

# **STRENGTH AND CONDITIONING SEMESTER 2, GRADING PERIOD 2 STUDY GUIDE**

## **HOW THE BODY CHANGES IN RESPONSE TO TRAINING**

1. **NEURAL CHANGES** = The term neural relates to the contribution of the nervous system working with the muscular system to increase strength.
  - A. The nerves that are attached to specific muscles are “taught” when to transmit. Thus, an improvement in technique occurs that permits handling poundages more efficiently (with less effort).
  - B. Through repetition one’s body becomes able to recruit more muscle fibers. Thus, there is a learning factor that contributes to strength changes, some of which may be quite dramatic. It is generally well accepted that it is this neural learning factor that accounts for the strength improvements realized during the very early weeks of weight training.
  - C. Although the neural learning factor will continue to play a role, continued gains in strength are mostly associated with increases in muscle mass. As the cross-sectional area of the muscle becomes greater (because the individual fibers become thicker and stronger), so does the muscle’s ability to exert force. Therefore, the neural factor accounts for the early increases in strength, whereas muscle mass increases are responsible for the changes seen later.
  
2. **MUSCLE SIZE CHANGES** = Exactly what accounts for muscle size increases is not fully understood; however, factors that are often discussed are hypertrophy, hyperplasia, and genetic potential.
  - A. **Hypertrophy** - Muscle size increases are most often attributed to an enlargement of existing fibers, the same fibers that are present at birth. Very thin protein myofibrils (actin and myosin) within the fiber increase, creating a larger fiber. The collective effect of increases within many individual fibers is responsible for the overall muscle size changes observed. This increase in existing fibers is referred to as hypertrophy.
  - B. **Hyperplasia** - Although hypertrophy is the most commonly accepted explanation of why a muscle becomes larger, there are studies suggesting that fibers split lengthwise and form separate fibers. The splitting is thought to contribute to an increase in the size of the muscle. This theory of longitudinal fiber splitting is referred to as hyperplasia.
  - C. **Genetic Potential** - If one accepts hypertrophy as the process whereby existing fibers increase in size, then one must also accept the idea that there are genetic limitations regarding the extent to which muscle will increase in size. This is because increases are due to the thickening of fibers that already exist. Some people are born with a greater number of muscle fibers than others, and therefore their genetic potential for muscle size growth is greater.

3. **MUSCULAR ENDURANCE** = The ability to perform repeated muscle contractions (using moderate loads) for a given period of time, or the ability to extend the period of time before muscle fatigue occurs.
  - A. **Anaerobic qualities** - Anaerobic is the energy system that operates in the absence of oxygen. Strength and power output are primarily fueled by anaerobic energy. When training over a period of time the body learns to use this energy system better.
  - B. **Muscle fiber reduction** - Training appears to bring about muscular endurance improvement by reducing the number of muscle fibers involved during earlier periods of an activity, thereby leaving some in reserve should the activity continue. For example, if you had to perform a 25 lb. bicep curl and had 50 lbs. of strength in your biceps, this exercise would require 50 % of your strength. If, however, your bicep strength increased to 100 lbs., the task would now require only 25 % of your strength and, thus, a lower percentage of effort.
  
4. **CARDIOVASCULAR FITNESS** = The ability to transport and utilize oxygen by the muscles (aerobic) is called oxygen uptake.
  - A. **Heavy loads** - There is only a minimal effect on cardiovascular fitness when training programs involve heavy loads (weight) with few repetitions and long rest periods between sets.
  - B. **Light to moderate loads** - There is moderate improvement in oxygen uptake when training programs include light to moderate loads, high number of repetitions, and very short rest periods between sets.
  
5. **MUSCULAR COORDINATION** = The ability to use the muscles working together to create simple and complex movements.
  - A. **Myth** - Some people still believe that weight training will somehow negatively affect muscular coordination. The heaviness in the arms and legs, and the numb feeling that occurs immediately after a set of reps are only temporary and will not reduce coordination levels.
  - B. **Improved** - Weight training sessions that handle and move bars from the floor to overhead, balancing the bar on your back, and evenly pressing dumbbells all contribute to improving muscular coordination.
  
6. **FLEXIBILITY** = The range of possible movement in a joint and its surrounding muscles.
  - A. **Improved** - Weight training, if performed properly with a full range of motion of both the agonist and antagonist muscles, does not adversely affect flexibility.
  - B. **No evidence** - There is no reliable evidence to support the contention that properly performed weight training exercises reduce flexibility.
  
7. **MUSCLE SORENESS** = Tightness and soreness in the muscles experienced 1-3 days after working out. There is no definitive explanation of why we experience delayed muscle soreness.
  - A. **Micro tears** - These tears of the muscle and connective tissue cause the muscle soreness.
  - B. **Ischemia** - The lack of oxygen to muscle tissue causes muscle soreness. This occurs as a natural consequence of intense work and maybe due to muscle spasms.
  - C. **Recovery** - The very thing that stimulates soreness (exercise) helps to alleviate it. Light exercise combined with stretching activities is ideal for speeding the recovery from muscle soreness.

8. **OVERTRAINING** = A condition in which there is a plateau or drop in performance over a period of time. This occurs when your body does not have time to adequately recuperate from training before the next workout.

A. The physical warning signs of overtraining:

- Extreme muscle soreness days after a training session
- A gradual increase in muscle soreness from one training session to the next
- A decrease in body weight
- An inability to complete a reasonable training session
- A sudden or gradual increase of 8-10 beats per minute in resting heart rate
- A lowered general physical resistance to illness
- A loss of appetite
- A swelling of the lymph nodes in the neck, groin, or armpits
- Constipation or diarrhea
- An unexpected drop in physical performance during competitive activities

If you develop two or more of the above symptoms, you should reduce the intensity, frequency, and/or duration of training until these warning signs abate.

B. It is more desirable to prevent overtraining than to try to recover from it. To help prevent overtraining:

- Increase training intensity gradually
- Alternate aggressive with less aggressive training weeks
- Get adequate amounts of sleep
- Eat properly
- Monitor your physical vital signs and note significant changes
- Made adjustments in training intensity as needed

9. **MALE/FEMALE DIFFERENCES** = It is well established that the quality of muscle tissue and its ability to produce force is identical in both sexes. It should be no surprise to find out that when comparisons are made of women and men who have followed similar weight training programs, the women and men are found to respond similarly. Since a woman possesses less muscle mass than a typical man, her absolute strength may not be as great; but her potential for improvement (percentage-wise) is.