Sports Nutrition
Lesson 1

Introduction

There's nothing like the subject of nutrition to stir debate. It seems like the experts change their minds almost daily about what we should and shouldn't eat. In truth, scientific nutrition hasn't changed much at all in the last fifteen years.

It's the constant and never-ending emergence of fad diets and weight loss programs that adds to the confusion. It appears everyone has differing opinions...

Fortunately, scientific sports nutrition is a little less contested. There are some very well-researched, well-practiced dietary strategies that have been used by athletes for many years. They are applicable to most sports. In fact, they are more than applicable - they are a pre-requisite to peak performance.

The aim of this health unit is to outline the basics of sports nutrition with an emphasis on practical application. Split into 7 separate lessons, it covers macronutrients (fat, carbohydrate and protein), vitamins and minerals, pre and post competition eating and fluid replacement. There is also a lesson reviewing some of the most popular sports supplements available to today's athletes. In an industry that boasts some of the best marketing strategies around, the claims often fall short of the facts.

The final lesson provides a summary of recommendations that athletes can begin to use immediately.

Carbohydrates

All energy, whether it's to play sport or carry out any other activity, comes from three classes of food called macronutrients. These nutrients are better known as carbohydrates, fats and proteins. Each is important - not only to fuel athletic performance but also for overall health and well-being.

Weight for weight carbohydrates contain the least amount of energy out of the three macronutrients – 4 calories/gram. Yet they are the most important type of fuel to an athlete.

During short, intense bouts of exercise (like sprinting), carbohydrate is the only fuel capable of supplying the body with energy quickly enough. In the first few minutes of any activity, it is carbohydrate that almost exclusively meets energy demands. In addition, the ability to repeat a sprint at the end of a game or race, to the same high level as at the start of the game relies, in part, on the body's carbohydrate stores.

Although the body does use fat for lower intensity activity, carbohydrate acts as a "primer" or catalyst for fat to be broken down. Finally, carbohydrates play a key role in central nervous system function. The brain for example, uses glucose almost exclusively as its fuel.
Can diet significantly affect the body's carbohydrate stores?

The average person has about **2000 calories** of stored carbohydrate. An overnight fast (8 to 12hrs) and a low-carbohydrate diet can dramatically lower these stores. More importantly, a carbohydrate-rich diet can more than double them. The body's upper limit for carbohydrate storage equates to about **15 grams per kilogram (2.2lbs)** of bodyweight. So an 80kg (175lb) person can potentially store up to 1200 grams of carbohydrate or 4800 calories worth of energy - all with just a few dietary modifications.

There are different types of **carbohydrates**. Understanding **what** they are and **how** they affect the body differently, is important to **athletes** and what they eat **before and after** a game.

### Monosaccharides

This is the most basic unit of carbohydrate. Examples of monosaccharides include **fructose** (sugar found in fruit) and **glucose** (also called blood sugar). Cells can use the glucose found in food directly for energy, while fructose is converted to glucose in the liver.

### Disaccharides

Combine two **monosaccharides** and the result is a **disaccharide**. **Sucrose** or table sugar is a disaccharide and it's the result of combining glucose and fructose. The sugar in milk, lactose, is another disaccharide. The collective name for both monosaccharides and disaccharides is **simple sugars**. Simple sugars are quickly absorbed by the body and provide a rapid source of energy.

Simple sugars such as **fruit** and sports drinks are a good food choice to refuel **AFTER** a game when the body's energy stores are low.

### Polysaccharides

**Starch** and **fibre** are both **polysaccharides**. Starch is the combination of hundreds of monosaccharides joining together. Nutritionists often refer to polysaccharides as **complex carbohydrates**. Examples include bread, potatoes, rice and pasta. It takes longer for the body to break these complex structures down so they release their energy over a longer period than simple sugars.

Fibre differs from starch in that it **cannot** be digested and used for energy. It's still an important dietary component though and there is a growing link between lack of fibre and certain degenerative illnesses.

**Starchy complex carbohydrates are the best choice BEFORE** a game as a pre-match meal.
Fat contains more than twice the amount of energy as carbohydrate. A single gram contains nine calories making it a valuable source of fuel for longer duration activities. While fat cannot supply energy quickly enough for very intense activity, it can be used by the body to power lower intensity exercise such as jogging and walking.

Fat also provides insulation and protection to vital organs such as the heart, lungs and liver and transports vitamins throughout the body.

Not all dietary fat is the same. Like carbohydrate, fat can be broken down into several different groups:

**Saturated Fats**

Saturated fats are found in foods such as red meat, egg yolks, cheese, butter, milk and commercially prepared cakes, pies and cookies. The typical western diet consists of almost 40% total fat. Of this, 15% is made up of saturated fats, which is considered a major cause of coronary heart disease, diabetes and other degenerative illnesses. No more than 10% of the diet should come from saturated fats.

**Unsaturated Fats**

Unsaturated fats come in the form of monounsaturated fats and polyunsaturated fats. Monounsaturated fats can actually lower the risk of coronary heart disease and are found in foods like olive oil, canola oil, avocados, almonds and pecans. Polyunsaturated fats, found in sunflower oil, safflower oil and corn oil are not thought to contribute to heart disease but don't offer the same protection as monounsaturated fats.

**Essential Fatty Acids**

Essential fatty acids are a class of polyunsaturated fats that have received a lot of attention in the media recently. They are thought to be cardio-protective and may help prevent a range of other illnesses. There are three types of essential fatty acids - Omega 3, Omega 6 and Omega 9. Omega 3 and Omega 6 must be consumed while the body can produce some Omega 9 on its own. Essential fatty acids are required for healthy cardiovascular, reproductive, immune, and nervous systems. Found in foods like walnuts, pumpkin seeds, Brazil nuts, sesame seeds, avocados, some dark leafy green vegetables and oily fish, the typical Western diet is often deficient of essential fatty acids.
Cholesterol

Despite its bad press, cholesterol is actually essential for many important bodily functions. There are essentially two types of cholesterol - low-density lipoprotein (LDL) and high-density lipoprotein (HDL). LDL is known as the "bad" cholesterol because it carries and then deposits cholesterol at the artery walls. HDL on the other hand, is known as "good" cholesterol because it acts as a scavenger removing cholesterol from artery walls and transporting it to the liver to be excreted.

Although some foods like cream, butter, ice cream, egg yolks, shellfish and red meats contain cholesterol, it's a high intake of saturated fat that causes the body to synthesize too much cholesterol. The maximum amount of dietary cholesterol recommended each day is 300mg.
Correct and adequate protein intake is crucial for anyone involved in vigorous training. Protein is essential for the growth and repair of skin, hair, nails, bones, tendons, ligaments and muscles. It also serves a crucial role in enzyme production and maintaining a strict acid-base balance.

The Recommended Dietary Allowance (RDA) for the average male and female adult is just **0.83 grams of protein per kilogram (2.2lbs) of bodyweight**. In a 70kg (154lb) individual this equates to just 58 grams of protein per day or about two chicken breasts worth.

Some research shows that competitive athletes, particularly those involved in heavy weight training, may require more protein. The recommendation for strength and endurance athletes ranges from **1.2 to a maximum of 2.0 grams per kilogram (1kg = 2.2lbs)**. Research has shown that consuming more protein than this serves no benefit and may be harmful in the long term.

Good sources of protein include low fat milk, poultry, fish, lean red meat, eggs, nuts, beans and lentils and soy products. Fatty meats like pork and fast food hamburgers as well as most cheeses contain a lot of saturated fats so are not as suitable sources of protein.

Recently, the emergence of high protein, low carbohydrate diets have become popular in the weight loss industry. While they may or may not help to shed the pounds, high protein, low carbohydrate diets are unsuitable for athletes.

Many athletes are afraid that their heavy training schedule will force their bodies to breakdown lean muscle mass and then use it as energy. The body does use protein sparingly as a source of fuel after 45 minutes of exercise, however consuming more protein is not a good strategy.

By consuming plenty of carbohydrates **before, during and after** exercise it acts as a protein "sparer". Only in the absence of adequate carbohydrate stores will the body begin to metabolize significant amounts of protein for use as energy.

### The Athlete's Diet

A typical western diet contains too much **fat** and not enough healthy, whole grain carbohydrates.

Athletes should aim to make **60-65%** of their diet carbohydrate, with an emphasis on fresh fruit and whole grains such as brown rice and pasta, whole wheat bread, potatoes and high fibre cereals. About **20-25%** of total calories should be in the form of **fat**.

The majority of this should be in the form of good fats (monounsaturated, polyunsaturated, omega fatty acids) found in oily fish like mackerel and salmon, olive oil, avocado and raw nuts (not roasted or salted). **Protein** should make up the remaining **10-**
15% of an athlete’s diet derived from fish, poultry, low fat milk and lean red meat for example.

<table>
<thead>
<tr>
<th>Ideal Diet Composition for a Sport Player</th>
</tr>
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<tbody>
<tr>
<td>Carbohydrate</td>
</tr>
<tr>
<td>---------------</td>
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<tr>
<td><strong>Average Western Diet</strong></td>
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<tr>
<td><strong>Ideal Sport Player’s Diet</strong></td>
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Take a look at the table below for a sample day’s eating plan:

<table>
<thead>
<tr>
<th>Sample Day’s Diet for a Sport Player in Training</th>
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</thead>
<tbody>
<tr>
<td><strong>Breakfast</strong></td>
</tr>
<tr>
<td>Piece of fruit</td>
</tr>
<tr>
<td>Bowl of oatmeal or porridge (sweeten with dried fruit or honey)</td>
</tr>
<tr>
<td>3-4 slices wholemeal bread toasted with small amount of butter/olive oil spread, jelly/jam</td>
</tr>
<tr>
<td>Glass of fresh fruit juice (not concentrated)</td>
</tr>
<tr>
<td><strong>Snack</strong></td>
</tr>
<tr>
<td>Piece of fresh fruit</td>
</tr>
<tr>
<td>Plain yoghurt</td>
</tr>
<tr>
<td>2-3 fig biscuits/cookies</td>
</tr>
<tr>
<td><strong>Lunch</strong></td>
</tr>
<tr>
<td>Tuna or grilled chicken</td>
</tr>
<tr>
<td>Bagel, baguette etc. (preferably wholemeal)</td>
</tr>
<tr>
<td>Mixed salad with olive oil and lemon juice dressing</td>
</tr>
<tr>
<td>Glass fresh fruit juice or low fat milk</td>
</tr>
<tr>
<td>Low fat or bran muffin</td>
</tr>
<tr>
<td>1-2 bananas</td>
</tr>
<tr>
<td><strong>Snack</strong></td>
</tr>
<tr>
<td>Bag of nuts and raisins (such as almonds, pecans, Hazelnuts etc)</td>
</tr>
<tr>
<td><strong>Dinner</strong></td>
</tr>
<tr>
<td>Large serving rice or pasta</td>
</tr>
<tr>
<td>Tomato sauce</td>
</tr>
<tr>
<td>Grilled fish, chicken or lean beef mince</td>
</tr>
<tr>
<td>Large mixed vegetable salad with dressing</td>
</tr>
<tr>
<td>Small serving of ice cream and strawberries</td>
</tr>
</tbody>
</table>

This is one sample day only and a wide range of foods should be eaten. Try also to drink 2 litres (68 oz) water each day (fluids as part of a sports drink count).
Thirteen different vitamins have been identified and studied to date. They are classed as either fat-soluble (vitamins A, D, E, K) or water-soluble (vitamin B complex, vitamin C). Together they are responsible for blood clotting, neuromuscular function, healthy skin, teeth and bones and numerous other bodily functions.

A well-balanced diet should provide an adequate supply of all the vitamins regardless of age and level of physical activity. During periods of intense training, a natural increase in food intake supplies any extra vitamin demand the body may have.

Free Radicals, Antioxidants & Exercise

Free radicals are highly reactive molecules that can cause damage to the cells and are thought to accelerate the aging process and contribute to cancer, heart disease and diabetes. They are found in cigarette smoke, environmental pollution and some medications. Exercise may also increase the production of free radicals.

The body has an elaborate defence system against free radicals in the form of antioxidant enzymes. Vitamins A, C and E are known as antioxidant vitamins and can protect the cells against free radical damage. Although foods like citrus fruits, green vegetables and nuts contain antioxidant vitamins, some athletes feel the need to take a supplement due to the high level of training they undergo.

Although exercise is thought to increase free radical production, it also appears to increase the body’s antioxidant defence system at the same time. However, there is some research to suggest that a vitamin E supplement can reduce harmful free radical production associated with exercise. Whether this offers any overall health benefits is still unclear.

Over 40 years of research has failed to show that vitamin supplementation can offer any sort of performance enhancement when a nutritionally balanced diet is present. Some vitamins (such as vitamin C) taken in excess can actually be harmful. The recommendation is to eat a well balanced diet rich in fresh fruit and vegetables.

Minerals

Minerals account for roughly 4% of a person’s body mass. They provide the structure for forming bone and teeth. They also help muscles to contract, maintain normal heart rhythm and control the acid-base balance as well as other important bodily functions.

Minerals are classed as either major or trace depending on how much is required per day. Major minerals include calcium, phosphorus, sodium, potassium and magnesium. Trace minerals include iron, zinc, copper, selenium and chromium.
**Calcium**

The typical Western diet contains too little calcium. The RDA for calcium is 800-1000 mg for adults and 1200 mg for adolescents. The average adult consumes just 500-700 mg per day and for many it’s as little as 300 mg per day. Calcium deficiency can lead to a condition called osteoporosis - a weakening of the bones. Exercise actually helps to maintain healthy bone density.

**Sodium**

Most adults consume too much sodium (found in abundance in processed foods), which can lead to high blood pressure. The RDA of 1100-3300 mg is equivalent to 0.5-1.5 teaspoons of table salt. Most people consume more than 2 teaspoons from processed foods even when table salt isn’t used as seasoning.

**Iron**

Iron helps the blood to carry oxygen so an iron deficiency (called anemia) can lead to fatigue even with mild exercise. Some research has suggested that heavy exercise training creates an increased demand for iron. However, even in elite athletes, supplements are unnecessary if the diet contains iron-rich foods.

As with vitamins there is no convincing research to suggest taking mineral supplements can improve sporting performance. Exceeding the recommended daily allowance can also be potentially harmful. The only exception is adding a small amount of sodium to sports drinks during hot weather (¼ -½ teaspoon per litre of water).
Long gone are the days when athletes thought that eating a big steak before a game would give them lots of energy. Today's elite sports men and women follow a strict diet, particularly on the day of a competitive match or event. While diet won't turn poor athletes into great ones, it can make the difference between performing poorly and tapping your full potential.

The Glycemic Index

Not all carbohydrate is digested and absorbed at the same rate. The Glycemic Index (GI) is a scale of how much a particular type of food raises blood sugar over a two-hour period compared to pure glucose.

For example, a piece of food with a GI score of 45 means that it raises blood sugar 45% as much as pure glucose in that two-hour period.

Common sense says that simple sugars which are broken down quickly, like fructose in fruit, should have a higher GI than complex carbohydrates, but that's not always the case. White bread, white rice and potatoes (all classed as complex carbohydrates) have a very high GI. That means they raise blood sugar almost as much or even more than pure glucose. Fructose has medium GI because the fibre found in fruit slows digestion and absorption.

Choosing foods with a high GI will help to quickly replenish carbohydrate stores after a game or event. Before a game or event, low GI foods are more appropriate as they release energy more slowly and for a longer period.

Pre Match Eating

The goal prior to a game or event (and even a training session) is to maximize carbohydrate stores in the muscles and liver and to top up blood glucose stores. Studies have shown that consuming foods with a high GI within an hour of exercise can actually lower blood glucose, which is not what an athlete wants! The reason is because the body produces an "overshoot" of insulin, which helps muscles to take up sugar in the blood. This in turn causes low blood sugar levels.

Athletes should eat foods with a low to medium GI before a match. This allows for a relatively slow release of glucose into the blood and avoids the unwanted insulin surge.

Consuming carbohydrate at least an hour before the start allows any hormonal imbalance to return to normal.
Examples of low GI foods include pasta, whole grain breads and rice, oatmeal, milk and milk products and fruit (except bananas and dried fruit).

The pre-match meal might consist of pasta in a low-fat tomato sauce, baked beans or scrambled eggs on toast and fresh fruit such as apples, pears or orange juice. Some grilled fish or chicken and vegetables could accompany the carbohydrates. Ideally this meal should be eaten at least three hours prior to the start - especially if nerves are a factor, which can impair digestion.

Food in the stomach is given a high priority to be digested before it has chance to spoil. As a result greater blood flow is directed to the digestive tract - not good news when players' muscles will soon be demanding an increase in blood flow too. The result of performing with a full stomach is nausea - the body's attempt to cease exercise so that it can redirect blood flow back to the stomach.

There is one exception to consuming carbohydrate immediately prior to the start of a game and it's in the form of a sports drink 5 or 10 minutes before kick off. This is discussed in more detail in part 6 tomorrow.

Post Match Eating

As an example, soccer players can use up 200 to 250 grams of carbohydrates during a game. It's important that they (and other athletes that perform for a similar duration) replenish those stores as quickly as possible. It becomes even more important if the athlete has more than one competition in the week or are involved in heavy training.

Ideally, a large, high-carbohydrate meal should be eaten within two hours of the finish and it can and should consist of high GI foods. Bananas and dried fruits are good immediately following a match, as are sandwiches and high-carbohydrate drinks like Gatorade Exceed and Lucozade. A main meal several hours later might consist of bread, pasta, potatoes and rice as well as other simple sugars like cakes and sweets.

Even under the best circumstances it can take over twenty hours to fully restore carbohydrate stores. This has implications for athletes who are competing five or six days a week (perhaps during a tournament). In this case carbohydrate replenishment at regular intervals during training sessions becomes very important. This is where high-carbohydrate drinks can offer a real advantage.

Carbohydrate Loading

Carbohydrate loading is often used by long distance athletes to "pack" their muscles with energy. The actual process involves depleting the muscles of carbohydrate a week or so before the event with exhaustive exercise and a low-carbohydrate diet.

Two to three days before the event the athlete switches to a very high-carbohydrate diet. In their depleted state, muscles take up more carbohydrate than they normally would giving the athlete a large store of energy.
For most sports and events, carbohydrate loading is unnecessary. In fact a disruption in an athlete's normal eating pattern can actually cause stomach upset and lead to impaired performance. A more sensible approach is to increase carbohydrate intake in the days leading up to a game or event.
Athletes can lose between 2-3 litres of sweat during 90 minutes of intense exercise, particularly in hot and humid conditions. They can also lose as much as 2-3 kg (4½-6½ lbs) in bodyweight during the same period. This amount of fluid loss will certainly have a negative affect on performance.

Ideally to counteract dehydration, athletes should consume 200-400 ml (7-14 oz) of cold water or a suitable carbohydrate solution 5 to 10 minutes prior to the start of their event. During any intervals, they should try to drink another 300-500 ml (10-17oz) of a sports drink. During hot weather or strenuous training sessions, coaches should try to provide their athletes with 150-250 ml (5-8oz) of drink about every 20 minutes.

Following a match or hard training session, it's essential that lost fluids be replaced. Water on its own is fine, but to replace fluid AND replenish energy stores, a high carbohydrate drink may be more suitable.

**Drinking Before & During Competition**

The right carbohydrate drink taken before and during competition can postpone fatigue and stabilize blood sugar preventing light-headedness, headaches, nausea and "jelly-like" muscles. However, not all carbohydrate drinks are created equal. Too much carbohydrate or sugar can actually hinder performance.

A solution that contains 40% carbohydrate empties the stomach much slower than plain water (which is 0% carbohydrate). This means that high sugar drinks such as Coca Cola, regular Lucozade, Exceed High Carbohydrate Source and Gator Lode (up to 40% carbohydrate) are NOT the best fluids to consume before or during exercise.

The ideal sports drink should contain 6-8% carbohydrate. It should also contain a small amount of salt. Sodium concentration in the blood can reduce due to sweating and drinking lots of diluted fluids. If it gets too low it can lead to nausea, headaches and blurred vision. Adding just a pinch of salt can offset this potential danger.

Sodium is also an electrolyte. Electrolytes help control the passage of water between body compartments and they also help to maintain the acid-base balance of the body. Electrolytes (or lack of them) have been associated with muscle cramps in the latter stages of sport games.

Here are some effective sports drinks currently on the market suitable before and during a match or training session:
Drink 200-400 ml (7-14oz) of a suitable sports drink 5 to 10 minutes before the start but no earlier unless it’s several hours before the start. During any intervals drink up to 300-500 ml (10-17oz). In hot climates try to drink 150-250 ml (5-8oz) every 20 minutes or so.

### Drinking After Competition

Within **two** hours after the event you should aim to consume **100-200 grams of carbohydrate**. Muscles are depleted of carbohydrate stores, which need to be replenished as quickly as possible. Sometimes it can be impractical or unpalatable to eat a large meal immediately afterwards. High carbohydrate drinks offer a convenient alternative.

The sports drinks mentioned in the table above are good but this is one of the few occasions when taking a **high carbohydrate drink** is preferable.

### How to Make Your Own Sports Drinks

You may have heard of "isotonic" sports drinks that have been "scientifically developed in conjunction with top athletes". But it's very easy to make your own, low-cost carbohydrate drink that is just as effective!

**Isotonic** means a fluid containing **electrolytes** and **6-8% carbohydrate** (such as the sports drinks in the table above). To make your own add 200 ml (7oz) of concentrated orange juice (orange squash) to 1 litre (34oz) of water and add a pinch (¼-½ teaspoon) of table salt.

**Hypotonic** is a fluid that contains electrolytes and a **very small** amount of carbohydrate. This is used in very **hot** conditions where fluid replacement is the most important factor. To make your own add 100 ml (3.5oz) of concentrated orange juice to 1 litre (34oz) of water and add a pinch (¼-½ teaspoon) of table salt.

<table>
<thead>
<tr>
<th>Suitable Sports Drinks for Sport</th>
<th>Amount of Carbohydrate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gatorade</td>
<td>6%</td>
</tr>
<tr>
<td>Lucozade Sport</td>
<td>6.4%</td>
</tr>
<tr>
<td>Exceed</td>
<td>7.2%</td>
</tr>
<tr>
<td>Quick Kick</td>
<td>4.7%</td>
</tr>
<tr>
<td>Isotar</td>
<td>NA</td>
</tr>
<tr>
<td>High Five</td>
<td>6%</td>
</tr>
<tr>
<td>Powerade</td>
<td>6%</td>
</tr>
</tbody>
</table>
Hypertonic refers to a fluid that contains a large amount of carbohydrate and is ideal for refuelling after a game. To make your own add 400 ml (13.5oz) of concentrated orange juice to 1 litre (34oz) of water and add a pinch (¼-½ teaspoon) of table salt.
Ergogenic aids consist of supplements, drugs or procedures believed to improve athletic performance. Some of these substances are completely legal while others remain banned and unethical. Many are completely untested yet still receive endorsements from professional sports stars.

Those supplements that do have some limited research to back up the claims seem to receive even greater media hype. This section examines some of the more popular substances that many enthusiastic athletes consider a necessary training and performance aid.

**Amphetamines**

Often referred to as "pep pills", amphetamines exert a powerful stimulating effect on the central nervous system. Two of the most commonly used substances at the time of writing are Benzedrine and Dexedrine. They increase blood pressure, heart rate, breathing rate, cardiac output and blood glucose. They are said to increase alertness and a feeling of energy, decrease the sensation of fatigue and enhance self-confidence. Amphetamines create similar stimulatory sensations to that of cocaine but the effects last considerably longer. Some of the short-term side effects include headaches, insomnia, hallucinations, convulsions and even heart attack. Longer-term use can lead to uncontrollable movements of the face, paranoid delusions and nerve damage.

Amphetamines are a banned substance and if athletes are made aware of the well-documented side effects it's unlikely they would consider using them. However, sport is not immune to amphetamine abuse. The National Center For Drug Free Sport (NCDFS) completed a survey in 2001 amongst college soccer players in the USA. Approximately 2.9% of those surveyed admitted taking amphetamines on a regular basis. The percentage of women's soccer players admitting to amphetamine use in 2001 was higher than in any other sport at 4.6%.

Ironically, the majority of the research shows that taking amphetamines prior to an event has no advantage. While it may "psyche up" athletes, excessive stimulation and palpitations can severely hinder performance.

Another banned stimulant commonly used by athletes in many sports is ephedrine. Ephedrine is found in many cold remedies and can be bought as a weight loss supplement in the UK (although it is now banned for this use in many countries including the USA). Although there are a few studies that show limited beneficial effects to athletic performance thought to be due a reduced perception of exertion, the overall evidence is by no means convincing. Ephedrine use has also been linked with serious health concerns such as heart attack and stroke.
Anabolic Steroids

An estimated one to three million athletes (90% of male and 80% of female bodybuilders) in the USA use steroids or androgenic substitutes. Statistics for the UK are unknown but many believe it to be proportionally similar to the US. The drug is not just reserved for bodybuilders and power athletes either. As team sports becomes faster and athletes become stronger and more powerful, more and more players are inclined to experiment with steroids.

Anabolic steroids function in a similar manner to the male sex hormone testosterone. Testosterone contributes to gender differences such as greater muscle mass and strength. The hormone's effects are lessened when synthetically prepared in the form of anabolic steroids but they still augment an increase in lean muscle mass and strength gain when combined with resistance training. Athletes often take a combination of steroids (called "stacking") in an increasing dose (called "pyramiding"). Dosages for medical uses are usually in the 5-20mg range, however, athletes take between 50-200mg to achieve an ergogenic effect.

Despite the positive gains in strength and power, there are many, well documented negative side effects to taking steroids (which is banned by all sporting governing bodies). They include: damage to the cardiovascular system, increased risk of coronary heart disease, alterations to normal hormonal balance, infertility, abnormal liver function and interference with the immune system.

A substance called Androstenedione (known as "Andro") claims to offer similar androgenic effects to anabolic steroids and can still be bought over-the-counter without prescription in some countries at the time of writing. It's often marketed as "one step away" from testosterone without the negative side effects of steroids. Some sporting governing bodies such as the IOC and the Men's Tennis Association ban its use because it may endanger health. Andro is classed as a food and so bypasses the Food & Drug Administrations rules. It can even be bought in the form of chewing gum.

There is little scientific evidence to support the use of Andro in sport. Studies comparing a supplemented group who undergo a weight training program versus a placebo group show that gains in strength and lean mass are the same. Unfortunately, HDL (good cholesterol) is often reduced in those taking Andro potentially increasing their risk of coronary heart disease. Serum estrogen (female sex hormone) has also shown to increase with Andro supplementation, which can lead to gynecomastia (breast development). One of the appeals to athletes is that there is no specific test for Andro. However, because commercially produced Andro is not always pure and may contain testosterone, there is a real risk athletes may test positive for steroid use anyway.

Other common substances often used by athletes, known as prohormones, include Clenbuterol and DHEA. Clenbuterol, a drug often prescribed in Europe for obstructive pulmonary disease, is banned for sporting use in the UK. Studies show that, like anabolic steroids, it can increase lean muscle mass but also has potentially serious side effects. DHEA has been labelled in the media as "the mother of all hormones" and receives much hype in the anti-aging community. Athletes believe that it can also provide androgenic effects similar to testosterone but there is little research to back up this theory. Although DHEA is available without prescription at this time, it is banned by many Sporting Committees because of the long term health concerns that have yet to be researched.
Caffeine

In athletes, caffeine is a controlled / restricted drug. Found naturally in coffee beans, tea leaves, cocoa beans and carbonated drinks it stimulates the central nervous system within 30 to 120 minutes of consumption. While not all studies support the beneficial affects of caffeine, ingesting an amount of caffeine equivalent to 2.5 cups of regular, percolated coffee (330 mg) an hour before exercising has been shown to increase endurance performance on a number of occasions.

As with other stimulants (such as amphetamines) the effect is thought to come from a greater tolerance to fatigue rather than an increase in cardiopulmonary variables. It may also help the body to use fat as a source of fuel thus sparing carbohydrate reserves.

Individuals who do not normally drink coffee or try to avoid dietary intake of caffeine may experience undesirable side effects if they take it in supplemental form. It can produce restlessness, headaches, insomnia, irritability and muscle twitching. Caffeine also acts as a potent diuretic, which may cause pre-exercise fluid loss, negatively affecting performance in a hot climate.

Supplemental caffeine is taken in tablet form rather than drinking coffee. Lower doses (3-6mg per kg body mass) have shown the same beneficial effects as higher doses with a decreased risk of dehydration. Although caffeine is one of the few legal substances with scientific evidence to back it up, there is no reason for athletes to feel they should take it prior to a game or event and should be extra cautious if they maintain a low-caffeine diet.

Creatine

Creatine is an organic compound found in foods such as meat, poultry and fish. The body can only create a limited amount of creatine on its own so dietary intake becomes important. Nearly all creatine taken in from food becomes incorporated into the body's muscles. A large amount combines with phosphate to form a substance called phosphocreatine and it's this substance that powers muscles during very intense, short-term activity - such as sprints in sport.

The body has only a limited store of phosphocreatine, enough to power just 5 to 8 seconds of all-out sprinting. Once this has been used, the body must rely on other metabolic systems to produce energy and during intense activity this quickly leads to a build up of blood lactate and subsequent fatigue.

Taking creatine in supplemental form significantly increases intramuscular stores of creatine. The rationale behind taking it as a performance aid is that it will allow athletes to perform a higher level of explosive activity for longer. It should also delay the onset of blood lactate accumulation.

Creatine is probably the most well-researched supplement on the market. Numerous studies do confirm that it improves performance in high intensity exercise, particularly in repeated bouts of effort. It has been used successfully by sprinters, football players, weight lifters and is now becoming more commonplace in other sports. Creatine is most often taken in a loading format. Athletes take 20 to 30 grams of creatine a day (usually in the form of powder added to liquid) for 5 to 7 days. A maintenance phase then follows during which athletes take as little as 2 to 5 grams daily.
Maintaining high levels of creatine through supplementation has lead to reports of some minor negative side effects including abdominal cramping, muscle cramping and diarrhoea. The main concern regards the long-term effect that regular creatine consumption may have on the liver and kidneys. At this time it is still too early to say.

Glutamine

Glutamine is a non-essential amino acid that serves many regulatory functions in the body. Its use by athletes falls under two categories - to prevent muscle breakdown and to protect the immune system. Some studies have shown that supplemental glutamine can help to prevent protein breakdown (beneficial for anyone following a strength training program) but the research is by no means conclusive.

In the body, glutamine is an important fuel for some cells of the immune system. In situations of stress, such as clinical trauma, starvation, or prolonged, strenuous exercise, the concentration of glutamine in blood is decreased, often substantially. In endurance athletes (such as marathon runners) this decrease occurs alongside temporary immunodepression. Heavy training schedules have also been linked to increase the occurrence of minor infections, particularly in the upper respiratory tract. Several clinical studies have found that oral glutamine can decrease the incidence of illness and infection in endurance athletes or athletes undergoing heavy training.

Glutamine is classed as a nutritional supplement and is considered completely legal and ethical by all sporting bodies (as are all amino acid supplements). It can be found in most health food stores in the form of gels or tablets and is often an ingredient in many commercial protein powders. Due to the lack of research there are no guidelines for doses. Bodybuilders take up to 15mg per day but a more sensible recommendation for athletes trying glutamine is to start at 2-6mg per day and gauge reaction.

While some early research appears promising (particularly in relation to immune function) there is not enough evidence to suggest healthy individuals, even those involved in intense training, should take glutamine as a matter of course.

Growth Hormones

Doctors and pharmacologists are predicting that human growth hormone will overtake anabolic steroids as the most widely used training and performance aid. Human growth hormone (HGH) stimulates bone and cartilage growth, enhances fat metabolism and inhibits amino acid (and therefore muscle) breakdown. With age, there is a natural reduction in lean muscle mass and an increase in fat mass. Genetically engineered HGH can reverse these negative effects and is often used to treat children who suffer from kidney failure and the inability to thrive.

The innumerable advertisements off and online are for a supplemental form of HGH (as opposed to the injected, genetically engineered form). To date there is no proven replacement for injectable HGH and very few well-controlled studies have examined how HGH supplements (such as an oral spray) affect exercise performance. Genetically engineered HGH is only available to healthy individuals on the black market and is often in an adulterated form. Child athletes who take HGH in the belief it will give them a
competitive edge have an increased risk of gigantism, while adults can develop acromegalic syndrome and insulin resistance leading to type II diabetes. For obvious reason, genetically engineered HGH is banned in sport and as yet there is no evidence to suggest supplemental HGH is effective and safe long term.

**Sodium Bicarbonate**

During all-out exercise lasting between 30 and 60 seconds (such as several sprints up and down a soccer / rugby field), dramatic alterations take place in the chemical balance of the body's fluids. This occurs because the body must use anaerobic energy pathways to supply muscles with energy - and a by-product of this process is a sharp increase in blood lactate. To defend against an increase in acidity, the body has a buffering system, part of which is bicarbonate (which is highly alkaline). In theory, if high levels of bicarbonate can be maintained during exercise it will help to offset the increase in acidity and reduce the limiting affects of blood lactate accumulation.

Compared to many popular, commercial supplements, sodium bicarbonate is fairly well researched. While studies have produced conflicting results, many trials have found that taking a bicarbonate solution prior to exercise can indeed increase anaerobic exercise performance. One study into 800-m race performance showed that taking a sodium bicarbonate solution prior to the start decreased race time by a significant 2.9 seconds compared to a placebo. Other studies, while less dramatic, support the benefits of sodium bicarbonate and many studies show no effects at all. There seems to be a wide variation between individuals, which may be related to their level of fitness.

The type of exercise also seems to play a major role. Continuous, all-out activities like sprint swimming or cycling are easier to measure than intermittent sports such as soccer or rugby. However, recent studies have shown that sodium bicarbonate can improve the performance in a multi-sprint test and intermittent sports.

Currently, taking sodium bicarbonate (considered a food not a drug) is not banned by any sporting governing bodies. A typical dose, 1 to 2 hours prior to exercise is 300 mg per kg of bodyweight. There are some reported side effects, which include stomach cramps, nausea and diarrhea. These negative effects would minimize and positive benefits gained from taking sodium bicarbonate so it's important athletes do not try the supplement for the first time on the day of an important competitive event.

There are many more supplements and performance enhancing aids on the market and this list is by no means exhaustive. Before you add to the industry's multi million pound turnover, and before you potentially put your health at risk, be sure to spend time researching any supplement you are unfamiliar with.
There's nothing like the subject of ________ to stir debate. It seems like the experts change their minds almost daily about what we should and shouldn't eat. In truth, scientific ________ hasn't changed much at all in the last fifteen years.

It's the constant and never-ending emergence of ______ diets and ______ loss programs that adds to the confusion. It appears everyone has differing opinions...

Fortunately, scientific sports nutrition is a little less contested. There are some very well-researched, well-practiced dietary ________ that have been used by ________ for many years. They are ________ to most sports. In fact, they are more than applicable - they are a pre-requisite to peak ________.

The aim of this health unit is to outline the basics of sports nutrition with an emphasis on practical application. Split into 7 separate lessons, it covers macronutrients (______, __________ and ____________), __________ and ____________, pre and post __________ eating and ________ replacement. There is also a lesson reviewing some of the most popular sports ____________ available to today's athletes. In an industry that boasts some of the best marketing strategies around, the claims often fall short of the facts.

The final lesson provides a summary of ____________ that athletes can begin to use immediately.

Carbohydrates

All ________, whether it's to play sport or carry out any other activity, comes from three classes of food called _____________. These nutrients are better known as ____________, _______ and ___________. Each is important - not only
to fuel athletic ____________ but also for overall ____________ and ____________.

Weight for weight ____________ contain the ____________ amount of energy out of the three ____________ - ____ calories/gram. Yet they are the most ____________ type of fuel to an athlete.

During ____________, ____________ bouts of exercise (like sprinting), ____________ is the only fuel capable of supplying the body with ____________ quickly enough. In the first few minutes of any activity, it is ____________ that almost exclusively meets ____________ demands. In addition, the ability to repeat a sprint at the end of a game or race, to the same high level as at the start of the game relies, in part, on the body's carbohydrate ________.

Although the body does use ______ for lower intensity activity, ____________ acts as a "primer" or catalyst for ______ to be broken down. Finally, carbohydrates play a key role in central nervous system function. The ____________ for example, uses ____________ almost exclusively as its fuel.

**Can diet significantly affect the body's carbohydrate stores?**

The average person has about ____________ calories of stored _________________. An overnight fast (8 to 12hrs) and a low-carbohydrate diet can dramatically ____________ these stores. More importantly, a carbohydrate-rich diet can more than ____________ them. The body's upper limit for ____________ storage equates to about ____ grams per kilogram (2.2lbs) of bodyweight. So an 80kg (175lb) person can potentially store up to 1200 grams of carbohydrate or 4800 calories worth of energy - all with just a few dietary modifications.

There are different types of _________________. Understanding ______ they are and _____ they affect the body differently, is important to ________________ and what they eat ________________ and ________________ a game.

**Monosaccharides**
This is the most basic unit of _______________. Examples of monosaccharides include _____________ (sugar found in fruit) and _______________ (also called blood sugar). Cells can use the _______________ found in food directly for _______________, while fructose is converted to glucose in the _______________.

**Disaccharides**

Combine two _______________ and the result is a _______________. _______________ or table sugar is a disaccharide and it's the result of combining _______________ and _______________. The sugar in milk, _______________, is another disaccharide. The collective name for both _______________ and _______________ is _______________ _______________. Simple sugars are quickly _______________ by the body and provide a rapid source of _______________. Simple sugars such as _______________ and energy drinks are a good food choice to refuel _______________ a game when the body's energy stores are low.

**Polysaccharides**

_______________ and _______________ are both _________________. Starch is the combination of hundreds of _________________ joining together. Nutritionists often refer to polysaccharides as _______________ carbohydrates. Examples include bread, potatoes, rice and pasta. It takes longer for the body to break these complex structures down so they release their _______________ over a _______________ period than simple sugars.

Fibre differs from starch in that it _______________ be digested and used for energy. It's still an important dietary component though and there is a growing link between lack of fibre and certain _______________ illnesses. **Starchy complex carbohydrates are the best choice _______________ a game as a pre-match meal.**
Sports Nutrition

Lesson 2

Fat

_____ contains more than twice the amount of ________________ as _________________. A single gram contains ______ calories making it a valuable source of fuel for ________________ duration activities. While fat cannot supply energy __________ enough for very ___________ activity, it can be used by the body to power __________ intensity exercise such as jogging and walking.

Fat also provides ___________ and ___________ to vital organs such as the heart, lungs and liver and transports ___________ throughout the body.

Not all dietary fat is the same. Like carbohydrate, fat can be broken down into several different groups:

**Saturated Fats**

_____________ fats are found in foods such as red meat, egg yolks, cheese, butter, milk and commercially prepared cakes, pies and cookies. The typical western diet consists of almost _____ total fat. Of this, _____ is made up of ___________ fats, which is considered a major cause of coronary __________ disease, ___________ and other degenerative ___________. No more than _____ of the diet should come from ___________ fats.

**Unsaturated Fats**

_____________ fats come in the form of _________________ fats and _________________ fats. Monounsaturated fats can actually __________ the risk of coronary heart disease and are found in foods like olive oil, canola oil, avocados, almonds and pecans. Polyunsaturated fats, found in sunflower oil, safflower oil and corn oil are not
thought to contribute to heart disease but don't offer the same __________ as monounsaturated fats.

**Essential Fatty Acids**

__________ fatty acids are a class of __________________ fats that have received a lot of attention in the media recently. They are thought to be __________-protective and may help prevent a range of other __________. There are __________ types of __________ fatty acids - __________, __________ and __________. Omega 3 and Omega 6 must be __________ while the body can produce some Omega 9 on its own. __________ fatty acids are required for healthy __________, __________, __________, and __________ systems. Found in foods like walnuts, pumpkin seeds, Brazil nuts, sesame seeds, avocados, some dark leafy green vegetables and oily fish, the typical Western diet is often __________ of __________ fatty acids.

**Cholesterol**

Despite its bad press, __________ is actually __________ for many important bodily functions. There are essentially ______ types of __________ - low-density lipoprotein (______) and high-density lipoprotein (______). ______ is known as the "______" cholesterol because it __________ and then __________ cholesterol at the __________ walls. ______ on the other hand, is known as "______" cholesterol because it acts as a __________ removing __________ from __________ walls and __________ it to the __________ to be __________.

Although some foods like cream, butter, ice cream, egg yolks, shellfish and red meats contain __________, it's a high intake of __________ fat that causes the body to __________ too much __________. The __________ amount of dietary __________ recommended each day is __________.
Correct and adequate protein intake is crucial for anyone involved in vigorous training. Protein is essential for the growth and repair of skin, hair, nails, bones, tendons, ligaments and muscles. It also serves a crucial role in enzyme production and maintaining a strict acid-base balance.

The Recommended Dietary Allowance (RDA) for the average male and female adult is just 0.83 grams of protein per kilogram (2.2lbs) of bodyweight. In a 70kg (154lb) individual this equates to just 58 grams of protein per day or about two chicken breasts worth.

Some research shows that competitive athletes, particularly those involved in heavy weight training, may require more protein. The recommendation for strength and endurance athletes ranges from 1.2 to a maximum of 2.0 grams per kilogram (1kg = 2.2lbs). Research has shown that consuming more protein than this serves no benefit and may be harmful in the long term.

Good sources of protein include low fat milk, poultry, fish, lean red meat, eggs, nuts, beans and lentils and soy products. Fatty meats like pork and fast food hamburgers as well as most cheeses contain a lot of saturated fats so are not as suitable sources of protein.

Recently, the emergence of high protein, low carbohydrate diets have become popular in the weight loss industry. While they may or may not help to shed the pounds, high protein, low carbohydrate diets are unsuitable for athletes.

Many athletes are afraid that their heavy training schedule will force their bodies to breakdown lean muscle mass and then use it as energy. The body does use protein sparingly as a source of fuel after 45 minutes of exercise, however consuming more protein is not a good strategy.

By consuming plenty of carbohydrates before, during and after exercise it acts as a protein "sparer". Only in the absence of adequate carbohydrate stores will the body begin to metabolize significant amounts of protein for use as energy.

The Athlete's Diet

A typical western diet contains too much fat and not enough healthy, whole grain carbohydrates.

Athletes should aim to make 60-65% of their diet carbohydrate, with an emphasis on fresh fruit and whole grains such as brown rice and pasta, whole wheat bread, potatoes and high fibre cereals. About 20-25% of total calories should be in the form of fat.
The majority of this should be in the form of good fats (monounsaturated, polyunsaturated, omega fatty acids) found in oily fish like mackerel and salmon, olive oil, avocado and raw nuts (not roasted or salted). Protein should make up the remaining **10-15%** of an athlete's diet derived from fish, poultry, low fat milk and lean red meat for example.

![Ideal Diet Composition for a Sport Player](image)

<table>
<thead>
<tr>
<th></th>
<th>Carbohydrate</th>
<th>Fat</th>
<th>Protein</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Western Diet</td>
<td>46%</td>
<td>38%</td>
<td>16%</td>
</tr>
<tr>
<td>Ideal Sport Player’s Diet</td>
<td>60%</td>
<td>25%</td>
<td>15%</td>
</tr>
</tbody>
</table>

Take a look at the table below for a sample day’s eating plan:
Thirteen different vitamins have been identified and studied to date. They are classed as either **fat-soluble** (vitamins A, D, E, K) or **water-soluble** (vitamin B complex, vitamin C). Together they are responsible for blood clotting, neuromuscular function, healthy skin, teeth and bones and numerous other bodily functions.

A well-balanced diet should provide an adequate supply of all the vitamins regardless of age and level of physical activity. During periods of intense training, a natural increase in food intake supplies any extra vitamin demand the body may have.

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### Sample Day’s Diet for a Sport Player in Training

<table>
<thead>
<tr>
<th>Time</th>
<th>Meal</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breakfast</td>
<td>Piece of fruit</td>
<td>Bowl of oatmeal or porridge (sweetened with dried fruit or honey)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3-4 slices wholemeal bread toasted with small amount of butter/olive oil spread, jelly/jam</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Glass of fresh fruit juice (not concentrated)</td>
</tr>
<tr>
<td>Snack</td>
<td>Piece of fresh fruit</td>
<td>Plain yoghurt</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2-3 fig biscuits/cookies</td>
</tr>
<tr>
<td>Lunch</td>
<td>Tuna or grilled chicken</td>
<td>Bagel, baguette etc. (preferably wholemeal)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mixed salad with olive oil and lemon juice dressing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Glass fresh fruit juice or low fat milk</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Low fat or bran muffin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1-2 bananas</td>
</tr>
<tr>
<td>Snack</td>
<td>Bag of nuts and raisins (such as almonds, pecans, Hazelnuts etc)</td>
<td></td>
</tr>
<tr>
<td>Dinner</td>
<td>Large serving rice or pasta</td>
<td>Tomato sauce</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Grilled fish, chicken or lean beef mince</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Large mixed vegetable salad with dressing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Small serving of ice cream and strawberries</td>
</tr>
</tbody>
</table>

This is one sample day only and a wide range of foods should be eaten. Try also to drink 2 litres (68 oz) water each day (fluids as part of a sports drink count).
Free Radicals, Antioxidants & Exercise

Free radicals are highly reactive molecules that can cause damage to the cells and are thought to accelerate the aging process and contribute to cancer, heart disease and diabetes. They are found in cigarette smoke, environmental pollution and some medications. Exercise may also increase the production of free radicals.

The body has an elaborate defence system against free radicals in the form of antioxidant enzymes. Vitamins A, C and E are known as antioxidant vitamins and can protect the cells against free radical damage. Although foods like citrus fruits, green vegetables and nuts contain antioxidant vitamins, some athletes feel the need to take a supplement due to the high level of training they undergo.

Although exercise is thought to increase free radical production, it also appears to increase the body's antioxidant defence system at the same time. However, there is some research to suggest that a vitamin E supplement can reduce harmful free radical production associated with exercise. Whether this offers any overall health benefits is still unclear.

Over 40 years of research has failed to show that vitamin supplementation can offer any sort of performance enhancement when a nutritionally balanced diet is present. Some vitamins (such as vitamin C) taken in excess can actually be harmful. The recommendation is to eat a well balanced diet rich in fresh fruit and vegetables.

Minerals

Minerals account for roughly 4% of a person's body mass. They provide the structure for forming bone and teeth. They also help muscles to contract, maintain normal heart rhythm and control the acid-base balance as well as other important bodily functions.

Minerals are classed as either major or trace depending on how much is required per day. Major minerals include calcium, phosphorus, sodium, potassium and magnesium. Trace minerals include iron, zinc, copper, selenium and chromium.

Calcium

The typical Western diet contains too little calcium. The RDA for calcium is 800-1000 mg for adults and 1200 mg for adolescents. The average adult consumes just 500-700 mg per day and for many it's as little as 300 mg per day. Calcium deficiency can lead to a condition called osteoporosis - a weakening of the bones. Exercise actually helps to maintain healthy bone density.

Sodium

Most adults consume too much sodium (found in abundance in processed foods), which can lead to high blood pressure. The RDA of 1100-3300 mg is equivalent to 0.5-1.5 teaspoons of table salt. Most people consume more than 2 teaspoons from processed foods even when table salt isn't used as seasoning.

Iron

Iron is helps the blood to carry oxygen so an iron deficiency (called anaemia) can lead to fatigue even with mild exercise. Some research has suggested that heavy exercise
Training creates an increased demand for iron. However, even in elite athletes, supplements are unnecessary if the diet contains iron-rich foods.

As with vitamins there is no convincing research to suggest taking mineral supplements can improve sporting performance. Exceeding the recommended daily allowance can also be potentially harmful. The only exception is adding a small amount of sodium to sports drinks during hot weather (¼ -½ teaspoon per litre of water).
Sports Nutrition
Lesson 5
Pre & Post Competition Eating

Long gone are the days when thought that eating a big before a game would give them lots of . Today's elite sports men and women follow a strict diet, particularly on the day of a match or event. While diet won't turn poor athletes into great ones, it can make the difference between performing poorly and tapping your full potential.

**The Glycemic Index**

Not all is and at the same rate. The (GI) is a scale of how much a particular type of food raises over a two-hour period compared to pure .

For example, a piece of food with a GI score of 45 means that it raises blood sugar 45% as much as pure glucose in that two-hour period.

Common sense says that which are broken down quickly, like in fruit, should have a higher GI than carbohydrates, but that's not always the case. White , white and (all classed as carbohydrates) have a very GI. That means they raise blood sugar almost as much or even more than pure glucose. has GI because the fibre found in fruit slows and .

Choosing foods with a GI will help to quickly replenish stores a game or event. a game or event, GI foods are more appropriate as they release more and for a period.

**Pre Match Eating**

The goal prior to a game or event (and even a training session) is to maximize stores in the and and to top up blood stores. Studies have shown that consuming foods with a high GI within an hour of exercise can actually blood glucose, which is not what an athlete wants! The reason is because the body produces an "overshoot" of , which helps to take up sugar in the blood. This in turn causes low blood sugar levels.
Athletes should eat foods with a _______ to ___________ GI ___________ a match. This allows for a relatively slow release of glucose into the blood and avoids the unwanted insulin surge.

Consuming carbohydrate at least an hour before the start allows any hormonal imbalance to return to normal.

Example low GI foods include pasta, whole grain breads and rice, oatmeal, milk and milk products and fruit (except bananas and dried fruit).

The pre-match meal might consist of pasta in a low-fat tomato sauce, baked beans or scrambled eggs on toast and fresh fruit such as apples, pears or orange juice. Some grilled fish or chicken and vegetables could accompany the carbohydrates. Ideally this meal should be eaten at least three hours prior to the start - especially if nerves are a factor, which can impair digestion.

Food in the stomach is given a high priority to be digested before it has chance to spoil. As a result greater blood flow is directed to the digestive tract - not good news when players' muscles will soon be demanding an increase in blood flow too. The result of performing with a full stomach is nausea - the body’s attempt to cease exercise so that it can redirect blood flow back to the stomach.

There is one exception to consuming carbohydrate immediately prior to the start of a game and it's in the form of a sports drink 5 or 10 minutes before kick off. This is discussed in more detail in part 6 tomorrow.

**Post Match Eating**

As an example, soccer players can use up 200 to 250 grams of carbohydrates during a game. It’s important that they (and other athletes that perform for a similar duration) replenish those stores as quickly as possible. It becomes even more important if the athlete has more than one competition in the week or are involved in heavy training.

Ideally, a large, high-carbohydrate meal should be eaten within two hours of the finish and it can and should consist of high GI foods. Bananas and dried fruits are good immediately following a match, as are sandwiches and high-carbohydrate drinks like Gatorade Exceed and Lucozade. A main meal several hours later might consist of bread, pasta, potatoes and rice as well as other simple sugars like cakes and sweets.

Even under the best circumstances it can take over twenty hours to fully restore carbohydrate stores. This has implications for athletes who are competing five or six days a week (perhaps during a tournament). In this case carbohydrate replenishment at regular intervals during training sessions becomes very important. This is where high-carbohydrate drinks can offer a real advantage.

**Carbohydrate Loading**
Carbohydrate loading is often used by long distance athletes to "pack" their muscles with energy. The actual process involves depleting the muscles of carbohydrate a week or so before the event with exhaustive exercise and a low-carbohydrate diet.

Two to three days before the event the athlete switches to a very high-carbohydrate diet. In their depleted state, muscles take up more carbohydrate than they normally would giving the athlete a large store of energy.

For most sports and events, carbohydrate loading is unnecessary. In fact a disruption in an athlete's normal eating pattern can actually cause stomach upset and lead to impaired performance. A more sensible approach is to increase carbohydrate intake in the days leading up to a game or event.
Athletes can lose between 2-3 litres of sweat during 90 minutes of intense exercise, particularly in hot and humid conditions. They can also lose as much as 2-3 kg (4½-6½ lbs) in bodyweight during the same period. This amount of fluid loss will certainly have a negative affect on performance.

Ideally to counteract dehydration, athletes should consume 200-400 ml (7-14 oz) of cold water or a suitable carbohydrate solution 5 to 10 minutes prior to the start of their event. During the any intervals, they should try to drink another 300-500 ml (10-17oz) of a sports drink. During hot weather or strenuous training sessions, coaches should try to provide their athletes with 150-250 ml (5-8oz) of drink about every 20 minutes.

Following a match or hard training session, it's essential that lost fluids be replaced. Water on its own is fine, but to replace fluid AND replenish energy stores, a high carbohydrate drink may be more suitable.

### Drinking Before & During Competition

The right carbohydrate drink taken before and during composition can postpone fatigue and stabilize blood sugar preventing light-headedness, headaches, nausea and "jelly-like" muscles. However, not all carbohydrate drinks are created equal. Too much carbohydrate or sugar can actually hinder performance.

A solution that contains 40% carbohydrate empties the stomach much slower than plain water (which is 0% carbohydrate). This means that high sugar drinks such as Coca Cola, regular Lucozade, Exceed High Carbohydrate Source and Gator Lode (up to 40% carbohydrate) are NOT the best fluids to consume before or during exercise.

The ideal sports drink should contain 6-8% carbohydrate. It should also contain a small amount of salt. Sodium concentration in the blood can reduce due to sweating and drinking lots of diluted fluids. If it gets too low it can lead to nausea, headaches and blurred vision. Adding just a pinch of salt can offset this potential danger.

Sodium is also an electrolyte. Electrolytes help control the passage of water between body compartments and they also help to maintain the acid-base balance of the body.
Electrolytes (or lack of them) have been associated with muscle cramps in the latter stages of sport games.

Here are some effective sports drinks currently on the market suitable **before and during** a match or training session:

<table>
<thead>
<tr>
<th>Suitable Sports Drinks for Sport</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Brand</strong></td>
</tr>
<tr>
<td>Gatorade</td>
</tr>
<tr>
<td>Lucozade Sport</td>
</tr>
<tr>
<td>Exceed</td>
</tr>
<tr>
<td>Quick Kick</td>
</tr>
<tr>
<td>Isotar</td>
</tr>
<tr>
<td>High Five</td>
</tr>
<tr>
<td>Powerade</td>
</tr>
</tbody>
</table>

Drink 200-400 ml (7-14oz) of a suitable sports drink 5 to 10 minutes before the start but no earlier unless it’s several hours before the start. During any intervals drink up to 300-500 ml (10-17oz). In hot climates try to drink 150-250 (5-8oz) ml every 20 minutes or so.

**Drinking After Competition**

Within two hours after the event you should aim to consume **100-200 grams of carbohydrate**. Muscles are depleted of carbohydrate stores, which need to be replenished as quickly as possible. Sometimes it can be impractical or unpalatable to eat a large meal immediately afterwards. High carbohydrate drinks offer a convenient alternative.

The sports drinks mentioned in the table above are good but this is one of the few occasions when taking a **high carbohydrate drink** is preferable.

**How to Make Your Own Sports Drinks**

You may have heard of "isotonic" sports drinks that have been "scientifically developed in conjunction with top athletes". But it's very easy to make your own, low-cost carbohydrate drink that is just as effective!

**Isotonic** means a fluid containing **electrolytes** and **6-8% carbohydrate** (such as the sports drinks in the table above). To make your own add 200 ml (7oz) of concentrated
orange juice (orange squash) to 1 litre (34oz) of water and add a pinch (¼-½ teaspoon) of table salt.

**Hypotonic** is a fluid that contains electrolytes and a **very small** amount of carbohydrate. This is used in very hot conditions where fluid replacement is the most important factor. To make your own add 100 ml (3.5oz) of concentrated orange juice to 1 litre (34oz) of water and add a pinch (¼-½ teaspoon) of table salt.

**Hypertonic** refers to a fluid that contains a **large** amount of carbohydrate and is ideal for refuelling after a game. To make your own add 400 ml (13.5oz) of concentrated orange juice to 1 litre (34oz) of water and add a pinch (¼-½ teaspoon) of table salt.
Sports Nutrition
Lesson 7
Supplements & Ergogenic Aids

______________ consist of ____________, ______ or ____________ believed to
______________ athletic ____________. Some of these substances are completely
__________ while others remain ____________ and ____________. Many are completely
untested yet still receive endorsements from professional sports stars.

Those ____________ that do have some limited research to back up the claims seem to
receive even greater media hype. This section examines some of the more popular
substances that many enthusiastic athletes ____________ a necessary training and
performance aid.

Amphetamines

Often referred to as "________", ____________ exert a powerful ____________
effect on the central nervous system (______). Two of the most commonly used
substances at the time of writing are ____________ and ____________. They
__________ blood pressure, heart rate, breathing rate, cardiac output and blood
glucose. They are said to increase ____________ and a feeling of energy, decrease the
sensation of ____________ and enhance self-confidence. Amphetamines create similar
stimulatory sensations to that of ____________ but the effects last considerably longer.
Some of the short-term side effects include ____________, ____________,
__________, ____________, and even heart attack. Longer-term use can lead to
uncontrollable ____________ of the face, paranoid ____________ and ____________
damage.

______________ are a ____________ substance and if athletes are made aware of the
well-documented side effects it's unlikely they would consider using them. However,
sport is not immune to amphetamine abuse. The National Center for Drug Free Sport
(NCDFS) completed a survey in 2001 amongst college soccer players in the USA.
Approximately _____% of those surveyed admitted taking amphetamines on a
____________ basis. The percentage of women’s soccer players admitting to
amphetamine use in 2001 was higher than in any other sport at 4.6%.

Ironically, the majority of the research shows that taking amphetamines prior to an
event has ____ advantage. While it may "psyche up" athletes, excessive stimulation and
palpitations can severely hinder performance.

Another banned stimulant commonly used by athletes in many sports is ____________.
Ephedrine is found in many ________ remedies and can be bought as a weight loss
supplement in the UK (although it is now banned for this use in many countries including
the USA). Although there are a few studies that show limited beneficial effects to athletic performance thought to be due a ____________ perception of ____________, the overall evidence is by no means convincing. ____________ use has also been linked with serious health concerns such as heart attack and stroke.

Anabolic Steroids

An estimated one to three million athletes (90% of male and 80% of female bodybuilders) in the USA use ____________ or ____________ substitutes. Statistics for the UK are unknown but many believe it to be proportionally similar to the US. The drug is not just reserved for bodybuilders and power athletes either. As team sports become ____________ and athletes become ____________ and more ____________, more and more players are inclined to experiment with ____________.

Anabolic steroids function in a similar manner to the male sex hormone _____________. Testosterone contributes to ____________ differences such as greater muscle mass and strength. The hormone's effects are lessened when synthetically prepared in the form of anabolic steroids but they still augment an ____________ in lean muscle mass and ____________ gain when combined with ____________ training. Athletes often take a combination of steroids (called "__________") in an increasing dose (called "__________"). Dosages for medical uses are usually in the 5-20mg range, however, athletes take between ____________mg to achieve an ____________ effect.

Despite the positive gains in strength and power, there are many, well documented ____________ side effects to taking ____________ (which is banned by all sporting governing bodies). They include: damage to the ____________ system, increased risk of coronary heart ____________, alterations to normal ____________ balance, ____________, abnormal ____________ function and interference with the ____________ system.

A substance called Androstenedione (known as "Andro") claims to offer similar androgenic effects to anabolic steroids and can still be bought over-the-counter without prescription in some countries. It's often marketed as "one step away" from testosterone without the negative side effects of steroids. Some sporting governing bodies such as the IOC and the Men's Tennis Association ban its use because it may endanger health. Andro is classed as a food and so bypasses the Food & Drug Administrations rules. It can even be bought in the form of chewing gum.

There is little scientific evidence to support the use of Andro in sport. Studies comparing a supplemented group who undergo a weight training program versus a placebo group show that gains in strength and lean mass are the same. Unfortunately, _______ (good cholesterol) is often reduced in those taking Andro potentially increasing their risk of coronary heart disease. Serum ____________ (female sex hormone) has also shown to increase with Andro supplementation, which can lead to ____________ (breast development). One of the appeals to athletes is that there is no specific test for Andro. However, because commercially produced Andro is not always pure and may contain ____________, there is a real risk athletes may test positive for ____________ use anyway.

Other common substances often used by athletes, known as ____________, include ____________ and _____________. Clenbuterol, a drug often prescribed in Europe for obstructive pulmonary disease, is banned for sporting use in the UK. Studies show that,
like anabolic steroids, it can increase lean muscle mass but also has potentially serious side effects. DHEA has been labelled in the media as "the mother of all hormones" and receives much hype in the anti-aging community. Athletes believe that it can also provide androgenic effects similar to testosterone but there is little research to back up this theory. Although DHEA is available without prescription at this time, it is banned by many Sporting Committees because of the long term health concerns that have yet to be researched.

Caffeine

In athletes, caffeine is a controlled / restricted drug. Found naturally in coffee beans, tea leaves, cocoa beans and carbonated drinks it stimulates the central nervous system within 30 to 120 minutes of consumption. While not all studies support the beneficial affects of caffeine, ingesting an amount of caffeine equivalent to 2.5 cups of regular, percolated coffee (330 mg) an hour before exercising has been shown to increase endurance performance on a number of occasions.

As with other stimulants (such as amphetamines) the effect is thought to come from a greater tolerance to fatigue rather than an increase in cardiopulmonary variables. It may also help the body to use fat as a source of fuel thus sparing carbohydrate reserves.

Individuals who do not normally drink coffee or try to avoid dietary intake of caffeine may experience undesirable side effects if they take it in supplemental form. It can produce restlessness, headaches, insomnia, irritability and muscle twitching. Caffeine also acts as a potent diuretic, which may cause pre-exercise fluid loss, negatively affecting performance in a hot climate.

Supplemental caffeine is taken in tablet form rather than drinking coffee. Lower doses (3-6mg per kg body mass) have shown the same beneficial effects as higher doses with a decreased risk of dehydration. Although caffeine is one of the few legal substances with scientific evidence to back it up, there is no reason for athletes to feel they should take it prior to a game or event and should be extra cautious if they maintain a low-caffeine diet.

Creatine

Creatine is an organic compound found in foods such as meat, poultry and fish. The body can only create a limited amount of creatine on its own so dietary intake becomes important. Nearly all creatine taken in from food becomes incorporated into the body’s muscles. A large amount combines with phosphate to form a substance called phosphocreatine and it’s this substance that powers muscles during very intense, short-term activity - such as sprints in sport.

The body has only a limited store of phosphocreatine, enough to power just 5 to 8 seconds of all-out sprinting. Once this has been used, the body must rely on other metabolic systems to produce energy and during intense activity this quickly leads to a build up of blood lactate and subsequent fatigue.

Taking creatine in supplemental form significantly increases intramuscular stores of creatine. The rationale behind taking it as a performance aid is that it will allow athletes
to perform a higher level of explosive activity for longer. It should also delay the onset of blood lactate accumulation.

Creatine is probably the most well-researched supplement on the market. Numerous studies do confirm that it improves performance in high intensity exercise, particularly in repeated bouts of effort. It has been used successfully by sprinters, football players, weight lifters and is now becoming more commonplace in other sports. Creatine is most often taken in a loading format. Athletes take 20 to 30 grams of creatine a day (usually in the form of powder added to liquid) for 5 to 7 days. A maintenance phase then follows during which athletes take as little as 2 to 5 grams daily.

Maintaining high levels of creatine through supplementation has lead to reports of some minor negative side effects including abdominal cramping, muscle cramping and diarrhoea. The main concern regards the long-term effect that regular creatine consumption may have on the liver and kidneys. As this time it is still too early to say.

Glutamine

Glutamine is a non-essential amino acid that serves many regulatory functions in the body. It’s use by athletes falls under two categories - to prevent muscle breakdown and to protect the immune system. Some studies have shown that supplemental glutamine can help to prevent protein breakdown (beneficial for anyone following a strength training program) but the research is by no means conclusive.

In the body, glutamine is an important fuel for some cells of the immune system. In situations of stress, such as clinical trauma, starvation, or prolonged, strenuous exercise, the concentration of glutamine in blood is decreased, often substantially. In endurance athletes (such as marathon runners) this decrease occurs alongside temporary immunodepression. Heavy training schedules have also been linked to increase the occurrence of minor infections, particularly in the upper respiratory tract. Several clinical studies have found that oral glutamine can decrease the incidence of illness and infection in endurance athletes or athletes undergoing heavy training.

Glutamine is a classed as a nutritional supplement and is considered completely legal and ethical by all sporting bodies (as are all amino acid supplements). It can be found in most health food stores in the form of gels or tablets and is often an ingredient in many commercial protein powders. Due to the lack of research there are no guidelines for doses. Bodybuilders take up to 15mg per day but a more sensible recommendation for athletes trying glutamine is to start at 2-6mg per day and gauge reaction.

While some early research appears promising (particularly in relation to immune function) there is not enough evidence to suggest healthy individuals, even those involved in intense training, should take glutamine as a matter of course.

Growth Hormones

Doctors and pharmacologists are predicting that human growth hormone will overtake anabolic steroids as the most widely used training and performance aid. Human growth hormone (HGH) stimulates bone and cartilage growth, enhances fat metabolism and inhibits amino acid (and therefore muscle) breakdown. With age, there is a natural
reduction in lean muscle mass and an increase in fat mass. Genetically engineered HGH can reverse these negative effects and is often used to treat children who suffer from kidney failure and the inability to thrive.

The innumerable advertisements off and online are for a supplemental form of HGH (as opposed to the injected, genetically engineered form). To date there is no proven replacement for injectable HGH and very few well-controlled studies have examined how HGH supplements (such as an oral spray) affect exercise performance. Genetically engineered HGH is only available to healthy individuals on the black market and is often in an adulterated form. Child athletes who take HGH in the belief it will give them a competitive edge have an increased risk of gigantism, while adults can develop acromegalic syndrome and insulin resistance leading to type II diabetes.

For obvious reason, genetically engineered HGH is banned in sport and as yet there is no evidence to suggest supplemental HGH is effective and safe long term.

**Sodium Bicarbonate**

During all-out exercise lasting between 30 and 60 seconds (such as several sprints up and down a soccer / rugby field), dramatic alterations take place in the chemical balance of the body's fluids. This occurs because the body must use anaerobic energy pathways to supply muscles with energy - and a by-product of this process is a sharp increase in blood lactate. To defend against an increase in acidity, the body has a buffering system, part of which is bicarbonate (which is highly alkaline). In theory, if high levels of bicarbonate can be maintained during exercise it will help to offset the increase in acidity and reduce the limiting affects of blood lactate accumulation.

Compared to many popular, commercial supplements, sodium bicarbonate is fairly well researched. While studies have produced conflicting results, many trials have found that taking a bicarbonate solution prior to exercise can indeed increase anaerobic exercise performance. One study into 800-m race performance showed that taking a sodium bicarbonate solution prior to the start decreased race time by a significant 2.9 seconds compared to a placebo. Other studies, while less dramatic, support the benefits of sodium bicarbonate and many studies show no effects at all. There seems to be a wide variation between individuals, which may be related to their level of fitness.

The type of exercise also seems to play a major role. Continuous, all-out activities like sprint swimming or cycling are easier to measure than intermittent sports such as soccer or rugby. However, recent studies have shown that sodium bicarbonate can improve the performance in a multi-sprint test and intermittent sports.

Currently, taking sodium bicarbonate (considered a food not a drug) is not banned by any sporting governing bodies. A typical dose, 1 to 2 hours prior to exercise is 300 mg per kg of bodyweight. There are some reported side effects, which include stomach cramps, nausea and diarrhea. These negative effects would minimize and positive benefits gained from taking sodium bicarbonate so it's important athletes do not try the supplement for the first time on the day of an important competitive event.

There are many more supplements and performance enhancing aids on the market and this list is by no means exhaustive. Before you add to the industry's multi million pound turnover, and before you potentially put your health at risk, be sure to spend time researching any supplement you are unfamiliar with.