upper tiers).

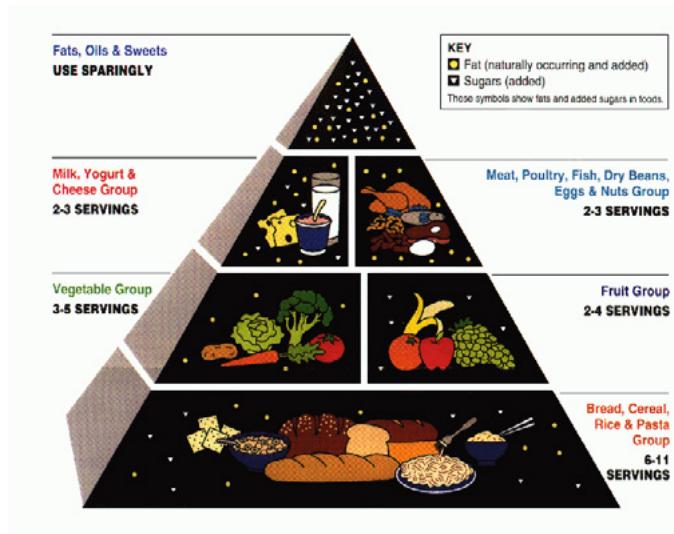
The first US Department of Agriculture food pyramid was released in 1992 and updated in 2005 and again in 2011. All models suggest that the majority of the energy in your diet should be derived from carbohydrates, especially grains and grain foods such as bread, rice and pasta. Next, you should be consuming around three to five servings of fruits and vegetables. Protein-rich foods make up the next level with, according to the USDA, meats, fish, eggs and dairy all being equally comparable. Finally, at the top of the pyramid are the foods you should be eating the least – specifically fats, oils and sugar.

Since their inception, all of the food pyramid models have been criticised. Accused of being shaped by agriculture rather than nutritional requirements of the majority of the population, it has been suggested that the pyramid is biased in favour of vegetable and grain farmers over meat farmers.

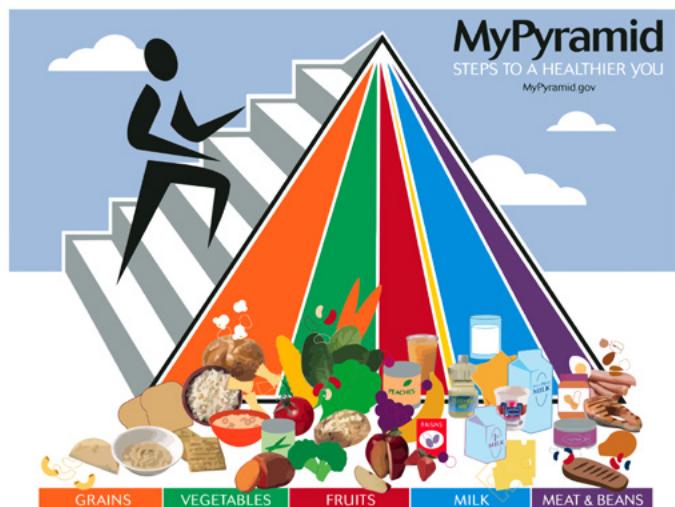
Dieticians also point out that comparing soya, nuts and beans with meat, as the food pyramid suggests, sends out the wrong message about the protein content and quality of two very different food groups. Finally, anyone with gluten or dairy intolerance or following a vegetarian diet is not catered for in the food pyramid.

Others suggest that the food pyramid is an acceptable method of eating if you are very active but a carbohydrate-based diet is not suitable for those members of the population that are sedentary. Some theorists suggest that the food pyramid models are actually responsible for the current obesity epidemic but this accusation is more properly aimed at food manufacturers and the abundance of high calorie/low nutrient junk food that many people eat far too much of.

Food Pyramid Versions



1992 - 2005

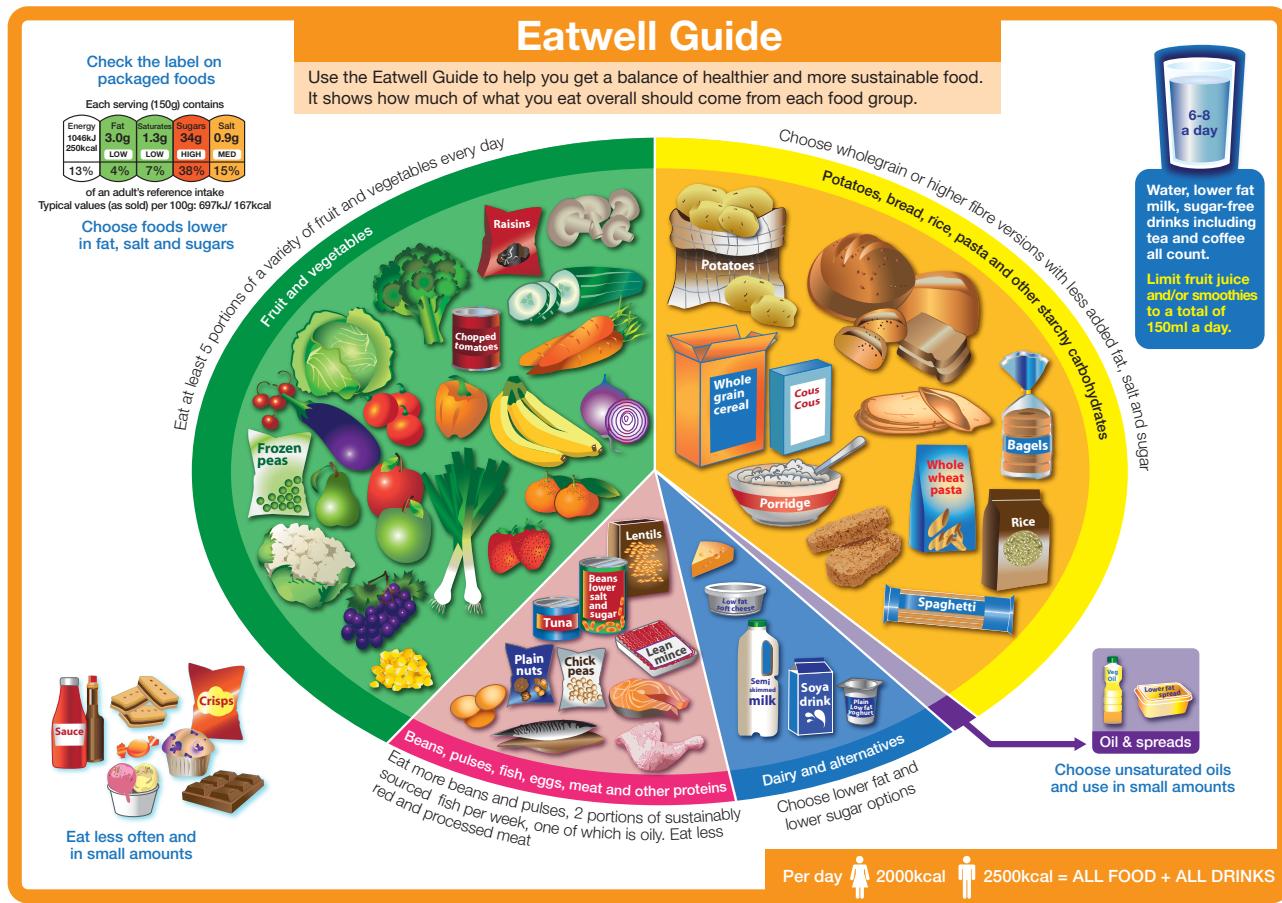


2005 - Present

The UK Eatwell Guide

DOWNLOADABLE
RESOURCE AVAILABLE

ON LEARNING PLATFORM



The Eatwell Guide shows the proportions of the main food groups that form a healthy, balanced diet and suggests a person should:

People should eat at least 5 portions of a variety of fruit and vegetables every day and base meals on potatoes, bread, rice, pasta or other starchy carbohydrates; choosing wholegrain versions where possible. When they consume dairy or dairy alternatives (such as soya drinks) it should be sporadic; choosing lower fat and lower sugar options. Eating some beans, pulses, fish, eggs, meat and other proteins (including 2 portions of fish every week, one of which should be oily) daily. Choose unsaturated oils and spreads and eat these occasionally. Finally drink 6-8 cups/glasses of fluid a day each day.

The 5 Sections of the Eatwell Plate

1. Fruit and Vegetables



Most people know we should be eating more fruit and veg, but many of us aren't eating enough. Fruit and veg should make up just over a third of the food we eat each day.

Aim to eat at least five portions of a variety of fruit and veg each day. If you count how many portions you're having, it might help you increase the amount and variety of fruit and veg you eat. Choose from fresh, frozen, canned, dried or juiced. A portion is 80g or any of these: 1 apple, banana, pear, orange or other similar-size fruit, 3 heaped tablespoons of vegetables, a dessert bowl of salad, 30g of dried fruit (which should be kept to mealtimes) or a 150ml glass of fruit juice or smoothie (counts as a maximum of one portion a day).

2. Starchy Carbohydrates; Potatoes, Bread, Rice, Pasta



Starchy food is a really important part of a healthy diet and should make up just over a third of the food we eat. Choose higher-fibre, wholegrain varieties when you can by purchasing wholewheat pasta, brown rice, or simply leaving the skins on potatoes.

Base your meals around starchy carbohydrate foods. So, you could:

- Start the day with a wholegrain breakfast cereal; choose one lower in salt and sugars
- Have a sandwich for lunch
- Round off the day with potatoes, pasta or rice as a base for your evening meal

Some people think starchy food is fattening, but gram for gram it contains less than half the calories of fat. You just need to watch the fats you add when you're cooking and serving this sort of food because that's what increases the calorie content.

WHY CHOOSE WHOLEGRAIN?

Wholegrain food contains more fibre than white or refined starchy food, and often more of other nutrients. We also digest wholegrain food more slowly so it can help us feel full for longer. Wholegrain food includes wholemeal and wholegrain bread, pitta and chapatti, wholewheat pasta, brown rice, wholegrain breakfast cereals and whole oats. Remember, you can also purchase high fibre white versions of bread and pasta which will help to increase your fibre intake using a like-for-like substitute of your family favourites.

3. Dairy and Alternatives

Try to have some milk and dairy food (or dairy alternatives) – such as cheese, yoghurt and fromage frais.

These are good sources of protein and vitamins, and they're also an important source of calcium, which helps to keep our bones strong. Some dairy food can be high in fat and saturated fat, but there are plenty of lower-fat options to choose from.

Go for lower fat and lower sugar products where possible. For example, why not try 1% fat milk which contains about half the fat of semi-skimmed milk without a noticeable change in taste or texture? Or reduced-fat cheese which is also widely available. Or you could have just a smaller amount of the full-fat varieties less often. When buying dairy alternatives, go for unsweetened, calcium-fortified versions.



4. Beans, Pulses, Fish, Eggs, Meat and Other Proteins



These foods are sources of protein, vitamins and minerals, so it is important to eat some foods from this group.

Beans, peas and lentils (which are all types of pulses) are good alternatives to meat because they're naturally very low in fat, and they're high in fibre, protein, vitamins and minerals. Pulses, or legumes as they are sometimes called, are edible seeds that grow in pods and include foods like lentils, chickpeas, beans and peas. Other vegetable-based sources of protein include tofu, bean curd and mycoprotein; all of which are widely available in most retailers.

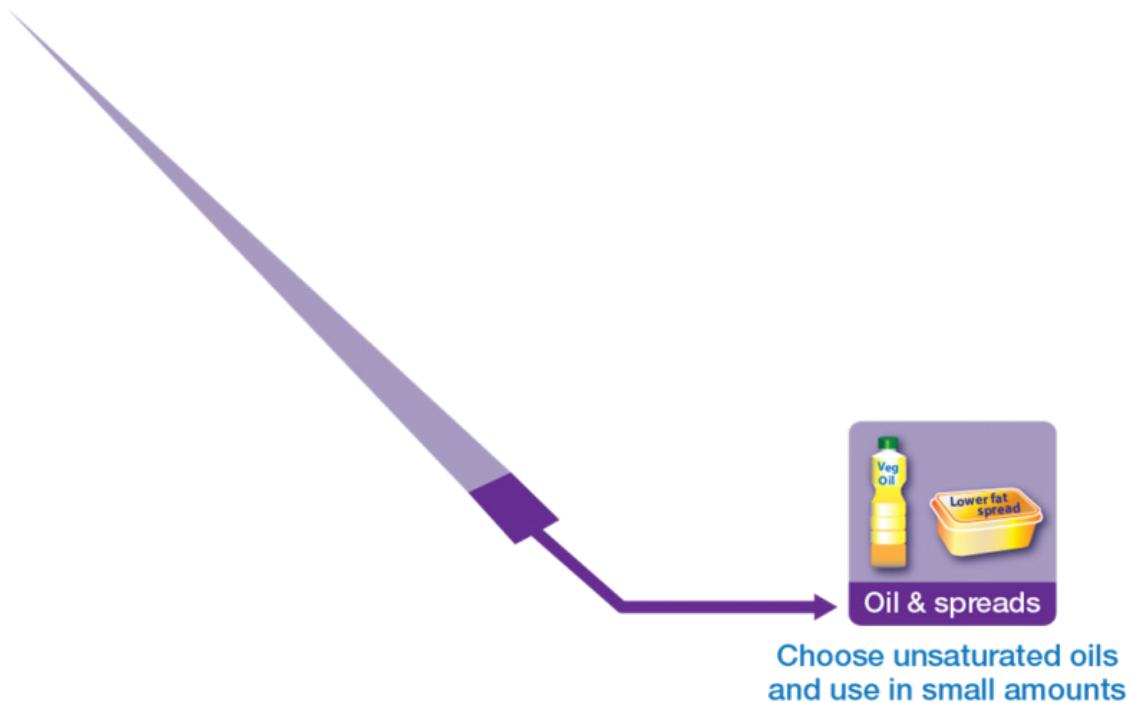
Aim for at least two portions (2 x 140g) of fish a week, including a portion of oily fish. Most people should be eating more fish, but there are recommended limits for oily fish, crab and some types of white fish. For more information on fish please see www.nhs.uk/Livewell/Goodfood/Pages/fish-shellfish. Also www.msc.org/ for more guidance on sustainably sourced fish.

Some types of meat are high in fat, particularly saturated fat. So when you're buying meat, remember that the type of cut or meat product you choose, and how you cook it, can make a big difference. To cut down on fat: choose lean cuts of meat and go for leaner mince, cut the fat off of meat and the skin off of chicken, try to grill meat and fish instead of frying and have a boiled or poached egg instead of fried. If you eat more than 90g of red or processed meat per day, try to cut down to no more than 70g per day. The term processed meat includes sausages, bacon, cured meats and reformed meat products.

5. Oils and Spreads

Although some fat in the diet is essential, generally we are eating too much saturated fat and need to reduce our consumption. Unsaturated fats are healthier fats that are usually from plant sources and in liquid form as oil, for example, vegetable oil, rapeseed oil and olive oil. Swapping to unsaturated fats will help to reduce cholesterol in the blood, therefore it is important to get most of our fat from unsaturated oils.

Choosing lower fat spreads, as opposed to butter, is a good way to reduce your saturated fat intake. Remember that all types of fat are high in energy and should be limited in the diet.



Other Areas of the Eatwell Guide to Discuss

Hydration

Aim to drink 6-8 glasses of fluid every day. Water, lower-fat milk and sugar-free drinks including tea and coffee all count. Fruit juice and smoothies also count towards your fluid consumption, although they are a source of free sugars* and so you should limit consumption to no more than a combined total of 150ml per day.

Sugary drinks are one of the main contributors to excess sugar consumption amongst children and adults in the UK. Swap sugary soft drinks for diet, sugar-free or no added sugar varieties to reduce your sugar intake in a simple step.

Alcohol also contains lots of calories (kcal) and should be limited to no more than 14 units per week for men and women. The calorific content of an alcoholic beverage depends on the type of alcohol, the volume served and the addition of mixers. As an example, 1 pint of standard strength lager contains approximately 136kcal, a 175ml medium glass of wine contains approximately 135kcal and a 25ml shot of spirit (40% vol) contains approximately 56kcal.

The information has been taken directly from Public Health England (PHE).



Foods High in Fat, Salt and Sugars

This includes products such as chocolate, cakes, biscuits, full-sugar soft drinks, butter and ice-cream. **These foods are not needed in the diet** and so, if included, should only be done infrequently and in small amounts. If you consume these foods and drinks often, try to limit their consumption so you have them less often and in smaller amounts.

Food and drinks high in fat and sugar contain lots of energy, particularly when you have large servings. Check the label and avoid foods which are high in fat, salt and sugar!

What is Included?

Food group	What's included?			How much?	Tips
Fruit and vegetables	All fruit and vegetables including fresh, frozen, canned, dried and juiced varieties. Potatoes do not count as they are considered a starchy carbohydrate food.			Eat plenty of fruit and vegetables. Aim for at least 5 portions of a variety of fruit and vegetables every day. Remember that a portion of dried fruit is 30g and should be kept to mealtimes. Limit fruit juice and smoothies to a combined total of 150ml which counts as 1 of your 5 A Day. There is evidence to suggest that people who eat lots of fruit and veg are less likely to develop chronic diseases such as coronary heart disease and some types of cancer.	Try to eat as many different types of fruit and vegetables as possible. Avoid adding sauces/dressing high in fat, salt or sugar to your fruit and veg e.g. chocolate sauce on banana or honey/butter glaze on your parsnips. Bulk out your meals with vegetables such as grated carrot, mushrooms or peppers for an extra portion of your 5 A Day which will make your meal spread further. Remember to keep fruit in your bag as a convenient and healthy snack and frozen vegetables in your freezer so you don't run out.
Potatoes, bread, rice, pasta and other starchy carbohydrates	<ul style="list-style-type: none"> • bread, including: soda bread, rye bread, pitta, flour tortilla, baguettes, chapatti, bagels • rice 	<ul style="list-style-type: none"> • potatoes • breakfast cereals, oats • pasta, noodles • maize, cornmeal • couscous, bulgur 	<ul style="list-style-type: none"> • polenta • millet, spelt • wheat, pearl barley • yams and plantains 	Eat plenty of starchy carbohydrates including potatoes, bread, rice and pasta. Choose wholegrain varieties, or keep the skins on potatoes, for more fibre, vitamins and minerals.	Base your meals around starchy carbohydrates. Check the labels and choose the products lowest in fat, salt and sugar. If you are having chips, go for oven chips lower in fat and salt. If you are serving starchy foods, try to avoid adding too much fat (eg oil or butter on roast potatoes) or sauces (creamy pasta) as these contain lots of calories.
Dairy and dairy alternatives	Milk, cheese, yoghurt, fromage frais, quark, cream cheese. This also includes non-dairy alternatives to these foods. Butters and creams are not included in this group as they are high in saturated fat and so they fit into the 'foods to eat less often and in small amounts' section.			Eat some dairy or dairy alternatives. Choose lower fat options when possible. For products like yoghurt, check the label and go for ones lower in fat and sugars.	Try swapping to 1% fat milk as opposed to whole or semi-skimmed milk. Cheese is high in saturated fat, so try buying reduced fat cheese. Alternatively grate it instead of slicing it to avoid using more than you need. Try to use low fat plain yoghurt as opposed to cream, crème fraîche or mayonnaise.
Beans, pulses, fish, eggs, meat and other proteins	<ul style="list-style-type: none"> • meat, poultry and game, including: lamb, beef, pork, chicken, bacon, sausages, burgers • white fish (fresh, frozen or canned), including: haddock, plaice, pollock, coley, cod, tuna 	<ul style="list-style-type: none"> • oily fish (fresh, frozen or canned), including: mackerel, sardines, trout, salmon, whitebait • shellfish (fresh, frozen or canned), including: prawns, mussels, crab, squid, oysters 	<ul style="list-style-type: none"> • nuts • eggs • beans and other pulses, including: lentils, chickpeas, baked beans, kidney beans, butter beans • vegetarian meat alternatives eg tofu, mycoprotein 	Eat some beans, pulses, fish, eggs, meat and other proteins. Eat at least 2 portions (2 x 140g) of fish each week, one of which is oily. Limit processed meats such as sausages, bacon and cured meats. If you eat more than 90g per day of red or processed meats, try to reduce the amount to no more than 70g per day.	<p>When you're cooking and serving these foods, try not to add extra fat or oil.</p> <p>When you're buying meat, ask your butcher for a lean cut or compare the labels on different products and choose the one lower in saturated fat.</p> <p>Watch out for meat and fish products in pastry, batter or breadcrumbs as these can be high in fat and/or salt.</p> <p>Remember that an 80g portion of beans or pulses can count as 1 of your 5 A Day!</p>
Oils and spreads	Unsaturated oils including vegetable oil, rapeseed oil, olive oil and sunflower oil. Soft spreads made from unsaturated oils. Butters are not included in this section as these are high in saturated fat and are included in the 'foods to eat less often and in small amounts' section.			Use these products sparingly as they are high in fat. Cutting down on these types of foods could help to control your weight as they are high in calories.	<p>Choose lower fat spreads where possible and use sparingly.</p> <p>Check the label and choose oils high in unsaturated fat and low in saturated fat. Oils expand when heated and so heating oil in the pan before you use it will make it go further so you don't need to use as much.</p>
Foods to eat less often and in small amounts	<ul style="list-style-type: none"> • cakes • biscuits • chocolate • sweets • puddings 	<ul style="list-style-type: none"> • pastries • ice cream • jam • honey • crisps 	<ul style="list-style-type: none"> • sauces • butter • cream • mayonnaise 	These foods are not required as part of a healthy, balanced diet. If included, they should only be consumed infrequently and in small amounts. Most of us need to cut down on the amount of high fat, salt and sugar foods we eat and drink.	<p>Use lower fat spread instead of butter. Swap cakes and biscuits for a slice of malt loaf or a teacake with low fat spread. If you add sugar to your food or drinks, gradually reduce the amount you add until your taste buds adapt and you can cut it out altogether. Alternatively try using a calorie-free sweetener instead.</p>

8 Tips for Eating Well (Healthy Eating)



Daily Calorie Requirements

Energy Expenditure

Age	Daily energy requirements			
	Males		Females	
	kcal	kJ	kcal	kJ
1	765	3201	717	3000
2	1004	4201	932	3899
3	1171	4899	1076	4502
4	1386	5799	1291	5402
5	1482	6201	1362	5699
6	1577	6598	1482	6201
7	1649	6899	1530	6402
8	1745	7301	1625	6799
9	1840	7699	1721	7201
10	2032	8502	1936	8100
11 and over	2500	10,460	2000	8368

NB: 11 and over = ADULT



Advantages and Disadvantages of the Eatwell Guide (Limitations)

Advantages	Disadvantages
Easy on the eye – Colours help with association.	Incorrectly uses a “one size fits all” ideology
Allows for a greater emphasis on food choices	Criticised as being shaped by food companies rather than dieticians
Highlights the importance of fruit and vegetables.	Non-specific for special population groups
Ensures that every plate of food can be balanced	Does not highlight portion sizes
Does aim to reduce processed food consumption.	Permits the use of highly processed foods.
Shows food to help guide the people who use it.	Assumes that all macronutrients are created equal.
Allows alcohol use but it is not moderated.	

The importance of healthy eating in relation to growth, repair and injury.

The body needs all nutrients in appropriate amounts to be able to grow and repair itself following injury. Without the right balance of all required nutrients (particularly calcium and other minerals for bone growth and protein for muscle growth and repair), the body does not have the available resources to build and rebuild the appropriate structures in the body.

Food Labelling

Understanding and interpreting food labels is an essential skill for anyone interested in nutrition. Food manufacturers are required by law to put certain information on their labels and this information can be helpful when deciding what to eat.



Nutrition Label Basics

Food label layout and contents must follow a certain universal format and include the following information:

- Identify macronutrient and calorie values per 100g/ typical serving
- List ingredients in order of weight
- Manufacturer's details
- Potential allergens in the product
- Total volume or weight
- A "best before date"
- Storage instructions
- Preparation instructions

The label provides average nutritional values but it should be stressed that a 20% margin of error is permissible by law and, in a 2005 BBC study, it was revealed that out of 70 products tested for 570 nutrients, only 7% actually matched the stated values and food sold loose or cooked in-house is not covered by the same labelling legislation.

In the UK, food manufacture, marketing, sales and labelling is controlled by the Food Standards Agency or FSA for short. This independent body acts in the public interest and serves as an advisory body to the government regarding food. The current food manufacture and labelling standards, the 1990 Food Safety Act and the Eat Well Plate both fall under the auspices of the FSA.

Nutrition and Health

MODULE 5:

UNDERSTANDING MOVEMENT, APPLYING NUTRITION FOR ENERGY DEVELOPMENT AND PROGRAMME PLANNING

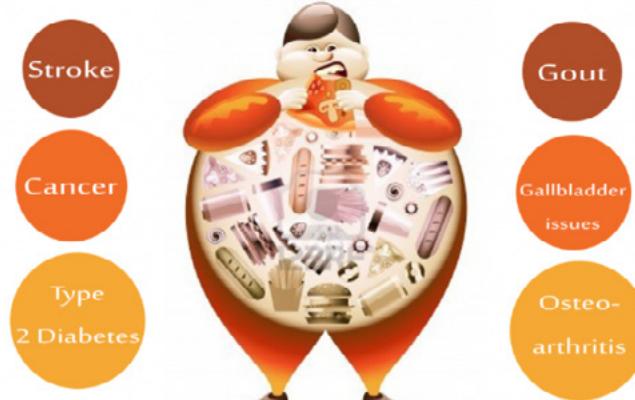


Lack of physical activity and poor nutritional choices can have a very negative impact on health – health being optimal bodily system function and an absence of disease. Exercise is very important for fitness and health but the food we eat arguably has the biggest impact; it is possible to be healthy and not fit after all. Because the food we eat affects us at a cellular levels (remember; you are what you eat), unhealthy foods lead to unhealthy bodies and poor nutritional choices are inextricably linked to a wide range of often avoidable medical conditions and diseases.

Examples include:

- **Obesity**
- **Heart disease**
- **Strokes**
- **Several cancers**
- **Metabolic syndrome**
- **Tooth decay**
- **Diabetes**
- **Hypertension**
- **Food allergies**
- **Attention-deficit disorder**
- **High cholesterol**
- **Asthma**
- **Some forms of Menstrual irregularities**
- **Difficulty conceiving**
- **Hormonal imbalances**
- **Hyperactivity**
- **Insomnia**
- **Eczema**
- **Systemic**
- **Inflammation**

OBESITY is Harmful



The list of diseases directly attributable to poor nutrition is almost endless and yet, in the vast majority of cases, the cause of these problems is all but ignored (poor nutrition) and the bulk of medical resources is directed at finding treatments for symptoms.

However, as important as the link between food and disease is, it is important to understand that personal trainers are not qualified to offer advice or attempt to treat medical conditions with food or exercise; that is beyond the scope of this level of qualification. If, on screening, a client reveals that they are suffering from a medical condition such as one of those listed above, the personal trainer, for legal and ethical reasons, must initially refer their client to an appropriately qualified registered dietitian.

On completion of this course, the trainer will be qualified to offer nutritional advice to healthy individuals. However, they are not qualified to treat medical conditions using food and/or supplements and doing so exceeds the limits of this qualification. It is worth noting that implementing the information in this course will significantly reduce the risk of developing many of the conditions listed.

Professionals

The range of professionals and their roles in the area of nutrition:

There is a lot of confusion over the terms used to describe people who offer nutritional advice. With job titles like lifestyle coach, nutritional adviser, dietitian, nutritionist, weight loss coach and nutritional therapist being bunched around, it's no wonder that many of the public are unsure of who they can turn to for advice on what they should and shouldn't eat.

Nutritionist

Nutritionists will evaluate your individual needs and use extensive evidence base for nutrition science to develop a personalised, safe and effective nutrition and lifestyle programme. This is regulated by the association for nutrition (AF). They help people by providing advice that is regulated and confirmed as true.

Dietician

In contrast to a nutritionist, the term "dietician" is a protected term and can only be used by qualified people approved and registered with the Health Professions Council. Dieticians generally have Bachelors or Masters Degrees and are trained to interpret complex scientific information into practical dietary advice. Dieticians are regulated by the British Dietetics Association which, as well as being a regulatory body, also serves as the dietician's professional union. The other main regulatory body that dieticians may be members of is the Nutrition Society which requires an appropriate degree and supporting evidence before granting membership.

Nutritional Therapist

Nutritional therapists are those who have dietetic qualifications and are registered to British Association for Nutrition & Lifestyle medicine (Formerly therapy) (BANT). Nutritional therapists will evaluate your individual needs and use extensive evidence base for nutrition science to develop a personalised, safe and effective nutrition and lifestyle programme.

General Practitioners (GPs)

It's also worth noting that general practitioners (GPs) do not cover much information on nutrition during their otherwise lengthy studies and so should not be considered good sources of nutritional information or advice. Nutrition is simply not part of a GP's job however they are perfectly placed to signpost or refer patients to appropriate professionals.

PT Professional Boundaries

Your professional role boundaries with regard to offering nutritional advice to clients as a Personal Trainer are:

- As a personal trainer, you can legally call yourself a "Nutritionist" as the term is not written in statute however; you will not be regulated by any equivalent nutritional bodies.
- Once qualified, PTs can offer advice to individuals about eating for optimal health.
- PTs cannot offer advice on the prevention or treatment of disease or the use of supplements.



Sources for Professional Support

Nutrition is a huge, complex, and ever-evolving subject and everyone working in nutrition must keep abreast of any changes. In order to give up-to-the-minute information, nutritional advisers must keep their knowledge up to date and know where to look to get quality, authoritative information.



Those sources include:

- The Food Standards Agency
- The Committee on Medical Aspects of Food and Nutrition (COMA)
- The British Nutrition Foundation
- The Institute of Optimal Nutrition
- Any scientific nutrition journals e.g. the British Journal of Nutrition

Unfortunately, a very large percentage of the population get their nutritional advice from unqualified sources such as fitness magazines, supplement companies, the mass media and unqualified nutritionists which helps explain why so much confusion surrounds the subject of nutrition. Many of the population's information about nutrition comes from sensationalist media headlines e.g. "Eggs - as bad for you as smoking".

In addition to understanding the effect and impact of the nutrient groups, dieticians and nutritional advisers also need to have a broad familiarity with cultural and religious practices and attitudes to food and nutrition. These practices and attitudes must be respected if an offence is to be avoided because some clients will be unable to follow some of the well-meaning advice given by even the most knowledgeable food professional. In many cases, where familial traditions can be modified, religious and cultural practices cannot so the nutritional adviser must be prepared to acknowledge, respect and then work around such practices.

Food and nutrition are often very sensitive subjects because beliefs can be so ingrained. No one likes to be told that the things they believe to be true are, in fact, completely wrong despite overwhelming evidence to the contrary (poor health, being significantly overweight etc.). For that reason, personal trainers must be non-judgemental, show empathy toward their clients and be sensitive to the opinions and beliefs of their clients.

In order for a personal trainer to offer nutritional advice to otherwise healthy clients, he/she should have a sound understanding of the various nutrient groups and be familiar with how they affect the human body. That way, the trainer will be able to provide recommendations based on the needs of the client and according to the current nutritional guidelines.

Exercise Nutrition

MODULE 5:

UNDERSTANDING MOVEMENT, APPLYING NUTRITION FOR ENERGY DEVELOPMENT AND PROGRAMME PLANNING

Nutritional intake should be aligned to activity levels and relevant to the training program. Because of the demands of exercise on the body differ according to the type of activity being performed, the food consumed should be specific to the training goal.

In addition to the food they eat day by day, the serious exerciser also has several choices when it comes to deciding how to fuel their workouts:

- The sole use of food
- The sole use of sports drinks
- The sole use of protein drinks
- A combination of sports drinks
- A combination of protein drinks plus food
- A combination of protein drinks and sports drinks
- A combination of food plus water
- The sole use of water

Carbohydrate And Physical Activity

Carbohydrates are an important fuel for most physical activity and the higher the intensity, the bigger the role carbohydrate plays in energy production. Subsequently, there is a strong link between carbohydrate consumption and exercise. This can be seen in the common usage of products like sports drinks and energy gels which all supply fast-acting carbs in abundance.

However, as carbohydrates are never used in isolation but also in the presence of fat, the importance of dietary fat should not be underestimated. As the chart below illustrates, even in activities such as sprinting which are dominated by the anaerobic energy systems, a meaningful contribution is made by the aerobic system which requires fat for fuel.

That being said, even the leanest of body's have an abundance of fat for energy and as low blood glucose and low muscle glycogen can adversely affect energy production, it makes sense to be "carbohydrate aware" when discussing exercise nutrition.

Event	Gender	Aerobic	Anaerobic
100 meters	Male	21%	79%
	Female	25%	75%
200 meters	Male	28%	72%
	Female	33%	69%

Hydration And Sports Drinks

Your body is made up of between 65 to 75% water so a ten-stone (140 pound/64 kilograms) person's body contains around 42 to 48 litres of water! It's no wonder then that virtually every nutritional expert places a high value on hydration, rehydration and avoiding dehydration.

Water Is A Number Of Functions In Your Body Including:

- Temperature regulation through sweating
- Movement of chemicals around your body
- Medium for chemical reactions
- Lubrication of digestive tract
- Elimination of waste materials and toxins
- An integral part of all muscles
- Provides a carrier medium for blood cells - known as plasma

Water is the most essential part of your diet. You can live for quite a long time without food as even the leanest person has a significant supply of body fat but, as we cannot store much water and it is essential for virtually every reaction that occurs in your body, you won't live more than a few days without water to drink.

Staying Hydrated

As it is water your body needs, it is the water you should drink but there are numerous opinions about how much water you need. The most common hydration recommendation is six to eight tall glasses of water a day; the equivalent of around two litres. Interestingly, this figure has absolutely no scientific basis and is not the result of any studies, medical journals or statistical research. It's simply a figure that was proposed back in 1945 by the American Nutrition and Food Board that was adopted by just about everyone thereafter.

That is not to say that these figures are wrong but only that two litres are an arbitrary number based on one organization's opinion as opposed to scientific fact.

The Table Below Provides A Summary Of The Suggested Water Intake According To Bodyweight:

Bodyweight (kg)	55	60	65	70	75	80	85	90	95	100
Water intake (liters)	1.70	1.85	2.00	2.15	2.30	2.45	2.60	2.75	2.90	3.05

Post-Exercise Carbohydrate

After exercise, muscle glycogen, liver glycogen and blood glucose can be partially depleted; the degree of depletion depending on the intensity and duration of the exercise. On completion of the exercise, this used glycogen must be replaced to facilitate recovery.

To ensure the fast and complete restocking of used glycogen stores, the muscles and cells are much more sensitive to the effect of the glucose transport hormone insulin and this increase in sensitivity lasts approximately two hours after exercise.

Fast-acting, high glycaemic carbohydrates are most appropriate at this time.

High Glycemic Carbohydrates Will:

- **Increase glucose availability**
- **Increase insulin production**
- **Increase glucose uptake into cells**
- **Increase glycogen synthesis**

Some studies have used convoluted systems for replacing lost glycogen such as consuming one gram per kilo of body weight every two hours for 12 hours. However, the simpler and more accessible method of consuming a sports drink immediately after exercise and a high glycaemic carb-based meal such as white rice within two hours of exercise has been shown to be similarly effective. It appears that small, infrequent feedings and less frequent but larger feedings produce very similar results.

General Exercise

For most general exercisers, no special emphasis needs to be put on pre, during or post-training carbohydrate consumption.

For those individuals, the following guidelines are appropriate:

- Aim to stay within energy balance
- Create a daily calorific deficit of 250 kcals if trying to lose weight
- Choose low to moderate glycaemic carbohydrates to fulfil carbohydrate needs
- To avoid fuel conflicts, do not consume high fat/high carbohydrate meals
- Eat smaller, more frequent meals to favour digestion
- Micronutrient intake should be high
- Fibre intake should be adequate
- Protein intake should match exercise goals
- EFAs should be eaten inbalance
- Water consumption should be plentiful and sufficient to ensure hydration

Pre-Exercise Carbohydrate

Pre-exercise carbohydrate ensures that blood glucose levels and muscle glycogen stores are maximized. Starting a workout with low carbohydrate levels can impair performance intensity and duration and lead to hypoglycemia.

Around two hours or so prior to exercise, low glycaemic index (slow releasing) carbs are often believed to be best so that they are fully digested and blood glucose/muscle glycogen levels are optimized by the time the workout is due to begin.

Exercising on a stomach full of food is at best uncomfortable and at worst can cause severe cramp and stomach upset and is best avoided. More recent research has revealed that the glycaemic index of the 2-hour pretraining carbohydrate is not that important and even a high glycaemic index carb will be effective as they do not, contrary to popular belief, trigger a hypoglycaemic episode.

The actual length of time an exerciser can eat before activity varies from person to person but 90 to 120 minutes is about right for most people. Closer to the start of the workout, a higher glycaemic (fast-acting) carbohydrate is believed to be more beneficial and as digestion can be impeded by exercise, a drink is a better choice than food.



Carbohydrate During Exercise

In certain circumstances, consuming carbohydrates during exercise can be beneficial. For the majority of recreational exercisers, plain water is adequate but where performance is more important than burning calories or fat, carbohydrates consumed during exercise may be beneficial.

Consuming carbs during exercise is acceptable if:

- **The session is longer than one hour**
- **If the match or race is longer than 90-minutes**

If a pre-exercise carbohydrate meal is not possible e.g. early morning training. The consumption of carbohydrates during prolonged exercise has been shown to delay the onset of fatigue but it is important to realise that ingesting carbs during exercise can inhibit fat loss.

Rather than focus on the amount that your body may need, it is better to focus on what your body actually does need. The best determinant of your water needs, are your thirst and your urine colour and output.

Thirst

Thirst should be our best hydration indicator. Our caveman ancestors' probably only used thirst to govern their water drinking habits. If you were thirsty, you needed to drink. Simple! The problem now is that, because modern man often slakes his thirst with sweetened, calorie-dense beverages, thirst and hunger signals can become confused. In other words, you might feel hungry but, in reality, you are actually thirsty but your brain gets the signals all turned around. This was not a problem for our non-sugary drinking ancestors. Subsequently, thirst has become a less accurate indicator of hydration. Because of this lack of thirst sensitivity, it is better to drink enough water to avoid thirst in the first place.

Urine Colour and Output

Other than your first urination of the day, most experts agree that your urine should be relatively clear, fairly copious and also odourless. Dark, smelly and infrequent urination can be a sign of dehydration and the less than rosy odour suggests a build-up of undiluted toxins and waste products.

By avoiding thirst and making sure most of your urinations are a light straw-like colour and neutral smelling, you can be confident that your body has all the water it needs to maintain healthy metabolic and thermoregulatory functions.

Dehydration

Mild dehydration is common. A hard workout, too much coffee or alcohol, too little water or hot weather can all result in less than optimal water levels in your body. This is not a serious problem if this is a short term or infrequent occurrence but regular and/or long term dehydration can cause numerous performance and medical-related problems.

Signs Of Dehydration In Approximate Order Of Onset And Severity:

1. Dry mouth (sometimes referred to as "cottonmouth")
2. Reduced urine output
3. Dark, odious urine
4. Headache
5. Muscle cramps
6. Fatigue
7. Cessation of sweating
8. Hot, dry skin
9. Elevated heartrate
10. Confusion
11. Elevated core temperature
12. Heart palpitations
13. Unconsciousness
14. Kidney failure
15. Coma
16. Death is death

Too Much Of A Good Thing?

While water is essential for life, too much water can actually be harmful to your health. Although very rare, some people have suffered from a condition called hyponatraemia, also known as water intoxication. This condition can manifest if you drink very large volumes of water, for example during a long-distance running event where you consume significantly more water than you are losing by overtaking on the water at each and every feed station.

This results in a dangerous dilution of essential minerals collectively called electrolytes and specifically sodium. Sodium is essential for muscle contractions, regulating inter and extracellular fluid levels and pressure as well as controlling heart rate and rhythm. A significant enough sodium dilution can even prove to be fatal. Needless to say, this is a very rare occurrence and is usually the result of an underlying medical condition combined with an extreme excess in water or sports drink consumption.

Sports Drinks

No discussion of hydration would be complete without mentioning sports drinks. With so many on the market and so much advertorial information telling you what drink you should consume when it can be very hard to choose a sports drink that is ideally suited to your needs.

The first question to ask yourself is, however, do you really need a sports drink? If you are exercising for 60 minutes or less, are exercising for weight loss and have eaten properly in the hours leading up to your workout, it is suggested that plain water is more suited to your purposes. If, on the other hand, you have not eaten properly before training, are going to be working for 60 minutes or more and are not trying to burn fat during your workout, a sports drink is an acceptable way to stay hydrated.



There Are Three Main Types Of Sports Drinks:

Hypotonic: With a very low amount of carbohydrate, a hypotonic drink is mostly about hydration and offers very little in the way of fuel. That being said, ingesting any carbohydrates can suppress fat burning so water is the better choice if that is your exercise goal.

Isotonic: Containing around 6 grams of carbohydrate per 100 millilitres of water, isotonic drinks are the most common sports drinks. Usually engineered to provide a mix of slow, medium and fast-acting sugars for energy plus essential electrolytes, an isotonic drink provides fuel and hydrating fluids in equal measure. Isotonic drinks are ideal for long workouts where a drop in blood glucose or muscle glycogen levels would result in decreased performance. However, the carbohydrate content and extra calories in these types of products would negate most of the benefits of a fat-burning workout.

Hypertonic: Ten plus grams of sugar per 100 millilitres of water means that hypertonic drinks are more food than rehydrating fluid. The high level of sugar may actually interfere with water absorption so these drinks are not ideal for helping you stay well-hydrated. If you chose to use a hypertonic drink, you should also consume plenty of plain water to make sure that you rehydrate as well as refuel.

Many sports drinks contain artificial flavours, colours, sweeteners and a host of other chemicals that have no place in a beverage designed to be healthy.

If you would prefer not to use commercial sports drinks, you can easily make your own isotonic sports drink by following these recipes from the Paralympic Association:

- Dissolve 60g of glucose powder into a litre of water and add one-fifth of a teaspoon of natural unprocessed salt
- Mix 500ml of unsweetened natural fruit juice with 500ml of water and add one-fifth of a teaspoon of natural unprocessed salt

Protein Shakes

Protein shakes are a very popular group of supplements, especially in bodybuilding and strength training circles. Advertising in magazines and on the internet helps drive sales and as people involved in strength training generally need more protein than sedentary people, protein shakes make a lot of sense as it's no easy thing to get enough protein from real food if you have high body weight and/or limited opportunities to eat real food.

Protein shakes can be made from a variety of ingredients including egg, soya, rice, hemp and milk but arguably the most common form of protein shake is made from whey.

Whey protein is a derivative of milk and is actually a by-product of the cheese manufacturing process – think curds and whey. Until it was used in the manufacture of protein shakes, whey was either discarded or used in animal feed.

Whey has a very high concentration of the branched-chain amino acids leucine, isoleucine and valine and also scores very highly on the biological value scale which means that whey has a good affinity with muscle.

However, one tub of whey protein can significantly differ from another and there are even different types of whey protein.

Whey Protein Isolate

Whey protein isolate or WPI for short is the purest form of whey protein currently available and by weight contains between 90 to 95% protein. WPI contains very little or no lactose which makes it ideal for individuals who suffer from lactose intolerance. WPI contains only trace amounts of carbohydrates and fats which makes it ideally suited for those looking to gain lean mass or lose fat. The purity of WPI can mean it is slightly more expensive than other types of whey but as you get a purer and more concentrated product, there is a benefit to this elevated cost. Of all the whey protein forms, WPI is the fastest and most easily digestible which makes it especially well-suited for post-exercise consumption.



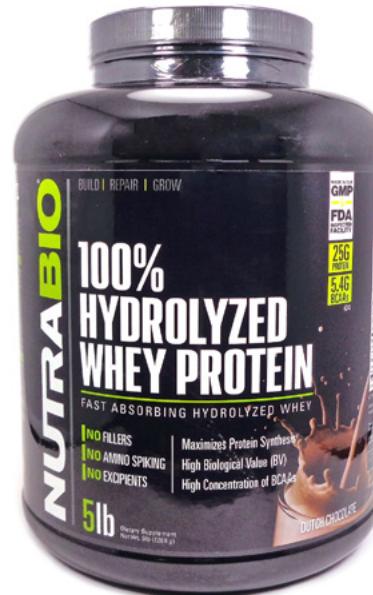
Whey Protein Concentrate

Whey protein concentrate, WPC for short, is less pure than WPI and provides anywhere between 25 to 85% protein by weight depending on the quality of the product in question. Lower-grade WPC is often used in protein bars and also as an added ingredient in more common foods such as soups, crackers and cereals. WPC contains more carbohydrate in the form of lactose plus slightly more fat and also minerals and water when compared to WPI and this reduction in purity is usually reflected in the price. If you use WPC, seek out products that provide around 80% protein by weight as these are the most useful for muscle growth and repair.



Hydrolyzed Whey Protein

Protein is made up of chains of amino acids called polypeptides. The longer and more complex the polypeptide chain, the longer the protein will take to digest. Sometimes, for example between meals or late at night, a slow-digesting protein may be useful but in the period immediately before and after exercise, a more fast-acting protein is better. In hydrolyzed whey protein, the long polypeptide chains have been broken down into shorter chains called oligopeptides which are rapidly digested and provide a very quick supply of amino acids to your muscles. This rapid delivery of amino acids results in a speedier recovery from strenuous exercise. Hydrolyzed whey protein is more expensive than WPI and WPC and is best kept for immediately post-exercise. Of all the forms of whey protein, hydrolyzed whey is the least likely to cause digestive upsets.



Whey Protein Blends

While it is possible to buy products that contain either whey protein isolate, whey protein concentrate or hydrolyzed whey protein, many products use a customized blend so that you can benefit from the unique properties of each type of whey. Whey protein blends are usually good value for money and suitable for a wide variety of users and purposes as well as being widely available. Read the ingredients list so you know exactly what is in your whey protein blend and be aware that many products use a lot of whey protein concentrate as it is the cheapest form of whey.

When Considering A Whey Protein Product Consumers Should:

- Seek out cold-processed protein powders manufactured below 50 degrees C to avoid denaturing (damaging the protein and rendering it less digestible)
- Choose products with no added sugar, sweeteners or artificial flavours
- Mix whey protein with full-fat milk, organic peanut/almond butter or coconut oil to enhance protein metabolism
- Remember that whey protein shakes are a supplement to and not a replacement for healthy food
- Protein consumption beyond what is actually needed will not automatically be converted to muscle but may actually become fat

Micronutrient Supplementation



Vitamins

The use of vitamins and minerals has been favoured amongst the general public and athletes alike. Some argue on the effectiveness of taking these supplements and that they are often excreted in the urine. This may be the case of overdosing with certain vitamins however, not all are water-soluble so they would not be able to pass through urine.

It is worth noting that overdosing with vitamins will not provide any further improvement, it will simply ensure that your natural ability is maximised. Vitamins B & C are water-soluble and once your body has its natural highest amount it will start to excrete it through urine. Vitamins A, D, E & K are able to be stored in adipose tissue and will be used when activity levels are reduced.

Minerals

Minerals are required to ensure that chemical reactions happen correctly within the body. They act as biological catalysts, helping to speed up processes, this is commonly seen with the electrolyte group.

Ensuring that mineral intake is kept on top of, is vital for normal bodily function but for ensuring proper physical performance in your clients sport it is even more vital.

As with fat soluble vitamins, these can build up to toxic levels very quickly. Minerals are required to ensure that chemical reactions happen correctly within the body. They act as biological catalysts, helping to speed up processes, this is commonly seen with the electrolyte group.

Ensuring that mineral intake is kept on top of, is vital for normal bodily function but for ensuring proper physical performance in your clients sport it is even more vital.

As with fat soluble vitamins, these can build up to toxic levels very quickly.

Advice

Advising clients to eat a whole food diet is the best way to ensure adequate amounts of vitamins and minerals are being consumed. As discussed earlier (In module 2) non medical deficiencies can be supplemented however, once the body has reached its own natural ceiling any surplus supplementation will be wasted.

It is for this reason that a whole food diet is the best method to gain all requirements, if a client supplements first then eat food, that foods contents may be wasted. Also, consider that the vitamin and mineral supplement market is not fully regulated and the version of the vitamin/mineral may not be the most efficient at being absorbed.

Conclusion

As personal trainers, Multivitamin and mineral tables are the very definitions of a supplement, they should be used to benefit the client's exercise goals and aims. A healthy diet will keep the client healthy and should they not be training intensely, the need for the supplement is reduced. Some vitamins and minerals can build up within the body and lead to toxicity, this again backs up the need to avoid overdosing with these supplements.

Side effects of too many vitamins and minerals:

Vitamin A: Liver toxic, hair and skin changes.

Vitamin B: Ataxia

Vitamin C: Gastric upset

Vitamin D: Soft tissue calcification

Vitamin E: Possible anti-platelet effects

Iron: Constipation

Zinc: Immunosuppression

Selenium: Brittle hair and nails.

Avoid and Advise

Supplements such as protein shakes are often marketed as being essential but, in reality, it is quite possible to get all the protein required to fuel muscle growth by eating meals based on meat, fish, poultry and eggs and through the use of complementary proteins. However, protein shakes do make for a convenient way to get additional protein if eating a solid meal is not practical.

Nutrition for exercise can be a complex subject and that the complexity is partially because very little of the information around is actually impartial. Much of the research and information is biased toward a particular product and often paid for by the manufacturers.

Rather than try to decipher the often wildly inaccurate exercise and sports nutrition information in the fitness magazines that are often advertising in disguise, personal trainers should endeavour to stick to the tried-and-tested exercise nutrition principles outlined below:



Avoid	Advise
Low quality protein shakes and most commercial sports drinks	Make your own isotonic drink if needed for energy
Most cereal bars and energy gels	Eat organic animal products for protein
Low quality refined carbohydrates	Eat organic nuts, seeds, fruit etc. for snacks
Using carbohydrates in isolation for energy	Allow time to prepare and eat "real" food rather than rely heavily on supplements
Ignoring the importance of pre and post-exercise meals	Drink water as primary rehydrating fluid
Ingesting carbohydrates during short workouts or when fat loss is the primary goal	

Evaluation of Supplementation

Protein

Safe Use

Protein powders can be used to increase a clients daily protein intake.

Keep within the recommended amount for the clients ability level.

Effectiveness

Protein powders that are not cold pressed or properly processed will be denatured and therefore less useful on a gram for gram basis.

Contraindications

Pre-existing kidney conditions can be worsened.

Kidney conditions can be hidden, therefore ensure that increased protein intake is incremental.

Vitamin Supplementation

Safe Use

Taking no more than one serving size daily of any given multivitamin is safe for all healthy clients.

Consume multivitamins alongside food that contains both water and fat to improve absorption.

Effectiveness

Multivitamins range in prices from pennies to many £'s. The cheaper it is the less of the active nutrient will be available.

Tablets or capsules can be as low as 5% vitamin with the other 95% of tablet weight being a binding agent.

Contraindications

Both fat soluble vitamins and the mineral group can be stored within the body to toxic levels, causing serious side effects.

Many vitamins in large qualities can cause diarrhoea.

Vitamin K specifically in low quantities can cause a decrease in blood clotting.

Weight Management

The goal of weight management is to prevent the accumulation of excess body fat or reduce fat levels to an acceptable level in order to minimize the health risks associated with obesity. To achieve a bodyweight with which they are happy, many people embark on one of the many diets available or exercise specifically to burn calories.

Adipose Tissue

Excess calories (energy) from any macronutrient group are ultimately converted to fat and stored in specialist cells called adipocytes which are collectively called adipose tissue.

Adipocytes can swell in size and can even undergo hyperplasia which means they increase in number. It is theorized that being overweight, especially during puberty, can increase the number of adipocytes which can lead to an increased risk of obesity and diabetes in later life. Genetics can also play a role in the size and number of adipocytes but, despite this, a sound diet and exercise program can still result in fat loss.

Distribution Of Body Fat

The distribution of body fat is influenced by genetics and gender and plays a part in how dangerous accumulated body fat can be to health.

There are two main types of body fat accumulation:



Apple-shaped
Fat Patterning
ANDROID

Android obesity is characterised by fat accumulation around the midsection and internal organs and is also known as central obesity. This fat accumulation is most commonly associated with men and is often seen as a large "beer belly". Influenced by the hormone testosterone, android obesity is a leading factor in the development of coronary heart disease. While more common in men, some women can experience android obesity if their oestrogen levels decline and testosterone levels rise.



Pear-shaped
Fat Patterning
GYNOID

Gynoid obesity is characterised by fat accumulation around the body's periphery e.g. the hips, thighs, chest and arms. Normally associated with females, this fat accumulation presents less of a CHD risk but still increases the risk of developing diabetes and other fat-associated health risks. While normally associated with females, men can suffer this type of obesity if their testosterone levels decline sufficiently.

There are several methods commonly used to assess the health risks of obesity and the different fat distribution sites:

- **Body mass index**
- **Abdominal circumference**
- **Hip to Waist Ratio**

While none of these methods directly measure body composition, they are all simple to perform and have been shown to identify major risk indicators.

BMI: is calculated by dividing body weight in kilograms by height in meters squared or KG/ M². This calculation is straight forward but there are also several BMI calculators available on the internet. While BMI is a good indicator of risk for BMI in sedentary people, it is less useful when assessing people with above average amounts of muscle who tend to be heavier than non-exercisers but considerably leaner. The table below provides information on how to assess risk based on BMI.

Classification of obesity by Body mass index (BMI)

Classification	BMI (KG/M ²)
Underweight	<18.5
Normal – acceptable	18.5 – 24.9
Overweight – special attention	25 – 29.9
Obesity – medical referral I	30 – 34.9
Severe obesity II	35 – 39.9
Morbid obesity III	>40

Abdominal circumference: the larger the abdominal circumference, the greater the risk of suffering health issues such as coronary heart disease. Measurements should be taken horizontally around the umbilicus or belly button as that point will not move and provides a handy reference for future measurements.

Lowered risk	High risk
Men <94cm or <37 inches	Men >102cm or >40 inches
Women <80 cm or <32 inches	Women >88cm or >35 inches

Hip to Waist Ratio: fat stored in greater amounts around the abdomen as opposed to the hips is a prime health risk indicator. The measurement of the waist is simply divided by the widest measurement around the hips and the results can then be compared to the chart below.

Classification	Male	Female
High risk	>1.0	>0.85
Moderate risk	0.90 – 1.0	0.80 – 0.85
Low risk	<0.90	<0.80

Harris Benedict Equation

To reduce body fat levels for either aesthetic or health reasons, many people use low-calorie diets. Unfortunately, cutting calories too low can trigger something called the starvation response. In addition to being a storage site for energy, adipose tissue is also a secreting organ; the main secretion being the hormone leptin.

Leptin levels are proportional to the amount of fat mass and rapid fat loss will result in rapid falls in leptin. A very low-calorie diet leading to a rapid fall in leptin levels is detected by the hypothalamus region of the brain and is what triggers the starvation response.

The starvation response was once an essential mechanism for keeping humans alive during periods of famine but is now redundant.

However, it still remains active and will result in the following:

- Decreased metabolic rate to preserve fat stores
- Increased hunger
- Increased use of muscle for fuel
- Increased Lipoprotein Lipase (LPL) activity

(LPL being the enzyme responsible for moving triglycerides into adipocytes).

Once the diet is over and the client returns to eating normally, the reduction in metabolic rate and muscle mass and the increased LPL activity will mean that fat is not only regained, but more is regained than was originally lost. This results in what is commonly referred to as yo-yo dieting where instead of losing weight and fat, dieters actually get fatter over time.

To avoid triggering the starvation response, any energy restriction should not exceed 500 kcals below total daily energy expenditure or TDEE.

Men:

$$66 + (13.7 \times \text{weight kg}) + (5 \times \text{height cm}) - (6.8 \times \text{age})$$

Woman:

$$655 + (9.6 \times \text{weight kg}) + 1.8 \times \text{height cm} - (4.7 \times \text{age})$$

Activity level	Activity multiplier
Sedentary	BMR x 1.2
Lightly active	BMR x 1.375
Moderately active	BMR x 1.55
Very active	BMR x 1.725
Extra active	BMR x 1.9

Energy

Genetics

Some people are much more likely to gain fat than others. Those with endomorphic tendencies and those with a higher than the average number of adipocytes and hormonal disruption can all play a part. However, obesity has not been common enough for long enough for major genetic changes to have occurred and, in reality, environmental factors are more likely to be the cause of obesity than genetics in the vast majority of cases. In an environment conducive to weight loss, even genetically predisposed people with obesity will lose weight.

It is worth noting that, according to set-point theory, there is a percentage of body composition at which your body prefers to be and it will ultimately "swing back" to that level given the opportunity to do so. This may help explain why some people can only maintain a low body fat percentage for a relatively short time.

Energy And Metabolism

Energy and metabolism are essential players in the battle against body fat. It is important for any trainer to know not just where energy comes from (the macronutrients) but how it is expended (metabolism). Metabolic energy expenditure is made up of several components:

- **Basal Metabolic Rate:** BMR for short, this refers to the amount of energy used by the body at rest in a 24-hour period. This is the sum total of calories required to sustain body function at complete rest and when no digestion is occurring.
- **Thermal effect of food:** TEF for short, this refers to how much energy is used during the ingestion, digestion, absorption, storage and elimination of food. TEF accounts for between 6 to 10% of total daily expenditure for men and 6 to 7% for women.
- **Thermal effect of activity:** TEA for short, this figure refers to the energy used during planned and unplanned physical activity. Low levels of activity mean that fewer calories are used and higher levels of activity mean that more calories are used. TEA accounts for 20 to 40% of total daily energy expenditure and is also the most modifiable form of energy expenditure.

The following chart provides a rough estimate of the amount of energy used during different activities for a 65 kg female and a 79 kg male.

ACTIVITY	MEN (79KG)	WOMEN (65KG)
High impact aerobics	553	455
Badminton	356	293
Basketball	632	520
Light cycling	474	390
Building work	435	358
Heavy cleaning	237	195
Table tennis	316	260
Swimming vigorously	790	650
Volleyball	316	260
Weight training	390	390
Dancing	356	293
Rugby	790	650
Golf	237	195
Horse riding	316	260
Jogging	553	455
Pilates	277	228
Pushing baby buggy	198	163
Tennis	553	455
Brisk walking	395	325
Sitting	198	163

- **Total daily energy expenditure:** TDEE for short, TDEE is the sum total of all energy required to fuel all activities including eating, sleeping and physical activity. If this figure is equal to energy input, body fat levels and weight should remain stable but if food intake is greater than TDEE, body fat and weight will increase. Conversely, if calorific intake is less than TDEE fat loss should be the result. Expending more calories than are consumed is called creating an energy deficit and is an intrinsic part of weight management.

Creating An Energy Deficit

To avoid triggering the starvation response and preserving muscle during a period of caloric restriction, it is recommended that dieters do not reduce their energy intake by more than 500 calories below TDEE. While greater deficits are possible, they are much more likely to result in a fat gain rebound.

An energy deficit of 500 calories per day should result in a one-pound fat loss per week as 500 multiplied by seven days will result in a 3500 calorie deficit which is the approximate amount of energy contained in a pound of fat.

An energy deficit can be achieved in several ways:

- Diet restriction alone
- Exercise alone
- The combination of diet restriction and exercise

In the majority of cases, option three is the best choice. Diet restriction alone means that diet must be very strict and maybe nutritionally poor while exercise alone means that approximately one hour of exercise must be performed every single day. Combining diet and exercise has been shown to be the most sustainable method for creating the required energy deficit.

Effective Dietary Interventions

Just as exercise must be programmed correctly to be effective, so too must any dietary interventions. Just skipping a meal or "eating less" will not be as effective as implementing tried-and-tested dietary interventions.

Factors to consider include:

- Frequency of meals
- The Effect of Insulin
- Macronutrient Balance
- Biological Individuality

Frequency Of Meals

Eating little and often has been shown to be a beneficial strategy for weight management. Studies suggest that people three meals of 500 calories versus people eating a single meal per day of 1500 calories lose weight faster, experience less hunger and enjoy a higher degree of dietary compliance. More frequent meals are also linked to a reduction in loss of fat-free mass, more stable blood glucose levels and more stable energy levels; therefore a minimum of three meals per day is advised.

The Effect Of Insulin

Insulin is an essential hormone that helps drive nutrients into cells. Produced by the pancreas, insulin levels increase whenever blood glucose levels increase. Insulin is essentially an anabolic or building hormone and its benefits can be harnessed by always consuming a post-workout meal to facilitate rapid restocking of muscle and liver glycogen.

However, elevated insulin levels can also inhibit fat loss and is partially responsible for the uptake of unused glucose into fat cells. For this reason, foods that trigger a rapid rise in blood glucose and therefore insulin are not conducive to weight management; low glycaemic index carbohydrates are the carbs of choice when eating for weight control.

In addition to avoiding high glycaemic foods and the associated high insulin levels, it is also important to try and increase insulin sensitivity. This is best achieved through exercise and especially resistance training.

Macronutrient Balance

Balancing intake of the three macronutrients is key to preventing weight gain and facilitating fat loss. All three macronutrients are essential but need to be consumed in the right balance if they are to be utilized efficiently.

Excess dietary fat, which is high in calories, is easily converted to body fat while carbohydrate, which is lower in calories, can also be easily converted to fat when consumed in excess. Protein, which has the highest thermal effect of the three food groups, is much tougher to convert to fat when consumed in excess and should be present in most if not all meals.

With all these points in mind, it makes sense to either reduce fat intake or reduce carbohydrate intake. This reduces any competition for fuel, will help control insulin levels or negate the negative aspect of elevated insulin levels and ensure meals have as high a thermal effect as possible.

Biochemical Individuality

"One man's meat is another man's poison," said Roman philosopher Lucretius back in 200 BC. Without realizing it, Lucretius was referencing something we today call biochemical individuality. Biochemical individuality describes how we are all slightly biologically and chemically different and respond differently to the foods we eat. That is why dietary models such as the food pyramid and Eat Well Plate do not work for everyone.

Because of biochemical individuality, there is no one perfect diet and this premise helps explain why some diets work for some people and not for others. Some people seem much better suited to a lower carb, higher protein and moderate fat diets while others thrive on higher carbs, low fat and moderate protein. This means that any adopted nutritional approach may need to be adjusted or even abandoned if it does not work for a particular individual.

Modern Systems for Weight Management

Open any fitness or popular entertainment magazine and you will inevitably find a diet being promoted. Every month a new diet tops the non-fiction book charts and celebrities do their part by talking about their latest weight loss regimen. There are literally hundreds of different diets around many of which are effective for no other reason than they result in an energy deficit. Other diets create more than a simple energy deficit and are designed to make the most of hormones, metabolism and enzymes in an effort to maximise fat loss.

Some diets are actually very safe and effective while others are less so. In reality, there is no real need to follow a diet so long as food intake is restricted slightly to facilitate a caloric deficit.

That being said, a personal trainer needs to have a passing knowledge of popular, modern diets so they can offer appropriate advice to his/her clients.

Modern Systems For Weight Management

Fasting	Helps detoxify bodily systems	Risk of malnourishment
	Creates significant energy deficit	Low energy levels
	Gives digestive system "a rest"	Severe hunger
	Result in rapid weight loss	Increased risk of headaches, allergies, aches and pains and bad breath
Very low calorie diets	Result in rapid weight loss	Should be conducted under medical supervision
		Often only 800 calories per day.
	Designed for obese people	Severe hunger and lack of nutrients. Constipation and digestive upset. Risk of heart damage.
Calorie counting diets	Controls calorific intake	Focus placed on calories rather than nutrients
	Provides guidance as to which foods are to be consumed	Very time consuming and restrictive
Meal replacement diets		Does not teach new nutritional habits.
	Easy to implement as no calorie counting required	Not suitable for long term use.
		Meal replacements can be more expensive than food can result in social exclusion at meal times
Food combining	Proteins and carbohydrates are digested better separately.	Meals will be very restrictive. No real data to support claims. Not practical so low level of adherence
	Foods eaten separately more likely to be burnt as fuel and less likely to be stored as fat	No real data to support claims. Not practical so low level of adherence
Fat burning supplements	Creates an energy deficit by raising metabolic rate	Fat burners are generally ineffective or dangerous. Effective fat burners only raise metabolism very slightly



The wholefood diet	Low in fat, high in unrefined carbs and contains moderate amounts of protein	Should be conducted under medical supervision
	Foods should be unprocessed Wide range of foods recommended	Caters to individuals Caters for population rather than individuals
Ketogenic diets	Naturally low in sugar, salt and additives	
	High thermal effect of protein elevates metabolism	Can make some people feel unwell and lacking in energy Lack of carbohydrate can make diet nutritionally unbalanced Initial weight loss is water – not fat Adherence levels low
	Low carbohydrate intake eliminates competition for fuel	Very restrictive Lack of Some concerns over heart and kidney health
	Blood glucose and insulin levels stabilized to facilitate fat loss	
	Ketones (produced from protein and fat) are inefficient energy sources which create a greater caloric deficit	Food choice very restrictive
	Palaeolithic diet - all modern foods such as bread, refined foods and sugar eliminated	Some concerns over lack of fibre and carbohydrate
	Food consumed that was available to hunter/gatherer ancestors	Deemed to be a high fat diet so some concerns over increased CHD risk
	Some low GI carbohydrates are allowed	Lack of dairy may mean low calcium intake
	Contains lots of omega 3 and omega 6 fatty acids Can help stabilize blood glucose levels	
	Foods eaten in as natural a state as possible	

General Weight Management Nutrition Guidelines

Frequent Smaller Meals

- Increases metabolism (metabolic bursts)
- Staves off hunger
- Helps regulate blood glucose levels
- Smaller meals less likely to be stored as fat
- Negative Energy balance
- Reduce energy intake by 250 –300
- Include activities to use a further 250
- Never consume fewer kcal than BMR

Nutrient Intake

- Consume vitamin and mineral-rich whole foods
- Intake of fibrous food should be high
- Avoid processed, energy-dense, sugary foods
- Drink at least 2 litres of water a day
- Avoid high carbohydrates and high fat at the same time

General Weight Management Exercise Guidelines

Resistance Training Aim:

- To maintain
- Increase FFM

Cardiovascular Training Aim:

- To increase metabolic rate
- Increase energy expenditure

Disordered Eating

While weight management usually means maintaining or lowering body fat levels to within healthy parameters, in some instances, weight management can be taken to unhealthy extremes or the methods used for weight control can themselves be unhealthy. This is usually described as disordered eating. There are several types of disordered eating but the most common are anorexia nervosa and bulimia nervosa.

Anorexia And Bulimia Nervosa

Personal trainers are not equipped to deal with people suffering with disordered eating as the behaviours associated with these two different problems are medical and specifically psychological in nature. The National Institute of Clinical Excellence (NICE) advocate that most disordered eating patients should be treated on an outpatient basis and with appropriate psychological treatment and familial support where appropriate.

Unfortunately, many sufferers of disordered eating are in denial that they have a problem and that means referral, the correct course of action, can be difficult and must be treated sensitively.

While personal trainers should not attempt to treat or otherwise intervene if they suspect disordered eating, they should be able to recognise the signs and symptoms of both anorexia nervosa and bulimia nervosa for referral purposes.

In working with people who have previously suffered disordered eating, it is essential that the subject of weight, nutrition and food is dealt with very sensitively so as not to cause a repetition of the original condition.

Signs and Symptoms

Signs and symptoms of anorexia nervosa			
Physical	Psychological	Behavioural	Long term
Extreme weight loss	Intense fear of weight gain	Eating rituals	Difficulty getting pregnant
Insufficient growth	Distorted perception of body – body dysmorphia	Eating in secrecy	Osteoporosis
Constipation or abdominal pains	Dental problems	Restlessness and hyperactivity	Death
Dizzy spells	Mood swings	Wearing baggy clothes	
Hair loss		Vomiting or taking laxatives	
Poor circulation			
Dry, rough, discoloured skin			
Dysmenorrhoe			

Signs and symptoms of bulimia nervosa

Physical	Psychological	Behavioural	Long term
Frequent weight changes	Uncontrollable urges to eat	Binging and vomiting cycles	Heart attack
Going to the toilet after eating	Obsession with food	Excessive use of laxatives	Rupture to stomach
Sore throat and tooth decay	Body dysmorphia	Periods of fasting	Teeth erosion
Swollen salivary glands	Mood swings	Excessive exercise	Choking
Swollen face	Anxiety and depression	Eating in secrecy	Death
Poor skin	Low self esteem	Abuse of fat burning supplements	
Dysmenorrhea	Guilt associated with eating		
Lethargy and tiredness			