Training, Fitness and Performance
Dr David Marlin

There are three main reasons why we train horses. These are:

1. to make them easier to ride and manage
2. to improve their performance
3. to decrease the risk of injury during exercise and or competition

What is training?
Training can be physical, that is increasing the capacity for exercise or the ease with which a horse can exercise by increasing muscle strength or muscle endurance. However, not all training is “physical”. When we train horses to jump or to learn new movements this often may not affect the horse physically and the improvement may simply come as a result of the horse “learning” or practising the skill.

Training is repeated episodes or bouts of exercise that have a cumulative effect on a horse’s physical or mental capacity for exercise. Improvement in the physical capacity for exercise is what we call fitness. A single piece of exercise has very little impact on a horse’s fitness. It is the combined effect of many repeated exercise sessions that produce a training effect.

We can think of two types of training that we perform with horses. Physical training makes exercise easier for the horse or allows the horse to exercise for longer or allows a horse to run faster or jump higher or further or accelerate faster. These changes come about mainly because with training the locomotory (movement) muscles and the heart (which is also made of a special type of muscle) have a tremendous capacity to change and adapt to repeated bout of exercise.

The other type of training we commonly undertake with horses is focussed more on improving skill and modifying behaviour. Training a horse to load into a trailer or to stand when we mount into the saddle are examples of behavioural training and do not involve any physical changes in the horse’s body. Training a horse to perform dressage movements is primarily skill training but may also have a small physical training component as well. Whilst we are teaching the horse how to perform these movements (the skill training) we may also get some development of the muscles involved in making these movements (physical training).

What is the difference between exercise and training?
Any activity that increases the metabolic activity of muscles (increases the rate at which they are using energy) can be considered to constitute exercise. This results in other changes in the horse’s body including increases in breathing rate and depth and heart rate. These changes occur to help transport more oxygen to the muscles and to remove heat and waster products such as carbon dioxide and lactic acid. Exercise always uses up energy, but does not always result in an increase in fitness.

How does the horse’s body respond to exercise?
Single bouts of exercise have very little effect on a horse’s fitness. Why is this? Lets take the example of an event horse that has been turned out in the paddock for 4 months over the winter. The rider puts together a training plan with daily training exercise starting February 1st for a competition on May 1st. The reason you cannot
expect anything from a single session is because even an unfit horse has a high capacity for exercise. The rider knows that they are going to repeat the exercise perhaps daily for the next two weeks. The horse’s body does not know what’s coming. It will only begin to adapt and change if the exercise stimulus is repeated.

The horse’s body can adapt to changes in the level of daily exercise quite quickly. But if the intensity of exercise is not increased then the horse’s body will adapt but no further changes will take place.

We start with an unfit horse and start trotting for 45 minutes a day. The figure above shows that when we first start training our horse (Day 0) there is initially no increase in fitness. However, the horse’s body soon gets the message and begins to adapt. Fitness increases slowly and then quite rapidly. But after around 10 days of training, the response starts to slow down and plateau. This is because the horse can now comfortably trot for 45 minutes each day. Why would the horse’s body waste energy trying to adapt to be able to canter at cross-country pace for 10 minutes? It won’t. It will only adapt to the level to which it is “stressed” or challenged. It cannot predict what you have in mind for the future.

This gives us our first general rule of training – Change the intensity of the training around every 2-3 weeks.

What can I expect to see as my horse gets fitter?
Training an unfit horse is quite rewarding. If all is going well you should soon notice quite an improvement in your horse’s ability to handle its’ daily training sessions. You may notice after a week or so that your horse maintains a more even pace or even starts to get a little stronger and pull. You may also notice that your horse is sweating less or that when you pull-up he is not breathing as hard. If you are training with a heart rate monitor you should notice that his heart rate is lower during exercise and that his heart rate drops (recovers) much more quickly when you stop exercising. This all points to the fact that your horse has increased his fitness as a result of your
training and that he is now coping with the exercise more easily. This is the point to increase the training load (difficulty). This can be done by increasing speed, distance or using softer surfaces or hills or even working in hotter part of the day and we will look at this later on.

**Training and the law of diminishing returns**
The reason why you often notice the most improvement in your horse’s fitness at the start of your training programme is because training follows the law of diminishing returns. At the start you put in 10 units of training and get 10 units of increase in fitness. But as your horse gets fitter, 10 units of training gives less and less units of fitness.

**Training is a compromise**
No-one can be good at everything. In sport, all-rounders in sports such cricket who can bat and bowl may be very good sportsmen, but are usually not the best as specialised batsman or bowlers. The best batsman are rarely the best bowlers and the best bowlers often bat low down the batting order. The same is true of Olympic
heptathletes. They may be great all round athletes, but none of them is likely to win a gold medal in any of the events they compete in against those athletes who specialise in the individual events. We can think of the event horse as a good equestrian example of the all-round athlete. They do a reasonable dressage and show-jumping, but we would never see them competing at Olympic level in pure dressage or show-jumping.

Why can’t a horse be a champion sprinter over a ¼ of a mile and a champion endurance horse over 100 miles? The answer lies in the physical attributes required for each task. Sprinters require large, powerful muscles to accelerate them and maintain them at a high speed for a short distance. Peak speed can only be maintained for short periods relying primarily on anaerobic metabolism (without oxygen) and lactic acid production. To cover 100 miles requires the ability to run at a fast average speed relying almost entirely on aerobic metabolism (with oxygen). In order to maximise the transport of oxygen into the muscle cells, the muscle cells themselves are thin and packed with mitochondria (where the oxygen is used to produce energy in the form of ATP) and surrounded by an extensive network of capillaries (small blood vessels). The muscles of a sprinter are the exact opposite. The fibres are big, have few blood vessels (because oxygen is of lower importance) and have few mitochondria.

The reason a human marathon runner and a human sprinter look different is mainly down to muscle bulk. The same is true for the ¼ horse and the endurance horse. Most of the reason why the horses have different muscle is due to different genes.
Can you train a born sprinter to be better at endurance and vice versa? The answer is yes. But, training a ¼ horse at speeds that will develop its aerobic capacity will have two main effects. It will lose some muscle bulk, it will become better at using oxygen, it will improve its endurance performance but it will also become slower over a ¼ mile. And, it will never be as good an endurance horse as a sprinter. The same is true for an endurance horse. We can improve its speed over ¼ mile but this will be at the expense of its endurance capacity.

The reason a horse cannot excel at both sprinting and endurance is because the type of muscle development is in opposite directions. If you train a horse with a combination of sprint and aerobic (endurance) type exercise, you will not maximise sprinting speed nor endurance capacity, but end up somewhere in the middle…a horse that will be moderately fast over moderate distances.

**Getting the right balance between fitness and risk of injury**

If we were to enter an unfit horse in a race there are two things we could expect to happen. The first is that the horse would perform poorly, and in all probability finish last and way behind the rest of the field. The second consequence we might expect is for the horse to pick up an injury. So unfit horses are at risk of injury and poor performance. We know that fit horses perform better but are they at a decreased risk of injury? Unfortunately, scientific studies show us that orthopaedic injuries (injuries to the limbs) are very common in horses in training. Horses that are either trained by covering high numbers of miles at low speeds or those that cover shorter distances at high speeds are both at risk of injuries. Good training is about balancing fitness, performance and risk of injury.
Danger Zone
Target Zone
Training / Increasing Fitness
Performance
Risk of Injury

Weeks Of Training
Fitness
Training intensity too low
Low Fitness
High risk of “wear and tear” injuries

Training intensity increasing too rapidly
High Fitness
High risk of injury

Weeks Of Training
(1) (2) (3)
If every 2-3 weeks the intensity of training is increased, but if the increases are too big (see 1), then there is a high risk of injury. In young racehorses the injury may be sore shins or even a fracture. If the intensity of training is increased every 2-3 week but the increase is too small, then fitness increases more slowly (2) and this may result in “wear and tear” type injuries to structures like the foot and joints (arthritic conditions).

Too big an increase in Training Load
Weeks 1 and 2: Trot 30 min per day
Weeks 3 and 4: Medium Canter 2 miles, 3 days per week
Weeks 5 and 6: Gallop 2 miles, 3 days per week

Too small an increase in Training Load
Weeks 1 and 2: Trot 30 min per day
Weeks 3 and 4: Trot 40 min per day
Weeks 5 and 6: Trot 50 min per day

**How do I know how hard exercise is for my horse?**
How hard a piece of exercise is for a horse depends on some factors specific to the horse such as it’s innate or genetic ability or talent, its current level of fitness, its age and any health problems or injuries.

How hard a piece of exercise is also varies with other factors such as:

- Speed
- Distance/Time
- Weight carried
- Terrain
- Going
- Climate

Thus, exercising fast for a long time carrying a heavy weight uphill on soft-ground in a hot climate would be about as intense an exercise that you devise for a horse. Similarly, very low intensity exercise could consist of walking for 10 minutes carrying a small child down a slight hill on firm ground in cool weather.

**How often do you need to exercise a horse to get it fit?**
A large number of conventional training programmes dictate that horses should be exercised 6 days a week with one day off. In recent times other trainers have experimented with training regimens where horses are exercised twice a day for 7 days a week. Quality of training exercise rather than quantity is extremely important. For aerobic training, horses may only need to be trained 3 days per week. This does not mean that they cannot be ridden 6 or even 7 days a week, simply that structured exercise sessions should be undertaken every other day. A common type of training that is both ineffective and likely to lead to injury is the concentrated type of training that sometimes occurs when people have to work and manage their horses. In this situation the training may be “shoe-horned” into the weekends, with sessions on a
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Friday, Saturday and Sunday and no further quality exercise until the following weekend.

The horse’s body needs time to adapt to the stresses of physical training. Piling on day after day is more likely to lead to injury and also be less effective in getting horses fit. Why? Because although three successive days of hard training may initially generate a bigger training response, because the stimulus is not repeated again the effect starts to decline. This type of training will have some effect, but not nearly as great as quality bouts of exercise every other day.

Understanding training load
Training load is the “stress” you place on your horse’s body over a period of time. The type of stress that results in an increase in fitness and performance is physiological rather than psychological. Training load is determined by factors such as:
- Intensity – how intense (hard) the load (work/exercise) is
- Duration – how long the load is applied
- Frequency – how often the load is applied e.g. twice daily, daily, every other day, weekly

Do all horses respond the same to training?
The answer to this question is definitely no. How you respond to training to a large extent depends on a horse’s genetic makeup and of course any injuries, health issues, management issues, previous training and age.

To start with a simple example, we can consider two three-year old racehorses. One is well-bred and has a large heart and a tremendous capacity for exercise, even when unfit. The other horse is moderately well-bred. We train both horses together on the track. They both gallop together at the same speed and for the same distance with jockeys and saddles of the same weight. Which horse finds the work easiest? If we do this 2-3 times a week, in a month which horse will be fitter? The answers are straightforward: the horse with the lesser ability will find the training harder, but this horse will increase in fitness more. At the end of the month the more able horse may still have greater potential, but in order to realise that potential we are going to have to
up his training speeds and or distances over our moderate horse. We can no longer train them together.

If you find the horse example difficult to follow, imagine a serious amateur marathon runner and an Olympic marathon runner who moves in next door. The two become friends and decide to train together. The problem is that if they run at the amateurs pace, the Olympic runner does not even break a sweat and goes home feeling he has only warmed-up. If they run at the Olympic runners pace, the amateur gets left behind before they have even run the first few miles.

How can we train both athletes at an appropriate level in order to maximise their fitness? How can we avoid training the amateur runner or the moderate horse too hard or the Olympic marathon runner or well-bred horse too softly? We need some simple indicator of how hard the body finds exercise. Under laboratory situations the Gold-standard measurement for athletes competing in aerobic events (those that rely primarily on energy generation using oxygen) is how much oxygen is being used as a proportion of the maximum rate that oxygen is being used. This is technically very difficult to measure in horses even on treadmills let alone under field conditions. Fortunately, a very good alternative is to measure heart rate during exercise? Heart rate may not be such as useful indicator of training load in very short, high-power events such as barrel racing or ¼ horse racing, in which the majority of energy is derived from anaerobic metabolism. But as can be seen from the figure below, most equestrian disciplines rely primarily on aerobic metabolism.

![Heart Rate Chart](image_url)

**Anaerobic** – energy generated without oxygen which leads to lactic acid. Can only be used for short periods of exercise.

**Aerobic** – energy generated with oxygen. Becomes more important the longer the exercise is.
Heart rate as an indicator of exercise intensity

Why is heart rate a good indicator of exercise intensity? The harder a horse works, the more the muscles contract and the more energy in the form of ATP is used. The more ATP is used the more energy must be provided either from the anaerobic (without oxygen) breakdown of glycogen to produce lactic acid or by the breakdown of glycogen or fats with oxygen in mitochondria (aerobic metabolism). The harder a horse works, the more oxygen its muscles use. The more oxygen that is required at the muscles, the faster the heart must pump in order to deliver sufficient oxygen. So oxygen consumption (VO₂) by the muscles and heart rate both increase together with increasing intensity of exercise.

Heart rate and oxygen consumption by the muscles both increase linearly initially. That is if the rate of oxygen usage doubles, the heart rate must also double. However, a point is reached where neither can increase further and a plateau or maximum rate is reached. The maximum heart rate is reached just before the speed at which maximum oxygen uptake is reached. This is normally when the horse is almost at its maximum pace. The horse can still run even faster when it has reached its’ maximum oxygen uptake, but beyond this all the additional energy required must come from anaerobic metabolism with the production of lactic acid.

In simple terms, the faster a horse runs or the harder it works (remembering that trotting uphill in sand in hot weather could be equally as physically demanding as a fast canter on level ground in cool weather) the higher its heart rate will be.

How do we classify intensity of exercise in horses?

There are two practical ways we can try to assess how hard a horse is exercising under field conditions and these both involve using heart rate (expressed as beats per minute or bpm for short). In the first example we simply use a heart rate monitor and we can judge the exercise intensity based on how high the heart rate is. For example:

<table>
<thead>
<tr>
<th>Heart rate</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>30-40 bpm</td>
<td>Rest</td>
</tr>
<tr>
<td>40-80 bpm</td>
<td>Low-intensity exercise e.g. walking</td>
</tr>
<tr>
<td>80-120 bpm</td>
<td>Low-medium intensity exercise e.g. trotting</td>
</tr>
<tr>
<td>120-160 bpm</td>
<td>Medium-intensity exercise e.g. canter</td>
</tr>
</tbody>
</table>
In general terms this works quite well but there is one limitation. As a horse gets older its maximum heart rate decreases (the same happens in people as well). So whilst a 2 year-old horse might have a maximum heart rate of 230 bpm, a similar breed/sex/weight horse 20 years older may only have a maximum heart rate of 210 bpm. Let’s try and explain why this is important when it comes to exercise.

If we exercise the two horses together and they are galloping side-by-side, then we can say that they are both working at the same absolute exercise intensity. When we measure the heart rate of each horse during the exercise, we also find these are similar at around 210 bpm. Can we conclude the horses are working as hard as each other? In absolute terms, yes we can. They are both doing the same thing. However, in terms of relative exercise intensity, the older horse is working harder. Why?

The old horse has a maximum of 210 and when we measure his heart rate during the gallop we find he is working at 210 bpm, his maximum. Therefore we can express his relative exercise intensity as a % of his maximum heart rate or \( \%HR_{\text{max}} \) for short:

Relative exercise intensity (\%) = heart rate during exercise / maximum heart rate x 100

Older Horse

\[
\frac{210 \text{ bpm}}{210 \text{ bpm}} \times 100 = 100\% \text{ maximum heart rate (}\%HR_{\text{max}})\]

We can now make the same calculation for the younger horse:

Relative exercise intensity (\%) = heart rate during exercise / maximum heart rate x 100

Younger Horse

\[
\frac{210 \text{ bpm}}{230 \text{ bpm}} \times 100 = 91\% \text{ maximum heart rate (}\%HR_{\text{max}})\]

So what we find is that although both horses are doing exactly the same exercise at the same heart rate, in terms of the relative exercise intensity the older horse is working harder than the younger horse.

Another way to think of absolute and relative intensity is to think of a car. The speed is what the car is actually doing but the rev counter tells you how hard the engine has to work to run the car at this speed. The rev counter in a horse is the heart rate which we can measure with a heart rate monitor.
Differences in relative exercise intensity, even when measured heart rate responses between two horses may be similar can also occur due to difference in breed, athletic (genetic ability), health and fitness.

**Exercise intensity based on % of maximum heart rate**
The table below gives the approximate relative intensities for different values of $%HR_{\text{max}}$ in horses. The actual heart rate values that could reasonably be expected for a 10 year-old sport horse are also shown. The actual values for any horse will depend on factors such as fitness, health and ability.

Approximate heart rate for a 10 year-old sport horse

<table>
<thead>
<tr>
<th>%HR_{\text{max}}</th>
<th>Heart Rate Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;50</td>
<td>below 110 bpm</td>
</tr>
<tr>
<td>50-65</td>
<td>110-143 bpm</td>
</tr>
<tr>
<td>65-80</td>
<td>143-176 bpm</td>
</tr>
<tr>
<td>80-95</td>
<td>176-198 bpm</td>
</tr>
<tr>
<td>95-100</td>
<td>198-220 bpm</td>
</tr>
</tbody>
</table>

**How do we measure maximum heart rate?**
There are two ways we can try to work out a horses’ maximum heart rate. The first is to perform an incremental exercise test either on a high speed treadmill or in the field. This involved exercising the horse, following an appropriate warm-up, at 5-6 different speeds from trot, through canter and up to maximal gallop. Each speed needs to be maintained for around 2 minutes for the heart rate to stabilise. This type of test is most readily carried out on a treadmill as this gives a greater degree of control. To do this under field conditions an oval track of at least ½ mile around is required. The horse is then ridden for perhaps 1 lap at trot, two laps at slow-canter, 3 laps at medium-canter, 3 or 4 laps at fast canter and 4 laps at gallop. This type of test involves working horses quite hard and is not advisable unless you have good facilities.
An easier way to get an estimate of $HR_{\text{max}}$ rather than measure it is to use the following equation:

$$HR_{\text{max}} (\text{bpm}) = 220 \ (\text{bpm}) - \text{age (in years)}$$

This is the same as the equation that is used to estimate $HR_{\text{max}}$ in people as was validated for horses in a scientific study in 2006.

**Some limitations in using heart rate in horses that you should be aware of**

1) *Excitement*

If a horse is excited his heart rate may be increased above the level that is actually required for the exercise he is doing. This is most common when the heart rate is below around 160-170 bpm. Thus, in horses exercising at walk and trot, the heart rate in excitable horses does not always give a true reflection of how hard the horse is working. This is easy to spot with experience.

The trace below shows some good examples of periodic elevations in heart rate in a horse at trot. The horse is maintaining a good steady pace but the heart rate fluctuates up and down from as low as 114 bpm to as high as 156 bpm.

In the trace below, when the horse moves into walk there is a large increase in heart rate which then settles down as the horse continues to walk. This is often observed in horses, even in ones that are not particularly excitable.
Elevations in heart rate that are independent and appear unrelated to the intensity of exercise are also often most common in the early stages of exercise before a horse has been warmed-up. In very excitable horses the heart rate may only be a reliable indicator when the horse is working at a fast-canter (i.e. exercise heart rates would be over 170 bpm) or in the first 1-2 minutes recovery after a piece of fast exercise at canter or gallop. In the figure below, the heart rate drops quickly from the end of the canter (marked by the arrow) but after around 2 minutes there is a small increase of 15 bpm (circled). If the heart rate was measured at this point it could lead us to conclude that the horse had not recovered well.

2) Pain
Heart rate is also elevated by pain. Of course veterinary surgeons use this when making clinical examinations of horses. A horse with signs of colic and a heart rate of 80 bpm is probably in significant pain. Heart rate can also be elevated by horses with lameness or sometimes when there is pain but no obvious lameness. This can be used to the horse owner or trainers advantage, especially if you monitor heart rate regularly.
and get to know what to expect for different horses. If you warm your horse up for exercise you will soon begin to build-up a picture of what is normal for his heart rate. If the heart rate at walk is normally between 60 and 70 bpm and you find that one day it is close to 90 bpm, this is a good indicator that there may be a problem. It could be that your horse has pain or it could be that he has some other illness, such as an infection. Whatever the case, this is an indication to stop riding, check for stones trapped in the foot or other obvious external injuries and look at the horse for lameness. If there is no obvious problem then it may be wise to take your horse back to his stable and take his temperature. A higher than normal heart rate during exercise is a warning sign that should not be ignored.

3) Dehydration
A dehydrated horse will have a higher heart rate than a normally hydrated horse. The heart pumps a certain amount of blood into the arteries with every beat. The muscles need blood flowing through them at a particular rate in order that they can have enough oxygen. If required rate of blood flow is 50 litres per minute and the heart can pump one litre with each beat (known as stroke volume), then we can see the heart would need to beat at around 50 bpm (50 beats per minute x 1 litre = 50 litres/minute). The volume of blood being pumped each minute is known as the cardiac output (litres/minute). However, if the horse became dehydrated then the volume of blood in the circulation would be decreased. This in turn would mean that the amount the heart could pump with each beat would be decreased. If the amount of blood being pumped with each beat decreased to only 0.5 litres, the horse would still need blood flowing around the body at 50 litres/minute, so the only way to now achieve this would be for the heart to pump twice as fast i.e. 100 bpm x 0.5 litres = 50 litres/minute. This is why dehydrated horses have higher heart rates at rest and during exercise compared with when they are fully hydrated.

4) Heat
Exercising in the heat may cause your horses heart rate to be higher than if the horse was exercising in cooler conditions. For example, if you school your horse in the morning the heart rate may only be between 80 and 120 bpm, but the same schooling in the middle of the day in summer may cause the heart rates to be between 90 and 130 bpm. Heat can also cause the horses heart rate to drift upwards over time. This is known as cardiac drift. So if you start trotting on a warm day at a heart rate of 110 bpm, you may find that 30 minutes later the heart rate has drifted up to 120 bpm.

5) Abnormalities in heart rhythm - Arrhythmias
Horses can sometimes develop abnormalities of heart rhythm where the heart does not beat regularly and these can be difficult for heart rate monitors to accurately calculate the true heart rate. If you are having problems getting a reliable heart rate recording from a horse, especially one in which you have previously managed to get good recordings it is worth finding a stethoscope and listening to the heart or feeling for a pulse to see if the rhythm is regular. In fit horses at low heart rates horses do sometimes miss or “drop” beats. The rhythm is essentially normal except that there is sometimes a long pause between beats every 3-4 beats where one beat is missed or dropped:

Beat  Beat  Beat  Beat  Beat  Beat  Beat  Beat
This is perfectly normal and the veterinary name for this is 2nd degree atrio-ventricular or 2nd degree A-V block. If the rate is very low because of 2nd degree A-V block then the heart rate monitor may struggle to measure this. If you don’t believe the rhythm is regular, with the exception of dropped beats described above, then you should seek veterinary advice.

1) Designing and applying Fitness Training Programmes for horses

How you approach training a horse will depend on many factors, including:

- Age (maturity)
- Previous training history
- Previous health problems and current health
- Discipline
- Level of competition
- Temperament
- Facilities available

Basic Rules in Training Horses

1) Many horses are overloaded in training.
2) The most common injuries are orthopaedic and occur during training.
3) Injuries occur to the legs and to the areas in contact with the saddle
4) The goal of training is to improve skill, performance and resistance to injury
5) Horses do not respond in the same way as human athletes
6) Training load should be increased gradually
7) Horses need periods of time to recover physically and possibly even mentally in training
8) Long durations of exercise at low-moderate intensity (heart rates below 160 bpm) will not influence fitness beyond the first few months of training

Facilities for Training

The most basic training facility is usually an all-weather manege or field or land on which a horse is ridden. Working on horses on surfaces that are very soft or very hard and or uneven greatly increases the risk on injury. The risk of injury also increases with increasing speed so it may be worth considering boxing or riding horses to good ground or all-weather gallops if you need to do faster work but your surfaces at home are not ideal. Remember that uphill exercise will make the horse work harder. A gallop on the flat will be approximately equal to a canter up a moderately steep hill (~10% incline). Don’t forget to also consider the environmental conditions. When exercising on hot day with no wind and moderate to high humidity your horse may be working around a third harder than when being exercised on a cool, breezy day. Other facilities that are often used include horsewalkers, swimming pools and treadmills and can all have their use.

Treadmills are ideal for controlled exercise. They have the advantage that the horse works in a straight line and without weight on its back. Treadmill exercise can be used to settle horses that have a tendency to pull and horses that are prone to back problems. It is possible on most treadmills to vary the incline, however trotting horses fast (above 5 m/s) uphill should be avoided as this appears to increase the risk of
hindlimb lameness. Treadmill surfaces are often towards the hard side and may not suit horses with a very upright front leg conformation. Even though the surface is usually harder the treadmill has the advantage that the surface is consistently flat. Treadmill exercise can therefore be used to replace ridden exercise.

Horsewalkers are widely used and give the advantage of controlled exercise at walk and trot. Standard practice is to reverse the direction of exercise so that horse are not always working on the same direction of turning. Horsewalkers are used for warming-up before exercise, for warming-down and as supplemental exercise. They are labour saving but overuse should be avoided. There is currently a question mark over whether round walkers, especially smaller ones, could increase the risk of injury. However, there are many factors to be considered including the surface of the walker and the horses previous history of injury. Oval walkers may offer a more natural way to exercise horses as they combine straight line and turning exercise. A variation on the normal treadmill is the water treadmill. These usually only operate at speeds of walk and trot. They increase the effort above exercise on a normal treadmill as the horse must push its legs through the water.

Another variation on the horsewalker are sea-walkers. A sea-walker is effectively a horsewalker with a circular channel of water in which the horse walks. The temperature of the water is usually maintained around 5°C. These are useful for reducing inflammation in the limbs, especially immediately following hard exercise. When used immediately after exercise the warm-down of the muscles by walking is combined with cooling of the lower legs.

Swimming pools are also often used. These come in essentially two configurations, round and straight. Swimming has the advantage of being “non-weight bearing exercise”. What this means is that although the muscle, heart and respiratory system are being trained when a horse swims, there is no loading on the limbs and so the risk of injury should be lower. Swimming is a good substitute for ridden exercise and can be used for example as a replacement on alternate days. Swimming is however a bit like ridden exercise in that the effort is related to how fast the horse is moving. If a horse is allowed to swim slowly then it will get less benefit than if it is encouraged to work in the pool. Swimming does not suit all horses and can easily be overused. Horses that hollow their backs when swimming may be at increased risk of developing injuries.

Fitness for Purpose
The level of fitness developed through training should be appropriate for the type and level of competition that the horse is being prepared for. For example, the level of cardiovascular (heart and aerobic) fitness that an advanced event horse requires is much greater than for a novice event horse. Similarly, any horse performing dressage does not require the same level of cardiovascular fitness as an event horse.

Dressage
Scientific studies have shown that in competition Dressage horses work at heart rates between 120 and 150 b.p.m. This suggests that the majority of the effort is aerobic. However, because some muscle groups are worked very intensely for short periods of time, there may be anaerobic components to the training and competition. Aerobic conditioning is relatively straightforward. As a rough guide, to improve aerobic capacity the horse should be trained at around a heart rate of 150-180 b.p.m. building
up to around 10 minutes three times a week. For an unfit horse this would most likely equate to slow canter and for a fitter horse, a fast canter. In order to train specific muscle groups involved in specific movements, training can be achieved by performing those movements. The ideal approach is to initially perform the movements for short periods (e.g. 20-30 seconds) with an alternative form of recovery exercise, such as walking or trotting or even cantering for several minutes, in between. This ensures that the muscles do not become excessively fatigued. Also, repeated short bouts of specific exercise result in a greater overall physical training effect that one long intense session. In order to increase muscle size and therefore strength which will make the movements more expansive and easier for the horse to perform, specific strength conditioning can be introduced. This would include exercises such as being long-reined behind a “sledge”, onto which increasing weight can be added or driving in harness. This type of exercise has been shown to increase hindlimb and forelimb muscle size and strength in as little as 2 weeks. Physical conditioning (NOT skill training) of dressage horses that have previously been trained can probably be achieved in around 12-16 weeks.

**Showjumping**

Aerobic ability is probably least important in showjumpers. Whilst there is a significant proportion of the total energy that a horse uses to go around a course of jumps that comes from aerobic metabolism (oxygen), anaerobic metabolism (without oxygen and producing lactic acid) is mainly used for the jumping efforts. For example, a study from Holland in 2006 showed that when horses went round a course of jumps with the poles taken out (i.e. they cantered around the course at the same speed as they would when jumping but there were no jumping efforts) the heart rate (as an indicator of aerobic effort) was only about 1/6th higher whilst the lactic acid (as an indicator of anaerobic effort) was around 4 times higher. This proves that the cantering comes mainly from aerobic but the jumping ability comes from anaerobic. So it would be counter-productive to spend too much time training a showjumper aerobically (i.e. at heart rates between 150 and 180bpm). Most of the training should focus on work at higher heart rates (above 180 bpm), with short periods of intense exercise.

Human athletes rarely train simply by replicating the movements or exercise that they have to do in competition. For example, human hurdlers would train on the track, running and jumping hurdles, but they would also spend a considerable amount of time in the gym. In order to replicate the equivalent of human gym work for horses we need to be a little more creative. Showjumpers, like dressage horses, can also benefit from exercise specifically designed to develop larger muscles. These exercises include pulling exercises such as long-reining behind a sledge, being driven or working uphill on a treadmill in harness against a weight. These types of training have the advantage of increasing the effort without increasing loading on the more injury prone structures such as tendons and joints.

**Eventing**

Training for eventing is challenging as the rider must balance the different requirements of the different disciplines. As we can see from the sections of showjumping and dressage, the type of training we would use for these is not ideal preparation for the cross-country phase. For example, maximising showjumping capacity by specific strength training would be to the detriment of aerobic capacity.
In a number of different studies of event horses, the common finding has been that the intensity of training has often been much lower than the intensity of competition. For example, out of 14 event horses in Australia being prepared for a three-star CCI, the highest heart rates in 13 of the horses were only between 120 and 180 b.p.m. when the peak heart rates during cross-country in these horses were around 195 b.p.m. Therefore, only one horse was exercising hard enough in training in order to be prepared appropriately for competition. A previously trained event horse should be competition fit after 12-16 weeks of training.

**Maintaining Fitness**
Once a horse has reached a suitable level of fitness it is not necessary to maintain the same level of training in order to maintain that fitness level. For human athletes, once they have reached competition fitness, if the training intensity is reduced this usually results in a decrease in fitness and performance. However, once horses have reached competition fitness, they will retain physical fitness even if the amount of weekly exercise is reduced. This of course may not be true for skill training.

**Over-training**
In human athletes a condition known as “over-training” is recognised. In over-trained athletes despite no obvious health or injury problems and despite maintaining their training level, performance decreases. Often any changes in the athletes can be very subtle and hard to detect and may be something as a slight change in mood. Over-training of this nature has been hard to demonstrate in horses. Horses are often recognised to go “stale” and whether this is simply a psychological problem or a problem with a physical basis is hard to know. What is more common in horses is “overloading”. This is where horses are trained too hard to the extent that they suffer injury.

**Tapering**
Most human athletes use an approach known as tapering when approaching competition. This involves maintaining the intensity of training but decreasing the amount of time spent training. This approach has been shown to allow muscles to fully recover strength and to maximise energy stores and result improved performance. Scientific studies have shown that Standardbred racehorses that were tapered ran faster than those that were conventionally trained i.e. normal training was maintained right up to and including the day of competition.

In many equestrian disciplines it is not uncommon to observe riders who rather than decrease or even maintain training intensity as they approach competition, actually start to ride harder, more frequently and for longer. In some cases, where the sport has a high skill component this might be justified for individual horses, but from the physical component of performance this is almost certainly likely to be detrimental. In many cases it may be that the main reason for increased riding is related more to the riders anxiety than the horse actual need for increased work and working closely with a sports psychologist to address this may be highly beneficial.