SECTION 2

Periodization:
The Implementation of Stress

2.1: MICROCYCLE: UNDULATING MODEL

Stress is the key. Without stress and its derivatives, athletic performance stagnates. However, simply understanding that stress is the most important component to training will get you nowhere if you don't have a structured system in place that gives guidance and organization to its application. Simply walking into a weight room every day to have an athlete perform ten sets of ten reps on the back squat, six days a week for six months straight will not make him a better athlete. In fact, a reckless application of stress such as this will be more detrimental to athletes in the long run than if you didn't stress the athletes enough because it will lead to severe overtraining—complete adrenal and psychological fatigue. Instead, a coach needs a periodization method that allows for the application of high levels of stress within a framework that gives optimal recovery time between workouts to ensure proper, continuous adaptation to stress.

To achieve that goal, I use a microcycle method known as undulated periodization. Undulation can be defined as *the acute variation of volume and intensity on a weekly (microcycle) or daily basis*. It is the most effective means of applying stress to the human body within the athletic model. The value to an athlete of using a model such as this, using variation of load and volume on a workout to workout basis, became apparent to me when I stumbled across an article published by Dr. Anatoly Bondarchuck in the 1970s. In the study, he performed an experiment with a very simple goal—find which loading method for the back squat would have the greatest positive impact on vertical jump scores over a training period of six weeks. The vertical jump is often considered to be the best marker of explosive, athletic performance. In this study, there were three groups. Group one used loads equaling 50 percent of their maximum loads, group two used 90 percent of their maximum loads, and group three used a combination of 90 percent and 50 percent of their maximum loads. As you can see by the chart below, the combination group outperformed the 50 percent and 90 percent groups by a large margin.

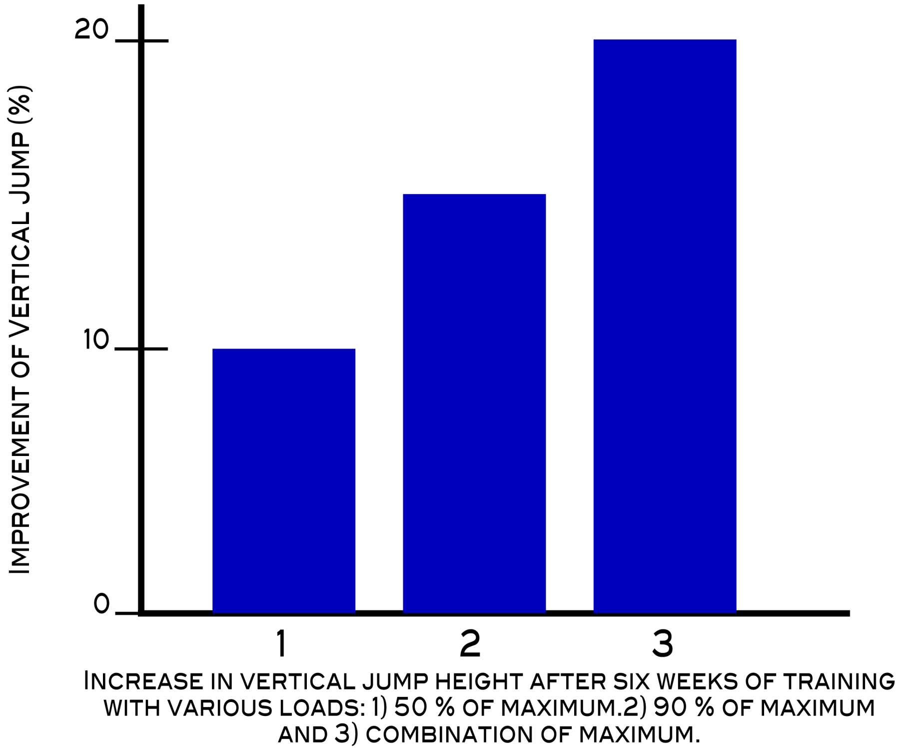

Figure 2.1: Graph showing the results from Dr. Bondarchuk's 1970 study.[4]

The brilliance of this study and its implications for programming lies in its simplicity—pre-test the vertical jump, allocate lifters into three groups, squat for six weeks, and retest. There is little room for confounding factors to influence results. And even better, the variable marker in the study, the vertical jump, showed the transferability of each loading method to dynamic, explosive movement as would be required in sport. The study found that using a combination of various loads elicited the best results, resulting in a higher vertical jump. Undulation not only allows for a wide range of variability within the microcycle but also allows for changes in load and intensity on a daily basis, ensuring that the athlete is constantly stressed at a level sufficient enough to promote proper, constant adaptation. This model will work for athletes in any sport that requires dynamic muscle movement.

[4] Bondarchuk, A (1970). Effect of mixed load training on vertical jump performance. *Soviet Sports Review.*

CLASSIC UNDULATING MODEL

The undulating model was first made famous by the Bulgarian National Weightlifting team in the 1970s. Their coach during this time, Ivan Abadzhiev, is to sport performance what Einstein is to physics. The man was a genius. In this model, what you essentially have is a progressive increase in intensity throughout the week with a decrease in total volume. To make simple the understanding and application of the undulated model, I will use a three-day, weekly training schedule (Monday, Wednesday, Friday) to explain its workings. Once you understand the basic principles and foundations of this method, you will be able to use and apply them to programs of varying training day lengths (six days, five days, four days, etc.).

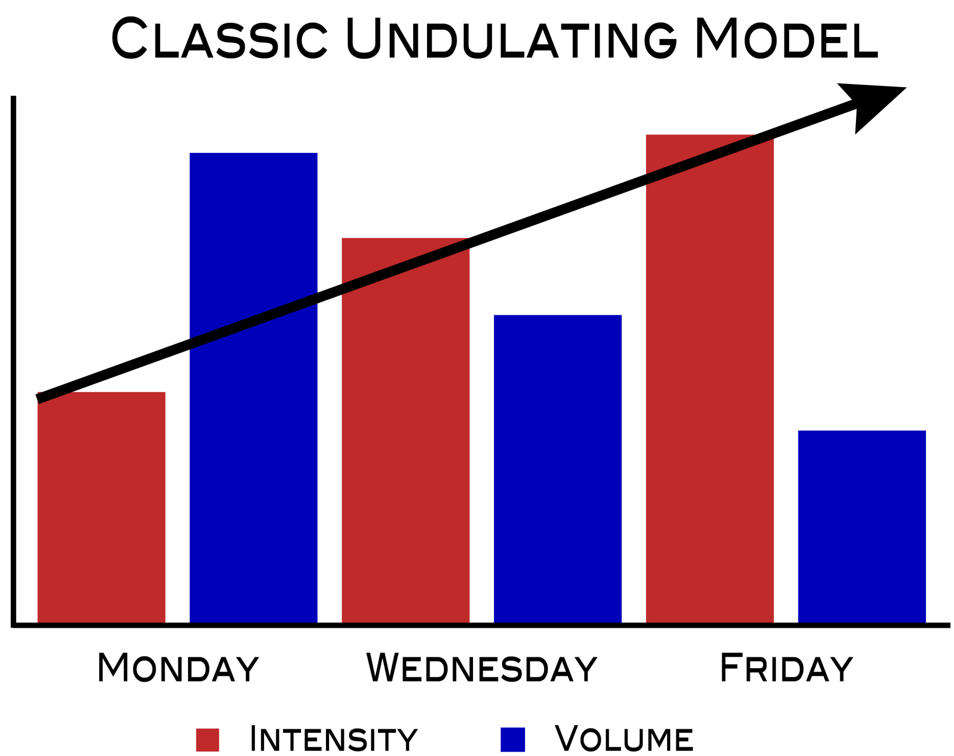

Figure 2.2: Graph depicting a three-day classic undulating model. It shows a parametric relationship. As intensity increases throughout the training week, volume decreases.

Table 2.1 depicts the loading schemes for three different mesocycles that would have typically been applied during training. As you can see, the loading percentages (intensity) increase as the week progresses. This, in turn, requires a decrease in associated volume.

TABLE 2.1: Three-Day Classic Undulated Model Loading			
Mesocycle	Monday (% 1RM)	Wednesday (% 1RM)	Friday (% 1RM)
Strength Method: Above 80%	High Volume 75%–80%	Moderate Intensity 82.5%–87.5%	High Intensity 90%–97.5%
Speed Strength: Between 55%–80%	High Volume 55%–65%	Moderate Intensity 65%–72.5%	High Intensity 80%–75%
Peaking Method: Below 55%	High Volume 25%–35%	Moderate Intensity 40%–45%	High Intensity 50%–55%

For all the success that this periodization model had for Bulgarian weightlifters, I found it didn't work at all for my collegiate athletes. In fact, the first year that I changed my programming model to an undulating one, most of my track athletes' performance declined. It dawned on me fairly quickly what the problem was. The Bulgarians had been very open about their use of anabolic steroids within their training schools during the 1970s and 1980s to promote "faster recovery" for their athletes. Simply put, my collegiate, drug-free athletes, could not recover from the high volume on Monday's training day according to the model; it beat them up. As a result, they couldn't come back and do quality work on Wednesday. Furthermore, the added work from Wednesday simply prolonged their adrenal and neural fatigue through Friday, again inhibiting the athletes' ability to do quality work during the workout. It took them through the weekend, when they had 72 hours of rest between workouts, for their bodies to recover. Consequently, I was only getting one good lifting day out of my athletes each week—Monday, the high volume day.

What I was seeing in my athletes was the manifestation of what I had known for years—drug-free athletes have a hard time recovering from high volume workouts. High volume workouts, as compared to high intensity workouts, cause an enormous amount of physiological damage to muscle tissue and severely depleting muscle and liver glycogen. The only way to repair and refill the damage done to the muscles is through a hormonal response. In addition, anabolic hormones fortify tendons and ligaments as well as aid in increasing bone density. Hormones such as testosterone or growth hormone do a fantastic job of repairing and rebuilding tissue, but they have one huge drawback—they take a long time to work.

A typical 18- to 25-year-old male will have somewhere between 19 to 23 nmol/L of testosterone in his body at any one time[5]. The anabolic effect of exercise will increase that number by 20–30 percent. (It should be noted that the percentage increase in testosterone found in women would be similar to that of males. However, overall levels are much lower.) The problem with the classic undulating model was that it wasn't giving my athletes enough time to take advantage of this anabolic surge to repair and grow from the damage done by the initial workout before they had to deal with the stress of a second or third workout. Do you remember the four possible outcomes of Seley's GAS from the previous section? In using the classic undulating model, I was overtraining my athletes each week, leading to decreased sport performance as outlined in figure 2.3.

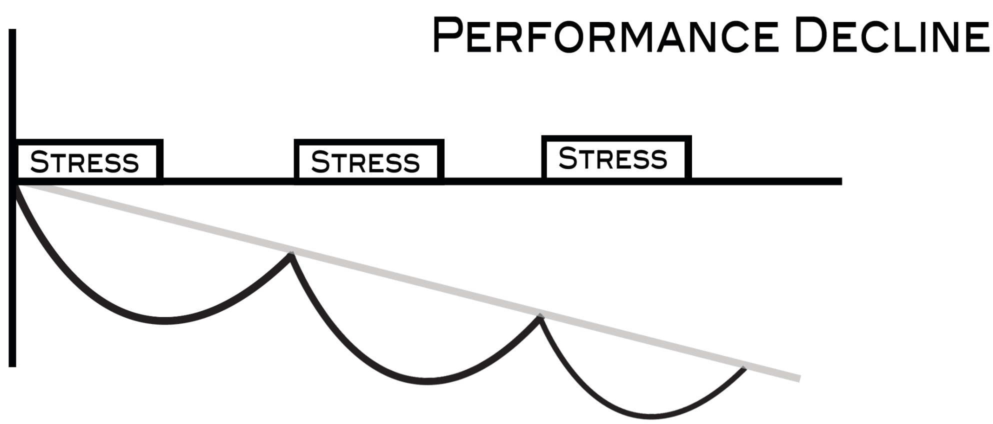

Figure 2.3: Overtrained performance response. The repeated application of stress, without sufficient time for the body to adapt during Selye's recovery stage, leads to a performance decline over time.

When the human body encounters a stressor that it believes justifies an anabolic hormonal response such as a high volume leg day, it initiates a long series of signals that must first take place before the hormone has any beneficial effect. This signaling begins with Seley's *alarm stage*, culminating with a massive hormonal release during the *recovery stage*. Let's take

[5] Vermeulen A (1996) *Declining Androgens with Age: An Overview***.** New York: Parthenon Publishing.

testosterone as an example. Testosterone takes fifteen steps from onset of stress to protein synthesis for it to have any positive anabolic effect. Looking at the figure 2.4, you can see that testosterone actually requires two hormones—the follicle stimulating hormone (FSH), which is released from the hypothalamus, and the leutinizing hormone (LH), which is released from the anterior pituitary. Then testosterone (T) is released from the adrenals and testicles (or ovaries in women).

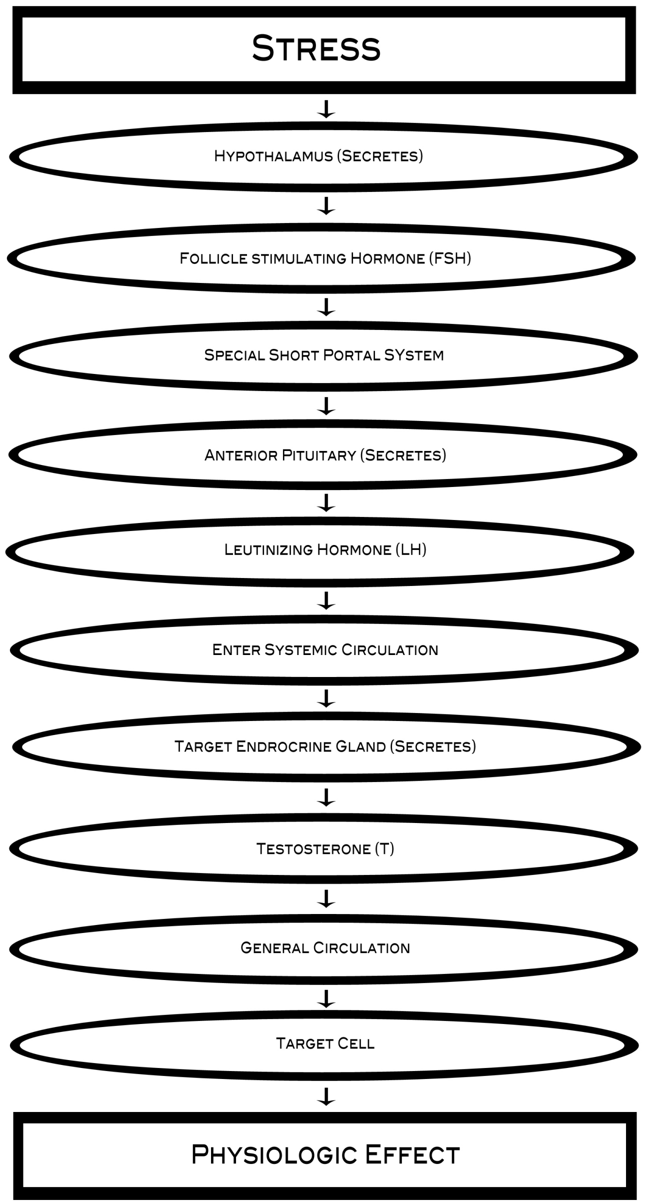

Figure 2.4: Figure showing the twelve extracellular (outside target cell) steps in testosterone production.[6]

[6] Sherwood L (2010) *Human Physiology: From Cells to Systems*. 7th Edition. Belmont, CA: Brooks/Cole Publishing.

Once the testes (or ovaries) receive the signal, they release T into the blood stream to find cells that require protein synthesis. But the story doesn't end there. Once the T hormone finds a target cell, it still must go through three more steps before the process of protein synthesis can commence:

1) Transition through the lipid bilayer through osmosis
2) Bind to a hormonal receptor
3) Enter into the cell's nucleus to signal the formation of new proteins

The Bulgarians and Soviets could make incredible gains on this classic model because they were cheating. They could skip steps one through twelve. By artificially increasing their free testosterone pool through the use of anabolic steroids, their bodies could immediately begin protein synthesis, repairing the structural damage done from the workout the instant they set down the barbell. For my drug-free athletes, there was simply too much high volume, low stress work at the onset of the training week to allow their natural hormonal response to repair the physiological damage that was done. If this is repeated for several weeks, it compounds itself and leads rather quickly to an overtrained, underperforming athlete.

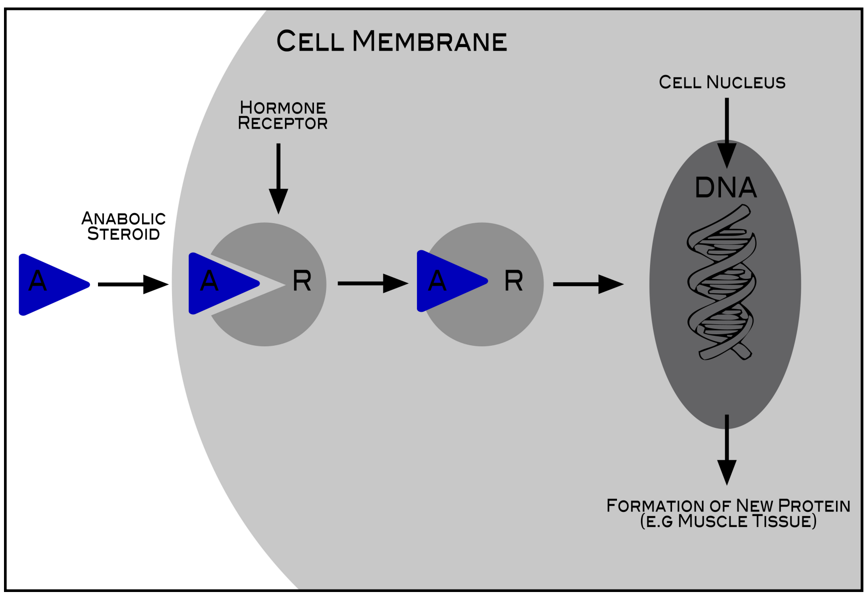

Figure 2.5: Image depicts process by which testosterone diffuses across the cells lipid bilayer, activating intercellular hormone receptors that travel to the cells' nucleus to signal protein synthesis.

From an evolutionary perspective, the human body has evolved to deal with short, acute bouts of high stress very well. For example, imagine a hunter gatherer living 10,000 years ago who is out collecting berries and nuts when he stumbles across a Saber-toothed tiger. He needs a physiological mechanism that will allow him to either fight the tiger or run away from it. In either case, the response only needs to last ten to thirty seconds. By then, our caveman is either safely up a tree or lunch. Because we have already seen the amount of time a hormonal response takes to facilitate action, the human body had to develop a second mechanism, a faster one, to mobilize the body for action.

The system that evolved is known today as the “fight or flight” response. Unlike our hormonal pathways, the fight or flight response is initiated through the sympathetic nervous system (SNS). Traveling with the speed of an internet signal through a cable line, the SNS signals the release of catecholamines (better known as epinephrine and norepinephrine or adrenalin), dilates the pupils, releases glucose into the bloodstream, increases the heart rate, and diverts blood from the internal organs to the muscles. In short, it gets the human body ready for war in the blink of an eye.

The fight or flight response is the most powerful mechanism the human body possesses. It is a very effective, efficient way to deal with high intensity, short-term stress. The only drawback to it is that it weakens fairly quickly. Because it is such a violent shock to the system, the system can’t maintain such a high state of readiness for a prolonged period of time. On the bright side, the central nervous system doesn’t require a lot of rest between responses to recover.

The way the body deals with long-term stress is very different. Prolonged levels of high stress (like that brought about by the high volume work in the classic undulating model) lead to elevated cortisol levels that can act like a toxin in the athlete if they remain high for an extended period of time, leading to muscle breakdown, poor sleep patterns, decreased metabolism, and an inhibited hormonal response.

I still believed that undulated loading was the best method to elicit change in my athletes. However, I had to come up with a variation that would account for both the duration required to benefit from the hormonal response while maximizing the use of their fight or flight mechanism and central nervous system. In looking at the classic model, I knew that Wednesday and Friday weren't my issue. I had to find a way to adjust the volume from Monday.

MODIFIED UNDULATING MODEL

I'm always hesitant to admit to people how I fixed the undulating model to work for athletes. I would love it to be some great stroke of genius, a story the likes of Newton's apple or Einstein's elevator. But to be honest, the solution was so 'slap you in the face' simple, I'm embarrassed to say that it didn't come to me sooner. It took several microcycles through that first off-season trying other, more complicated remedies before I realized a true solution. True to form, Occam's razor prevailed—the simplest solution was the best.

Backtracking for a moment, I began using the undulating model with my track athletes in 2003. As I stated before, it took me several weeks to realize that the classic model was hurting my athletes—the volume was too high for a drug-free athlete to handle. To fix the problem, I came up with the very complex, arduous, and intricate (please note tone of intense sarcasm) solution—I shifted all the training days one slot to the left. Ta da! In the new modified undulating model, Monday is now the medium heavy day, Wednesday is the high intensity day, and Friday becomes the high volume day (Figure 2.6). I don't want to demean the importance or significance that this small change has on athletic performance. I sit here and poke fun at myself thinking back on

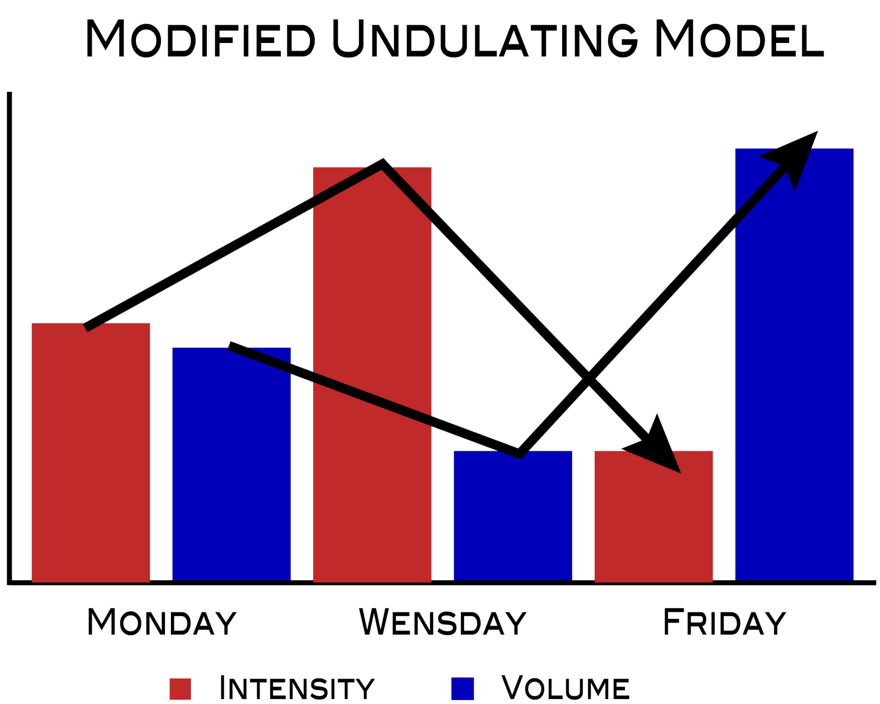

Figure 2.6: Graph depicting a three-day modified undulating model. High volume work is pushed to the end of the training week (Friday), allowing for sufficient time to recover over the weekend. High intensity work is placed on Wednesday to take advantage of the neural priming that the moderate intensity work plays on Monday.

my revelation. However, no one up to that point had thought to shift the undulating model in that way. So I guess I'm half genius, half lucky.

Below is the same table you saw before with the classic model in table 2.1. However, now the loading scheme has shifted to place the volume at the end of the training week.

TABLE 2.2: THREE-DAY MODIFIED UNDULATED MODEL LOADING			
MESOCYCLE	MONDAY (%1-RM)	WEDNESDAY (%1-RM)	FRIDAY (%1-RM)
STRENGTH METHOD: ABOVE 80%	MODERATE INTENSITY 82.5%–87.5%	HIGH INTENSITY 90%–97.5%	HIGH VOLUME 75%–80%
SPEED STRENGTH: BETWEEN 55%–80%	MODERATE INTENSITY 65%–72.5%	HIGH INTENSITY 80%–75%	HIGH VOLUME 55%–65%
PEAKING METHOD: BELOW 55%	MODERATE INTENSITY 40%–45%	HIGH INTENSITY 50%–55%	HIGH VOLUME 25%–35%

The new model allowed for 72 hours between both higher volume workouts, Monday and Friday, giving the athletes' hormonal response sufficient time to pass through Selye's *recovery stage*, fixing any musculoskeletal damage as well as replenishing muscle and liver glycogen stores. In addition, the moderate intensity of Monday and subsequently higher intensity of Wednesday didn't have any detrimental effects on the athletes' performance on Friday, as they could recover from these shorter, high bouts of stress much more easily with their fight or flight response. Finally, the high volume on Friday that used to kill my athletes physiologically at the start of the week now had enormous benefit for two very important reasons.

First, the higher volume took on a small role as an active recovery day, forcing blood and nutrients into the muscles to help speed recovery. Secondly, and more importantly, it enabled me to push them a little past their physical limits. Some weeks I pushed more than others, but with 72 hours to rest before their Monday morning workout rolled around, I could employ an even higher level of stress than I could have previously with the classic model, pushing them to the point of overreaching each week. I found that if I pushed like this for four to six weeks and overreached just a little bit each week, the athletes, coming back from a *download week,* would supercompensate at a level I had never seen. They could leave their last plyometric jump workout of the training block (more on blocks in the next section), just barely clearing the hurdles, only to come back ten days later and jump over them like they were the Easter bunny on speed. Again, the undulating model is the perfect fit for high school and collegiate athletes because it forces them to take periods of rest away from the gym. Knowing this fact, a strength coach must increase the stress loads of an athlete as much as possible to allow this supercompensation to occur.

Below are two figures. The first, figure 2.8, displays the physiological response my athletes were having to the classic undulating model used by the Bulgarian and Soviet national teams. In this instance, the volume from Monday was pushing them so far down the rabbit hole that they couldn't climb back to the surface before they had to repeat Monday the following week. After only three weeks in this model, as shown in the graph, you can see that the athletes are severely overtrained.

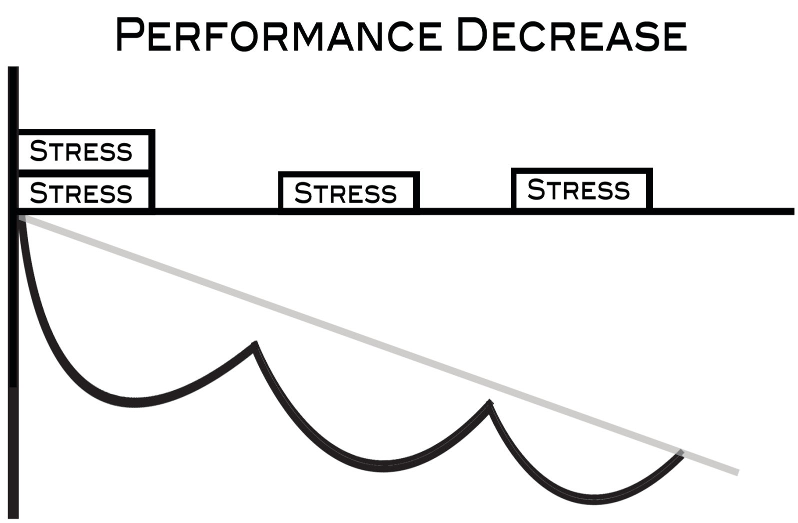

Figure 2.8: Shows the effect of the classic undulated model. High volume work incurred largely physiological stress, accumulating metabolites and inhibiting full recovery during the week.

In sharp contrast to figure 2.8 is figure 2.9, which displays the athletes' response to the modified undulating model. Here you can see that the athletes aren't overwhelmed by the higher intensity at the start of the week. While the high volume of Friday (formerly Monday) still pushes the athletes down the rabbit hole, they now have 72 hours to allow their bodies to recover by climbing back to the surface and are able to exceed that through a small supercompensation.

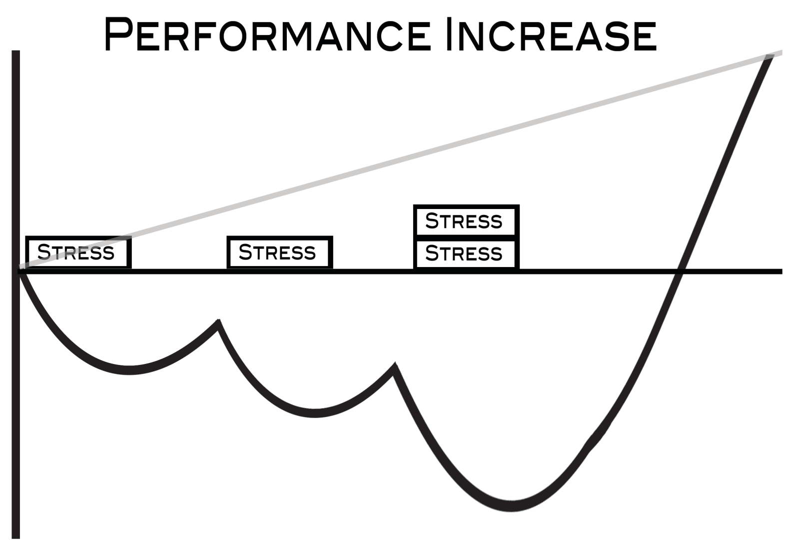

Figure 2.9: Shows the effect of the modified undulated model. High intensity work done early in the week is primarily neurological stress, and athletes can recover more quickly due to lack of metabolite accumulation. Volume at the end of the week gives the athlete time to recover over the weekend.

I was also lucky (and again I'm a firm believer that every good idea requires a little bit of luck) that the track coach's running schedule at this time was front end loaded, with higher intensities at the start of the week, and lighter at the back end because he was expecting his athletes to be more beat up. As I would find out later in talking with the coach, Phil Lundin, he had modeled his off-season running program for his athletes after some of the same concepts used by the Soviet team in the 1980s. He was using an undulating type model as well. Go figure! This fit perfectly with the modified undulating model, as the higher volume later in the week then acted as an active recovery day in addition to helping with increased work capacity. After I changed to the modified model, the athletes were able to practice at a high level during the week on the track and train hard in the weight room at the same time. There wasn't any sacrifice on either end. I saw continuous improvement throughout the entire course of that off-season. I knew then that I had found a method of training that could have tremendous benefit for the team that season.

I didn't have to wait very long into that season to see not only one but two justifications that proved to me that my modified undulating model was far superior to its predecessor. At the NCAA Outdoor Track and Field Championships that year, both my 400-meter runners ran the fastest times recorded in the world to date that year! I can't take full credit for this accomplishment. Much of that goes to the athletes themselves for their hard work and dedication, as well as to their coach, Phil Lundin, for his skill and knowledge in peaking them for the meet. However, at that point, I began to realize the undulated model fit very well within many coaching models and was something I needed to apply with all of my athletes.

By simply changing the order of the stressors applied with the classic undulating model, an athlete was now able to handle both the high levels of intensity and volume during a training week. In the end, this new modified undulating model allows an athlete to be stressed at higher intensity levels for longer periods of time using higher volumes, all within a weekly periodization model that allowed for a very high level of variability. Hundreds of hours of research have gone into understanding the undulated model. The results of this research have time and again justified both its means and approach as an effective method of training that maximally stresses the athlete. In simplest terms, I have yet to see a method that creates a state of fatigue that garners greater gains for drug-free athletes than my modified undulating model.

2.2: MESOCYCLE: BLOCK SYSTEM

The undulating model is clearly a potent method of training that generates amazing results. However, athletes train for periods of time that last much longer than one week. As a coach, you must have a plan, a blueprint, that lays out dozens of weeks, months, or even years of consecutive training phases. Great programs are those that are laid out with an end goal in mind with each phase building on the last, increasing and varying the stress placed on the athlete, all while improving their performance measures. The undulating model, while great at applying stress, is broad and needs guidelines. It will not be a very effective approach if, as a coach, you walk into your office, spin the "Undulating Wheel o' Fun," and see what type of workout it lands on for the week. "Oh look! Let's do box jumps!" No, the workout plan must be organized and well thought out. And while this all starts with a weekly microcycle undulating outline, it must be built into a larger mesocycle template.

How do you do that? The best way I have found is to layer the undulating model into a block periodization system. Establishing stress as the foundation on which every training program must be built, it is the job of the strength and conditioning coach to employ a method of periodization that allows for the constant pursuit of stress, a course that relentlessly, consistently, and vehemently stresses the athlete at an optimal level. To ensure success in this endeavor, my athletic undulating model serves as the framework supported by a block training system. Keeping with my analogy of a strength coach as a mechanic, the modified undulating model is a tool (the means) that is used to build the separate parts of the athlete's engine, these parts being speed, strength, power, and sport-specific endurance. The block system, in turn, can be viewed as the method, or instructions, with which a coach actually builds the engine.

CREATION OF THE BLOCK SYSTEM

The origins of the Block Training System can be traced back to the early 1960s in—where else?—the Soviet Union. Two colleagues, scientists by the name of Yuri Verkhoshansky and Vladimir Issurin, were experimenting with a method of training that they, at the time, called the Conjugate

Sequence System.[7] Revolutionary for its time, the Conjugate Sequence System was the first to look at the importance of varying the type and application of stress within a structured system to maximize adaptation, allowing athletes to reach the highest levels of performance. This system laid the foundation from which the theories and practices of the Block System would eventually be built.

Image 2.1 - Dr. Verkhoshansky (Far Left)

Now to fully understand the Block System and its application to training, you must understand some basic vocabulary.

Means: Any form of training stressor applied to an athlete—squats, presses, sprints, or jumps. These are the *five factors* and their derivatives outlined in Section 1.3 (high volume, high intensity, high frequency, high expectations, and overreaching) and the things that stimulate Seley's GAS response.

Parameter: A measurable factor forming one of a set that defines a system. These are the performance measures of an athlete (strength, speed, power, etc.) or the parts of the athlete's engine and the things a coach must focus on improving.

System: A set of connected parameters forming a complex whole, or in particular, a set of parameters working together as part of a mechanism towards a unifying goal. Strength, power, and speed parameters are targeted and laid out in a structured and thoughtful way to ensure the accomplishment of the end goal—improved sport performance.

[7] Image 2.1: Used with permission from Natalia Verkhoshansky.

Dr. Verkhoshansky performed research that looked into the amount of stress required to elicit continuous adaptation. What he found with his athletes was that even with high volumes of training, there wasn't any statistically significant correlation that proved an increase in the level of stress resulted in improved sport performance. First of all, we should all be impressed that Dr. Verkhoshansky was using math to prove the validity of training. I had a hard time passing algebra in high school. There isn't any chance that I could ever use it to find validity to a strength training protocol. Secondly, and more importantly, Dr. Verkhoshansky had stumbled onto what, at the time, was a paradox. At the time, he knew what you learned in Section 1—in order to see significant improvements in sport performance, an athlete has to be put through very high levels of stress (high volume, high load, high frequency). Yet, his research couldn't find any correlation to prove that. What he saw in his data was actually the opposite. High stress resulted in decreased sport performance. What Dr. Verkhoshansky soon realized was that this wasn't a paradox but simply an issue of misplaced emphasis. Athletes *do* need to be stressed to the highest levels. (I wasn’t lying to you about that.) However, that stress must be focused on a specific performance parameter to ensure maximal adaptation of the athlete. If multiple forms of stress are applied to multiple parameters at once, the level of stress on each declines along with adaptation and performance.

In the early 1960s, Soviet athletes were mostly trained within a system they called the “complex parallel form of training.” In more modern terms, this is what we could call a “mixed method of training,” where the athlete is exposed to several different means focusing on two or three parameters in each workout. They may start with an explosive movement, such as cleans, and then progress to a strength movement like a back squat and end the workout with hypertrophy work on the leg press. Given what we now know about how the body interprets and adapts to stress, this mixed training approach is a suboptimal way to improve the sport performance parameters of an athlete. Although the “total” stress of a mixed training workout can be very high, the amount of stress placed on each specific training parameter is very low.

Let's say that it takes 15,000 pounds of training volume (stress) in a workout to see a positive adaptation. (This is a completely fictional number, so take it with a grain of salt. I'm just using it to illustrate a point. Don't go to the weight room tomorrow and have your athletes all lift 15,000 pounds worth of volume, please.) Looking at the example below, you can see that the total stress of the different training means is high—over 25,000 pounds. This gives us a clearance of more than 10,000 pounds over what is needed to see an adaptation from stress. However, when the stress placed on each training parameter is examined individually, the means used only elicit a fraction of the total stress from the entire workout. Our stress level required to see positive adaptation, 15,000 pounds, only occurs in the parameter for local muscular endurance (LME). That's great if that was the training goal but terrible if you're trying to build a powerful athlete. However, this is a workout that many coaches would use to try to get their athletes stronger and more explosive in the off-season. The stress placed on the athlete, focusing on LME, decreases the total stress able to be placed on the other parameters, speed-strength and strength, resulting in no positive adaptation. Going back to Seley and GAS, the resulting stress for each parameter incurred only a mild alarm reaction stage and, as a result, a substandard hormonal response and performance adaptation.

TABLE 2.3: Mixed Training Workout

Exercise	Protocol	Parameter	Total Stress (by volume)	Stress by Parameter (by volume)
Clean	4x2 @ 275 lbs (85%)	Speed-Strength	29,100 lbs	2,200 lbs
Back squat	5x5 @ 320 lbs (80%)	Strength		8,000 lbs
Leg press	4x15 @ 315 lbs (65%)	Local Muscular Endurance		18,900 lbs

When different training parameters are targeted within the same workout they must be seen as having a negative or detractory effect on one another. That is, stress placed on one training parameter detracts from the stress that could be placed on a different training parameter. This led

Dr. Verkhoshansky to believe that the only way to produce significant sports performance improvement was through the use of a specific concentrated loading system, implemented by specific training "blocks," each focusing on one specific training parameter at a time.

Quickly, I want to point out some of the other shortcomings that mixed training methods have on the development of sport performance as compared to the Block System. These concepts will be further drawn out in the next section of this chapter. However, keep these in mind as a frame of reference:

1) Mixed training only allows for one to three peaks per year. Due to the low levels of stress able to be applied to each performance parameter of an athlete, gains are slower and harder to come by. This model used to work better for international competitors when there were only two or three competitions per year (local qualifier, nationals, and worlds) and the athlete had ample time to develop and prepare for each. However, in today's modern sport environment, athletes need to peak more often—sometimes dozens of times per year.

2) Differing neurological signals interpreted by the athlete's body cause confusion within the homeostatic response. With no one stressor clearly signaling for adaptation, the multiple training targets worked during mixed training elicit conflicting responses within the athlete. More on this in a moment when we look at the biological justification for the Block System.

3) Mixed training doesn't provide sufficient stimuli for high level athletes. The more proficient the athlete, the higher level of stress required to spur positive adaptation. Every athlete reaches a point where the stress required to improve one's performance target (i.e. strength) is so high that to try to improve another performance target (i.e. speed) at the same time would be impossible, as the extra stress load it would place on the athlete would elicit negative catabolic effects and lead to overtraining.

Around the time Dr. Verkhoshansky was experimenting with the rudiments that would eventually transform into the Block System, Dr. Issurin was performing similar research into the optimal methods of stressing and adapting an athlete.[8] He observed that every training means he applied to an athlete had the ability to improve only a specific training parameter for the athlete. For example, a heavy back squat would improve an athlete's raw strength while a depth jump would improve an athlete's reactive ability. Performing means not specific to a parameter did not stimulate the correct adaptation. After running further experiments, Dr. Issurin noticed that as the length of application of a specific means increased, the related training parameter improved as well. Inversely, he also noticed that the longer he applied a certain means to an athlete, the positive adaptation seen in that training parameter would decrease. Simply put, it showed that a specific type of stress caused a specific type of adaptation within the athlete. However, as the athlete adapted to that stress, he became less inclined to see continued improvement.

Image 2.2 - Dr. Vladimir Issurin

Figure 2.10 shows a typical response that athletes might exhibit after weeks of training to improve their maximal strength in the back squat. You can see that as the time the athletes are exposed to heavy loads increases, the improvement rate (percentage gain in 1RM) decreases. This isn't to say that the athletes can no longer make gains if they continue to train for the same parameter for extended periods of time. However, those gains will become harder and harder to come by and begin to stagnate.

[8] Image 2.2. Used with permission from Dr. Vladimir Issurin.

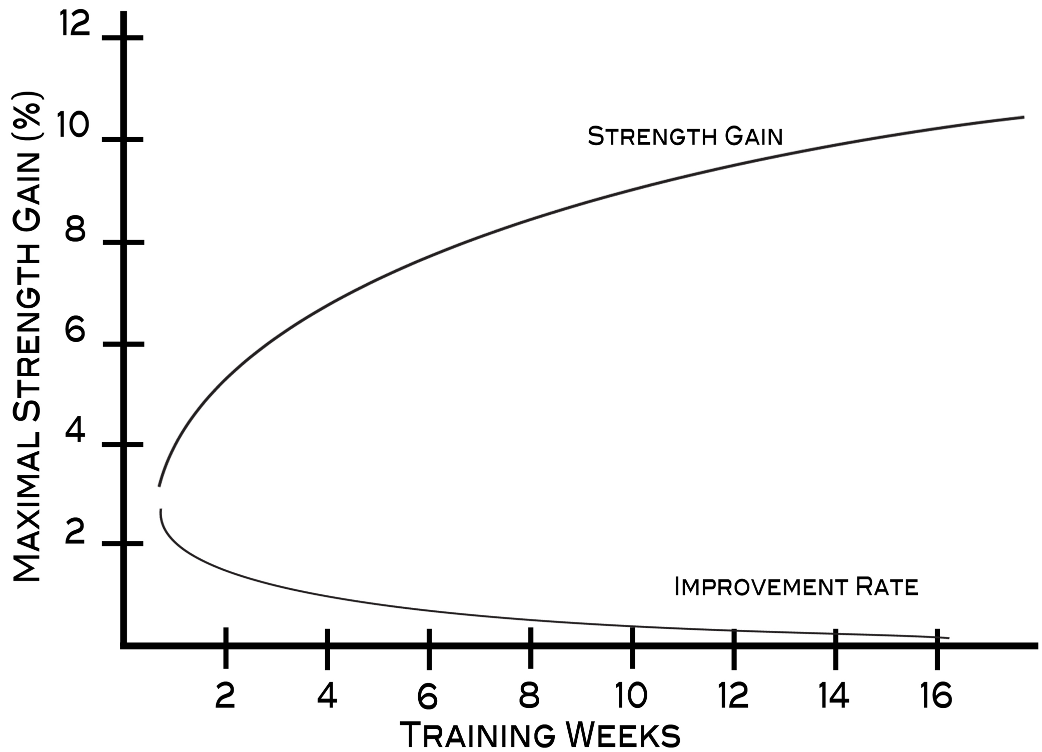

Figure 2.10: Graph shows the rate of diminishing improvement in maximal strength as duration of exposure to unchanging stimulus increases.

This led Dr. Issurin to believe that there needed to be a systematic implementation of training means in order to maximize the adaptation of training parameters and thus performance of an athlete. If one form of training means showed continued adaptation to a training parameter for only a short period of time, then different training means would have to be "strung" together, one after another, to ensure continuous adaptation of the athlete. If an athlete ceased to see substantial gains in his strength-speed parameter after three weeks (for example, as seen by a decrease in gains in the athlete's power clean), then it does the athlete no good to continue training that parameter. No sense beating a dead horse. Instead, Dr. Issurin noted, a coach must change the focus to a different training parameter in order to see continued adaptation.

Knowing that means caused improvements in parameters but that these gains only lasted for short periods of time, he realized that a systematic approach to the application of stress had to be created that constantly changed and varied the means used to ensure continuous adaptation. Furthermore, both Dr. Verkhoshansky and Dr. Issurin understood that in order to see the best possible adaptation in those parameters, their athletes could only train one parameter at a time. Therefore, the systematic approach taken would have to account for the least pertinent parameters (and by least pertinent, I mean those parameters that have the lowest direct transfer to the athlete's sport) to be trained first with the most important parameters trained as close to competition as possible (parameters that directly transferred to improved performance).

Because of the necessity for the high concentrations of stress on a parameter, an athlete can't train for strength, speed, and power all together immediately before a competition or competitive season. The subsequent stress of each would be too low to see maximal improvement, or the total stress would be too great and the athlete would be overtrained. In either case, performance would suffer. Instead, a coach must analyze which training parameters are most vital to athletic success in an athlete's respective sport and make sure those parameters are trained and peaked last or as close to competition as possible.

Looking at this through the wide lens of anaerobic sports (understanding that on a basic level, all anaerobic athletes need to be strong, fast, and above all, powerful), there is a common sequencing of parameters that should be used to allow maximal transfer of training gains. This sequence is usually as follows:

1) General fitness
2) Maximal strength
3) Strength endurance and power
4) Maximal speed

Luckily, the human body lays out the systematic approach to the training of these parameters for us through its own physiological adaptive processes. As you will see shortly, through the adaptive process known as *long lasting delayed training effect (LDTE)* or *residuals*, a coach is able to systematically train all the components required for an athlete to excel in an anaerobic sport (strength, speed, and power) without sacrificing the potential development of any within a training year and ensure that these qualities all peak at the same time!

From the insights and discoveries of Dr. Verkhoshansky and Dr. Issurin, the Block Training System can be summed up in three essential points:

1) **Concentrated loads:** In order to see the highest levels of adaptation, the means used to elicit stress must be highly concentrated, allowing for only one training parameter to be trained at a time to ensure sufficient stimulation of the athlete.

2) **Specificity:** Stress leads to positive adaptation of the athlete through a reaction between specific training means and parameters. These reactions, however, take place for a limited time, as the athlete begins to see diminished returns to training as he adapts to the means being applied.

3) **Systematic implementation of training means:** With only one parameter able to be trained at a time, it is imperative that the application of training means is used in a well thought out sequential manner using LTDE, enabling an athlete to peak the training parameters most pertinent to his sport as close to the competition period as possible.

FOUR ESSENTIAL PRINCIPLES

By today's definition, the Block Training System is the sequencing of specialized mesocycle blocks, a block being a training cycle of highly concentrated, specialized work that serves to improve a specific performance parameter of the athlete. Again, performance parameters refer to one specific part of the athlete's engine—speed, power, strength, or sport-specific endurance. In essence, you're trying to isolate one specific part of the athlete's nervous system or a specific physiological adaptation at a time.

Keeping the limitations of mixed training in mind, the block system, like everything else, is outlined by certain rules or basic principles. This will be a little bit of a review of what you have just read, however, it's essential that you understand these basic concepts before you can fully grasp the methods and correctly implement them with your athletes. Here is a quick overview so you can see how each builds on the previous rule before we look at each in depth:

1) The main principle, the foundation on which block periodization exists, is that maximal performance enhancement can only be obtained through highly concentrated training loads (stress). This should make sense after what you learned about stress earlier in this book—high stress is the key. In order to provide sufficient stimuli to induce a supercompensation effect as outlined by Seley's GAS, the athlete must endure a high level of stress.

2) The second principle is a derivative of the first—if an athlete must endure high levels of stress to improve a specific performance parameter, only a minimal number of those parameters (usually one) can be pursued during a single block without compromising performance enhancement or severely overtraining the athlete.

3) The third principle dictates that blocks must be laid out in such a way as to promote the consecutive development of many training parameters. Due to the fact that anaerobic sports require more than one ability (speed, strength, power, and endurance), the Block System needs a way to ensure that an athlete can develop and retain numerous training parameters without upsetting the second principle.

4) Finally, the fourth principle solves the problem postulated by principle number three through the use of LDTE or residual training effects. The correct order of training blocks is imperative, as it allows for both the assimilation of acute exposures to high stress from previous workouts to spur adaptation within blocks and the superimposition of the residuals of previous training blocks, permitting multiple training parameters to peak at the same time.

Principle #1: High training loads

This first principle comes back to the first point I made in this book—stress your athletes and stress them often! In high level athletes, only highly concentrated training loads provide sufficient training stimulus to generate positive adaptation. I say high level athletes because this principle wouldn't hold true for novice athletes. Early on in an athlete's career, stress, any stress, will be new and likely cause a supercompensation effect, promoting positive adaptation. Multi-targeted training (like that seen in mixed training) still provides enough stress to the athlete's different systems to see improvement in various aspects of performance. When an athlete is young (and by this, I mean a training age of three years or less), it is possible to improve multiple parameters at once because they are all underdeveloped. As athletes mature and as their bodies adapt to higher and higher levels of stress, a coach must continually push the envelope by increasing stressors to ensure that positive adaptation continues.

Let's revisit the stress/volume example from table 2.3. This time we'll compare two athletes performing the same workout:

> **Athlete A** is a second year starting running back at a Division I program. He has been training hard for six years (since his freshman year of high school). He requires 20,000 pounds of volume a day to signal a positive adaptation in a training parameter and see improved sport performance.
>
> **Athlete B** is a freshman running back in high school. His first exposure to weight training was last summer before football camp (his training age is therefore one) and he's back in the gym this summer trying to win the starting spot on the JV team next fall. Being so young, he only needs 2,000 pounds of volume a day to see improvement in a training parameter.

Based on what you know about these two athletes, which would benefit the most from the training program outlined earlier in table 2.3? If you said Athlete B, you're right! Because his training age is so young, Athlete B doesn't require as much stress as Athlete A to see an adaptation in a specific parameter. Athlete B will see improvement in all three parameters targeted in the workout; speed strength, strength, and muscular endurance. Athlete A, on the other hand, has adapted to a much higher level of stress required to elicit adaptation over his training life span and wouldn't see any improvement from performing the outlined program. This, I believe, is the main reason why mixed training has such a strong hold in western training culture. It starts in high school where most athletes are introduced to a mixed form of lifting. They see great results, not because it's a great method in promoting sport performance improvement, but because their training age is so young that any level of stress will give them decent gains when first starting out. The seed is planted and takes root in their brain that a mixed approach to training produces great results. Many of these young athletes, in turn, grow up to become strength coaches who teach the same methods they used in high school to a new generation. As a result, it is a vicious cycle creating decent high school athletes who will never reach their full potential due to lack of highly concentrated training loads.

Principle #2: Focus on a minimal number of training targets

Due to the high training loads that are required from principle number one, it becomes impossible to train multiple parameters at once. An athlete can't train for strength and power at the same time because the training loads required to elicit positive adaptation for each are too great—the sum of the total stress from the two training targets would severely overtrain the athlete. As a result, each block must focus on one training parameter at a time. In focusing on only one parameter per block, it is important to know the optimal duration for which the athlete should remain in that block. Too little time and valuable adaptation is wasted; too much time and the athlete may regress due to stagnated gains or overtraining.

At the beginning of a block, athletes will see good gains as a result of a high improvement rate—a new stress elicits a massive response of adaptation. As the block progresses, the athlete will continue to see gains. However, these gains will come with smaller and smaller improvement rates. He won't improve as quickly in week three as he did in week one. Figure 2.10 shows a typical response you might see with improvements on the back squat for a football linebacker. Initially, the player sees large gains in strength due to a high improvement rate. As the weeks progress, however, you see that both strength gains and improvement rate begin to plateau.

The duration of a block is essential to ensure that an athlete is maximally stressed, ensuring maximal gains without overworking the specific parameter, which would cause a decrease in performance. Remember, everything must build on itself. For most blocks, this length seems to be two to six weeks because it gives sufficient time for the body to attain and build new physiological, biochemical, and neural adaptations from training.

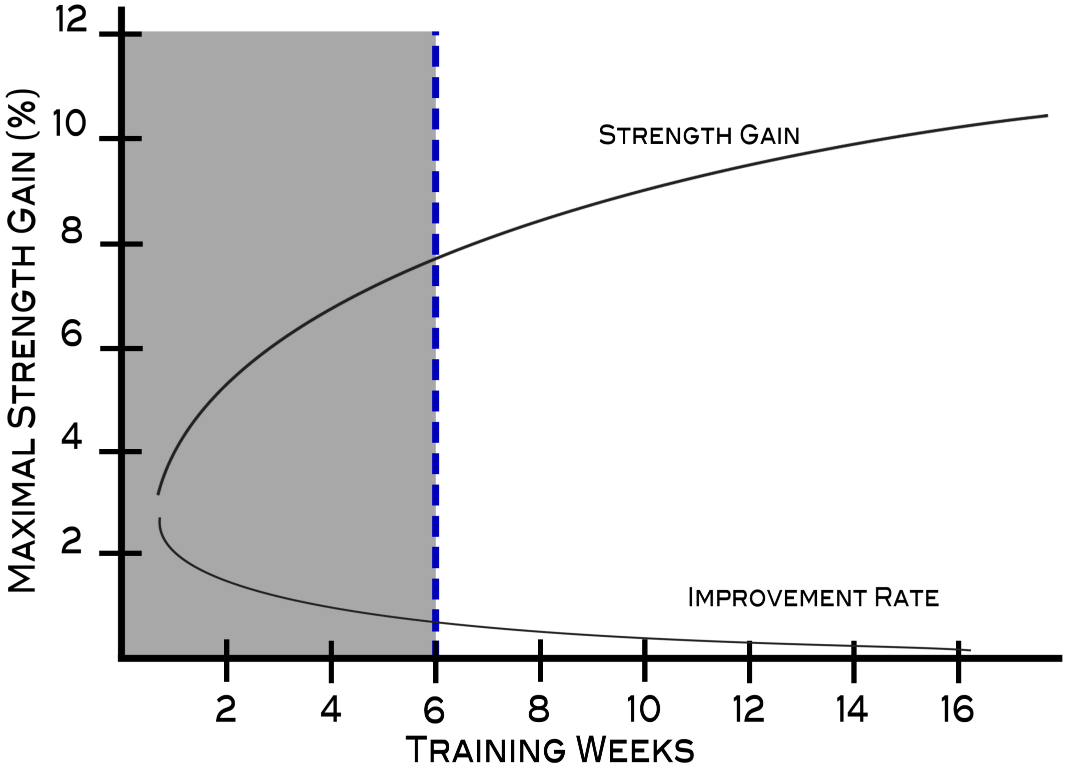

Figure 2.10: Graph shows the optimal training block length of a parameter to ensure maximal gains (gray shaded area). For most parameters this is two to six weeks.

Remember, improvement rate is the level to which the body adapts to a stressor. As the athlete continues to train strength, his strength gains begin to decrease (stagnate) as the improvement rate slows. This decrease is the result of the athlete's body adapting to strength oriented workouts —heavy loads and high intensities. While the athlete would likely continue to make small gains in strength if the block was extended past four weeks, these gains would be so small that they would have little to no positive translation to improved performance on the field. As a result, the athlete is better served to focus on a new block, a new set of stimuli that will use his newly acquired strength to improve a related, albeit, different performance quality.

Principle #3: Consecutive development of training targets

Knowing that each block must entail extremely high levels of stress and the result of those high levels being that only one parameter can be effectively trained at a time, it is imperative that training blocks be laid out in a specific order to ensure the continued development of the athlete. Performance, in any sport, requires the use of several performance abilities to excel. In the case of the Block System where each block must be laid out using a highly concentrated level of stress, these abilities must be developed consecutively rather than concurrently.

You must keep in mind that whenever you train a specific training parameter or performance quality, you do it at the expense of another parameter. Every time athletes train for strength, they are sacrificing time they could have spent training power, speed, or endurance, the result of which implies that the performance level of these other targets decreases. For that reason, the sequencing of the training blocks becomes extremely important. A coach can't randomly choose a block to have his athletes perform at their peak. He needs to have an understanding of how the training effect of that block will carry over to the next block or competition.

> *"When learning how to cook, an inexperienced chef understands primarily the types of and quantity of the ingredients in a dish. A master chef, on the other hand, understands the way and sequence of their addition to the dish to maximize taste."*
>
> -Dr. Verkhoshansky
> *"Special Strength Training Manual for Coaches"* (2010)

Principle #4: Long lasting, delayed training effect—residual training effect

As was just pointed out in the previous paragraph, the use of training blocks is associated with the loss of performance in other, non-targeted performance qualities. It is therefore imperative that coaches understand the importance of residual training effects. Residual training effects can be defined as *the retention of changes induced by systematic workloads beyond a certain time period after the cessation of training.* Put another way, a residual training effect is the retention of physiological or neural adaptations after the cessation of training for a certain period of time. Understanding the time period, or residual, that certain performance parameters have is paramount in planning sequential blocks of training to ensure both continuous adaptation of the athlete and the peaking of all his performance qualities before competition to maximize performance.

It is important to understand that not every performance target has the same residual. For example, strength residuals tend to last upwards of thirty days while speed residuals may only last for seven days. The short residual effect seen with maximal speed requires that an athlete must always peak with speed as close to the day of competition as possible. Other factors have shown to influence the length of training residuals as well. Prolonged periods of training, higher level athletes, and parameters associated with physiological and biochemical changes (such as sport-specific endurance or strength) are all associated with longer residual effects. Table 2.4 outlines the average residual training effect of training parameters:[9]

Table 2.4: Duration of Residual Training Effects (RTE) for Different Motor Abilities		
Motor Ability	RTE (Days)	Physiological Background
Aerobic Endurance	30±5	Increased number of aerobic enzymes, mitochondria, capillary density, hemoglobin capacity, glycogen storage, and higher rate of fat metabolism
Maximal Strength	30±5	Improvement of neural mechanism. Muscle hypertrophy due mainly to muscle fiber enlargement.
Anaerobic Glycolytic Endurance	18±4	Increased amount of anaerobic enzymes, buffering capacity, and glycogen storage. Higher possibility of lactate accumulation.
Strength Endurance	15±5	Muscle hypertrophy, mainly in slow-twitch fibers. Improved aerobic/anaerobic enzymes. Better local blood circulation and lactate tolerance.
Maximal Speed	5±3	Improved neuromuscular interactions and motor control. Increased phosphocreatine storage and anaerobic power.

Numerous studies have been done that calculate just how long an athlete is likely to retain a residual effect from training. Let's look at a couple of examples specifically so that you can begin to understand what an athlete's body goes through physiologically in trying to retain a specific performance quality.

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[9] Table adapted from: Issurin, V. (2001). "Block Periodization: Breakthrough in Sport Training." New York, NY: Ultimate Athlete Concepts.

Figure 2.11 depicts the average loss of strength as measured by a 1RM back squat over a period of twelve weeks. Looking at the figure, you will notice that the slope or decrease in strength from week zero to week four is fairly mild, only dropping off 1–2 percent. From this, we can infer that if an athlete abstained from training strength for up to four weeks, he would have very little drop-off when returning to the strength training a month later. As we move further right on the x-axis, however, you will notice that the slope begins to increase, meaning larger decreases in maximal strength. Between weeks eight and twelve, the athlete's max decreases to between 80–90 percent of what it originally was. That is the entire point of understanding residual training effects—understanding how long an athlete can take between similar blocks without worrying about drastically decreasing that specific parameter. For example, as seen in this graph, the athlete could take four to six weeks to focus on different training targets like speed or power before having to return to a strength block without fear of drastic decreases in strength.

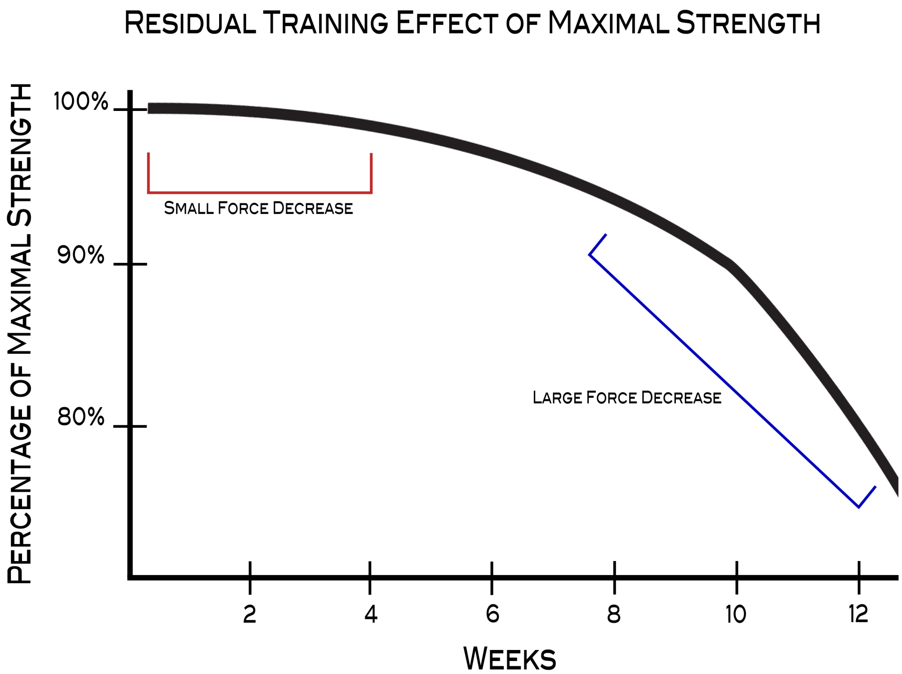

Figure 2.11: Showing the duration of residual training effect for maximal strength. Abstaining from max strength training for a period of up to four weeks only sees a decrease in the parameter of 1–2 percent (red box). Longer durations of detraining a parameter can lead to the accelerated loss of performance.

The problem is that most people, coaches and athletes included, believe that if they aren't training something specifically, they're getting worse at it. While this is true to a certain extent (the athlete did see a one percent drop in strength over the four-week time period), the athlete likely saw a 5–10 percent increase in the other training target trained during that month when strength wasn't trained. Training for sport performance is a give and take—three steps forward, one step back. If every time an athlete performs a strength block, he gains five percent on his 1RM and then loses one percent while improving other performance qualities for one or two blocks before returning to a strength block, that's a four percent net increase in strength. If an athlete can get three or four strength blocks in during a annual training cycle (which is entirely possible depending on the sport), that's a 12–16 percent increase in strength. That would equate to a 35- to 48-lb increase per year for an athlete who started with a 300-lb bench press. Not bad!

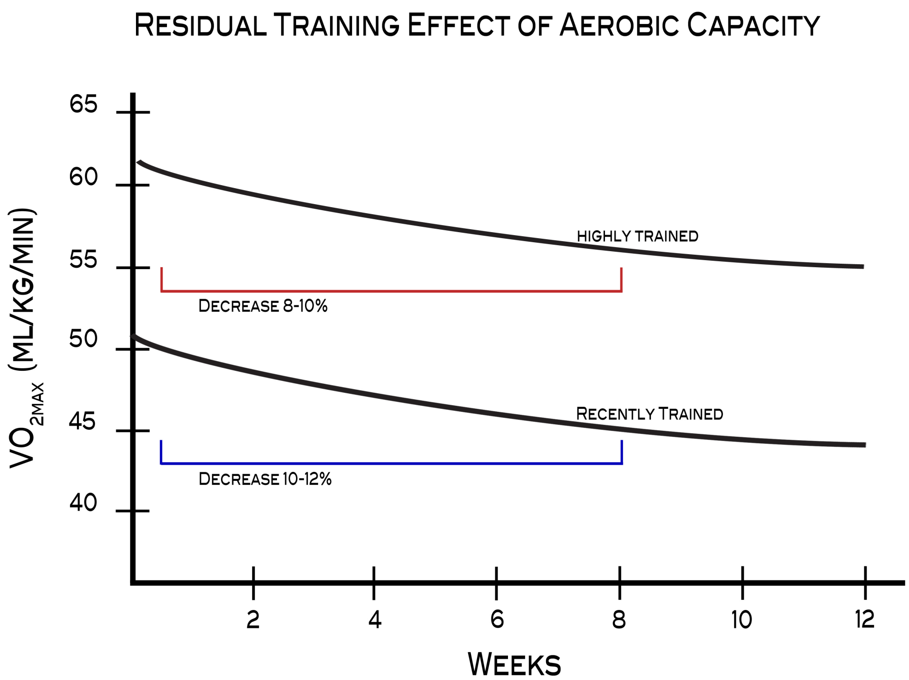

Figure 2.12: Aerobic capacity has the longest training residual. Regardless if the athlete is highly trained or not, aerobic adaptation decreases at a slow rate; only 2% per week.

Similarly, aerobic capacity, measured here as an athlete's VO2 max, can be retained by an athlete for just as long, if not longer, than maximal strength. Again this is due to the extensive physiological and biochemical restructuring of the muscle tissue that takes place for this type of adaptation (mitochondria creation, increased density of the rate limiting enzyme phosphofructokinase, improved rate of glycolysis, etc.). In the training of my athletes, I assume that they will retain a high enough level of aerobic capacity that I only need to train (or retrain) an aerobic block once every 42 to 56 days (six to eight weeks).

In looking at figure 2.12, a six- to eight-week break might seem excessive as it correlates to an aerobic performance decrease of 10–12 percent, but you must remember that I train predominantly anaerobic athletes—hockey, baseball, and track and field. They don't need to retain such high levels of aerobic fitness to see the improvement transfer to their sport. If, on the other hand, I was training a soccer team or basketball team, sports that require more support of the aerobic system to see success on the field (or court), I would likely have to change my block schedule to train (or retrain) the aerobic component every three to five weeks. This is why you must have a solid understanding of the physical demands placed on your athletes during competition and why you must have a firm grasp on training residuals and their time frames. Without these, obtaining maximal performance for your athletes will be impossible.

BIOLOGICAL JUSTIFICATION

Most coaches are taught that they should always start a workout with speed and/or power movements and then progress to strength movements before ending with higher volume hypertrophy work. As an example, table 2.5 shows a very simple high school football player's off-season leg workout may look like this:

TABLE 2.5: Example Off-Season Lower Body Workout

Exercise	Sets x Reps
Barbell clean	4 x 2
Back squat	5 x 5
Romanian deadlift	4 x 8
Leg press	3 x 12
Conditioning	100-yard shuttle x 6

The physiological basis for this type of training is that the athlete should perform high speed, high intensity movements that place the highest level of stress on the nervous system first, when the athlete is fresh, and then proceed to movements with higher volumes, lower intensities as the athlete fatigues.

I'm here to tell you that this is a poor training method, and I'll tell you why. Mixed training produces mixed results due to conflicting physiological responses. Simply put, your body doesn't know what you're trying to tell it to do. The athlete starts out with cleans, so the body thinks it wants to get more powerful, but then the athlete does heavy back squats. Well, now the body is a little confused. At first it thought the athlete wanted to be powerful, but now all of a sudden the athlete is signaling the body to be strong. To make matters worse, the athlete ends the workout by performing hypertrophy work with high rep sets of Romanian deadlifts and leg presses. By this point, the body is throwing its proverbial hands up in the air, completely confused by the conflicting signals. It asks, "Do you want me to be powerful, strong, big, or what?!"

Ultimately, simultaneous development of many parameters decreases the effectiveness of training. The human body wasn't designed to simultaneously adapt to many forms of stress. One of the most affirming supports for the use of the Block System over any mixed model of training is the human body's biological, evolutionary mechanism to adapt to stress. Remember, the flight or fight response that we talked about earlier was designed to deal with short, acute, high bouts of specific stress. See tiger, and run away from tiger. See heavy weight, and lift heavy weight. If instead the athlete is inundated with numerous varieties of stress (as is the case in any mixed training template), it's harder for the system to cope with and adapt to those stressors. If the athlete is asked to lift a 1RM squat, do leg presses for sets of twelve, and then run a few miles, the nervous system and physiological response don't know which stress they should adapt to or which stress is the most pertinent. The body will always believe the stresses must all be accounted for (evolutionary perspective) and will try to adapt to all stimuli. This, however, will limit the level of adaptation that takes place for each stress. This is not divide and conquer; this is divide and die.

Ask yourself this simple question—do you produce better work when you can focus all your time and effort on one thing, or when you have several things you have to get done all at once? In the eyes of an athlete's nervous system, the block system of training is focused, straightforward stress with only one logical adaptation. Mixed training is seen as chaos. Which do you think will result in improved sport performance? Below is a short excerpt taken from a presentation by Vladimir Issurin, the father of block periodization:

> *"Preparation that entails the use of both types of training concurrently demand energy needs that surpass the limits of homeostatic regulation. Correspondingly, stress reactions become stronger. This more strained metabolic and hormonal body environment suppresses homeostatic responses and has a deleterious effect on workloads intended to develop basic athletic abilities. Such conflicting responses, which are typical of mixed training among high-performance athletes, lead to a decline in general aerobic abilities, a reduction in muscle strength, and cases of overtraining."*
>
> \- Vladimir Issurin

The bottom line is that the Block System allows you to avoid sending conflicting signals to the physiological systems of your athletes, exploiting the most appropriate mode of biological adaptation.

BASIC LAYOUT

Using the four principles as the base for the development of the Block System, a macrocycle is generally laid out in three distinct sections or mesocycles—accumulation, transmutation, and realization. Each of these sections, in turn, consists of one to three separate blocks. The rationale for this layout is based upon two rules that result from an analysis of the four principles previously explained—the rule of specificity and the rule of sequential system adaptation.

Here is a quick overview of the three sections so that you see how they work in succession before we look at each in more depth:

1) **Accumulation:** Aims to develop basic motor and technical abilities such as aerobic endurance and muscular strength. This phase is associated with large volumes and medium to high intensities and requires the use of restorative methods to ensure physiological adaptations such as muscle tissue and energy substrates, which need time and materials to rebuild. It is normally the longest of the three phases.

2) **Transmutation:** Aims to develop specific motor and technical abilities specific to the athlete's sport such as anaerobic endurance, strength-specific endurance, and power. This phase is associated with high intensities and increased velocity of movement. Based on studies performed by German scientists, it was found that adaptation in this phase peaked after a three-week block.

3) **Realization:** Aims to develop a pre-competition level of readiness (also known as peaking). This phase is associated with the development of maximal speed and acceleration as well as event specific readiness. It is normally the shortest of the three phases and takes place as close to competition as possible.

TABLE 2.6: Mesocycle Overview

Main Characteristics	Accumulation	Transmutation	Realization
Parameters (motor abilities)	General athleticism: Aerobic endurance, maximal strength	Sport-specific: Local muscular endurance, strength endurance, power	Peaking: Transferability, maximal speed, event specific acceleration
Volume/intensity	High volume/low intensity	Reduced volume/ moderate intensity	Low volume/high intensity
Duration	2–6 weeks	2–4 weeks	1–2 weeks
Fatigue/recovery	Sufficient recovery time provided to ensure adaptation of physiological mechanisms	Fatigue accumulates as intensity increases	Full recovery; athlete is well rested

Phase #1: Accumulation

This first phase is sometimes referred to as the base phase because its main goal is to build a solid foundation of both strength and endurance, building up the athlete's level of homeostasis to enable higher levels of stress to be applied in subsequent blocks. In other words, it is general fitness. Unique to this phase is the long duration of its training residuals. This is due to the training parameters that are specifically targeted during this block—aerobic capacity and maximal strength. While an athlete needs to have some neurological adaptations to see an improvement in both endurance and strength, the main adaptations that take place are physiological. By that I mean they cause physical alterations within the athlete's body—muscle tissue is built through protein synthesis, glycogen stores are increased, and mitochondria are created within muscle fibers to facilitate ATP production and glycogen use.

As a result, this phase is the longest of the three and has the longest lasting residuals. Just as it takes a long time for the athlete's body to build the infrastructure that must come with improved aerobic capacity and strength, it also takes longer for those structures to break down. An athlete will usually spend four to six weeks building this base but will have a residual of nearly 35 days (five weeks) before having to return to it without fear of losing performance. Figure 2.13 gives a visual explanation of this concept:

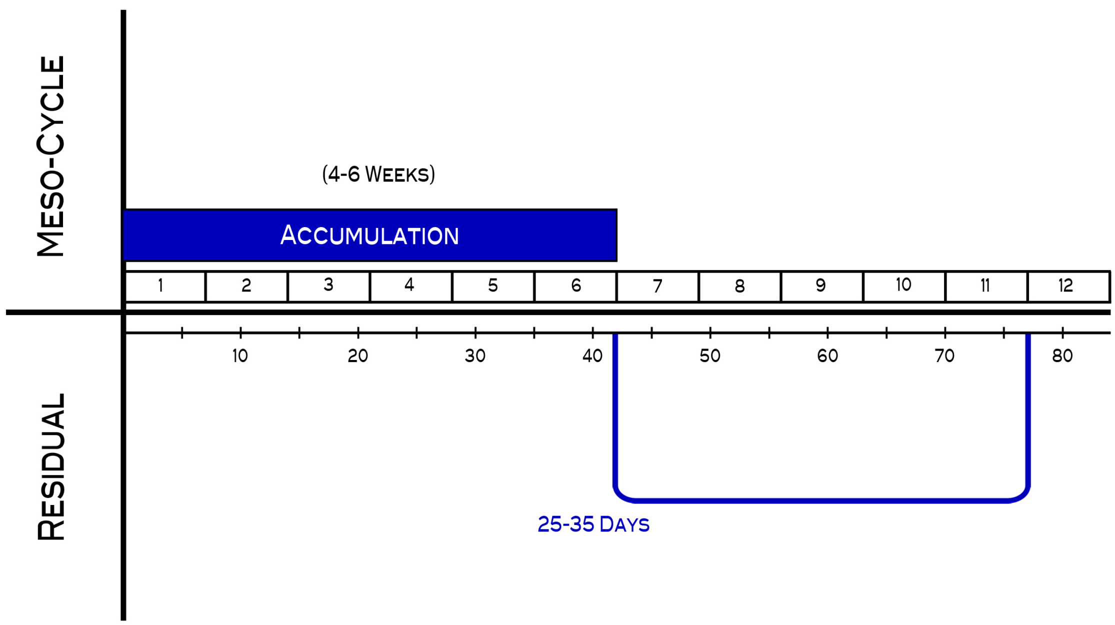

Figure 2.13: The top half of the figure displays the mesocycle. The accumulation phase is shown by the blue box, lasting for to six weeks. This allows for the full development of physiological mechanisms needed. The subsequent residual effect can be seen by the blue line on the bottom half of the figure shown in days. For example, the athlete would not have to retrain accumulation parameters until the eleventh week of the training cycle.

Phase #2: Transmutation

The emphasis of the second phase is to take the strength gained during the first phase and teach the athlete to use it in a fast, powerful manner. To accomplish this, less emphasis is placed on stressing the physiological processes of the athlete. Instead, the focus is placed on developing the nervous system and specific motor abilities. During this phase, the speed of the bar begins to become very important, as the goal should always be a high velocity of movement. Because this phase places a higher emphasis on the nervous system, its residual is much shorter than the accumulation phase with residuals lasting only two to three weeks. Figure 2.14 gives a visual explanation of this concept.

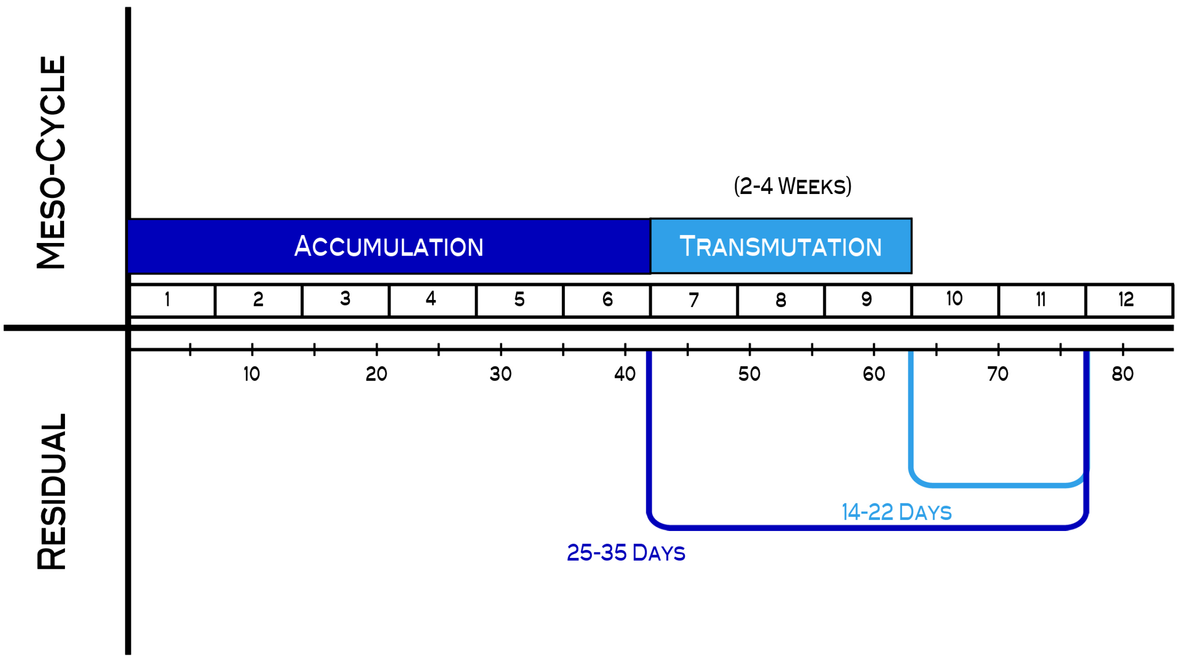

Figure 2.14: The transmutation phase follows the accumulation phase and lasts two to four weeks (light blue box), focusing on improving the neurological mechanisms of the athlete. Because these adaptations are primarily neurological, the residual effect is substantially shorter than those from the accumulation phase, lasting only 14 to 22 days. This is shown by the light blue line inlaid over the dark blue line in the bottom of the figure.

Phase #3: Realization

Also known as the peaking phase, its sole purpose is to prepare the athlete for competition. It is during this phase that the performance parameters, improved during the two previous phases, and their residuals are trained to be used by the athlete in an as explosive, powerful manner as possible. Residuals for this last phase are the shortest due to an ever increasing amount of stress placed specifically on the nervous system and thus must be trained as closely to the competitive event as possible. Figure 2.15 gives you a visual explanation of this concept.

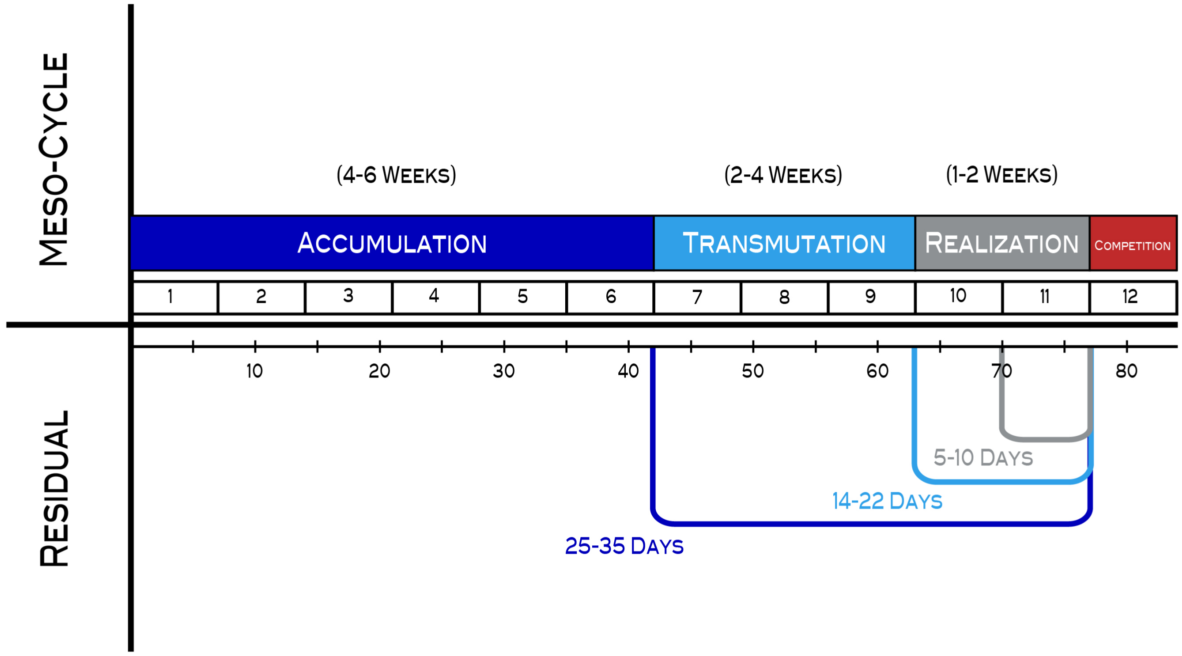

Figure 2.15: The realization phase is very stressful on the athlete because its training is focused on mimicking the rigors of competition. As a result, it is the shortest phase, lasting only one to two weeks. The high level of performance reached during this time also means that it has a small residual training effect, only five to ten days. The proper utilization of RTEs allows the athlete to peak all the performance abilities that are pertinent in optimal performance at once. This is shown in the figure where all the residual lines come together at the same point—week twelve right before competition.

When you understand how the blocks come together in sequence to peak an athlete for competition, you can begin to see how this integrated approach can allow for multiple peaks to be obtained within one training season. For example, in figure 2.16 you can see how a strength coach working with a football team might periodize his annual training cycle using a block system approach.

I can already hear the question being asked, “What if the training cycle lasts longer than the residual training effects allow?” That is a great question! Once the human body has adapted to a stressor, it is much quicker to readapt a second time. In a sense, every time a stress is seen by the body for the first time, it has to come up with a way to adapt to defend against that stress. Once it comes up with a plan that works and the body adapts, it catalogs and stores the process by which it accomplished that feat for future reference. When the stressor is encountered a second time, the body simply references the stored blueprints and carries out the instructions, quickly readapting to the stressor.

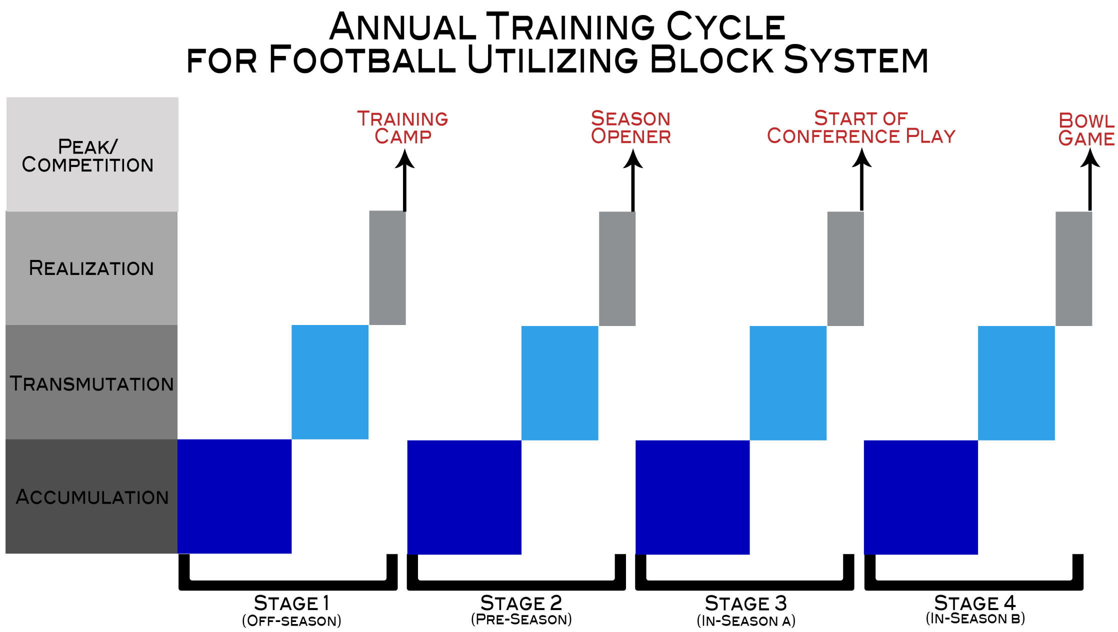

Figure 2.16: In the figure above, there are four "peaks" during a competitive season (shown in red at the top of the figure). In each case, the athlete's training is periodized to take him through each phase—accumulation (dark blue), transmutation (light blue), and realization (gray). This ensures that each parameter is maintained through the season, optimizing performance to the highest levels. This approach will minimize, if not eliminate, any decrease in performance (strength, power, speed) for an athlete over the period of a long season.

As long as the parameter is retrained within its residual time frame, you only need to superimpose one week of previously applied means to ensure that the adaptation gained when training the parameter is retained. For example, let's say that you have a macrocycle that lasts sixteen weeks. That's four weeks longer than what a normal cycle could support through normal training residuals to ensure that the positive adaptations seen in each parameter are retained all the way through to competition. The graph below depicts how by revisiting previous parameters, a coach can retain performance adaptations from each block.

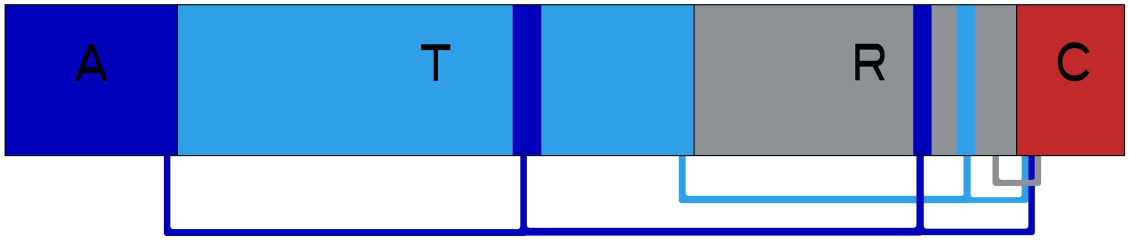

Figure 2.17: The strategic placement of training weeks, in which the athlete returns to previously addressed parameters, can extend their RTE longer than normal. Placing a week of accumulation training within both the transmutation and realization phases as well as an extra week of transmutation training within the realization phase allows for the extension of RTEs. This allows a coach with longer training macrocycles, those lasting longer than twelve weeks, to still peak all of an athlete's abilities for competition.

MY BLOCKS: AN OVERVIEW

My undulated block system has three mesocycles that comprise my off-season training cycle. Using high levels of undulated stress focused on a minimal number of training parameters, this system has proven itself time and again to create powerful, explosive athletes within the limited time frames that we, as coaches, must deal with.

TABLE 2.7: Block System Outline				
Phase (Mesocycle)	My Phase	Blocks	Block Classification	Duration (Weeks)
Accumulation	Above 80%	3	Strength 1) Eccentric 2) Isometric 3) Concentric	2–3 each
Transmutation	80–55%	1	Speed-strength	3–4
Realization	Below 55%	1	High velocity peaking method	3–5

2.3: COMPARISON TO LINEAR PERIODIZATION

There is always more than one way to skin a cat. My athletic undulating model is not the only method strength coaches could employ to train their athletes. However, with some self-admitted bias, I believe all other training models are inferior. One such approach that is often a popular choice by coaches is the classic linear periodization model. The granddaddy of them all, it is often referred to as the "western method" of training. Classic linear periodization was first implemented in—where else?—the Soviet Union. The first published reference I could find came from a book entitled *Olympic Sport,* written by a Russian named Sergei Kotov in 1917. The book outlined three stages of training—the general, preparatory, and specific stages. In many ways, this was a very crude, early version of what would later evolve into the western linear periodization method.

Your first clue to the inferiority of this method for training athletes should be that the Soviets got rid of it to adopt the Bulgarian undulating model in the 1970s. Furthermore, the western linear periodization model was the method by which the United States trained its athletes leading up to the 1984 Summer Olympics, the year that the Soviets would have taken forty-six gold medals from the US if they hadn't boycotted the games, holding their own Friendship Games in Moscow later that year.

The classic linear periodization model has been modified and altered somewhat since its humble beginnings in Kotov's book almost a century ago. It now consists of four periods, lasting four to six weeks per period:

1) **Preparation period:** This phase is intended to condition the athlete as well as build muscle mass. This phase is characterized by high volume and low intensity with loads generally between 50–70 percent and a rep range of ten to twenty.

2) **First transition period:** This is comprised of two separate sections. First, the strength phase, which is pretty self-explanatory, increases the athlete's strength. Loads are usually

between 70–85 percent of the 1RM with a rep range of four to six. The second part is known as the power phase. This phase is designed to increase the overall power of the athlete. Loads increase to 85–95 percent with a rep range that drops slightly to three to five.

3) **Competition period:** The final phase is designed to "peak" all the abilities that have been developed in earlier phases, specifically strength and power. Loads used here are generally 93 percent and higher. Athletes perform one to three repetitions with long periods of rest between sets (three to seven minutes) to ensure full recovery between sets.

4) **Active rest:** Normal strength training is replaced by general athletic activity. Athletes are encouraged to play organized sports (basketball, ultimate Frisbee, soccer) to allow the body to recover from the high stress of both the peak phase and the competition period.

The basic concept of linear periodization is to decrease the total volume of work while increasing the intensity as the athlete approaches the competitive period (figure 2.18).[10] The ultimate goal is to supercompensate the athletes, peaking them right before competition. While the model looks great on paper, it is fundamentally flawed when applied to sport.

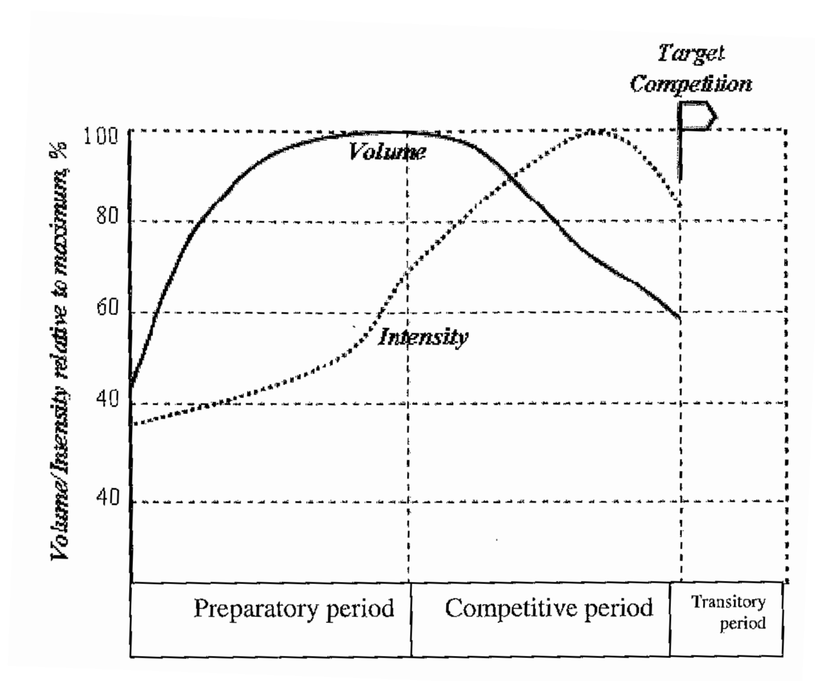

Figure 2.18 - Classic Linear Periodization

One of the biggest problems with this model, when looked at through an athletic coach's lens, is that it focuses solely on concentric muscle actions. Every phase of the linear

[10] Issurin V (2001) *Block Periodization: Breakthrough in Sport Training*. New York, NY: Ultimate Athlete Concepts.

periodization model is geared toward lifting as much weight as the athlete can concentrically handle given the percentage ranges for the given rep range. As you learned in section two, that is only working one-third of the athlete's necessary muscular and neural structures required for top end sport performance. It neglects the eccentric and isometric phases of dynamic movement as well as a host of other neurological processes.

Another drawback of the linear model is the athlete's inability to retain the residual training effects from one phase to the next. They simply can't maintain proficiency in the qualities developed as they move to subsequent phases. For instance, the strength developed in phase two will be lost by the time the athlete returns to the next hypertrophy phase ten to twelve weeks later. Even within the same macrocycle, the hypertrophy gained by athletes at the onset of the cycle will likely be lost or at the very least diminished to a high degree by the time they reach the power phase eight weeks later.

The last stumbling block that the linear model puts in front of a strength coach that I will address here is its focus on peaking the athlete only once per macrocycle. The classic linear periodization is aimed at giving the athlete one supercompensation prior to competition or the start of the season. Using an undulating model, as I do, you actually peak your athletes more often with smaller, weekly supercompensations. I don't know of any college sport that only has one game a year. Football, basketball, hockey, track, volleyball, softball, baseball—they all have long, grueling competitive seasons consisting of multiple games. It's physiologically impossible to peak athletes at the onset of a season and expect them to maintain those residuals throughout.

As a result, a strength coach must continue to train the athlete on the linear model through the season in an effort to maintain any positive training effects from the off-season work. This brings up a host of new issues. For example, an in-season hypertrophy phase for basketball players on the linear model could make them very sore and energy deprived, as this type of workout is usually associated with higher volume (four to five sets of ten to twenty reps) that will deplete muscle glycogen stores. This, in turn, will reduce the athlete's ability to perform at a high level in practice or a game later that day/week.

The undulated application of stress within a block periodization model is the strength coach's best option for in-season and out-of-season training. It gives the ability to modify methods and loading parameters on a weekly, even daily, basis to ensure the athlete is both neurally and muscularly primed to perform at optimal levels. In essence, it allows the coach unparalleled options to modify the stress levels being administered to the athletes. When you look at the two methods side by side (figure 2.8)[11] and compare them based on the factors that were found in successful programs throughout history, the answer is clear. The undulating block model enables an athlete to be stressed at a high level consistently with a high level of variability and volume, allowing for weekly supercompensations through progressive overtraining. Which model would you use to train your athletes?

TABLE 2.8: Training System Comparison

Characteristics of Training System	Linear/Mixed System	Undulated Block System
Loading Principles	Complex use of differing loads directed at many performance abilities (parameters).	Highly concentrated loads directed at specific performance abilities (parameters).
Scientific Justification	Cumulative training effect.	Cumulative, residual, and biological effects.
Sequencing of training to develop parameters	Simultaneous	Consecutive
Competitions	Corresponds to competitive period.	Occurs at the end of each stage.
Physiological Mechanism	Adaptation to concurrent training stimuli affecting many different targets.	Superimposition of residual training effects induced by highly concentrated training stimuli.

[11] Adapted from Issurin, V. (2001). "Block Periodization: Breakthrough in Sport Training." New York, NY: Ultimate Athlete Concepts.

2.4: SUMMARY AND REVIEW

One of the most interesting things about learning, I believe, is that it takes place in nearly the same way that athletes improve their performance. It is through the proper application of stress that an athlete is built. In much the same way, I feel coaches acquire applicable knowledge. I say applicable because it is one thing to know something and quite another to know how to apply it. Everyone who smokes knows that they should quit, yet millions of people still smoke.

In that sense, the first part of this book was all about stress and the need to apply it to an athlete. A strength coach is literally a stress manager, having to know when to add stress and when to take it away, often with only the smallest changes making large differences in the performance of their athletes. If we think of the first section as laying the foundation of knowledge about the importance of stressing the athlete, section two was the “why” and built the first couple floors, gaining knowledge and experience about its application.

I understand that up to this point I have not explicitly showed you exactly how to apply stress through an undulating block system, but I feel it is important that you understand the background and the basic foundational principals of the system with which you, as a coach, must apply stress to your athletes. Subsequent sections of this book will lay out *exactly* how you can use an undulated block model to stress your athletes and improve their performance—just flip through the next couple of hundred pages to see all the tables, charts, and programs laid out. But by learning this material up front, by stressing your brain a little, you have adapted a basic understanding of stress, undulation, and the block system of training that will enable you to fully grasp the programming that follows—its purpose, application, and results in sport performance.