Introduction

• Muscles are unique in their ability to relax, contract, and produce force.

• In addition, this metabolically active tissue is highly responsive to training stimuli.

• With appropriate exercise, muscles become larger and stronger; without appropriate exercise, muscles become smaller and weaker.
Strength Benefits

• Strength training is the process of exercising with progressively heavier resistance for the purpose of strengthening the musculoskeletal system.

• The positive results of strength training include:
  - Increased muscle fiber size
  - Increased muscle contractile strength
  - Increased tendon tensile strength
  - Increased bone strength
  - Increased ligament tensile strength
Strength Benefits

- Physical capacity may be loosely defined as one’s ability to perform work or exercise.

- Research indicates that previously untrained men & women gain about 2-4 pounds of muscle and 40-60% more strength after two (2) months of regular strength exercise.
Strength Benefits

• Strength training can play a major role in enhancing our body composition and physical appearance.

Ex., 114# Woman, 24% Fat (27# fat, 87# lean)
If she loses 4# fat and adds 4# muscle, she still weighs 114#, but she is only 20% fat (23# fat, 91# lean)

• Body weight may remain the same, but strength training results in less fat and more muscle for a leaner, firmer, and fitter appearance.
Strength Benefits

• The gradual loss of muscle tissue in non-training adults leads to a 5% reduction in metabolic rate every decade of life.

• This gradual decrease in metabolism is closely related to the gradual increase in body fat.

• Although our metabolism eventually slows down with age, metabolic function & other degenerative processes can be markedly delayed through regular strength training.
Strength Benefits

• Balanced muscle development reduces the risk of overuse injuries that result when one muscle group is much stronger than its opposing muscle group.

• Trainers should address opposing muscle groups to reduce the risk of unbalanced muscle development.
Strength Production

- Isometric contraction - when the muscular force is equal to the resistive force and there is no movement.

- Isometric is the most representative of one’s actual strength production.
Strength Production

- Concentric contraction - when the muscular force is greater than the resistive force and the muscle shortens.

- Concentric contractions are not as strong as isometric contractions.
Strength Production

• Eccentric contractions - when the muscular force is less than the resistive force and the muscle lengthens.

• Eccentric contractions are stronger than isometric contractions.
Strength Production

• **Prime mover muscles** - muscles that are principally responsible for a given joint movement.

• **Antagonist muscles** - muscles that produce the opposite joint movement; work cooperatively with prime movers to produce smooth and controlled joint movements.

• **Stabilizer muscles** - muscles that stabilize one joint so that the desired movement can occur at another joint.
Muscles are composed of two (2) primary fiber types:

1. **Type 1 (Slow-Twitch)** - smaller fibers that are suited for aerobic energy utilization; can produce relatively low levels of force for relatively long periods of time.

2. **Type 2 (Fast-Twitch)** - larger fibers that are suited for anaerobic energy utilization; can produce relatively high levels of force for relatively short periods of time.
Strength Production

- A motor unit consists of a single motor nerve and all of the muscle fibers to which it attaches.

- Typical slow-twitch motor units contain about 100 muscle fibers.

- Typical fast-twitch motor units contain about 500 muscle fibers.

- When activated, all of the muscle fibers in a motor unit maximally contract simultaneously; this is known as the all-or-none principle.
Strength Production

• Motor learning effect - most of the performance improvement during the initial weeks of strength training is due to more efficient motor unit utilization.

• Delayed onset muscle soreness (DOMS) - lasting form of muscle discomfort (typically, 24-48 hours) following a demanding strength-training session; typically associated with eccentric muscle contractions; most likely the result of microscopic tears in the muscle or connective tissue.
Strength Factors

A number of factors affect our strength performance:

1. Gender
2. Age
3. Limb length
4. Muscle length
5. Tendon insertion
6. Muscle fiber type
Strength Factors

- Research has revealed that men & women of all ages can increase their muscle size and muscle strength through progressive strength training.

- The rate of strength gain appears to be greater during the normal years of development: ages 10-20.
Strength Factors

- Most men & women have a fairly even mix of slow-twitch and fast-twitch fibers in a majority of their skeletal muscles.

- Some people inherit a higher percentage of one or the other.
  - Higher percentage of slow-twitch = increased performance potential for endurance exercise
  - Higher percentage of fast-twitch = increased potential for muscle size and better results from strength-training programs
Strength/Endurance Relationships

- Muscle strength - one’s ability to perform a single repetition with maximum resistance.

- Muscle endurance - one’s ability to perform many repetitions with a sub-maximum resistance.

- One may train specifically for muscle strength or muscle endurance; however, there is an inherent relationship between these abilities.
Strength/Endurance Relationships

- One repetition maximum (1RM) - the amount of resistance that can be moved through the range of motion one time before the muscle is temporarily fatigued.

- Because the ratio of fast-twitch to slow-twitch muscle fibers is largely *unaffected* by training protocol, it appears that genetics largely determines our muscle endurance with a given percentage of maximum resistance.
Strength-Training Equipment

There are basically four (4) categories of strength-training equipment:

1. Isometric resistance
2. Isokinetic resistance
3. Dynamic constant resistance
4. Dynamic variable resistance
Strength-Training Equipment

1. Isometric (static) Equipment - frequently used for testing muscle strength; seldom recommended for developing muscle strength

- Advantages: little equipment, low cost, space efficiency, time efficiency
- Disadvantages: blood pressure escalation, increases in strength only at specifically exercised positions in the movement range, training monotony, and lack of performance feedback
Strength-Training Equipment

2. Isokinetic Equipment - constant movement speed and a matching resistive force

- **Advantages:** accommodating resistance forces, speed regulation, detailed performance feedback, and reduced muscle soreness
- **Disadvantages:** cost of equipment, inconsistent force regulation, lack of eccentric muscle contractions
3. Dynamic (isotonic) Constant Resistance Equipment – amount of resistive force encountered determines the amount of muscle force applied (Ex., barbells)

• Advantages: low cost of equipment, similarity to most work and exercise activities, variety of training movements, tangible evidence of improvement, easy accessibility

• Disadvantages: inability to train through a full range of joint motion in some exercises and inconsistent matching of resistive forces and muscle forces throughout the exercise movements
Strength-Training Equipment

4. Dynamic (isotonic) Variable Resistance Equipment – amount of resistive force encountered determines the amount of muscle force applied by levers/cams/linkage systems

- Advantages: ability to train through a full range of motion on most exercises, reasonably consistent matching of resistive forces and muscular forces throughout the exercise movements, and tangible evidence of improvement

- Disadvantages: equipment expense, limited number of training movements, and lack of accessibility
Strength Program Considerations

Most common strength-training mistakes are related to exercise technique (poor form):

- Bench press: rebounding the bar of the chest
- Squat: bouncing at the bottom of the squat
- Barbell curls: using the hip/back extension to initiate curls
- Barbell press: bending backward under the press
- Or using momentum/fast training speeds in any exercise
Strength Program Considerations

- Always warm-up prior to strength-training.

- These few minutes of warm-up prepares the client physiologically and psychologically for higher levels of effort and energy utilization.
Strength Program Considerations

- Always cool-down following a strength-training session.

- Blood tends to accumulate in the lower body when a vigorous exercise session is stopped abruptly. With reduced blood return, cardiac output decreases and light-headedness may occur.
Strength Program Considerations

- Circuit training is a form of strength training in which the client performs a series of strength exercises with little rest between exercise stations.

- One popular circuit training involves a line of 10-12 exercise machines that work each major muscle group, from largest to smallest.
Strength Program Considerations

- Few things are more effective than a conscientious trainer who demands proper technique and full effort on every exercise – and gives plenty of encouragement and just enough assistance to permit completion of a final repetition.

- One of the most important functions of a personal trainer is to provide protection in high-risk exercises by “spotting.”
Strength Program Considerations

• To spot during a squatting exercises, the trainer should stand behind the client ready to help him/her to a standing position (arms around upper torso).

• To spot during a bench or incline press, the trainer should stand behind the bench ready to grasp the barbell and help lift it back to the standards when needed.
Strength Program Considerations

• The typical diet provides considerably more protein than the relatively small amount required for muscle development.

• Protein consumption in and of itself does not increase muscle size.

• Consuming too much protein can be harmful because it must be broken down metabolically and places additional strain on the kidneys.
Strength Program Considerations

- Anabolic steroids are synthetic derivatives of the male sex hormone testosterone and are taken to increase muscle size and strength.

- Potential effects of anabolic steroid use include increased blood pressure, decreased levels of HDL, liver enzyme leakage, liver cancer, uterus shrinkage, uncontrolled mood swings, depression, breast shrinkage, testicle atrophy, sterility, and aggression.

- The physical and psychological harm that results from anabolic steroid use far outweighs any/all possible benefits.
Strength Program Considerations

• In the absence of strength stimulus, the muscles gradually become smaller and weaker (atrophy).

• One (1) or two (2) brief workouts per week are sufficient to maintain strength levels for extended periods of time.
Strength Plateaus

The following strategies have proved useful in overcoming strength plateaus:

1. Training frequency
2. Training exercises
3. Training sets
4. Resistance/repetitions relationships
5. Breakdown training
6. Assisted training
7. Negative training
8. Slow training
Strength Plateaus

1. Training Frequency

More stressful training sessions may require longer recovery periods; reduce the training frequency.
Strength Plateaus

2. Training Exercises

The neuromuscular system adapts to specific movement patterns; change the training exercises occasionally.
Strength Plateaus

3. Training Sets

Vary the number of sets performed; change from multiple sets to a single-set routine or from a single-set routine to multiple sets.
Strength Plateaus

4. Resistance/ Repetitions Relationships

The neuromuscular system adapts to specific training workloads; change from high-repetition/ low-weight to low-repetition/ high-weight.
Strength Plateaus

5. Breakdown Training

Sometimes the training stimulus must be intensified to maximize muscle development; complete lesser-weight post-fatigue repetitions.
Strength Plateaus

6. Assisted Training

Help the client perform 2-3 post-fatigue repetitions.
Strength Plateaus

7. Negative Training

Effective muscle force output is greater during eccentric contractions; lower weights slowly that are too heavy to lift.

Negative training creates a higher risk of injury; therefore, negative exercises should only be attempted when carefully controlled and supervised by a competent personal trainer.
Strength Plateaus

8. Slow Training

Slow the movement speed to make the muscles work harder; slower speeds reduce the role of momentum and produce greater muscle tension.
Strength Plateaus

- Periodization - the systematic application of overload through the pre-planned variation of program components to optimize gains in strength (or any specific component of fitness), while preventing overuse, staleness, overtraining, and plateaus; used commonly in changing resistance/ repetitions relationships.
Training Motivation

• An effective personal trainer will be a great motivator:
  - Keep accurate records of routines & improvements;
  - Provide performance feedback;
  - Share information in a personal, positive manner;
  - Encourage and reinforce positively; and
  - Provide specific information/feedback.
Training Motivation

• The most powerful means of motivation is the strength-fitness model (The Personal Trainer).

• The trainers physical appearance, training regularity, exercise technique, and personal attitude provide an example that can significantly reduce or enhance the client’s enthusiasm.
Training Motivation

• The most important aspect of training motivation is maximizing the rate of improvement and minimizing the risk of injury.