Fabulous Fat Burning

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Introduction

It is predicted that by the year 2030 half of the adults in the United States will be obese. Not just fat, but obese. It is interesting to note that obesity rates in children living in the United States have increased dramatically over the past 50 years:

Age	1970's	2009	Increase
2 - 5 years old	5%	10 %	Doubled
6 - 11 years old	4%	20%	Quadrupled
12 - 19 years old	6%	18%	Tripled
19+	15%	34%	Doubled

Fat is laid down three times in our lives: in utero (when your mum is pregnant with you), at about two years old (when a child starts looking like a little person compared to a baby) and again at puberty. The fat cells you have on your body now, you've had since you were a child.

Contrary to popular belief, overeating is not the only cause of obesity, nor is dieting the best way to lose fat. Inactivity and heredity are the main contributors to a person becoming obese. Fat cells form during childhood, so an overweight child will likely grow into an overweight adult. But with proper guidance regarding nutrition and exercise, the child can make healthy life habits to prevent problems later.

Some studies suggest that the environment in the womb pre-programs the child's metabolism. This can mean exposure to gestational diabetes, the mother's obesity and other issues related to the mother can all affect or create weight issues and obesity in the child.

Humans are meant to move. If we don't, then our bodies change, and not for the better. When a young child doesn't move much their body's systems don't develop properly: muscles, bones and the heart don't strengthen; the metabolic system doesn't work properly and doesn't develop in the way it should.

We no longer live lives that require us to hunt and gather our food every day and yet our bodies are still designed for it. It's normal to walk for 10 to 15 kilometers every day and to have calluses on our feet. It isn't normal to sit all day. We pay a physical price for being sedentary with soft bodies, fatigue, heart disease and a host of other ailments. A lot of diseases that we get today are caused by a mismatch between the lives that we lead and the biology that we have inherited.

We need to get back to the active lifestyles that we once had. Encourage your, children, friends, family and clients to move more, play more and be more active, regardless of their age. Walk instead of drive to the store or to school. Reach, lift, squat, push, pull. Do anything instead of sitting all day.

In other times, being fat was a sign of being rich - those in society who had too much food and too much time to do nothing. The rich didn't have to expend as much energy - they had servants and slaves for that. It was the slaves, the gladiators, the farmers, the workers that were fit and strong and, given the right nutrition, healthier than their rich counterparts.

We humans are tougher than we think. We started out as hunters and gatherers, and we had to be physically active to survive. We could outrun many animals, who may have had more speed, but we had more endurance. Over the course of evolution, your body was chosen for you by nature, with genetics that gave you a body capable of being strong, powerful, agile and lean.

In this workshop you will learn what fat is, how the body uses and stores it, the best way to burn fat as a fuel and keep fat off the body, and the implications of being too fat.

Body Fat

Fat is the molecule that keeps you going. Your body isn't meant to burn protein for fuel (that's meant for building and repairing tissue). Carbohydrates are burned very quickly and since you don't store much carbohydrate on your body, you need to have fat as a fuel reserve.

The average body stores enough fat to run 25 marathons back to back (approx. 100,000 Calories worth) but stores only 2216 Calories worth of carbohydrates. The average adult has approximately 37 trillion cells and approximately 30 billion of those are fat cells. The weight of fat on the average healthy human adult is 13.5 kilos or about 30 pounds.

We need fat on our bodies for many reasons:

- Protects organs
- Forms cell membranes
- Give you more energy than carbs or protein
- Burned for fuel

- Makes up lipoproteins (soluble protein that combines with and transports fat and other lipids in the blood).
- Aids in nerve transmission.
- Thermal regulation (keeps you warm)
- Vitamin storage/carrier for fat soluble vitamins A, D, E, and K
- Forms a myelin sheath (a cover) on axons (long threadlike part of the nerve) that go to cells.

There are two types of body fat: subcutaneous fat and visceral fat.

Subcutaneous fat lies under the skin and having too much of it can cause the skin to dimple (this is called cellulite). Approximately twenty two percent of the body's fat is subcutaneous on the average healthy adult. Think of subcutaneous fat as a savings account. Once it's there it is harder to get rid of. While you may not think that it may not look good, many studies show that subcutaneous fat doesn't carry the same risks as visceral fat and may protect the body.

Think of **visceral** fat like a chequing account. It is more metabolically active than subcutaneous fat and easily goes in and out of the cells. Visceral fat lies deep in the abdomen and surrounds your organs to protect them. While some visceral fat is normal and healthy, too much can kill you indirectly through disease.

Visceral fat is like an endocrine organ. Endocrine organs secrete hormones and other products into the bloodstream. Unfortunately, visceral fat can cause diseases that afflict many of us as we get older. There is a protein called retinol-binding protein 4 that is released from visceral fat. This protein increases the risk of insulin resistance and heart disease. It has also been found to be a precursor to Type 2 diabetes

Even thin people can have too much deep abdominal fat that can lead to diabetes, inflammation, heart disease, dementia, insulin resistance and increased risk of death. Insulin resistance is when the cells are resistant to insulin and are unable to use it effectively. This leads to high blood sugar.

insulin is a hormone made by the pancreas. It allows the body to use glucose for energy. Insulin bundles up the carbohydrates you eat and helps prevent you blood sugar levels from getting to high (hyperglycemia) or too low (hypoglycemia).

Abdominal fat can lead to poor sleep, meaning you'll drag yourself through your day. Being sluggish and tired, the body craves quick energy food, so people tend to snack on high–calorie junk food. That extra junk food leads to more abdominal fat, which leads to…. you get the idea.

Women generally have more fat on their bodies, simply because of the way we are put together. The average healthy man has anywhere between 8 to 17% body fat, and women should have between 15 to 24% body fat. Since women carry more fat, especially in the leg and butt area. It is considered an indicator of good health to be curvy.

Men normally carry more visceral fat then women do – until menopause. Women burn approximately 5% more fat than men (before menopause) because of the estrogen levels. As women age, estrogen declines and fat burning slow down. Fat accumulates in the mid-section as we age. Estrogen and progesterone decline. This decline leads to a decrease in fat utilization and a decrease in fat free muscle. This means that we (especially women) need to work harder to burn fat as we get older.

Men often have stubborn areas around the mid-section. Men with large waists have shown to have higher chances of heart disease and diabetes as well as other obesity related illnesses. The more fat you carry in this area, the more dangerous it is.
Sit ups and other spot reduction exercises won't burn off belly fat. More on this in the Spot Reduction section below.

Stress causes the hormone *cortisol* to be released. Cortisol stimulates lipid storage, especially in the mid-section. Decreasing your stress which increases progesterone and estrogen has an anti-cortisol effect.

An ideal waist measurement for women is 32.5 inches. Over 37" is considered dangerous. The ideal for men is 35", where over 40" is considered dangerous.

There was a study done by the University of Oxford in England called the *Million Woman Study (MWS)* which was started in 1996 where they recruited 1 in 4 women in the UK. They originally set out to study breast cancer rates after menopause and the effects on health after menopause.

The study concluded that there is a direct link between increased waist size and heart disease. The study found that a large waist (over 35 inches in women) put women at risk for heart disease. The MWS concluded that the chances of getting heart disease doubled in women with large waists. For every two inches in waist size over 35 inches, their risk of heart disease increased by 10 percent.

Cancer risks for both men and women increase with people with larger waists. Another study (Canoy, D et al, 2013) showed that women who have more visceral fat have double the chance of getting colon or rectal cancer after menopause. Women with waists almost as large as their

hips have four times the risk of getting breast cancer than women with normal waist sized, according to two studies (India 2009 and Holland, 2010.)

However, if you are a post-menopausal woman don't be hard on yourself. Understand changes to the body during your lifetime. You may have to work harder to keep the weight off than when you were young, but if you are fit and healthy, you have a perfect body.

There are two types of fat on our bodies - white and brown fat. White fat is what we normally refer to as fat and is stored as calories. We also have brown fat. Brown fat is packed with mitochondria – the powerhouse, or furnace of the muscle cell.

Brown fat is laid down when we are in utero. Brown fat transfers food energy into heat. In other words, it keeps you warm. Did you know that babies don't shiver? This is because about 5% of a baby's body mass is made up of brown fat that keeps them warm. Most of the brown fat is along the back and upper half of the spine towards the shoulders. Adults still carry brown fat on their bodies, but only as much as we had when we were babies. Interestingly a study done in 2009 showed that brown fat can burn white fat to create heat.

Body fat is not just pure fat. Pure fat (the kind that you eat), has approximately 9 calories per gram. This amounts to about 4,100 calories per pound of pure fat.

Body fat consists of fat cells (adipocytes), which contain fluid and protein as well as fat. The calorie content of body fat is going to be slightly less than the calorie content of pure fat.

According to a study done in 1958 by a scientist named Max Wishnofsky, the caloric equivalent of one pound of body fat is 3,500 calories. For years this was taken to be completely true. Some current research now shows that there are slight variations.

We know that one pound of fat equals about 454 grams. Pure fat (the kind you eat) contains 8.7 – 9.5 calories per gram. Body fat tissue is anywhere from 72% - 87% fat, depending on the study you read. According to research body fat can contain anywhere from 3,436 to 3,752 calories, give or take a few.

Over Fat / Obesity

There are many reasons people get fat: age gender, physical inactivity, low resting metabolic rate (RMR), the thermal effect of food (TEF), ratio of fat to fat free mass, behaviour, genetics and certain enzymes (lipoprotein lipase – LPL) and a positive energy balance. This means more food (energy) going in than going out via movement and exercise.

Fat deposition is genetic. This means you can't decide where your fat is deposited on your body. To see where you might gain weight, look at your parents, your siblings and other relatives. If your mother has large thighs, chances are you will too.

Over $51 billion dollars is spent annually on weight loss products in the United States. One Canadian study revealed that approximately one half of the adults in this country are overweight. People who have 20% or more body fat are considered to be obese. What is happening to our society? Why are we getting fatter and fatter?

Being over fat not only causes health issues as discussed above, but it also increases your chances of having stress fractures, strokes and decreases sexual and reproductive health. It can also affect your mobility, interfering with how you move. It can affect your self-esteem and emotional health.

Atherosclerosis is an inflammatory disease which can be caused by increased fat in the abdominal area. There is even evidence that it plays a role in aging.

Upper-body obesity is the most significant risk factor for obstructive sleep apnea, asthma and gastro-esophageal reflux. Some studies have shown that where you carry your fat will determine your energy level. Fat carried around the mid-section has been shown to tire you out!

Obesity is not a sign of weakness or laziness. Obesity may be caused by one or several factors. It is important to have compassion and not judge people because they carry extra fat. It isn't fair to blame a young adult for the extra pounds. Fat cells (adipocytes) are formed when you are young. At this time in your life you don't have much say as to how much you eat, what you eat and what activity you do. Nor do you have a say about where you store your fat.

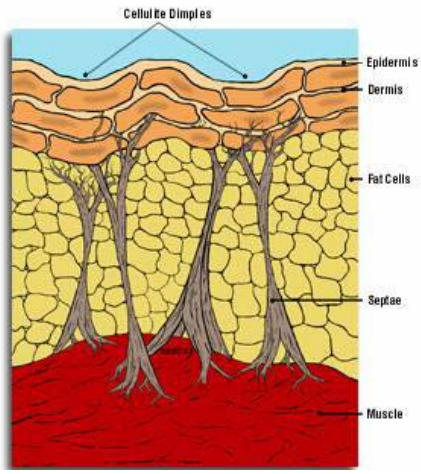
Overweight parents have a greater chance of having overweight children. You can blame your parents for the amount of fat cells you have, but you must take responsibility for the amount of fat in the cells. In extreme cases our bodies manufacture new cells to absorb excess fat, even in adulthood. Some studies suggest that if a person is 35 kilograms overweight, hyperplasia occurs. This means that the body can make new fat cells.

Lack of physical activity is the number one reason we carry lots of extra fat on our bodies. Often people say they eat too much, but if they simply moved around more, they could enjoy the foods they love without putting on those extra pounds. When you eat more than your body needs, energy input exceeds energy output. Physical activity accounts for approximately 25% of daily calories expended. It sounds so simple to say that you should simply move around more, but it really isn't much more difficult than that. It all depends on how you exercise. Overeating and a lack of exercise stimulates fat cell formation.

Some people complain of a slow metabolism, but you can boost your metabolism by exercising. The more muscle you have, the more fat you burn since muscle is much more metabolically active than fat cells. Caloric expenditure can increase almost 40% after exercise due to an increased metabolism.

Cellulite

Cellulite is no different from the fat anywhere else on your body. A fat cell is approximately as wide as a strand of hair. The bumps and ripples, usually on the back of the thighs and buttocks, is simply stored fat directly beneath the skin where connective fibers (septae) separate the fat compartments. The more fat stored, the more stretched the connective tissue becomes. The connective fiber in women may be tighter than in men, and women tend to carry more fat on their bodies. This may explain why women are usually the ones complaining about cellulite. Creams, injections, pills and lotions will not get rid of cellulite – only your money! Don't be fooled into silly gimmicks that don't work.



The Energy Systems

There are three methods of ATP production: ATP/CP which is energy stored in the cells; the aerobic system; and the anaerobic system. Recognition of the significance of how these energy systems works is critical to an understanding of exercise intensity and application of the FITT principle. And of course, fat burning.

The ATP/CP system is an immediate energy source. You have approximately 3 ounces (85 grams) of stored ATP in your entire body. ATP is the high energy molecule making all bodily functions possible. The ATP/CP system is meant for immediate use like running across the street or dodging out of the way of a car. It is also what fuels you in the first 10-20 seconds of movement if you don't warm up first. We won't discuss the ATP/CP system in more detail here as is isn't relevant to this workshop.

There are the two main sources of fuel in the human body: fat and glucose (carbohydrates). Your body can also burn protein, but this isn't a preferred fuel; more on this later. We need to exercise properly to change a fat-conserving body into a fat-burning body.

The body uses the energy stored in carbohydrates and fats as the raw fuel for muscular energy. Once these materials are absorbed into the body, they are stored within muscle, liver, blood and adipose tissues (fat cells). Glycogen is the form of carbohydrates stored in the liver and muscle, while in the blood carbohydrates are called glucose.

It's important to discuss carbohydrates first as without them we couldn't burn fat completely. When carbohydrates are eaten, they are taken into the body and broken down into glucose (blood sugar). Small amounts are stored in the muscles and liver cells as glycogen.

Carbohydrate molecules are made up of 6 carbon, 12 hydrogen and 6 oxygen.

Carbohydrate molecule
6 carbon
12 hydrogen
6 oxygen

Carbohydrates or carbs are abbreviated as CHO. When a CHO molecule is broken down in the muscle for fuel, it is literally broken in half and turns into 2 pyruvate molecules. Each pyruvate molecule is made up of 3 carbon, 6 hydrogen and 3 oxygen (two halves of a CHO molecule).

Fat is stored as triglycerides in adipocytes (fat cells). Triglycerides are a type of lipid (fat) that floats around in your blood. They are made of a glycerol molecule that is bound to three fatty acid chains. Fatty acids (small bits of fat) make up a major part of the triglyceride molecule. The fatty acids are linked together with hydrogen atoms. The body converts any calories it doesn't use right away as triglycerides. This means if you overeat (more than your body needs), you'll store fat in the form of triglycerides.

When fat is needed as fuel, an enzyme called hormone-sensitive lipase or HSL is released. This allows the fatty acids to come out of the adipose tissue and enter the blood stream. From there fat goes to the muscles to be used as energy. This is fat burning! We can only burn fat in the presence of oxygen, so this is known as beta-oxidation – the aerobic process of breaking down fatty acids inside the mitochondria.

Muscles do not directly "burn" fat or glucose to generate energy for contraction, they use ATP. An appreciation of how ATP is manufactured is crucial to understanding the relationship between exercise and fat burning.

You may remember learning that under conditions of mild-to-moderate exertion, ATP is manufactured by aerobic processes involving the breakdown of fat and glucose/glycogen in the presence of oxygen. Under more strenuous or shorter-term activity, insufficient oxygen is supplied to support this process, so ATP is manufactured anaerobically (without oxygen).

Anaerobic Glycolytic ATP Production

Anaerobic glycolysis is the breakdown of carbohydrates to create ATP without the use of oxygen.

Glyco – carbohydrates

Lysis – break down

This process produces a lot of by-products and only about 5% of the energy contained in the glucose is used as fuel. Anaerobic glycolysis produces less energy per molecule of glucose than aerobic glycolysis. One molecule of glucose burned anaerobically produces water, carbon dioxide, lactic acid and 2 – 3 ATP. The main by-product is lactic acid; thus, it is also known as the "anaerobic lactic acid system."

Glucose – glycolysis – no oxygen (anaerobic)

= water, carbon dioxide, lactic acid, hydrogen ions and 2 – 3 ATP

We carry very little carbohydrates in our bodies, and since we can't store very much, the same way we store fat, we need to ensure a continuous supply of carbohydrates in our diets. Carbohydrates are the main fuel for the brain and the main element in muscular ATP production. However, this continuous use of carbohydrates causes the body to run out of glycogen quite quickly if it is not replenished.

ATP hydrolysis is the catabolic reaction process by which chemical energy that has been stored in the bonds of the ATP molecule is released. ATP is broken down into ADP by having one phosphate removed. During the splitting of the phosphate one hydrogen ion is released. Hydrogen ions are also called **protons** which comes from a water molecule, hence the name hydrolysis.

For many years we were told that lactic acid (the major byproduct during anaerobic production) caused the burning sensation in the muscle cell. We now know this not to be true. It is the increase in the number of hydrogen ions and the presence of pyruvic acid that causes acidosis which causes the burning sensation we feel when doing intense (anaerobic) exercise.

When carbohydrates are broken down pyruvate molecules and hydrogen begin to accumulate in the cell. Each one of the pyruvate molecules absorbs two protons converting it into lactate. It is the lactate (or lactic acid) that slows down acidosis. It acts like a buffer to aid the cell. Contrary to popular believe (and what we've been teaching for years) lactic acid is good for contracting muscles.

You may gather from this discussion that without enough oxygen in the system (anaerobic) you are only burning carbohydrates. This is true. However, there are always other cells in the body that burn most fat through aerobic fatty acid oxidation.

Anaerobic exercise is any exercise that has you working so hard that you aren't getting enough oxygen into the working muscles. Exercises like weight training, sprinting or working out at intensities above 85% of your heart rate maximum.

So, if you are looking to burn fat right now, sprinting isn't the best choice because it's anaerobic. Many people think that the harder they workout the more fat they will burn.

But you should work out intensely if you are fit enough as a great deal of fat is burned in the recovery process. Much more on this later.

Aerobic Glycolysis and Fatty Acid Oxidation

At mild to moderate exertion ATP is manufactured aerobically. At rest, your body uses both glucose and fat for fuel in almost equal amounts because the oxygen you breathe in can meet the demands of the muscles. When you exercise, your muscles demand more energy.

In the first few minutes of activity, when oxygen is not able to meet the demands of the muscles, your body creates energy anaerobically. But, as your breathing and heart rate increase with movement, your body takes in more oxygen and the muscles receive enough to create energy aerobically. When this happens, you will still burn carbohydrates (glucose) but you will create more energy per molecule (36 to 40 ATP) than you did anaerobically (only 2 or 3 ATP). And you'll notice that there is a lot less by-product.

Glucose – glycolysis – oxygen is present = water, carbon dioxide, 36-40 ATP

Glycolysis is 30 – 40 times faster than fatty acid oxidation so glucose and glycogen give you a much fast shot of energy when you need it. It takes longer for fat to be burned.

Why do we discuss aerobic glycolysis when we want to talk about fat burning? When carbohydrates are broken down in the presence of oxygen, fat enters the picture. You may remember learning about the Krebs cycle. It is a series of chemical events that creates ATP by burning carbohydrates and then drawing fat into the cycle.

The Krebs cycle is considered a grindstone that breaks down fat and carbohydrates. When oxygen is supplied to the muscle, a compound from the breakdown of carbohydrates (acetyl-CoA) enters the second stage of carbohydrate breakdown known as the Krebs Cycle. This process occurs in the mitochondria (the powerhouse) of the muscle cell. The Krebs Cycle is a series of chemical reactions that degrades acetyl-CoA to carbon dioxide (which you exhale) and hydrogen. Then another set of chemical reactions, called the Electron Transport System, produces water and molecules of ATP. The Krebs Cycle releases an enzyme called Lipase that goes to the fat cells and liberates fatty acids from the cell that can be broken down as fuel.

Because oxygen is now present in the muscle cell, fat is broken down during fatty-acid oxidation (fat burned as fuel this way creates up to 100 ATP per molecule).

The aerobic metabolic pathway is:
Glucose enters muscle cell → goes through glycolysis
→ turns in to pyruvic acid
→ when oxygen is present, glucose enters the mitochondria (goes through the Krebs Cycle)
= CO_2+ H_2O + 36-40 ATP
Fat cells now release fatty acids, which are taken to the liver to be broken down, then brought to the muscle cells to make up to 100 ATP.

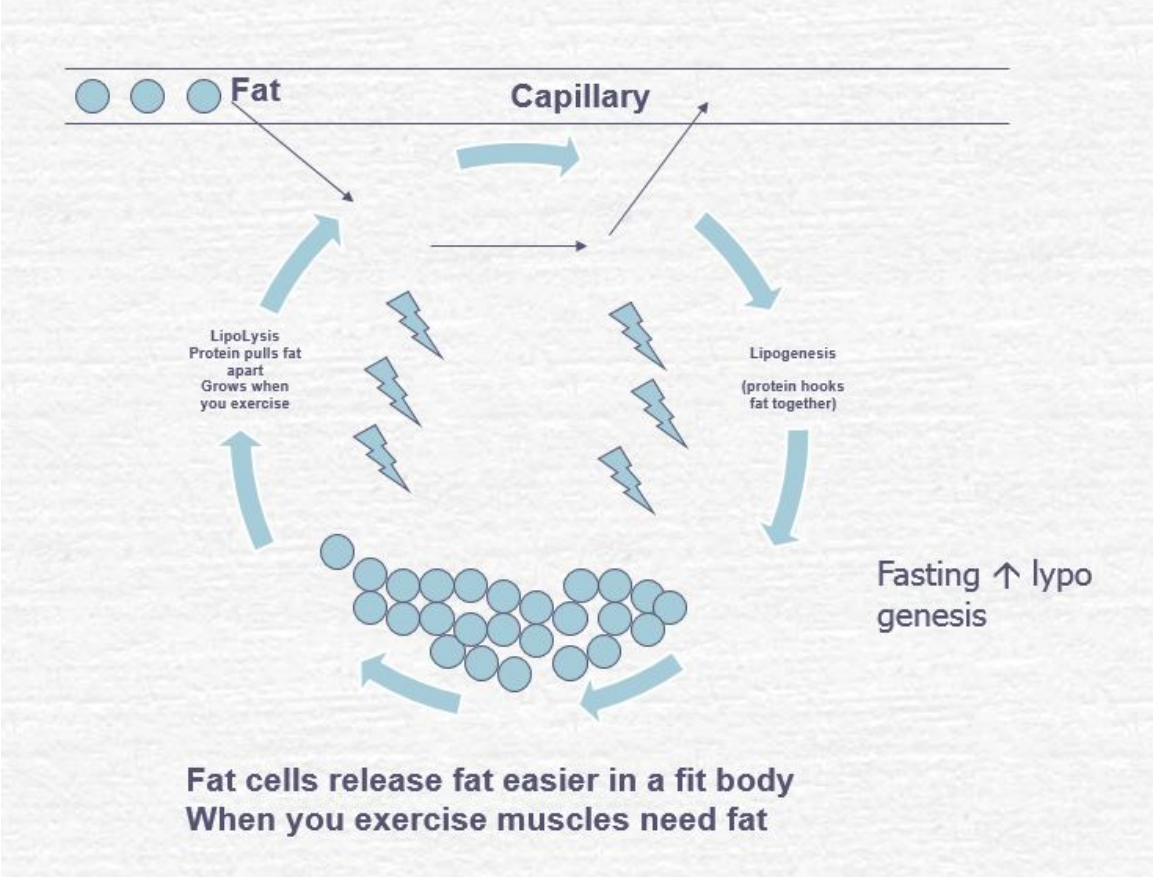
As time goes on during exercise, you will steadily burn more fat and less glucose.

The longer you exercise, more fat and less carbohydrates are used as a fuel. If you plan on doing cardio for a long time (running a 10K or swimming 2 kilometers) the exercise will be at a mild to moderate level. If it was intense you couldn't keep it up for an extended period.

Lipolysis is the breakdown of triglycerides separating fatty acids from the glycerol molecule they were attached to.

Lypo mean fat and lysis means the breakdown.

Lipo=fat
Lysis=breakdown



Lipolysis involves hydrolysis of triglycerides into glycerol and free fatty acids. Lipolysis mobilizes stored fat during fasting and exercise.

It is the use of stored body fat as a fuel that makes aerobic ATP production particularly significant. If you engage the aerobic energy system regularly, you no longer have to think of the fat stored on your body as useless extra weight – because now it's potential energy!

Because your body processes fat at a relatively slow rate and only during mild to moderate levels of exercise, fat burning can be maintained for extended periods, such as running a marathon or swimming long distances.

The rate of energy production in the aerobic process is much slower than with the first two energy systems. This is due to the time it takes the body to make the necessary circulatory and respiratory adjustments. Simply put, you can use fat as a fuel when oxygen is available. As exercise intensity goes up, your muscles burn more glucose and less fat.

The Significance of Fat as an Energy Source

Stored fat represents the body's greatest source of potential energy. Fuel reserves from stored fat represents approximately 100,000 Calories of energy in the average male or female. In contrast, the carbohydrate reserve represents less than 2,000 Calories. Relative to other nutrients, the quantity of fat available for energy release is almost unlimited. Very few people in North America have too little fat on their body. While fat may be an excellent fuel source, too much of a good thing can be disadvantageous as discussed previously.

When the body needs to make energy during extended periods of exercise, fatty acids come out of the storage cells and through the circulatory system, are taken to the liver, chemically changed and sent back to the working muscles. This will only occur during aerobic exercise – when oxygen is present.

Fat stored near a muscle cell is not usually used by that cell. You should understand why spot reduction does not work. More on this later.

The efficiency of the breakdown of fat for ATP production increases with training by permitting oxidation of fat at levels of effort lower than those for the untrained person. This means that you, the aerobically trained individual, can burn fat more readily than someone who doesn't exercise.

During exercise at sub-maximal level (mild to moderate exertion) greater fat oxidation means less glycogen depletion, less proton and pyruvate accumulation because of the availability of oxygen and less muscular fatigue. You can also exercise longer since you aren't burning through the carbohydrates.

With exercise, the body goes through many changes:

- Within the muscle cell, levels of the aerobic enzymes that are responsible for the fat burning process increase in aerobically trained individuals.
- Lungs become healthier and oxygen is absorbed more efficiently into the alveoli (air sacs in the lungs).
- The amount of hemoglobin (the oxygen carrying iron-containing protein) in the blood increases, making it easier to transport oxygen through the blood stream.
- The heart becomes stronger so cardiac output and therefore efficiency increases; more blood is pumped out per beat (increased stroke volume) of the heart so it doesn't have to work as hard.
- There is more myoglobin, which increases the muscles' ability to take in oxygen.

Making the body stronger and more efficient through exercise means that the body becomes more efficient at making energy, and exercise becomes easier to do. You will feel healthier and have more energy for everyday chores, and the more you do, the more you feel like doing.

At any given state, a mixture of carbohydrates, fat and even a little protein is being used for the body's energy needs. It is important to understand that these fuels for energy release are not only time–related, but intensity-related also.

At rest, the body uses approximately 40% glucose and 60% fat – but the energy demand is low at rest. With mild intensity endurance exercise the body uses approximately 50% each of carbohydrates and fat. High intensity short duration exercises use approximately 95% glucose.

If you sprinted for half a block to catch a bus, you will be using the same energy system as you would if you jumped out of the way of a car while crossing the road. Any relatively intense, short-term (less than 20 seconds) exercise is fueled by what is stored in your muscles (ATP/CP). However, if you got up right now and walked to the kitchen, would you be using the aerobic system? Yes – you would. Think not only about how long the activity lasts, but also the intensity of the activity. You have enough oxygen in your body to do mild exercise like walking.

Protein's job is to build and repair tissue. Your body rarely uses protein as fuel, because it is an expensive source of energy. For protein to be used as energy, the body must first convert it into carbohydrates. This conversion produces toxins that need to be removed with water, causing dehydration and stress on the kidneys. We'll discuss low calorie diets and low carbohydrate diets further on in this workshop and how (and why) the body converts protein to fuel.

Most of the fat you eat is broken down in the small intestines. Bile, from the gallbladder, emulsifies it and disassembles it into free fatty acids.

Fat has a 30% to 40% slower breakdown rate than carbs, that's why the body uses carbs first. They get burned much more quickly.

Other Factors Associated with Fat Burning

Lipoprotein lipase (LPL) is an enzyme which is found primarily on the surface of cells that line capillaries within muscles and fat cells. It plays an important role in breaking down fat in the form of triglycerides which are carried from organs to the blood by lipoproteins. Its main job is to deposit fat into other cells for energy.

Fat cells have alpha and beta receptors. A receptor is a protein molecule that receives a chemical signal from outside of the cell. A receptor binds to a chemical causing a cellular response. Think of a receptor as a lock. Various hormones and neurotransmitters are the key. Opening the door changes what is going on in the cell. There are many receptors on cells. Each one allows a certain chemical to bind to it causing a specific reaction at the cell.

Alpha receptors inhibit lipolysis (the breakdown of fat) and are sometimes seen as “bad” receptors since they inhibit the breakdown of fat from the adipose tissue. When lipolysis is inhibited fat stays where it is. Genetics will dictate how many alpha and beta receptors you have. The more alpha receptors you have the harder it will be for you to burn fat from that cell.

Beta receptors stimulate lipolysis causing fat to be broken down into fatty acids and released from the cell.

The ratio of alpha to beta receptors will determine the rate of fat burning. Interestingly in females, adiposities (fat cells) in the thighs, hips and buttocks have more alpha receptors and more lipoprotein lipase in the hips and thighs. It is safe to say that “stubborn” fat more than likely has more alpha receptors than beta.

The best way to burn reluctant fat is to activate beta receptors and inhibit alpha receptors. The “key” to unlock these receptors lies in the hormone catecholamines. There are two types of catecholamines: epinephrine and norepinephrine. These are triggered when you are under stress and are often called your “flight or fight” hormones. But remember, all stress isn’t bad. Exercise is stress. Simply put, epinephrine and norepinephrine break down fat. After only a few minutes of exercise catecholamines are released and fat breakdown begins.

The best way to inhibit alpha receptors and activate the beta receptors is to stop eating so much simple sugar! Simple sugars, you may remember learning, increase insulin levels. Higher insulin levels stop the fat burning process.

Some people suggest going on low carbohydrate diets or fasting. But this isn’t a good idea. We’ll talk about that further on in this workshop. But it is important to eat cleanly! And the very best way to burn fat is to exercise and avoid high sugary foods and exercise. We’ll discuss that later as well.

Fatty-acid binding protein (FABP). There are proteins in the body called fatty-acid binding protein (FABP) that facilitate the transfer of fatty acids between intracellular and extracellular space.

Mitochondria are the powerhouse of a cell. This is where most of the energy is made. All cells have mitochondria and muscles cells have the most compared to other cells in the body. One muscle cell has anywhere from 400 – 2000 mitochondria. Aerobic exercise can make the mitochondria 35% bigger and increase the size of each one anywhere from 15 – 50%. It is interesting to note that mitochondria respond very well to cardio training, but they don’t respond to resistance training. To turnup the mitochondrial process – do more cardio

We can break down carbohydrates anywhere in the muscle cell, but fat is only broken down in the mitochondria.

Dietary Fat

Fat provides energy and is the major store of fuel reserve in the body. Body fat holds organs and nerves in place, protects against injury and keeps you warm.

Your Recommended Daily Allowance (RDA) for dietary fat is 20-30% of your total daily calories. Ingested fat takes approximately 4 hours to digest and absorb, so it isn't a good choice just before exercise.

There are different types of dietary fats (which chemically are called lipids), some fats are bad for you and some are essential for good health. However, if you eat too much fat or too much of certain kinds of fats, such as saturated fats or trans-unsaturated fats, you could develop heart disease. Even athletes can be at risk for heart disease, Type 2 diabetes and other health problems by eating poorly.

Fat has more than double the number of calories per gram than carbohydrates or protein. Fat has 9 calories per gram, where carbohydrates and protein each have 4 calories per gram.

Summary of protein, carbohydrates, and fat:

Protein	**Carbohydrates**	**Lipids (Fat)**
• 1 gram = 4 Calories • 12 - 20% RDA of daily intake • Builds & repairs tissue • Major component of enzymes & hormones • Builds antibodies • 2 hours to digest and absorb	• 1 gram = 4 Calories • 55 – 65% RDA of daily intake • Major source of fuel Provides fiber • Brain food! • Takes 30 minutes or less to digest and absorb	• 1 gram = 9 Calories • 25 - 30% RDA of daily intake • Major source of energy • Insulates, protects nerves & organs. Helps carry fat-soluble vitamins • Good fat prevents heart disease • 4 hours to digest and absorb

Compound Fats & Cholesterol

Cholesterol is a waxy substance found in your blood and your cells and is present in every cell of the body. It is an essential structural component of cell membranes and of the myelin sheaths that insulate the axons of nerve cells. It aids in the development of adrenal and sex hormones. Cholesterol is a building block for the cells and hormones in your body and helps digest fats in the gallbladder. Cholesterol is also a precursor of steroid hormones and of the bile acids necessary for digestion. Approximately 70% of the cholesterol a body needs are made in the liver of all animals. The rest must come from a person's diet. Having too much cholesterol can cause problems.

Lipoproteins are essentially fat and protein (hence the name) and are the main form of transport of lipids, triglyceride, and cholesterol around the body. Lipoproteins are broken down into three categories:

- HDL (high density lipoproteins) –considered good fat since they carry more protein and less fat. It acts like a scavenger (the cleanup crew) of cholesterol, basically cleaning the blood stream. Low HDL levels put you at a higher risk factor for heart disease. Raising HDL helps take cholesterol out of the artery. Aerobic exercise increases HDL!
- LDL (low density lipoproteins) are a microscopic blob that are made up of lipoproteins that surround a cholesterol centre with a higher number of triglycerides. This is sometimes called "bad fat". LDL are mostly cholesterol. High LDL isn't **a** risk factor. It is the **direct** cause of heart disease.
- The third type of compound fat is VLDL (Very low-density lipoproteins) which is considered the very bad fat due to proportionally more fat than protein and the highest number of triglycerides. VLDL delivers fat to the muscle and the heart. Your liver makes VLDL cholesterol and releases it into your bloodstream.
-

HDL	LDL	VLDL
55% protein	20 % protein	10% protein
15% cholesterol	53 % cholesterol	15% cholesterol
30% fat (3-15% triglycerides, 24 – 46% phospholipids)	27% fat (10-15% triglycerides, 20-28% phospholipids*)	75% fat (50-55% triglyceride 18-20% phospholipid

* amounts are approximate

* phospholipids - a major component of cell membranes made up of glycerol, phosphates, and fatty acids

The body converts saturated fat into cholesterol. Total fat intake plays a bigger role in blood cholesterol level than cholesterol intake itself. Cholesterol in the bloodstream can clog arteries (arteriosclerosis) and cause heart disease. Too much cholesterol in your blood can lead to heart attacks or strokes. A 25% reduction in serum cholesterol levels reduces your risk of heart disease by half. Eat fewer fatty foods (no more than 30% of your daily calories should come from fat) and exercise more. Exercise increases HDL levels, which removes excess cholesterol from the bloodstream. Thousands of North Americans die each year from heart disease caused, partially, from eating foods high in fat and therefore cholesterol. And millions more have high cholesterol levels.

Cholesterol is absorbed into the blood and then taken into the liver. The liver (the largest organ in the body – other than your skin) wraps protein around cholesterol (hence the name lipo-protein). Fit people have fit livers, which grinds up the cholesterol and turns it into HDL. Lazy livers don't know what to do with it which can cause problems. If you eat well, don't drink alcohol (or drink in moderation), and you exercise, you may likely have a fit liver.

Triglycerides are a type of fat found in your blood. When you eat, your body either uses the food you eat as energy or stores it for later. Your body converts the food that isn't used immediately into triglycerides. They are stored in your fat cells as discussed earlier. Later, when your body needs it, hormones release triglycerides between meals for the energy you need.

Triglycerides are neither good nor bad. They do, however, contribute to total cholesterol levels when you get a blood test. High triglyceride levels are usually genetic and may be caused by diabetes and obesity. However, your diet contributes to triglyceride levels. Carbohydrates are the main factor affecting them, especially simple carbohydrates that are digested quickly.

Simple carbohydrates elevate insulin levels which trigger triglyceride synthesis and fat storage. High triglyceride levels often accompany low HDL levels which cause high blood pressure and can trigger higher chances of visceral fat and obesity.

Cholesterol Standards

These are American standards in milligrams per deciliter, as the BCRPA exam uses them, with the Canadian standards in millimoles per liter included. This applies to all adults over 20 years of age. For healthy individuals, physicians recommend a cholesterol test every 3 years.

Blood cholesterol levels are defined as:

	US standards (total cholesterol levels)	**Canadian standards (total cholesterol levels)**
Desirable	200 mg/dL	5.18 mmol/L
Borderline	200-239 mg/dL	5.18-6.11 mmol/L
High	240 mg/dL	6.12 mmol/L

*mg/dL = milligram/deciliter

*mmol/L - millimoles per liter

However, it isn't just the total cholesterol that we need to consider. If the good cholesterol (HDL) is low, it can also be a factor in heart disease. Here are the standards for LDL and HDL.

Desirable LDL	130 mg/dL or lower 3.5 mmol/L
Desirable HDL	40 mg/dL or higher 1.0 mmol/L for men 1.2 mmol/L for women

If a person's cholesterol test comes back at 200 mg/dL or greater your client should repeat the test and get recommendations on how to reduce their cholesterol levels. Individuals with high blood cholesterol levels over 240 mg/dL should have lipoprotein analysis on a regular basis. If your client has been told that they need to reduce their overall cholesterol, or specifically their LDL, the doctor should prescribe exercise to help reduce it - but some will prescribe pills instead. Keep in your scope of practice when giving advice to reduce cholesterol levels, but a careful overall decrease of fat in the diet is a safe bet.

The ratio of HDL to LDL can determine the probability of contracting heart disease and is usually controlled by genetics. This is because HDL carries cholesterol away from the arterial walls and, in the liver, degrades it to bile to be excreted via the intestines. LDL and VLDL carry cholesterol into the cells and have the greatest affinity (stickiness) for the arterial walls. This may cause arterial narrowing as the fat is deposited in the arteries.

So, to reiterate, total cholesterol should be under 200. HDL should be over 40 mg/dL.

What do you do if total cholesterol is under 200 mg/dL, but HDL is lower than 40 mg/dL? Low HDL can also contribute to heart issues. If this is the case, and you have a doctor's OK, start cardio as exercise bring HDL levels up. Also, encourage your client to watch their fat intake. Eat less red meat and eat more veggies and fruit!

Saturated and Unsaturated Fats

Saturated fats are sticky molecules and hold as much hydrogen (hence the name "saturated" as the molecule can hold. They include animal and other fats that harden at room temperature like palm, coconut, and cottonseed oils. They are associated with deposits of cholesterol in the arteries, causing occlusion and hardening of the artery. Saturated fat in particular has been linked to elevated total cholesterol and LDL cholesterol levels in the blood.

Hydrogenated fat is another name for saturated fat but refers to the chemical alteration of the fat. These are liquid vegetable oils that have had hydrogen atoms injected into them to make them harden so that they can be used for items such as margarine and shortening. Learn to read labels. If it says hydrogenated, don't buy it! Trans fats are a saturated fat (they have been saturated with hydrogen atoms). The consumption of trans fats has been shown to increase the risk of coronary heart disease. The baked goods section in most grocery stores have shelves of Nanaimo bars, donuts, cookies, and coffee cakes. If they aren't refrigerated it is a good indication that they are loaded with hydrogenated fats.

Unsaturated fats can be monounsaturated or polyunsaturated and help prevent heart disease by lowering LDL cholesterol levels. Monounsaturated fats are found in olive, canola and peanut oils, avocados and nuts. Polyunsaturated fats are found in plant and animals food products such as salmon, vegetable oils and some seeds and nuts. Polyunsaturated fats are the best kinds for your heart, have been shown to reduce the risk for ALS (Lou Gehrig's disease) and can fight breast cancer by accumulating in the breast and weakening the estrogen signal.

Omega-3 fatty acids are a type of essential fatty acid found in polyunsaturated fats, which have been the focus of many studies in recent years for their possible association with disease reduction. Sources of omega–3's are safflower, soybean, sunflower and corn oils, flax seed, salmon, trout and all cold-water fish.

Unsaturated Fats are considered the healthy fat and are an important part of a healthy diet. Unsaturated fat helps reduce the risk of high cholesterol levels.

Monounsaturated fats are found in foods such as olive oil, canola oil, peanut oil, safflower oil and sesame oil. As well as nuts and avocados. Eating moderate amounts of monounsaturated fats in place of saturated and trans fats benefit your healthy. Polyunsaturated fat is found in plant and animal food such as vegetable oil, some nuts and seeds and some fish, like salmon.

Essential Fatty Acids

There are two known essential fatty acids. Alpha-linolenic acid and linoleic acid. Alpha linolenic acid is an essential omega 3 fatty acid. It is needed for normal human growth and development. And linoleic acid which is an omega-6 fatty acid.

Your body can't make these two fatty acids, so it is known as essential. You need to eat foods such as nuts, vegetable oils, meat and dairy products. Alpha linolenic is a polyunsaturated fatty acid. It helps prevents heart attacks, lowers blood pressure and lowers cholesterol. Supplements are given to people with higher chances of heart disease, but the average person can get enough from the food they eat.

Exercise Burns Fat

There is no such thing as a quick fat loss scheme. It is important to distinguish between loss of fat and loss of weight. The four factors associated with fat burning are intensity, duration, and type of exercise, and fitness level.

Intensity

When an exercise is aerobic, more oxygen is available to the working muscle and the body can turn to fat as a fuel for energy production. Your body burns primarily fat in long, mild-to-moderate aerobic workouts (50% aerobic capacity). At this low intensity though, fat is burned quite slowly, approximately 3-5 Calories per minutes.

Higher intensity aerobic exercise (where oxygen is still readily available) has a greater total caloric expenditure, but a smaller percentage comes from fat.

The focus should be on the total caloric expenditure since fat is burned either directly or indirectly through all types of exercise. At a slightly higher intensity (70 – 75% aerobic capacity) more fat is burned overall because more muscle is used, requiring more energy. The focus should be on maintaining the activity at the highest comfortable intensity.

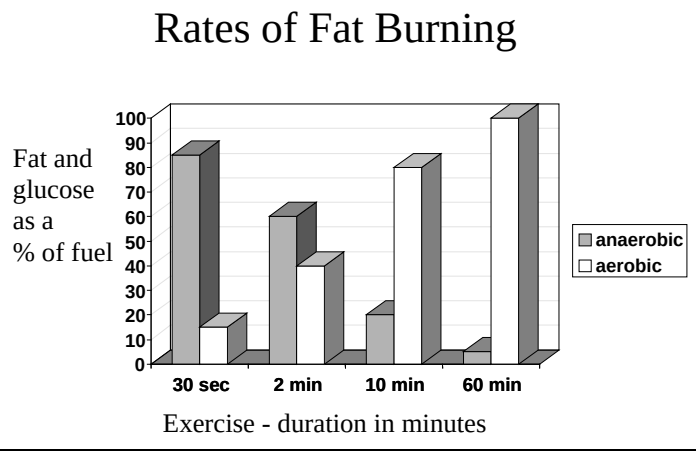
Once the participant starts to feel exhausted the body is no longer working aerobically. At a very high intensity, (85% of heart rate maximum and above) exercise is more anaerobic; not enough oxygen is reaching the muscle and energy production is switched to the anaerobic system. To meet the demands of the muscle, the body uses glucose (carbohydrates) for energy because it burns very quickly and is readily available.

Exercising at too high an intensity causes problems:

- Breathing becomes labored as we strive to obtain more oxygen, which causes us to fatigue.
- Protons and pyruvate build up in the muscles, causing fatigue and heaviness. Muscles can only tolerate so much before they feel stiff and sore. At this point, the exercise must be decreased or stopped, or injury may occur.
- the immune system can be triggered causing illness

During aerobic energy production, exercise can be maintained over a longer period of time with less fatigue. Aerobic exercise trains the body to burn fat and spare the sugar, improving endurance. One unit of fat metabolized aerobically produces 50 times the energy produced by the same measure of sugar metabolized anaerobically.

However, recent studies show that intense exercise boosts metabolism and post exercise physiological responses for up to 2 days after the exercise. This in turn creates a higher metabolism and more fat burning after the exercise has stopped.

Duration To burn more fat (as fuel) and increase cardiovascular efficiency, exercise at a steady pace for a longer time. The graph shows that at first glucose is the primary fuel during exercise, but the longer the duration, the more fat you burn.	

Fitness Level

Aerobically fit people burn more fat than those who are not fit. Fit people break down more fat following training due to several factors including increased efficiency of the heart, lungs and muscles (cardio-respiratory fitness) which we have discussed. Individuals who strength train burn more fat because more muscle means a higher metabolism. The changes that make your body more efficient at burning fat only occur with exercise.

Exercise Type

Different types of exercises burn fat at different rates. Generally, the more muscles you use, the more fat you burn. And since there is no such thing as a perfect exercise, it's important to find a variety of things you enjoy. Doing lots of different exercises rather than doing the same exercise over and over has many benefits such as:

- using different energy systems
- using different muscles
- more fat burning overall
- prevent overuse
- more enjoyment

Something like cross-country skiing is a great aerobic exercise. It spreads the workload throughout the whole body, not working any single muscle or muscle group especially hard. Moderate work using many muscle groups results in a higher rate of fat burning with less fatigue. Low intensity exercise tends to be safer and more enjoyable for most people.

High intense exercise is great for people with a good functional capacity. The fitter you are the more you can do and the more fat you will burn.

The more energy the whole system must expend, and the more muscles involved in expending the energy, the shorter the time required to burn an equivalent amount of fat.

The body expends the same amount of energy during:

- 40 minutes of walking
- 20 minutes of cycling
- 15 minutes of jogging
- 12 minutes of cross-country skiing

The most efficient way to expend fat-burning energy is to use a lot of muscles at a level that you can maintain for a longer period of time, 30–40 minutes or more. The level of intensity should produce a high overall energy output without the feeling of fatigue.

So many studies have been done on what is the best exercise. That's a tricky question to answer, but the best exercise is any exercise that you will do! Having said that, let's take a look at some of the exercises that cause you to burn the most fat.

Interval Training

Interval training is alternating periods of high-intensity and low-intensity exercising with periods of rest. The key to interval training is the intermittent rest, which reduces fatigue, thereby allowing you to increase the intensity of work. For example, you may not be able to run a kilometre in three minutes, but you may be able to run 250 metres in 45 seconds four times with 60-second rests in between each run. Because of the intense nature of interval training it is best used later in a conditioning program, after you have established a general base of cardio fitness; otherwise, you may injure yourself or over train.

Intense exercise is just that: It's hard. It is something that you couldn't continue for a long time. For it to be effective the exercise must be more challenging than you are used to. The intense exercise must put you in an anaerobic state working above your VO2 max (the capacity of the cell to take in oxygen). Since you can't do this for very long, it must be interspersed with periods of rest (or active rest – slower movement).

Intense exercise (above 85 per cent of your heart rate maximum) should only be done if you have the functional capacity to do it. In other words, if you aren't fit to begin with you should ease into the intensity of the exercise.

One of the benefits of intense exercise is that you spend less time training, and the results you achieve in the shorter amount of time are worth the extra effort you expend.

An intense bout of cardio exercise can last anywhere from 10–30 minutes, or more if you are up to it: You get more work done in a lot less time. Intense training should be done no more than three times a week.

The advantages of interval training:

- The heart rate can stay elevated to its threshold for the entire workout.
- Because it can be timed or performed on a track or circuit, you can control the amount of stress precisely and develop a good sense of pace.
- It can be used to complement sport-specific training.
- It yields larger increases in VO2Max (maximum oxygen uptake - the oxygen your body takes in).
- The body becomes more tolerant of protons and pyruvate and improves it pathways for removing it.

A recent study in the U.S. showed huge gains in fitness level with high intensity interval training (HIIT), in a much shorter period compared to long distance training at a moderate level. In test subjects, performing only 1.5 hours of high intensity interval training per week resulted in the same increase in amount of fat burned and glucose consumed by the muscles as 5 hours of long-distance training per week after six weeks. In only 2.5 hours of intervals over 2 weeks, the participants increased enzyme (fat burning) activity in the muscles; the group that did the long-

distance training took upward of 10 weeks to show the same level of improvement. It makes sense to assume that the harder exercise consumes more calories because of the increased demand on the muscles.

The energy expended in a single exercise session is dependent on the duration and intensity of the activity. Here are some examples of caloric expenditure during 30 minutes of activity:

• Badminton 220 • Marathon running 496 • Basketball 400 • Sitting 45 • Cleaning 95 • Skiing (Nordic) 540 • Cooking 110 • Sleeping 30 • Cycling, moderate 150 • Squash 325	• Dancing 250 • Studying 50 • Driving 75 • Swimming 300 • Gardening 150 • Tennis 250 • Golf 170 • Walking 160 • Jogging 300 • Watching TV 45

High Intensity Interval Training

You have learned that it is not lactic acid that causes the burning sensation during anaerobic work, it is the hydrogen that is produced every time you split ATP. This causes more protons and hydrogen to accumulate in the cells. However, we still refer to this as the lactate threshold (until "they" come up with something else to call it).

The lactate threshold (also called the anaerobic threshold) is the point at which the body can no longer supply oxygen to the cells and pyruvate and hydrogen ions (protons) – the by-product from anaerobic energy production – starts to accumulate in the muscle, because the body cannot absorb it that quickly. The muscle cells become more acidic.

Depending on your fitness level, lactate threshold will occur between 50 and 80 per cent of your VO2 max. When you exercise at a lower level of intensity, the body can cope with the by-products produced, and they are removed before they can build up in the muscles. It is the build-up of protons and pyruvate and resulting acidification of the muscles that causes us to feel stiff and sore. And remember mild exercise means it is aerobic and you won't make the by-products that cause stiffness and soreness.

Interval training allows the body to temporarily exceed its lactate threshold. While you are in the "rest" phase of your interval, the body can take in more oxygen, reducing the heavy muscular feeling. Obviously lactate threshold varies from person to person. However, your tolerance for lactate can be increased with training and prepares you for endurance sports

without having the body go into the anaerobic state. This means that as you get fit you can work harder while still being in an aerobic state. Also, the fitter you are the faster your body can deal with waste products.

High intensity interval training (HIIT) is excellent in raising the lactate threshold and increasing the body's ability to work aerobically during intense exercises. You can do more intense work without it becoming anaerobic. During HIIT, metabolism increases due to the high demands of the exercise. Shorter, intense workouts burn as much fat at the end of the day as longer, milder workouts done more often. In fact, studies are showing that you burn more fat with shorter and more intense exercise than if you did a long-distance run or swim or other extended exercise.

Long distance or prolonged aerobic workouts are still great ways to burn fat as a fuel during exercise. They are easier on the body and they may be more enjoyable for some people.

It may not make sense to say that intense exercise burns more fat because we know that anything over approximately 85% of your heart rate max is anaerobic and burns exclusively carbohydrates. But HIIT training is an excellent way to burn more fat. You'd have to run long distance for over 2 hours to get as much fat burning effect of a HIIT workout of 25 minutes. Fat doesn't get burned while you are doing the exercise, however. HIIT increases the After Burn (amount of fuel burned after exercise).

Exercise percentage of heart rate max (HRM)	**Percentage of Fat burned**	**Percentage of Carbs burned**
100%	0%	100%
96%	12%	88%
84%	53%	47%
76%	81	19%
70%	100%	0%

(Kravitz, L PhD., Anaerobic Spectacular, 2018)

Here you can see that the harder you work the more carbohydrates are burned. If you work at a lower level of intensity you will be burning more and more fat as time goes by, sparing carbohydrates.

When you exercise your body requires lots of fuel (fat and carbohydrates) and uses oxygen to aid in the burning of the fuels. During exercise other parts of the body slow down and do not require as much oxygen. Digestion, for example, will practically stop since energy is needed to fuel the muscle cells during exercises. If you work out intensely – harder than your body is used to – your breathing and blood circulation can't keep up with the muscles' demands for oxygen. The muscles will "borrow" oxygen from other parts of the body (organs and other cells). This creates an "oxygen debt" in the body. When the body goes into oxygen debt, it needs to "pay

back" the oxygen after exercise. Therefore, your heart rate and breathing rate may stay elevated for extended periods after exercise. An elevated heart rate for more than three or four minutes after exercise is a good indicator that you required more oxygen to the working muscles than your body was capable of taking in.

After exercise, your body goes through Excess Post Exercise Oxygen Consumption (EPEOC); this is also called the "**after burn**." EPEOC is the process that returns the body to its resting state. The body wants to be in homeostasis, the tendency of a system to maintain internal stability. A good example of this is when you are cold, you shiver. The shivering creates heat in the muscles, which warms you up. Conversely, if you are too warm, you sweat. The sweat takes heat from the body, which cools you down. This is homeostasis. EPEOC is the body's attempt to return to homeostasis.

EPEOC has several repercussions. After exercising your metabolism increases and the body needs to consume extra fuel to return to its pre-exercise state. More oxygen will be consumed in response to the exercise, which is directly related to the intensity of the exercise. The repair process of cells, hormones etc. requires fuel, and since there is a lot of oxygen present at rest, fat will be broken down in the body to free fatty acids which are released into the blood stream. These fatty acids now fuel your cellular repair and increased metabolism. A person's metabolism can be elevated for up to two days post-exercise.

After exercise the body's hormones, fuel stores and oxygen stores all need to return to pre-exercise levels. The body will try to repair itself by making you hungry, so you eat to get the carbohydrates and protein to fuel and repair the muscles. It will also cause you to consume more oxygen, and together the oxygen and fuel consumption equates to ATP (energy) levels being restored.

With EPEOC you consume more oxygen throughout the rest of the day than if you had done a long, steady run. This translates to more fat burning while you are resting later on in the day. This is because of your resting metabolic rate (RMR) increases for more than 14 hours after exercise which means you are burning 100% fat during this time.

HIIT stimulates mitochondria to increase in size and number building the fat burning furnaces. The longer you go the more mitochondria (larger and more active) will occur
With 12 weeks of HIIT you will get an increase fat burning rate anywhere from 20-41%.

There are so many ways to interval train. Your exercise intervals can be anything like running, hill running, cycling, swimming, skipping or… It is important to find something that you will enjoy and that you will do.

There are many ways to break up your intervals with a rest period:

High volume interval training	4 min workout 2 min rest x 10 intervals
Sprint interval	4 – 6 sprints for 30 sec each and 4 ½ min rest with 18 – 20 reps
HIIT with variable recovery	4 min with 1 min recovery, 4 min with 2 min recover and 4 min 4 min recovery.
Hill training	Use a treadmill on a 5 – 8-degree incline then walk or run (fast).
Recovery sprint option 1	30 second sprint with 30 second recovery x 10
Recovery sprint option 2	30 second sprint with 60 second recovery x 10
Recovery sprint option 3	30 second sprint with 90 second recovery x 10

When I swim I do so in a 25-meter pool. After my warmup of 6 laps or so I will do another 2 or 3 laps at a regular pace, then sprint one lap as fast as I can. Each lap at a regular pace takes approximately 25 -30 seconds. The sprint lap takes a lot less obviously. After each sprint lap, I will do one slower lap to recover, then one or two regular laps. Then sprint again.

It doesn't matter what you do but it matters that you do something! Interestingly some studies are showing that if you mix up your mode of movement it increases fat burning even more.

This means that if I swam with a front crawl, then a breaststroke it switches up the movement. This is more than likely because you are involving different muscles with each new movement pattern.

Try something like doing a sprint run, then high knees for the next interval, then fast side to side shuffle or football run for the next one. Anything to mix it up.

Strength Training

Studies show that resistance training is incredibly helpful in preventing muscle mass loss while dieting or trying to lose weight.

It is important to strength train at least twice per week. Resting metabolic rate (RMR) increases after weight training. Depending on the exercise you do (intensity and duration), your RMR can increases for more than two days after the exercise

Generally, we do two seconds on the concentric (shortening muscle under tension) phase and two seconds on the eccentric phase. Eccentric is when the muscle elongates under tension. This is written like this:

2-0-2

This means 2 seconds concentric, with 0 seconds rest and 2 seconds on the eccentric. But since the eccentric phase is where most of the "tearing" occurs during the breakdown of the muscle, it is important to go a little slower. You could do something like 2-0-4 or even 2-0-8. That would mean that you would do a regular concentric action then go more slowly on the eccentric. This means if you are doing a lat pull, focus on going slowly on the release stage. Or go slowly on the down phase of a push up or squat.

Strength training is anaerobic and doesn't directly burn fat. Glucose is the fuel during anaerobic exercise. So how does strength training help burn fat? The more muscle you have, the more you increase your metabolism. Muscles are metabolically very active – this means they need fuel. And when you are resting and repairing after having done some resistance training, the fuel is fat!!

A recent study compared walking 3-4 times per week with weight training 2-3 times per week. The individuals who strength trained had a higher caloric requirement by 350 calories per day than the people who walked. To effectively burn fat, strength train to build your fat-burning furnaces and do aerobic activity to burn the fat off.

How Much is Enough

You don't have to go overboard with exercise. It was said that you should move for 3 minutes for every 30 minutes you are awake. So, if you get up at 7:00 am and go to bed at 10:00 pm you are awake for 15 hours. This means you would have to move for at least 45 minutes every day. That's not difficult to do. Do something, anything that gets you out of your seat.

At best we should exercise anywhere from 225 minutes to 420 minutes per week. Some studies have shown that 300 minutes per week is adequate. That is 43 minutes per day. It can be something as simple as fast walking, swimming, weight training, anything to keep you moving.

Be careful of overtraining when doing HIIT. HIIT shouldn't be done more than 2 – 3 times per week. Of course, on other days you can do something else like hiking, walking, gardening, cycling or anything that keeps you moving for 45 minutes or so.

Overtraining will set you back. There are many symptoms of overtraining: fatigue, soreness, insomnia and more. Overtraining can trigger an auto immune system response causing a host of other problems. Plan your workshops sensibly and progress to more intense exercises as your body adapts and gets stronger and fitter.

Dieting

Many people (especially women) go on diets to lose weight. The word *diet* simply means the type of food that you are consuming. However, when we diet to lose weight, we eat less food than our body needs. When we diet, we want to lose body fat that lies underneath the skin and

around the organs. However, weight loss doesn't necessarily mean fat loss. If you eat less food than your body needs, you will lose weight but some of that lost weight may be muscle mass.

Simply reducing the number of calories (without adding exercise to your daily routine) translates to losing about 30% of the weight in muscle mass! There is a problem with this because the amount of muscle you have dictates how fast your metabolism is going. The less muscle you have the lower your metabolism will be.

If you aren't eating enough food to fuel your body, it must find the calories somewhere. The body needs carbohydrates. If you aren't eating enough of them, the body has a unique way of turning a non-carbohydrate product (such as protein) into carbs. This is called gluconeogensis. Literally meaning the "creation of carbs". People who cut their calories and don't exercise lose muscle tissue (this is called sarcopenia), lowering their metabolism. Sarcopenia comes from the Latin word meaning "poverty of flesh".

This is detrimental in several ways:

1) When your body doesn't have an appropriate level of carbohydrate intake, the body goes into a starvation situation, where muscle protein is broken down quickly for energy. Once glucose stores are used up or not present in the first place due to poor diet, fats are inefficiently broken down to be used with their fatty acid chains released. Without exercise these free fatty acids are converted to ketone bodies for energy. An excessive level of ketone bodies in the blood can result in ketosis, which can cause unnecessary stress on your body. When your body is in ketosis you have a higher risk of heart attacks, strokes, high blood pressure, headaches and nausea, just to name a few. It will also cause fatigue and loss of muscle strength.

2) A study in England (Jan 2019) found that eating a diet high in red meat and high fat may increase sarcopenia, especially in older adults compared with people who ate more fiber (from carbs), unsaturated fat and a higher percentage of lean protein (such as chicken breast and fish and legumes)

3) Protein broken down for fuel turns into amines (small chunks of protein), which are derivates of ammonia and are toxic to your cells.

4) If protein is being used as fuel it is not doing the job of building and repairing other cells of the body, including antibodies. This will cause your hair to fall out, the skin to become sallow and brain processes to slow down. Remember carbohydrates are needed for brain food.

5) The body needs to burn carbohydrates first for fat to be burned properly in the aerobic system. When carbs aren't available you can't burn as much fat from the body, and so cellular respiration is not as efficient as it could be.

Add to this, excess protein in your diet does not build muscle! Only hard work and effort does. Surplus protein (amino acids) cannot be stored in the body the same way as glucose and fat, they must be converted to other compounds. Amino acids in excess of daily requirements are broken down to several chemical compounds and finally used to make fatty acids which are stored in the body. This fatty acid cannot change back into protein!

The high-protein, low-carbohydrate dieter believes that this form of diet will make you lose weight. Weight loss occurs during carbohydrate starvation for several reasons, and there can be many downsides to this approach:

- Meals without carbohydrates are boring! Try eating a ham and cheese sandwich without the bread, lettuce and tomatoes, or the steak dinner without the peas and potatoes. People can quickly lose interest in low carbohydrate diets.
- High protein/low carb diets can make a person feel ill (tired, moody, etc.) and when they return to eating normally will have a slower metabolism and gain more fat than before. Studies have shown that over 85% of the people who crash diet not only gain the weight back, they become fatter after dieting!!
- High protein diets can dehydrate you if you don't drink enough water because of a substance called urea. Urea is the body's principal vehicle for excreting unused nitrogen, formed from the breakdown of protein. Because of a higher protein intake, there will be more urea excreted, which means more water being used from the body to wash it out.
- High fat diets will increase your LDL (bad cholesterol) levels increasing your risk of heart disease. Certain diets like the Atkins diet says that their studies found that cholesterol levels didn't rise, but it has been suggested that their studies were done on people with already high cholesterol levels. If they had done the study on a normal, healthy person, you can bet that the artery-clogging cholesterol levels will most definitely have gone up!!!
- The weight loss comes primarily from water, but you can also burn muscle. This muscle degradation can be from skeletal or heart muscle.

Protein is meant to build and repair tissue, not provide you with energy – and certainly not to burn fat! If you are not eating carbohydrates, which are your major supplier of energy, protein can be broken down to help give you energy. When this happens, protein is not being allowed to do what it is supposed to do – build and repair tissue.
Any more information here on this type of diet is beyond the scope of this workshop. For more information on goofy diets, check out our Nutrition workshop.

If you are not eating enough food, your body will break down muscle tissue for fuel. If you are eating reasonably well, your body will always use carbohydrates and fat as fuel and spare the protein.

Some carbohydrate-free diets declare that carbohydrates make you fat. The truth is that eliminating or drastically reducing carbohydrates from your diet will force your body to turn to (muscle) protein for energy. Compare the caloric value of carbohydrates and protein: both are worth four Calories. Contrary to popular belief among weightlifters, aerobic training will not burn off muscle tissue. Everybody should do some form of aerobic activity for the cardiovascular benefit.

Why have low carbohydrate diets become so popular? Since we are always looking for the "magic pill" and want the fastest way to lose weight, people will try anything if it promises a quick fix. I will try to explain the downside of a high protein, low carbohydrate diet. The only benefit is that you lose "weight" fast.

High protein diets encourage you to eat lots of meat. Some encourage you to eat butter, bacon and lots of eggs, but this kind of diet is absolutely loaded with fat and does, contrary to advertising, increase cholesterol levels in humans!!!

Although fat provides energy, it cannot provide it in the form of glucose, a different compound entirely. Glucose is the sole energy source for the brain and nerves. After a few days on a low carbohydrate/high protein diet, your brain is deprived of glucose and nerve cells develop the ability to derive about half of their energy from compounds known as ketone bodies (but they still require glucose as well). Prolonged elevated levels of ketone bodies in the blood can be damaging to the body's organs and systems.

With carbohydrates depleted, these cells demand glucose from the only alternative source, protein. This protein will come from dietary protein and from body stores – muscles, internal organs and other lean tissue in the body. These tissues give up their protein and atrophy, causing weakness and loss of function. When depriving your body of carbohydrates, you will become irritable, moody, tired, confused and have a shorter memory. Studies have shown that low carbohydrate diets slow down the thinking process, mimicking "starvation."

Eating quickly, emotional eating and skipping meals may also cause obesity.

Don't skip meals, especially breakfast. People who skip breakfast have a 5% slower metabolism than those who don't.

The most important take away from this workshop is that weightlifting (to increase your metabolism) and enough protein and carbohydrates will help prevent muscle loss while trying to lose weight.

Positive and Negative Energy Balance

When you eat more food than your body needs this is called a **positive energy balance**. For example, if you were to eat 2500 calories a day but you expended only 2000 a day then you have 500 more calories than your body needs. This puts you in a positive energy balance and means you are eating 3500 extra calories per week (7 x 500 = 3500). Since there are approximately 3500 calories in one pound of body fat (give or take a few hundred as previously discussed) you could gain one pound of fat per week.

However, if you are eating less food than your body requires this puts you in a **negative energy balance**. Say your body needed 2000 calories per day but because of a low-calorie diet you are on, you are only eating 1500 calories per day you are in a negative energy balance. It would make sense to say you would lose a pound of body fat a week.

But it doesn't quite work like that. Dieting is flawed! If you diet and don't exercise, you are losing about 30% muscle. The rest is fat and water. For most of us the water content remains the same as long as hydration is maintained. The goal of dieting is to lose fat! Not muscle.

This type of diet (eating less food) might work well on a short term basis but after a few weeks sets people up for failure. It doesn't take into consideration body composition and diet.

When you eat less, your body responds by lowering your caloric expenditure (your metabolism goes down). It can do the same amount of work as before but uses less calories to do so. This is called adaptive thermogenesis (also called starvation mode).

Unfortunately, our bodies are very clever at preserving fat stores. When you go into starvation mode (eating a lot less calories than your body needs), the body preserves fat stores. When insulin is low (think low carbohydrate diet), thyroid hormone production is decreased, which decreases your metabolism. This can occur in as little as 24 hours of starting your diet!!

The problem with this is that when you start to eat "normally" again, your body will react and store as much fat as it can in case you go into starvation mode again. I'm sure you have a friend or relative that is always on a diet. They may lose a few pounds (maybe even a lot of weight), but they soon gain it back again when their diet is finished.

After bouts of dieting, the body returns to its "normal" weight, but then consists of more fat tissue and less lean.

It is important to eat well, eat clean and add exercise to your routine. Then you don't have to count calories. Eating well is simple if you eat mostly natural foods. Eat high quality foods and avoid packaged food, especially those that have a lot of fat and a lot of sugary food. Stay away from foods that leave grease on your fingers or tongue. You could eat a sink load of green leafy vegetables that wouldn't have the calories that a small plate of French fries has.

To Eat or Not to Eat Before Exercise

You may be the type of person that doesn't eat before they exercise. There is a lot of information about intermittent fasting or simply not eating breakfast. Some people believe that if they do not eat before exercise, the body will use the stored fat instead of the carbohydrates in the food you ate. It doesn't quite work like that and this causes problems for two reasons:

1) if you exercise without having eaten you won't have the carbohydrates available to keep you going. You may become fatigued, dizzy or nauseated part of the way through your exercise.
2) You won't be burning fat as much as you would if you had eaten something. Remember we need carbohydrates to help initiate fat burning.

Studies done at the University of New Mexico have shown that people who eat before they exercise burn more fat than those that don't!

Exercising without having eaten first burns a slightly higher *percentage* of fat but the total number of calories burned is a lot less. This is because when you eat you have the fuel to exercise longer and harder. When you can exercise longer and harder you will get more fat burning *after* your exercise. This means the total number of fat and total calories is greater if you eat first. So, don't skip breakfast! Breakfast means to break the fast!

Metabolism

The metabolic rate is the rate at which you burn calories. The factors affecting metabolism in order of the biggest impact to the least is as follows:

Muscle tissue. The more you have the higher your metabolism. If you strength train you increase your muscle tissue - and your metabolism goes up. It's quite simple really. If you want to burn calories, you must increase your muscle mass.

How often you eat. If you don't eat on a regular basis your metabolism slows down. This occurs because you don't have enough energy to meet the basic needs of the body so the metabolism will slow to match the energy input. For people who skip meals or deprive themselves of food by going on ridiculous diets, are doing themselves a disservice. Not only are they not getting the foods that they need to fuel their body, but they are not eating the foods they enjoy. Some of the

low fat diets or diets that deprive you of some of the nutrition foods (like carbohydrates) result in poor hormone production with leads to a lower/slower metabolism. More on this in Nutrition below.

When you don't eat your body literally catabolises itself. If you don't get the energy you need to make it through the day, then your body goes through gluconeogenesis. The body basically makes carbohydrates out of non-carbohydrate products - protein. Since protein is meant to build and repair tissue and not a major source of energy, you can see the repercussions associated with using protein as a fuel. This will be discussed further on in Nutrition.

The absolute worst thing you can do to your metabolism is to skip meals. Doing so will cause your metabolism to decrease as the body is trying to conserve energy because it thinks it is starving. As a result, it takes less energy to fuel you. The problem with this is that you won't have the energy to do things you need to do.

Activity level. Of course, you need to exercise, but if you don't eat the foods you need to sustain your body, your metabolism. They type of exercise you do has an effect on metabolism. Weight training and interval training can increase your metabolism for up to two days after the workout.

Dehydration. More than 70% of the body's functions take place in water. Not drinking enough water causes all your systems to slow down and causes a lot of stress on the body.

Genetics. You can thank your parents for the amount of muscle cells you have. It is up to you if you keep them active. You can't change genetics. You are stuck with the colour of your eyes, the fat distribution on your body and the amount of muscle. But genetics is nowhere near the top of the list for effect on metabolism.

Hormone production. In my 35 years of personal training I've had literally dozens and dozens of people (usually women) blame their over fat body on a low thyroid. Again, it isn't at the top of the list for what decreases metabolism. Lack of exercise and too much food is what causes your body to be over fat. Usually people who eat poorly eat too much simple sugars which causes insulin levels to be unbalanced. THIS is what causes an effect on your metabolism (and energy level throughout the day). More on this in Nutrition.

Stress. Stress is unavoidable and, in some cases, essential (think about the stress you felt when preparing for an exam. It may have caused you to study more and think about the exam. However, if you didn't do that you may not have been as well prepared for the exam). What stresses you out is an individual phenomenon. A friend of mine once said to me " I don't know how you get so much done. It stresses me out just thinking about it." However, this friend has been on a diet since 1978, has tried every diet under the sun and is still over fat. How you handle stress will determine

how it affects your body. Many of us A type personalities thrive on stress to make our lives exciting, enjoyable and productive.

But how does stress affect metabolism? When you are stressed the sympathetic nervous systems is activated and adrenaline (also called epinephrine) and cortisol are released. The sympathetic nervous system is responsible for your "fight or flight" response and is constantly activated to keep your body at an even level (homeostasis). Adrenaline is a hormone that regulates heart rate, blood vessels and respiratory pathways. And it shifts metabolism. When you are stressed out and heart rate and breathing rate increases, adrenaline works to slow everything down to protect the body. As a result, your metabolism slows down to match it.

Having too much stress in your life simply makes you move slower. Add to that too much stress can cause health problems and depression.

Cortisol, your stress hormone, is released when you are stressed out. Repeated stress activates the sympathoadrenal system releasing both adrenaline and cortisol which increases insulin resistance (and increasing your chances of getting adult onset diabetes) and your chance of obesity and a host of other (and to some extent life threatening) health issues.

Chronic stress leads to hyperactive hypothalamic-pituitary-adrenaline which in turn leads to decrease fat metabolism, increased appetite, anxiety, depression and activation of lipoprotein lipase which deposits visceral fat – all of which leads to increased weight and higher chances of obesity. Which can cause increase chances of heart disease and cancer. It should go without saying that you should control stress as much as possible. For more information on stress and ways in which to control it, contact Body Blueprint for the Stress Management workshop.

Age. Your metabolism doesn't know when you have a birthday. Your body will slow down with disuse - not old age. The less you move, the weaker your muscles become, the lower your metabolism gets. It's quite simple.

Like a machine, your body requires fuel (fat and carbohydrates). It burns the fuel and either uses it immediately (kinetic energy) or stores it for future use (potential energy = fat on the body). We need energy for every function our body performs.

The efficiency with which we use food energy is profoundly affected by the way we exercise. Muscles are the body’s engines. The more muscle you have, the more fuel you burn. Compare the human body to a car: the bigger the engine, the more gasoline you consume. Muscles burn approximately 35 calories per pound per day – fat consumes only 1 calorie per pound per day. Muscular activity provides the body with heat and oxygen (via the blood), locomotion and a host of other necessities.

Gimmicks

There are many "gimmicks" on the market it is hard to know what to believe. Some of your clients may ask you about the quickest way to shed those unwanted pounds. Here are some of the fat loss schemes you may come across.

Saunas and Steam Baths

Hot baths, steam rooms and saunas do not speed up your basal metabolic rate, they simply make you hot. To burn fat, you must use the fat as a fuel. If you get hot you sweat; the sweat is again just water, and not fat, that you are losing. Steam baths and saunas do not melt off body fat; rather they dehydrate the person, so the scales show a loss of weight.

Vibrating belts

These machines are intended to break up fat by jiggling parts of the body, while the person leans passively on them. While they may provide pleasant stimulation, without expenditure of effort there is no expenditure of energy, so no decrease in body fat.

Diuretic and Water Pills

When taking a diuretic, water excretion is increased, causing sudden weight loss. An individual who fails to distinguish between fat and water loss may consider this to be desirable; however, the weight loss is due only to a loss of water, achieved by temporary dehydration.

Diet Pills

Both prescription and over-the-counter diet pills can be obtained. To help with weight loss, some doctors prescribe amphetamines (speed), such as Dexedrine and Benzedrine. These drugs temporarily reduce appetite. However, once the patient stops taking the medication, the appetite returns to normal, and the weight loss (and often more) is regained, so the user has the problem of getting off the drug without gaining weight. The only answer is a permanent change in eating behaviour. Pills will not help!

Rubber Suits & Salon Wraps

Rubber suits are dangerous because their insulating properties can trap body heat and cause heat injury. Water, not fat, is lost. During a salon wrap you are put in a warm room, wrapped tightly with a plastic type wrap (remember – fat is compressible) and offered coffee (a diuretic). After you are measured and weighed you pay your money and leave. You have lost girth (fat has been compressed) and weight (water). It doesn't take long for everything to go right back to where it was.

Weight Loss vs. Fat Loss

Weighing the body is not an accurate means of gauging fat loss. Under the positive influences of an exercise program, fat will be lost but the weight will be replaced by lean muscle mass and could result in a net weight gain! Lean tissue takes up less space and is denser than fat, at a ratio of approximately 3:1.

Many products on the market and those being used in fitness facilities claim that they can measure the amount of fat and lean tissue on the body. Each has its own drawbacks.

Skin fold measurement can be done relatively easily and quickly. It is not the most accurate measure for several reasons. Fat is compressible, so if the calipers are held too long in one spot or, if the person who is taking the measurements takes them on the wrong site, it won't be an accurate reading. Calipers also only measure fat under the skin and not intramuscular or visceral fat. Women tend to carry fat more subcutaneously (under the skin) and men carry fat more intramuscularly (in the muscles) and the readings are not gender specific.

Underwater Weighing requires a very expensive and bulky apparatus. It doesn't take into consideration bone density, which can vary with many factors including gender and race. Underwater weighing tends to overestimate fat in body builders. It is difficult to do this test as you have to exhale as much air from your lungs as you can, and then get dunked underwater. Ever tried this? Not the most comfortable feeling.

Bio-Impedance testing shoots an electric current through the body, which goes through lean tissue more slowly than through fat. A number is then fed into a computer that estimates the amount of fat, muscle and water on the body, but is only accurate if the subject is fully hydrated and hasn't drank coffee or exercised that day. It can track short term changes, but the accuracy decreases the more fit a person becomes.

Girth measurements and how your clothes fit are the easiest ways to tell if your body is changing. Even though a tape measure can't tell you how much fat you have on your body, it is a good indicator of changes towards a leaner body composition.

Spot Reduction

Spot reduction by working specific muscle groups is impossible, since the muscles do not "own" fat that surrounds them. Fat is shared by all muscles and organs. Once fat is required to make energy, it leaves the storage cell, travels to the liver and through the blood stream to the muscle cell that requires the energy.

Conclusion

Weight management should be well rounded. Emphasise enjoyment of food and physical activity combined with an awareness of things we can change and things we can't. Learn to accept ourselves for who we are.

Strength training will increase your metabolism by making the muscles larger, tighten the muscles and improve the appearance of fatty areas. Strength training also increases your metabolism since muscles need energy to survive. One pound of muscle burns approximately 6.5 calories per hour. One pound of fat requires only 1.2 calories per hour

To burn more fat, you need to work harder, or longer. Or, if you can, do both. If you want to burn fat and decrease the amount of fat you have on your body, you need to include cardio and resistance training into your fitness regime.

Move more and sit less. If you aren't into HIIT training do something you enjoy. Just don't sit. We need to exercise at least 5 hours per week.

Eat cleanly. Practice portion control, eat healthy, clean, nutritious foods and eat less high fat and simple sugars. Eat lots of fruits and vegetables and fibre including beans and whole grains. Enjoy a variety of foods. Cut out any excess fat and avoid saturated fats.

Sugar is the worst offender when it comes to putting fat on your body and causing health issues. Stop drinking soda, limit alcohol and avoid refined carbs like white rice and white bread.

Stop dieting! Don't deprive your body of the food you need. If you eat less calories, metabolism will go down, you get less nutrients and, for most of us, less enjoyment.

Do the 80/20 rule: 80% of the time eat healthily; 20% of the time enjoy "other" foods that are not part of the 4 food groups. An all-or-nothing approach doesn't work very well when it comes to eating. Just imagine how boring life would be if we couldn't occasionally indulge in a bowl of ice cream or a beer.
"Do it, enjoy it – then get back on track! Don't feel guilty for eating something you enjoy."

Get enough sleep. People who don't sleep enough often don't have the energy to exercise. A 16-year study done at Oxford University (Epidemiol, A 2006) showed that over 1/3rd of the people who got less than 6 hours sleep a night gained more than 30 pounds over the next few years. The exact mechanism isn't known.

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Instructor Information

Christina Truscott, who founded Body Blueprint Fitness Education in 1986, has taught thousands of students across five continents, and trained fitness professionals to become Personal Trainers, Group Fitness instructors, Older Adults instructors, Aqua Fitness instructors and weight room attendants, both in-class and online. She is the author of over 60 workshops and 5 course manuals used for continuing education, certification and to teach fitness courses. Christina's course materials have been used by colleges and universities in Canada and by the RCMP.

The staff at Body Blueprint Fitness Education continue to write new workshops and are here to serve your fitness education needs. To find out more information on a particular course or workshop, please contact us at info@bodyblueprint.com or visit our website www.bodyblueprint.com

