

The 10 Principles of Exercise Physiology

Basic principles you can apply to your everyday training to boost your horse's performance.

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Elite athletes are always looking for an edge over their competitors, and many times they find that edge by applying the science of exercise physiology to their training. From energy metabolism to the kinetics of joint movement, exercise physiology is geared toward optimizing performance, shortening recovery time, and improving fitness.

While it's easy to get lost in the literally thousands of books and scientific articles on this subject of exercise physiology, here are 10 basic principles that you can apply to your everyday training regime to boost your horse's performance to the next level.

The first five are general theories that serve as the framework of all good training plans, while the last five are more scientific principles that will help you understand how your horse's body responds during and after exercise.

As always, these principles only apply to healthy horses in good body condition, and it is recommended that you consult your veterinarian before beginning an exercise program.

1. A physiological system will adapt to stress by making itself more resistant to future stresses (the " Overload Theory ").

The body sees exercise as a stressor, in that it's something that requires more work than usual. Each time your horse exercises, his body adapts a little bit more, until the exercise becomes " normal " and ceases to be a stressor. While this might sound like a simple concept, the body will adapt in very specific ways to stressors of different types, frequencies, and intensities.

The key to using the overload principle to your advantage is to determine the correct exercises to stimulate your horse's body to adapt in a way that will maximize his performance.

2. The adaptation to overload occurs during rest periods.

While some of your workout sessions should challenge your horse to perform at a higher level, it is the time between these sessions when his body actually undergoes the adaptations necessary to improve. Depending on the nature and intensity of your workouts, full recovery can take anywhere from a few days to a week or more. Free exercise or light trotting and stretching might help, but additional stressful exercise can cause injury and overtraining. Unlike human athletes who can verbalize feelings of pain and fatigue, horses have few means of telling us when they have recovered. Be on the lookout for signs such as an elevation in resting heart rate, decreased range of motion, or muscle soreness when touched, all of which indicate that your horse isn't ready to return to his regular schedule.

3. All individuals respond differently to training.

At the heart of science lies this one small fact: one size does not fit all. While general principles apply to all individuals, putting these into practice is more art than science. Innate differences in aerobic

capacity, muscle fiber type, conformation, and even temperament affect how a horse will respond to a conditioning program. Only through trial and error will you be able to determine what works for you and your horse. Science is the framework that should guide the development and execution of your training program, but there is no substitute for experience and common sense.

4. All adaptations are reversible.

While the precise timeline varies according to the individual horse and the type of training, the unfortunate truth is that it takes about twice as much time to build up fitness as it does to lose it. If you went out of town for two weeks over the holidays, you can count on about four weeks of training to get your horse back to where he was before you left. And although it's probably easiest to notice the deficits in aerobic fitness, your horse will actually start losing bone density before his aerobic fitness starts to decline. Research has shown the skeletal system is compromised during layoffs that last several weeks, so be sure to take this into account when starting up again after a break.

5. There is a rate-limiting factor in all processes.

While this is more of a general scientific principle, athletes of all types would do well to remember it. While there are many different factors all working together to contribute to your horse's overall level of performance, there are only a very few that are preventing you from progressing. Whether it's a lack of flexibility, insufficient muscle strength, poor balance, or any of a number of other problems, the key is to figure out what the weaknesses are and spend your time fixing them. It won't do you much good to practice doing all the things that come easily to you and your horse, but mastering what is difficult will lead to much greater rewards.

6. Aerobic performance is determined by how much oxygen the cardiovascular system can transport to the working muscles and how efficiently those muscles can utilize the oxygen.

Known as the Fick principle, this theory states that maximal oxygen consumption, which occurs during maximal aerobic exercise, depends on heart rate, stroke volume (how much blood is pumped in one heartbeat), and the amount of oxygen that the muscle can extract from the blood. Aerobic training increases the size of the heart, which increases stroke volume, and also causes skeletal muscle to synthesize more metabolic enzymes that help the muscle use oxygen more efficiently. However, maximal heart rate does not increase with training. In fact, the heart rate of fit individuals is generally lower than that of unfit individuals; stroke volume and oxygen extraction are so much improved that the heart doesn't have to beat as many times to deliver the same amount of oxygen to the muscle. This makes heart rate a very useful tool in assessing how fit your horse is, as well as how hard he's working during a training session.

7. Skeletal muscle fibers are able to change their phenotype (collective characteristics) to match the demands placed on them.

This phenomenon is known as myoplasticity, and it encompasses everything from changes in fiber shape and size to alterations in protein expression and cellular metabolism. For example, weightlifting causes muscle fibers to get bigger and produce more contractile proteins, making them able to generate more force when they contract. In contrast, aerobic exercise increases the expression of oxidative enzymes, which help the muscles use fats more efficiently. This means that you need to spend time conditioning your horse to do exactly what he'll be asked to do in competition.

8. Improvements in muscle strength are caused by both muscular and neural adaptations.

While muscle adapts in its own way to new challenges, the nervous system itself can "learn" how best to coordinate new movements.

By recruiting the most appropriate muscle fibers, activating other muscles to stabilize the rest of the body, and improving the synchronization between different muscle contractions, neural adaptations can lead to large improvements in performance before any muscular adaptation occurs. This idea is particularly important in horse training, as we often ask our horses to perform new movements that require both strength and coordination.

Apply this principle by dividing new movements into several steps and allow your horse's nervous system to learn each step individually before trying to combine it into a complicated pattern.

9. Blood flow increases in response to the metabolic byproducts of exercise.

While large arteries are, essentially, pipes that transport blood around the body, smaller vessels called arterioles fine-tune the supply of blood to each organ. The arterioles act like a faucet: they dilate to allow more blood to flow through, and constrict to divert the flow of blood elsewhere. Arterioles located in skeletal muscle will dilate in response to changes in pH, oxygen and CO₂ content, and certain metabolites that are produced during exercise. This allows more blood to flow only to the exercising muscle groups where it is needed most.

This principle is one of the many reasons why good athletes always warm up prior to a workout. A warm-up ensures that muscles will have enough blood flowing to them to perform at high intensity.

10. Even modest levels of dehydration can impair performance.

The general rule of thumb is that even 2% dehydration can impair athletic performance. As the old saying goes, you can't make a horse drink, but there are some simple strategies for ensuring that he doesn't get dehydrated. In addition to always giving your horse access to fresh, clean water, be sure that you offer him a drink during your workouts, especially if you ride for more than an hour at a time.

Electrolyte replacements can be a good option in the summertime, but use these with caution, as excess salt can be as much of a problem as dehydration.