Warm-Up

I. Types of Warm-Ups
   A. Passive Warm-up
      1. Involves external methods (hot showers, heating pads, massage etc.) to increase body temperature
      2. May have a positive effect
      3. Advantage - does not prefatigue
      4. May not be practical in many settings
   B. General Warm-up
      1. Involves basic activities that require movement of major muscle groups (jogging, cycling, jumping rope, etc.)
      2. More appropriate than passive when goal is prepping body for demanding physical activity
      3. Increases heart rate, blood flow, deep muscle temperature, respiration rate, viscosity of joint fluids, and perspiration.
      4. Increases flexibility to prep the body for movement.
   C. Specific Warm-up
      1. Involves movements that are an actual part of the goal activity (slow jog before going on a run)
      2. Appears to be most desirable method because preps specific muscles for an activity, as well as, serves as rehearsal for goal activity.
      3. See Ch. 17 for examples
   D. Warm-up Guidelines
      1. Length of warm-up period depends on climate and physical conditioning level.
      2. In general should last approximately 5 to 15 minutes, long enough for client to break out in a sweat.
      3. As client’s conditioning level improves, duration and intensity of warm-up should increase, as well, to achieve optimal level of body temp.
**Flexibility**

II. **Terminology**
   A. **Active Stretching** – occurs when the person who is stretching supplies the force of the stretch.
   B. **Passive Stretching** – occurs when a partner or stretching device provides the force for the stretch.
   C. **Golgi Tendon Organs** – protective mechanism against injury during passive and active stretching. Located at musculotendinous junction. When excessive force generated in muscle Golgi Tendon Organ inhibits muscle contraction (relaxation).
   D. **Muscle Spindles** – protective mechanism against injury during passive and active stretching. Located within the muscle. When stimulated muscles react by contracting.

III. **Types of Flexibility Training**
   A. **Ballistic Stretching** (bouncing)
      1. Is rapid, jerky, uncontrolled movement during which body part is put into motion and momentum takes it through the ROM to the stretching limits of the muscle.
      2. No longer considered an acceptable method for increasing ROM at any joint.
      3. Four disadvantages to ballistic stretching:
         a. Increased danger of exceeding extensibility limits of tissues
         b. Higher energy requirements
         c. Greater likelihood of causing muscular soreness than with static stretching
         d. Activation of the stretch reflex
   B. **Static Stretching**
      1. Most commonly used method to increase flexibility.
      2. Involves simultaneous relaxing and lengthening of muscle at a slow, constant speed; with the stretched position generally held for 30 seconds.
      3. Opportunity for injury is lower than during ballistic stretching.
      4. Final stretch position should be moved into slowly and to a point of minor discomfort.
      5. Feeling of tension should diminish.
      6. Instructions can be found on pgs. 278 to 281.
   C. **Proprioceptive Neuromuscular Facilitation** (PNF)
      1. Normally performed with a partner
      2. Makes use of both passive movement and active (concentric and isometric) muscle actions.
      3. May be superior to other stretching methods because assists muscular relaxation, potentially assisting in increased ROM.
4. Three basic types:
   a. **Hold-Relax**
      i. Passive prestretch held at point of “mild discomfort” for 10 seconds
      ii. Partner applies hip flexion force to client (“hold and don’t let me move the leg”) and is held for 6 seconds
      iii. Client relaxes and passive stretch performed and held for 30 seconds.
   b. **Contract-Relax**
      i. Passive prestretch held at point of “mild discomfort” for 10 seconds
      ii. Client extends hip against resistance from partner so that concentric muscle action occurs through full ROM
      iii. Client relaxes and passive stretch performed and held for 30 seconds.
   c. **Hold-Relax with Agonist Contraction**
      i. Passive prestretch held at point of “mild discomfort” for 10 seconds
      ii. Partner applies hip flexion force to client (“hold and don’t let me move the leg”) and is held for 6 seconds
      iii. A concentric action of the agonist is used in addition to the passive stretch to add to the stretch force and held for 30 seconds (i.e., hip flexors contract & hamstrings stretched)

D. Dynamic Stretching
1. Involves faster movements but avoids bouncing and includes movements specific to a sport or movement pattern. (i.e., Lunge Walk)
2. As clients improve movements may be combined and is advantageous to clients because:
   a. Provides greater variety in flexibility program
   b. Is a more time efficient way to stretch a large number of muscle groups
3. Beginners:
   a. Clients should begin with low-volume & low-intensity
   b. Requires balance and coordination
   c. May experience muscle soreness for a short period of time during introduction.
FREE WEIGHT AND
MACHINE EXERCISE TECHNIQUES
*Coincides with Chapter 13 of CPT Text

1) Presentation Context

Note: This presentation is based upon the “Free Weight and Machine Exercise Techniques” videotape or DVD; of the 38 total exercises, 12 are highlighted in this outline. The full-length (82 minute) videotape/DVD and the comprehensive 67-page “Checklist Manual” can be obtained through the NSCA Certification Commission office. (Figure 1)

2) Spotting Criteria
   a) Bar or dumbbell moves over head or face – examples
      i) Barbell exercises
         (1) Hold bar with alternated hand grip
         (2) Establish solid base of support and flat back
      ii) Dumbbell exercises
         (1) Spot as close to the dumbbell as possible – spot the wrists, NOT the elbows
   b) Bar is placed on the back or racked at the front shoulders – examples
      i) Should be performed inside a power rack with the crossbars in place at an appropriate height
   c) Power exercises are typically not spotted

3) Weight Belt Recommendations
   a) Ground-based, structural exercises that load the trunk and place stress on the lower back AND front
   b) During sets at or near maximal loads (not warm-up or lead-in sets)
   c) Cautions
      i) May reduce training effect on spinal stabilizers/abdominals
      ii) May become habitual during other, non-indicated exercise (e.g., lat pulldown, bench press, biceps curl, leg extension)

4) Breathing Considerations
   a) General guidelines for typical and special population clients
      i) Breathe normally
      ii) Inhale during less-stressful phase of the repetition (eccentric)
      iii) Exhale through sticking point (typically soon after the transition from the eccentric to concentric phase)
   b) Specific considerations for advanced (i.e., trained and experienced) clients
      i) Inhale prior to beginning a repetition, breath-hold until immediately after the sticking point of the concentric phase, then exhale
      ii) OR: Inhale during eccentric phase until prior to beginning the concentric phase, breath-hold until immediately after the sticking point, then exhale
      iii) Valsalva maneuver
(1) Definition
(2) Value
(3) Actual duration
(4) Concerns

c) Guidelines for the personal trainer
   i) Educate client (teach proper exercise technique)
   ii) Evaluate status of the client
   iii) Evaluate type of exercise to be performed

5) Supine Exercises
   a) Maintain “5-point contact” body position:
      i) Head
      ii) Shoulders/upper back
      iii) Buttocks
      iv) Right foot
      v) Left foot

6) Standing Exercises
   a) Foot position:
      i) Feet slightly wider than hip-width
      ii) Heels and balls of the feet in contact with floor

7) Back Squat
   a) Bar position
      i) High (more vertical torso position)
         (1) Location of the bar
         (2) Creates more torque at the knee
         (3) Results in more stress on the quadriceps group
      ii) Low (slightly flexed torso position)
         (1) Location of the bar
         (2) Creates more torque at the hip
         (3) Results in more stress on the hip extensors
   b) Exercise description
      i) Exercise type – core, multi-joint
      ii) “Prime movers”
         (1) Hip extensors – hamstring group, gluteus maximus
         (2) Knee extensors – quadriceps group
   c) Start position
      i) Grip type and width
      ii) Pin bar in place on back
      iii) Stance/feet and heel position
      iv) Chest/shoulder/torso position
      v) Head position
      vi) “Flat back”
   d) Downward movement phase
      i) Breathing
ii) Back/torso position
iii) Chest/shoulder position
iv) Feet position
v) Balance of body weight
vi) Heels in contact with floor; do not use board/plates under heels
e) Lowest position
   i) Flexibility test
   ii) “Mid-line of the thigh”
   iii) Relationship of the center of gravity to the torque at the hip and knee
iv) Balance still over heels
v) Maintain torso position
f) Upward movement phase
   i) Breathing
   ii) Torso position
   iii) Knees track over feet

8) Leg Press/Hip Sled (machine)
a) Exercise description
   i) Exercise type – core, multi-joint
   ii) “Prime movers”
      (1) Hip extensors – hamstring group, gluteus maximus
      (2) Knee extensors – quadriceps group
      (3) Similar to the squat, but less supporting musculature is needed
b) Start position
   i) Full contact with machine pads – back, hips, buttocks, head (if applicable)
   ii) “Squat-like” foot position (wider ‘stance’ with toes slightly angled out)
      (1) Creates more torque at the hip
      (2) Results in more stress on the hip extensors
   iii) Closer, parallel foot position (typically in the middle and lower on the platform)
      (1) Creates more torque at the knee
      (2) Results in more stress on the quadriceps group
   iv) Thighs/knees/lower legs are parallel to each other
c) Moving the platform into starting position
   i) Rack should begin ‘lower’ rather than ‘higher’
   ii) Do not reach to unlatch catch bars
d) Downward movement phase
   i) Very similar to squat
e) Lowest position is achieved when one or more of the following occur:
   i) Thighs are parallel to the platform
   ii) Knees move in or out
   iii) Heels lose contact with platform (push through the heels, not toes)
   iv) Hips and/or buttocks move off the seat
f) Upward movement phase
   i) To full knee extension, but not forcefully locked
g) Racking the platform
i) Do not remove feet until supports are in place
ii) Rack ‘lower’ rather than ‘higher’

9) Lunge
   a) Exercise description
      i) Exercise type – assistance (cannot determine the 1Rm), multi-joint
      ii) “Prime movers”
         (1) Hip extensors – hamstring group, gluteus maximus
         (2) Knee extensors – quadriceps group
   b) Start position
      i) Stance
      ii) Torso position
   c) Forward movement phase
      i) Step, foot plant
         (1) Take an exaggerated step
         (2) Step straight ahead
      ii) Lunge
         (1) Flat lead foot
   d) Lowest position
      i) Foot position
         (1) Step straight ahead
         (2) Slight toed-in position of lead foot can aid in balance
      ii) Knee position
         (1) Lead knee – over ankle, but definitely not past lead toes
         (2) Trailing knee – several inches off floor (it should not touch down)
      iii) Erect torso – “sit back” on the trailing leg
   e) Backward movement phase
      i) Push lead foot the full distance back to the trailing foot
      ii) Initiate an “upward scissors motion”
      iii) Alternate legs
      iv) Torso/head position

10) Stiff-Leg Deadlift
   a) Exercise description
      i) Exercise type – assistance, single-joint (despite the numerous vertebral joints)
      ii) “Prime movers”
         (1) Hip extensors – hamstring group, gluteus maximus (PRIMAR Y)
         (2) Vertebral extensors – erector spinae (SECONDARY)
   b) Start position
      i) Alternated hand grip
      ii) Closer stance, feet parallel
      iii) Use an elevated platform?
      iv) Flat back
      v) Slightly flexed knees – to be maintained throughout entire movement
   c) Downward movement phase
      i) Maintain slight knee flexion
d) Lowest position
   i) Hands to mid-shin, unless using an elevated platform

e) Upward movement phase
   i) Contract gluteal muscles
   ii) Do not simply stand up and lean back

11) Pec Deck (machine)
   a) Exercise description
      i) Exercise type – assistance, single-joint (treating the shoulder complex as one joint)
      ii) “Prime movers”
          (1) Shoulder transverse (“horizontal”) adductors – pectoralis major, anterior deltoid
          (2) Shoulder girdle abductors – serratus anterior, pectoralis minor
   b) Moving the handles into starting position – one at a time, if there is no foot pedal
   c) Start position
      i) 5-point contact position
      ii) Upper arm parallel to floor
      iii) Torso to humerus angle should be at or less than 90°
      iv) Elbows flexed to 90°
   d) Backward movement phase
   e) Most rear position – pads level with the chest
   f) Forward movement phase
      i) No abdominal crunch movement
      ii) Maintain stationary torso position
   g) Returning the handles – one at a time, if there is no foot pedal

12) Flat/Incline Dumbbell Fly
   a) Exercise description
      i) Exercise type – assistance, single-joint (treating the shoulder complex as one joint)
      ii) “Prime movers”
          (1) Shoulder transverse (“horizontal”) adductors – pectoralis major, anterior deltoid
          (2) Shoulder girdle abductors – serratus anterior, pectoralis minor
   b) Start position
      i) 5-point contact position
      ii) Slightly flexed elbows – to be maintained throughout movement
      iii) Hands/dumbbell handles are parallel
      iv) Elbows point out
      v) Dumbbells begin over the:
          (1) Chest (flat fly)
          (2) Shoulders/face (incline fly)
   c) Downward movement phase
      i) Lower dumbbells in a wide arc
      ii) Shoulder/elbow/hand/dumbbells stays in one plane
d) Lowest position
   i) To chest/shoulder level
   ii) Elbows point down to the floor

e) Upward movement phase
   i) Raise dumbbells in a wide arc
   ii) “Hug a tree trunk” – go up and around, do not press dumbbells up

13) One-Arm Dumbbell Row
   a) Exercise description
      i) Exercise type – assistance, multi-joint
      ii) “Prime movers”
         (1) Scapular adductors – rhomboid, middle trapezius
         (2) Shoulder extensors – latissimus dorsi, teres major, teres minor, posterior deltoid
         (3) Elbow flexors – biceps brachii, brachialis, brachioradialis
   b) Start position
      i) One knee and hand (same side of body) are on a bench
      ii) Outside foot is next to bench; outside knee slightly flexed
      iii) Back flat and parallel to floor
      iv) Arm with the dumbbell is fully extended
   c) Upward movement phase
      i) Upper arm brushes against torso
      ii) Maintain body position
   d) Highest position
      i) Elbow points upward
      ii) Dumbbell raised to rib cage
   e) Downward movement phase
      i) Lower to full elbow extension
      ii) Maintain torso position

14) Shoulder Raise (front, side, and bent over)
   a) Exercise description
      i) Exercise type – assistance, single-joint (treating the shoulder complex as one joint)
      ii) “Prime movers”
         (1) Shoulder flexors – anterior deltoid (front raise)
         (2) Shoulder abductors – deltoid group (side raise)
         (3) Shoulder transverse (“horizontal”) adductors – posterior deltoid (bent over raise)
   b) Start position
      i) Front raise – dumbbell handles are aligned with each other
      ii) Side raise – dumbbell handles are parallel with each other
      iii) Bent over raise
         (1) Dumbbell handles are parallel with each other
         (2) Body position mimics the bent over row exercise
   c) Upward movement phase – for all three movements
i) Slightly flexed elbows and knees – to be maintained throughout entire movement
   ii) Movement only occurs at the shoulder
   iii) Torso remains stationary

d) Highest position – for all three movements
   i) Raise to a position where the upper arms are parallel to the floor

e) Downward movement phase

15) Lying Triceps Extension
   a) Exercise description
      i) Exercise type – assistance, single-joint
      ii) “Prime mover”
         (1) Elbow extensors – triceps brachii
   b) Start position
      i) 5-point contact position
      ii) Elbows point toward the legs
      iii) Bar over the chest, not the face
      iv) Upper arms parallel to each other
   c) Downward movement phase
      i) Upper arms and body stationary
      ii) Movement only occurs at the elbow
   d) Lowest position
      i) Lower to the forehead, top of head, over the head – depends upon arm length
      ii) Guard against striking the head or face
   e) Upward movement phase
      i) Upper arms and body stationary
      ii) Movement only occurs at the elbow

16) Functional Training
   a) Definition
      i) Type of training that conditions the body consistent with its integrated movement or chosen activity
      ii) Further application of specificity ( coordinative); conditions the body or a body part for specific activity
   b) Description and examples
      i) Activity-specific; strength and balance training exercises (e.g., ground-based, multi-planar)
Glossary

Assistance exercise – an exercise that is a 1) single-joint exercise; 2) involves smaller muscle groups (e.g. biceps, triceps, abdominals, forearms, calves, neck, etc.); and CANNOT safely and effectively be used in a 1 RM testing situation

Core exercise – an exercise that is a 1) multi-joint exercise; 2) involves larger muscle groups (e.g., chest, hip/thigh, and shoulders); and 3) can safely and effectively be used in a 1 RM testing situation

Multi-joint exercise – an exercise involving two or more (different) joints changing angles during the execution of a repetition

Prime mover – the predominant muscle/muscle group that is responsible for creating body movement during an exercise

Single-joint exercise – an exercise involving only one (particular) joint changing angle during the execution of a repetition

Valsalva maneuver – holding the breath and/or contracting the abdominal muscles during the exertion phase of a weight training exercise; results in increased intra-abdominal/intra-thoracic pressure and systolic/diastolic blood pressure
Resistance Training Program Design

*Coincides with Chapter 15 of CPT Text*

I. Terminology
A. Assistance Exercise – an exercise that is a 1) single-joint exercise; 2) involves smaller muscle groups (e.g., biceps, triceps, abdominals, forearms, calves, neck, etc.; 3) CANNOT safely and effectively be used in a 1RM testing situation
B. Circuit Weight Training – selected weight training exercises performed consecutively in an exercise sequence usually utilizing light resistances (40-60% of 1RM) and short rest periods
C. Compound Set – performing two consecutive exercises (with minimal rest, if any) that stresses the SAME muscle group (e.g., barbell biceps curl and dumbbell biceps curl)
D. Core Exercise – an exercise that is a 1) multi-joint exercise; 2) involves larger muscle groups (e.g., chest, hip/thigh, and shoulders); and 3) can safely and effectively be used in a 1RM testing situation
E. Multi-joint Exercise – an exercise involving two or more (different) joints changing angles during the execution of a repetition
F. Priority Training – to first perform/complete the mode or exercise that is most important or specific to the desired goal, session, season, or sport
G. Repetition Maximum (RM) – the number of repetitions allowed by a given resistance
H. Single-joint Exercise – an exercise involving only one (particular) joint changing angle during the execution of a repetition
I. Specialized Client – a client who requires additional, unique attention to program design (e.g., a client training for a specific competition, a hypertensive client who has exercise limitations, etc.)
J. “Split” Programs – to increase training frequency by dividing the exercises and/or muscle groups over a greater number of sessions
K. Superset – performing two consecutive exercises (with minimal rest, if any) that stress OPPOSING muscle groups (e.g., biceps curl and triceps extension)

II. Outcomes or Goals
A. Muscular endurance - The outcome of training for greater muscular endurance is an enhanced ability of the targeted muscles to perform at a submaximal level for many repetitions for an extended duration.
B. Hypertrophy - An increase in the cross-sectional area of the muscle fiber.
C. Muscular strength - Compared to training for muscular endurance and hypertrophy, training loads used for developing strength are heavier. Therefore, unless the client is already well resistance trained, he or she should become accustomed to “strength” training by following a hypertrophy or muscular endurance training program first.
III. Training Principles
A. Specificity – to train in a specific manner for a specific outcome or goal
   1. Muscle groups
   2. Desired sport / activity
B. Overload – to stress the muscular, ligamentous, tendinous, and skeletal systems at a level greater than what they are typically accustomed
   1. How to increase
      a. “Intensity”
      b. Frequency
      c. Duration
C. Progression - a method of advancing training variables

IV. Program Design Variables
A. Choice (exercise selection)
B. Frequency
C. Order (exercise arrangement)
D. Load (weight)
E. Repetitions (reps)
F. Sets
G. Rest periods
H. Variation
I. Progression

Choice, Frequency, and Order

I. Choice
A. Exercise selection based on:
   1. Specificity principle
   2. Client’s training status
   3. Client’s available training time (# and type of exercises)
   4. Equipment availability
   5. Client’s exercise technique experience
B. Types of exercises
   1. Main muscle areas
      a. “Large”
      b. “Small”
   2. Core exercises (criteria:)
      a. Involve 2+ joints (multi-joint, structural)
      b. Involve larger / multiple muscle groups / areas
c. Can safely and effectively perform a 1RM test

3. Explosive / power exercise
   a. Examples
   b. Typically for a client who desires to improve sport performance
   c. All explosive / power exercises are “core” exercises

4. Assistance exercise (three criteria):
   a. Involve 1 joint (single-joint)
   b. Involve smaller muscle groups
   c. Cannot safely and effectively perform a 1RM test

C. “What about exercises that train the upper back muscles?”
   1. Yes – typically multi-joint exercises (e.g., lat pulldown)
   2. Yes – it is a (very) large muscle group
   3. No – cannot safely and effectively perform a 1RM test
   4. Therefore, an exercise that trains this muscle group is categorized as an “assistance” exercise

D. Guidelines to follow when choosing exercises
   1. Basic / beginner’s approach – one exercise per muscle group
   2. Specialized client approach – sport / activity-specific

II. Frequency
A. Exercise frequency is based on:
   1. Overall amount of physical stress
   2. Training status
   3. Client’s personal schedule
   4. General rule – at least one day (but no more than three) between workouts stressing the same muscle group(s)

B. Guidelines to follow when determining training frequency
   1. Based on client’s fitness level
      a. Beginner: 2-3 times/week
         i. Spaced evenly (e.g., M+Th; Tu+F; M+W+F)
         ii. Each workout contains one list of all exercises (e.g., one exercise per muscle group)
      b. Intermediate: 4 times/week
      c. Advanced: 5-6+ times/week
   2. Split routine / program (applied to clients weigh training more than 3 times/week)
      a. 4 times/week
      b. “3 on + 1 off” (5-6 times/week)
      c. “3 on (two workouts/day) + 1 off” (10–12 times/week); called a double-split routine
   3. Additional “frequency” guidelines
      a. Training load
      b. Muscular involvement
      c. Exercise type
III. **Order**
A. Exercise order based on:
   1. Specificity principle = priority training
   2. Type of exercise
B. Guidelines to follow when establishing exercise order
   1. Primary options
      a. All multi-joint (MJ) exercises first, then all single-joint (SJ)
      b. All power exercises first, then all core exercises, then all assistance exercises
      c. Alternate “pushing” exercises with “pulling” exercises
      d. Alternate upper body (UB) exercises with lower body (LB) exercises
      e. “Push” and “pull” COMBINED with all MJ first then all SJ exercises
   2. Secondary options
      a. Superset
      b. Compound set

**Load and Repetitions**

I. **Relationships and Assignments**
A. Definitions (load)
   1. Total weight lifted per training session
   2. Weight assigned to an exercise for a set of repetitions
B. Link to training outcome
   1. A load can be lifted \(x\) times, place a specialized stress on the body, and result in a certain adaptation
   2. Focus on a specific outcome automatically implies a certain loading and repetition regime
C. Relationship between \(\%\) 1RM load and the number of repetitions “allowed” (see table)
D. Weaknesses in & 1RM-repetition tables
   1. Assume linear associations
   2. Trained athletes can perform more repetitions, especially for LB exercises
   3. Repetitions are based only on 1 set
   4. Based primarily on 3 exercises (bench press, squat, power clean)
   5. Difference between free weight and machine exercises
   6. Difference between large and small muscle groups
   7. Most accurate: \(\geq 75\%\) 1RM for \(\leq 10\) reps
II. Three Methods to Estimate a Client’s Training Loads

A. Method #1: Based on a percentage of the 1RM

1. Preliminary testing
   a. Option #1: directly testing the 1RM
      i. Trained and experienced athletes
      ii. Core exercises only
      iii. A 1RM testing protocol
   b. Option #2: estimating the 1RM
      i. Nearly all clients
      ii. Nearly all exercises (but there is a concern for fatigue)
      iii. 10RM to 1RM procedure
      iv. Prediction equations

2. Estimating training loads from a 1RM
   a. Decide goal number of reps in tested exercise (to use for the client’s program)
   b. Based on goal number of reps, find % 1RM
   c. Multiply % 1RM x 1RM = training load
   d. Example:

   | Exercise: | barbell shoulder press |
   | 1RM:      | 115 lbs |
   | Goal # reps for program: | 10 |
   | Corresponding % 1RM: | 75% |
   | Estimated training load: | 115 x .75 = 86.25 lbs |
   | Rounded (actual) load: | 85 lbs |

   e. Note – this training load may have to be adjusted (decreased) if multiple sets are performed

B. Method #2: Based on a percentage of the client’s bodyweight (BWT)

1. Qualifiers
   a. Max bodyweights for calculations – male (175 lbs); female (140 lbs)
   b. Nearly all clients (except well-trained)
   c. Nearly all exercises (where coefficients are available)

2. Preliminary testing
   a. Multiply BWT by the COEFFICIENT for the exercise to be tested; this is the TRAIL LOAD
      Example – female, FW shoulder press = 0.22 as the coefficient
   b. Divide the trail load by 2; this is the WARM-UP LOAD
   c. Perform one set of 12-15 reps with the warm-up load
   d. Rest one minute
   e. Perform one set of as many repetitions as possible (with proper technique and breathing) with the TRIAL LOAD
   f. Record # of reps completed

3. Estimating training loads from % of bodyweight testing
a. Decide goal number of reps in testing exercise (to use for the client’s program)
b. Note – the coefficients in Table 2 are designed to allow about 12-15 reps
c. If the goal number of reps differs from the number of reps completed with the trial load, use Table 3 to modify the trail load to allow (or limit) the client to complete the goal number of reps for the first session
d. Example:

Client: male, 160 lbs
Exercise: FW shoulder press
Coefficient (Table 2): 0.38
Estimated trail load: 160 x 0.38 = 60.8 lbs
Rounded (actual) trail load: 60 lbs
# reps completed: 15
Goal # reps for program: 10
Adjustment (Table 3): +10 lbs
Adjustment training load: 60 + 10 = 70 lbs
e. Note – this training load may have to be adjusted (decreased) if multiple sets are performed

C. Method #3: Based upon RM testing (must know goal reps before using this method)

1. Qualifiers
   a. All clients
   b. All exercises (except ≥8RM for assistance exercises)
2. Preliminary testing
   a. Same as 1RM testing, but with the “goal reps” as the number of reps performed per trial set
   b. Allow maximal rest (without cooldown effects)
   c. May want to use Table 3 after several trail sets in high RM testing situations – client becomes too fatigued
3. Estimating training loads from RM testing
   a. Since the actual load at the goal number of reps is determined, it IS the training load; no calculations necessary
   b. Note: this training load may have to be adjusted (decreased) if multiple sets are performed
A Step-By-Step Plan For Designing Wight Training Programs
*Coincides with Chapter 15 of CPT Text

I. **Gather Background Information**
   A. Client description (medical and exercise history)
   B. Gender
   C. Body Composition (weight and body fat %)
   D. Age
   E. Past / present injuries
   F. Any other pertinent information

II. **Assess Client’s Present Training Status**
   A. “Trained” (or) “untrained”
   B. “Experienced” (or) “not experienced”

III. **Determine Training Goal(s)**
    A. General fitness (or) specialized
    B. Muscular endurance (or) hypertrophy (or) muscular strength

IV. **Conduct Training Sessions**
    A. Decide method(s) – 1RM (and/or) %BWT (and/or) RM testing
    B. Always have a rationale to test in a certain manner

V. **Design Program: Determine Training Frequency**
   A. Based on client’s:
      1. Personal schedule
      2. Training status
      3. Other components of exercise program (e.g., aerobic workouts)
   B. Choose number of weekly workouts
   C. Choose specific days of week (if applicable)

VI. **Design Program: Choose Exercises**
    A. Decide a strategy based upon training goals, preferences, etc.
    B. If client will be following a split routine, decide body part grouping
    C. Make list(s) of specific exercises
       1. Machine or free weight
       2. Type (power, core, assistance)

VII. **Design Program: Place the Exercises in a Specific Order**
    A. Decide method(s)
    B. Create actual ordered list(s) of chosen exercises
VIII. Design Program: Determine Goal Number of Reps (based on:)
A. Overall goal of program AND
B. Type of exercise

IX. Design Program: Determine Loads
A. List results of testing next to exercise names
B. Perform calculations (if needed) bases on:
   1. Overall goal of program
   2. Use of program variation
   3. Goal number of reps
C. Determine exact loads
D. Make any adjustments to the loads (if needed)
E. Round the loads to nearest increment

X. Design Program: Determine Number of Sets (based on:)
A. Overall goal of program AND
B. Type of exercise AND
C. Client’s training status

XI. Design Program: Determine Rest Periods (based on:)
A. Overall goal of program

XII. Design Program: Decide Degree of Program Variation
A. Pyramid loads? For which exercises?
B. Include within-the week load variations?

XIII. Evaluate Client Over Time; Alter Program (progression)
A. Load
   1. Two methods to determine when to increase loads:
      a. “2 for 2” rule – 2+ reps over goal number in 2 consecutive
         workouts (in each exercise and set)
      b. “2-1-3” guideline – once client reaches the goal number of reps
         in each set, increase load in 2nd set first, then 1st set, and then
         3rd set
         i. For 2 sets – “1-2”
         ii. For 4 sets – “2-1-3-4”
   2. Estimated load increases based upon exercise type (or use a 2.5-
      10% increase)
      a. Upper body core exercise (add ~ 10-20 lbs)
b. Upper body assistance exercise (add ~ 5-10 lbs)
c. Lower body core exercise (add ~ 15-50+ lbs)
d. Lower body assistance exercise (add ~ 10-15 lbs)

B. All other program design variables

XIV. Evaluate Client’s Progress and Update the Program (start w/ step 1)

**Sample Exercise Frequency Options**

<table>
<thead>
<tr>
<th>Sunday</th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
<th>Saturday</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Beginner: two days exercise, five days rest</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Rest</td>
<td>Exercise</td>
<td>Rest</td>
<td>Rest</td>
<td>Exercise</td>
<td>Rest</td>
<td>Rest</td>
</tr>
<tr>
<td><strong>Beginner: three days exercise, four days rest</strong></td>
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<tr>
<td>Rest</td>
<td>Exercise</td>
<td>Rest</td>
<td>Exercise</td>
<td>Rest</td>
<td>Exercise</td>
<td>Rest</td>
</tr>
<tr>
<td><strong>Intermediate: four days exercise, three days rest</strong></td>
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<td>Rest</td>
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<td>Exercise</td>
<td>Rest</td>
</tr>
<tr>
<td><strong>Intermediate: five days exercise, two days rest</strong></td>
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<tr>
<td>Rest</td>
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<td>Exercise</td>
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<td><strong>Advanced: six days exercise, one day rest</strong></td>
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<td>Exercise</td>
<td>Rest</td>
<td>Exercise</td>
<td>Exercise</td>
<td>Exercise</td>
</tr>
</tbody>
</table>

**Assigned Loads and Repetitions Based on the Training Goal**

<table>
<thead>
<tr>
<th>Training Goal</th>
<th>Load (% 1RM)</th>
<th>Goal Repetitions</th>
<th>Sets**</th>
<th>Rest Period Length***</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muscular endurance</td>
<td>≤67%</td>
<td>≥12</td>
<td>2-3</td>
<td>≤30 seconds</td>
</tr>
<tr>
<td>Hypertrophy</td>
<td>67-85%</td>
<td>6-12</td>
<td>3-6</td>
<td>30-90 seconds</td>
</tr>
<tr>
<td>Muscular strength*</td>
<td>≥85%</td>
<td>≤6</td>
<td>2-6</td>
<td>2-5 minutes</td>
</tr>
</tbody>
</table>

*The % 1RM loads for muscular strength training apply to core exercises; assistance exercises should be limited to 8RM or higher (i.e., an 8RM load or lighter)

**These assignments do not include warm-up sets and typically apply to core exercises only.

***Because there are occasions when the prescribed percentage of the 1RM for assistance exercises falls outside the range associated with the training goal (e.g., 8+RM loads are recommended for assistance exercises as part of a muscular strength training program), the personal trainer should examine the loads used for each exercise when assigning rest periods rather than generally applying the guidelines for a training goal.
V. Terminology

A. Aerobic exercise – exercise performed predominantly in the presence of oxygen when the oxidative metabolic pathways are the predominant source of energy production

B. Anaerobic exercise – exercise performed primarily in the absence of oxygen when the anaerobic metabolic pathways are the predominant source of energy production

C. Anaerobic threshold – the last oxygen uptake rate (VO2) value fitting the linear trend when expired ventilation rate (i.e., ventilatory threshold) or lactic acid (i.e., lactate threshold) is plotted against VO2 or workload; anaerobic threshold represents the transition from predominantly aerobic metabolism to predominantly anaerobic metabolism during increased workloads; may be expressed in either liters per minute (L/min) or milliliters per kilogram of bodyweight per minute (ml/kg/min)

D. Cardiorespiratory endurance – the ability of the lungs and heart to take in and transport adequate amounts of oxygen to the working muscles, allowing activities that involve large muscle masses (movements???) to be performed over long periods of time

E. Duration of exercise – the length of time or distance completed during an exercise session

F. Frequency of exercise – the number of exercise sessions per week

G. Heart rate reserve (HRR) – maximal heart rate minus resting heart rate; typically expressed in beats per minute

H. Intensity of exercise – the % of maximal heart rate, heart rate reserve, or maximal oxygen uptake rate that is being performed during exercise

I. Lactate threshold – significant increase or breakaway in lactic acid production during exercise when workloads are increasing, resulting in an increase in blood lactate levels above resting levels (i.e., onset of blood lactate accumulation)

J. Maximal heart rate – the maximal rate at which the ventricles of the heart can contract; age-predicted maximal heart rate is equal to approximately 220 minus age in years; typically expressed in beats per minute

K. Maximal oxygen uptake rate (VO2 max) – the maximal amount of oxygen consumed by the body per minute; may be expressed in either liters per minute (L/min) or milliliters per kilogram of bodyweight per minute (ml/kg/min)

L. Metabolic equivalent (MET) – the amount of oxygen required per minute under resting conditions; 1MET is equal to an oxygen uptake rate of approximately 3.5 ml/kg/min

M. Ventilatory threshold – significant increase or breakaway in ventilation rate (i.e., hyperventilatory response) during exercise when workloads are increasing
VI. **Exercise Prescription vs. Program Design**
   A. Clinical setting – individuals with cardiovascular, pulmonary and/or metabolic disease
   B. Preventive setting – apparently healthy individuals

VII. **Objectives**
   A. Develop optimal cardiorespiratory function – to delay degenerative changes typically associated with inactivity
   B. Develop muscular strength and endurance – to meet the normal and emergency demands placed on the body throughout a day’s activities
   C. Develop adequate range of motion (ROM) of the joints – to aid posture and allow for needed movement and help prevent injuries
   D. Increase resistance to mental stress – to prevent or lessen the deleterious effects of nervous and hormonal changes
   E. Most common objectives – to improve personal appearance or to control weight (fat) and improve muscle tone
   F. Most important objective – to create a change in personal health behavior by making physical activity a habit

VIII. **Components**
   A. Mode
   B. Intensity
   C. Duration
   D. Frequency
   E. Progression

IX. **Definition of Terms**
   A. Aerobic exercise – energy generated through the metabolism of carbohydrates (CHO), fats, and protein in the presence of oxygen via the oxidative (aerobic) system
   B. Anaerobic exercise (not requiring oxygen)
      1. Phosphagen system – immediate energy generated through the metabolism of adenosine triphosphate (ATP) and phosphocreatine (PC)
      2. Lactic acid (anaerobic glycolytic) system – short-term energy generated through the metabolism of CHO without oxygen
   C. Blend of the three systems
      1. Immediate (phosphagen)
      2. Short-term (lactic acid)
      3. Long-term (aerobic)
   D. Cardiorespiratory endurance
      1. The ability to utilize oxygen efficiently that results in improved endurance and increased stamina
      2. The ability to perform large muscular movements over an extended time period thus necessitating the capacity of the “heart-lung” system to deliver sufficient oxygen for sustained energy production
E. Maximal oxygen uptake (VO2 max)
   1. Definition
   2. Aerobic power = fitness = functional capacity = cardiovascular strength
   3. Exercise response – given amount of O2 required to accomplish a task
   4. Determination of VO2 max
      a. Maximal stress test – laboratory assessment
      b. Submaximal stress test – prediction of VO2 max through a submaximal physical working capacity (PWC) test
         i. Description
         ii. Direct (linear) relationship: HR and workload
         iii. Submaximal test – gives baseline, shows progression, and provides motivation

F. Anaerobic threshold (lactate threshold)
   1. Definition
   2. Direct assessment – onset of blood lactate accumulation (OBLA)
   3. Indirect assessment (“bloodless” techniques)
      a. Ventilatory threshold
      b. Respiratory exchange ratio (RER) – O2 consumption/CO2 production

G. Metabolic equivalents (METS) – multiple of resting metabolic rate
   1. Definition/examples
   2. Equivalents
      a. 1 L (liter) O2 consumed = 5 kcals (kilocalories) expended
      b. 1 MET = 3.5 ml O2/kg/min (milliliters of oxygen per kilogram of bodyweight per minute) – RESTING
      c. 10 METs = 35 ml O2/kg/min = EXERCISE
      d. 1 MET = 1 kcal/kg/hr (kilocalorie per kilogram of bodyweight per hour)
   3. Energy costs of physical activities
   4. Variability in MET costs of Group 1, 2, and 3 activities
      a. Description and example of Group 1 activities
      b. Description and example of Group 2 activities
      c. Description and example of Group 3 activities

X. Use of VO2 Max and OBLA (Testing)
   A. Fitness appraisal/profile – predicted VO2 max
   B. Endurance/performance prediction
   C. Setting long-term work paces
   D. Exercises prescription/program design
   E. Motivational feedback/reinforcement

XI. Aerobic Exercise Program Design Variables
   A. Mode
      1. Continuous vs. discontinuous
         a. Continuous – large muscle group utilization with rhythmical movements such as in walking, jogging, swimming, skating, rowing, biking, cross-country skiing, stepping, etc.
b. Discontinuous – large muscle group utilization with rhythmical movements but with variations in intensity (e.g., racquetball, basketball, soccer, aerobic dance, etc.) – like Group 3 activities

2. Muscular strength/endurance requirements
3. Skill requirements – related to energy expenditure
4. Metabolic requirements – too little/too much
5. Preferences of exercise type – “likes/dislikes”

B. Intensity

1. Important general guidelines/considerations
   a. Signs and symptoms of cardiovascular/pulmonary disease
   b. Coronary artery disease (CAD) risk factor thresholds
   c. Initial risk stratification
      i. “Low Risk”
      ii. “Moderate Risk”
      iii. “High Risk”
   d. Recommendations for current medical exam and exercise testing and physician supervision for exercise testing
      i. “Moderate Exercise”
      ii. “Vigorous Exercise”
      iii. “Submaximal Test”
      iv. “Maximal Test”
   e. Those clients who do not need a physical exam or an exercise stress test prior to beginning an exercise program are…
   f. Classification of fitness level – use for clients who have undergone maximal or submaximal testing
      i. Check response to initial assignment of exercise intensity

2. Specific (numerical) guidelines to determine target heart rate (THR)
   a. Option: 1: Percentage of maximum heart rate (MHR)
      i. As age increases, MHR decreases
      ii. MHR = 220 – client’s age (this is a prediction or estimation)
      iii. Guideline – overall range: 60-90% MHR; actual THR depends on fitness status, etc.

   Example: 40 year old client; assigned an exercise intensity of 70-85% of MHR:

   \[220 - 40 = 180 \text{ bpm (beats per min)} \text{ (this is MHR)}\]
   \[180 \times .70 = 126 \text{ bpm (lowest # of THR)}\]
   \[180 \times .85 = 153 \text{ bpm (highest # of THR)}\]
   THR zone is 126 – 153 bpm

   b. Option: 2: Karvonen method - % of heart rate range (HRR)
      i. “Functional capacity” is often interchanged for HRR
      ii. HRR = MHR – Resting heart rate (RHR)
      iii. Guideline – overall range: 50-85% HRR; actual THR depends on fitness status, etc.
Example: 40 year old client with a RHR of 80 bpm; assigned an exercise intensity of 60% of HRR:

220 – 40 = 180 bpm (this is MHR)
180 – 80 (the RHR) = 100 bpm (this is the heart rate range)
100 x .60 bpm
60 + 80 (the RHR) = 140 bpm (this is the client’s THR)

iv. NOTE: exercising at a certain percentage of MHR is **NOT** the same as exercising at the same percentage of HRR or functional capacity (e.g., an intensity of 55% VO2 max or % HRR is **approximately** equal to 70% MHR)

3. **Rate of perceived exertion (RPE)**
   a. “Somewhat hard” = about 70% of functional capacity (or HRR)
   b. Valuable aid
      i. Clients having difficulty with palpating the heart beat
      ii. Clients having altered heart rate (HR) responses due to medication (e.g., beta blockers)
   c. Original (Borg) scale: 6-20
   d. Revised scale: 0-10

4. **Metabolic equivalents (METs)**

5. **Talk test** – ability to carry on conversation without difficulty

C. **Duration**

1. **General guidelines**
   a. To increase central circulation (cardiac output) to benefit general health – 20-30 min at a sustained THR (this also helps to meet caloric expenditure goals)
   b. To stimulate peripheral circulation increases (a-vO2 difference) for aerobic athletes – 60+ minutes at a sustained THR
   c. 20-60 min of continuous aerobic activity
   d. Duration/intensity relationship
      i. Athlete – higher intensity and shorter duration
      ii. Non-athlete – lower intensity and longer duration because it is less hazardous and encourages better adherence (compliance)
      iii. Severely deconditioned – multiple sessions of short duration

2. **Specific guidelines**
   a. Fitness level
   b. Physician recommendations
   c. Client goals – weight loss, athletic performance, etc.

3. **Special considerations**
   a. Time constraints – influences duration and frequency of exercise
   b. Initial goals – achieved with moderate duration (20-30 min)
   c. Undue fatigue/injury – negate increases in exercise duration
D. Frequency
1. General guidelines
   a. Functional capacity
      i. <3 METs – multiple short daily exercise sessions
      ii. 3-5 METs – 1 to 2 exercise sessions/day (not a typo)
      iii. >5 METs – 3 to 5 exercise sessions/week
   b. Well tolerated
      i. Physically
      ii. Mentally

2. Specific guidelines
   a. Fitness level
   b. Physician recommendations
   c. Client goals – weight loss, athletic performance, etc.

E. Progression
1. Rate
   a. Functional capacity/age
   b. Medical/health status
   c. Activity preferences/goals
2. Conditioning stages
   a. Initial stage (non-aggressive to maximize compliance/adherence)
      i. Purpose – minimize muscle soreness, discomfort, and injury
      ii. Stage length – 5-6 weeks; dependent upon individual adaptation
      iii. Frequency – 3 sessions/week on non-consecutive days
      iv. Intensity – begin at 40-50% VO2 max and progress to 70% VO2 max
      v. Duration – begin with 12 min. and progress to 20 min.
   b. Improvement stage
      i. Stage length – 5-6 months
      ii. Frequency – increases to 4-5 sessions/week
      iii. Intensity – 70-85% VO2 max
      iv. Duration – increases every 2-3 weeks until achieve 30 min.
   c. Maintenance stage
      i. Level that is appropriate and acceptable for the client
      ii. Variety in exercise plus enjoyable activities to ensure adherence

XII. Types of Aerobic Endurance Training Programs
A. Long, slow distance (LSD)
   1. Frequency: 1-2 times/week
   2. Duration: greater than race distance (~30-120 min.)
   3. Intensity: ~70% VO2 max
   4. “Conversation exercise” = the athlete is able to talk without undue respiratory distress
B. Pace/tempo
   1. Types
      a. Steady pace/tempo
      b. Intermittent pace/tempo
   2. Frequency: 1-2 times/week
   3. Duration: ~20-30 min.
   4. Intensity: at or slightly higher than race pace
C. Interval
   1. Frequency: 1-2 times/week
   2. Duration: 3-5 min. (work:rest ratio is 1:1)
   3. Intensity: close to VO2 max
D. Repetition
   1. Frequency: 1 time/week
   2. Duration: 30-90 sec. (work:rest ratio is 1:5)
   3. Intensity: greater than VO2 max
E. Fartlek
   1. Frequency: 1 time/week
   2. Duration: ~20-60 min.
   3. Intensity: easy running (70% VO2 max) combined with either hill work or short, fast bursts of running (85-90% VO2 max) for short periods of time
F. Additional Guidelines for Interval Training (Table)
   1. Interval training
      a. Primary energy system stressed
      b. Typical exercise time (work period)
      c. Work: rest ratios

### Interval Training Guidelines Table
*(Table 12)*

<table>
<thead>
<tr>
<th>Percent of maximum power</th>
<th>Primary energy system stressed</th>
<th>Typical exercise time</th>
<th>Work : rest ratios</th>
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<tbody>
<tr>
<td>90-100</td>
<td>Phosphagen</td>
<td>5-10 seconds</td>
<td>1:12 to 1:20</td>
</tr>
<tr>
<td>75-90</td>
<td>Fast glycolysis</td>
<td>15-30 seconds</td>
<td>1:3 to 1:5</td>
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<tr>
<td>30-75</td>
<td>Fast glycolysis and oxidative</td>
<td>1-3 minutes</td>
<td>1:3 to 1:4</td>
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<td>20-35</td>
<td>Oxidative</td>
<td>&gt;3 minutes</td>
<td>1:1 to 1:3</td>
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<tr>
<td>Program Phase</td>
<td>Week</td>
<td>Exercise Frequency (Sessions/week)</td>
<td>Exercise Intensity (% VO2 max or HR Reserve)</td>
</tr>
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<td>------</td>
<td>-----------------------------------</td>
<td>--------------------------------------------</td>
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<tr>
<td><strong>Initial Stage</strong></td>
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<td><strong>Maintenance Stage</strong></td>
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<td>3</td>
<td>70-85+</td>
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</table>
Sample Combined Aerobic and Resistance Training Programs

Goal: Increased Muscular Strength, Maintenance of Aerobic Endurance

1. Perform initial aerobic training for 8-10 weeks: three to four days a week, 50% to 85% HRR, 30-60 minutes.
2. Reduce aerobic training to two days per week, 50% to 85% HRR, 30 minutes, and begin resistance training.

Goal: Increased Aerobic Endurance, Maintenance of Muscular Strength

1. Perform 8-10 weeks of initial resistance training.
2. Reduce resistance training to two days per week and begin aerobic training three to four days per week, 50% to 85% HRR, 30-60 minutes.
CLIENT CONSULTATION
AND FITNESS ASSESSMENT

1) Client Consultation and Fitness Assessment
   a) Definition
      i) “A screening mechanism that allows the fitness professional to obtain valuable information that will be instrumental in developing comprehensive and sophisticated programs of health/exercise to safely and effectively meet a client’s individual objectives.”
   b) Purpose/outcome
      i) To assess information regarding health status and recognize those requiring referral to a health care professional
      ii) To assist in establishing goals
      iii) To develop personalized training programs
      iv) To identify baseline data of client’s fitness level
      v) To motivate performance and improve adherence/compliance
      vi) To educate clients

2) Program Delivery System
   a) Flow chart for assessing a client and administering the program (Figure 1)
   b) Implementation factors
      i) Credentials of the health/fitness professional
      ii) Setting for the policies and procedures
      iii) Specific goal of population served
      iv) Legal standards/statutes
   c) Definition of “scope of practice”
      i) Personal trainer – “Personal trainers are health/fitness professionals, who, using an individualized approach, assess, motivate, educate, and train clients regarding their health and fitness needs. They design safe and effective exercise programs, provide the guidance to help clients achieve their personal health/fitness goals, and respond appropriately in emergency situations. Recognizing their own area of expertise, personal trainers refer clients to other health care professionals when appropriate.” (Developed by the 2001 NSCA-Certified Personal Trainer Job Analysis Committee of the NSCA Certification Commission)

3) Initial Interview
   a) Determine client/trainer compatibility
      i) Provide explanation of services
      ii) Identify client psychographics
      iii) Present program delivery system
      iv) Assess suitability
      v) Refer if necessary
   b) Identify client goals
      i) Plan and document
      ii) Determine realistic content
iii) Address specificity
iv) Design for measurement
v) References for further reading
c) Finalize client/trainer agreement
   i) Introduce contract/agreement (Figure 2)
   ii) Review key critical content
   iii) Provide opportunity for discussion
   iv) Receive acknowledgement (signature of client)

4) Preactivity Screening
   a) Screening instruments (health appraisal forms)
      i) Purposes
      ii) PAR-Q (Physical Activity Readiness Questionnaire) (Figure 3)
         (1) Description/use
         (2) Problems/limitations
      iii) Health/Medical (and physical activity) Questionnaire (Figure 4)
         (1) Emergency information
         (2) Medical history
         (3) Coronary risk factors
         (4) Lifestyle inventory
   b) Evaluation of results
      i) Signs and symptoms of cardiovascular and pulmonary disease (Figure 5)
      ii) Coronary artery disease (CAD) risk factor thresholds (Figure 6)
         (1) Positive risk factors
            (a) Family history
            (b) Cigarette smoking
            (c) Hypertension (high blood pressure)
            (d) Hypercholesterolemia (high cholesterol)
            (e) Impaired fasting glucose
            (f) Obesity
            (g) Sedentary lifestyle
      iii) Negative risk factors
            (a) High serum HDLs (high density lipoproteins)


5) Interpret Results
   a) Interpret results and refer based on scope of practice
      i) Initial risk stratification (Figure 7)
         (1) “Low risk”
         (2) “Moderate risk”
         (3) “High risk”
      ii) Explanation to determine if client needs referral (for testing and/or medical exam prior to exercise) (Figure 8)
(1) “Moderate exercise”
(2) “Vigorous exercise”
(3) “Submaximal test”
(4) “Maximal test”

6) Implementation of Forms
   a) Informed Consent form (Figure 9) – must include:
      i) Purpose and explanation of procedures
      ii) Risks
      iii) Benefits
      iv) Confidentiality
      v) Inquiries and freedom of consent
   b) Physician Referral form (Figure 10)
      i) Assess for functional capacity
      ii) Classification
      iii) Identification of pre-existing conditions
      iv) Medications
      v) Recommendations
   c) Release/Assumption of Risk form (Figure 11)
      i) Voluntary involvement by the client
      ii) Acknowledgment of risk and documentation of questions/answers

7) Fitness Assessment
   a) Purpose of testing
      i) Establish baseline
      ii) Identify strengths and weaknesses
      iii) Normative comparison
      iv) Assess progress toward goals
      v) Evaluate overall effectiveness of program
      vi) Motivate performance
   b) Testing measurements
      i) Validity – definition and example
      ii) Reliability – definition and example
      iii) Objectivity – definition and example
   c) Selecting valid, reliable, and objective tests
      i) Age-related factors – example
      ii) Gender-related factors – example
      iii) Pre-training status – example
      iv) Criteria specificity – example
      v) Environmental factors – example
      vi) Implementation control (bias) – example
   d) Contents of testing
      i) Test order
         (1) Non-fatiguing
         (2) Agility
         (3) Maximum power and strength
(4) Sprint
(5) Local muscular endurance
(6) Fatiguing anaerobic capacity
(7) Aerobic capacity

ii) Environmental control
   (1) Equipment
   (2) Climate

iii) Health status

iv) Test administration
   (1) Define protocols BEFORE beginning each test
   (2) Equity of delivery
   (3) Accuracy of scoring
   (4) Safety

e) Typical/common fitness assessment components
   i) Resting heart rate
   ii) Resting blood pressure
   iii) Body composition
   iv) Muscular strength
   v) Muscular endurance
   vi) Flexibility
   vii) Cardiovascular endurance

f) Protocols, factors affecting test results, actions to improve reliability, and normative data – NOTE: For the protocols and norms listed below, refer to:


i) Resting heart rate
   (1) Palpation (protocol: pages 218-219; norms: Table 11.2, page 239)

ii) Resting blood pressure
   (1) Sphygmomanometry (protocol: pages 219-221; norms: Table 11.4, page 240)


iii) Body composition
   (1) Body mass index (BMI) (protocol: page 222; norms: Table 11.7, page 241)
   (2) Waist-to-hip ratio (protocol: page 226; norms: Table 11.15, page 247)
   (3) Skinfold calipers (i.e., percent body fat) (protocol: pages 223-235; norms: Table 11.14, pages 246-247)

iv) Muscular strength
   (1) 1RM testing (or can calculate relative strength; i.e., the 1RM-to-bodyweight ratio)
      (a) Bench press (protocol: page 235; relative norms: Table 11.25, page 255)
(b) Universal leg press (protocol: pages 235-236; relative norms: Table 11.26, page 256)

(2) Dynamometer

v) Muscular endurance

(1) 30-second chair stand test (“norms” shown in Figures A1 and A2)
(2) Modified abdominal crunch/partial curl-up test (protocol: page 236; norms: Table 11.28, page 257)
(3) YMCA fixed-load bench press test (protocol: page 236; norms: Table 11.27, page 257)

vi) Flexibility

(1) Sit and reach (standard and modified) (protocol: pages 237-238; norms: Tables 11.31 and 11.32, page 260)
(2) Back scratch test (“norms” shown in Figure A3)
(3) Functional screen tests

vii) Cardiovascular endurance

(1) Rockport walking test (protocol: page 234; norms based on time: Table 11.23, page 253)
(2) Step tests (protocol: page 232; norms: Table 11.22, page 253)
(3) Submaximal bicycle ergometer (protocol for the YMCA cycle ergometer test: pages 228-229 and Table 11.16 on page 248; protocol for the Astrand-Ryhming cycle ergometer test: pages 231-232 and Tables 11.19-11.21 on pages 251-252)
(4) 1.5 mile run or 12 minute run (protocols: pages 232-233; norms based on time and distance: Figure A4; 1.5 mile run/walk norms based on calculated VO2 max: Table 11.17, page 249)

g) Summary

i) Appreciate the value of the client consultation and fitness assessment tool as it relates to gathering valuable information regarding your client

ii) Realize your scope of practice is to assess, motivate, educate, train, and refer when necessary

iii) Implementation of a preactivity screening process and the completion of relevant forms prior to commencing activity is critical

iv) Assess for coronary risk factors and understand the risk stratification and the referral process

v) Introduce valid, reliable, and objective assessment tools

vi) Familiarize yourself with assessment protocols, factors which affect test results, actions to improve reliability, and interpretation of normative data
Glossary

1. **Blood pressure** – the pressure exerted by the blood against the walls of blood vessels (see: systolic BP/diastolic BP)
2. **Bradyardia** – slow heart action; usually defined as a heart rate under 60 beats per minute
3. **Cholesterol** – a fat that can be synthesized by the liver or ingested in the diet from animal fat; a precursor of various steroid hormones and used in the biosynthesis of cell membranes
4. **Circumference assessment** – measurement of selected body girths
5. **Diabetes mellitus** – a metabolic disorder characterized by an inability to oxidize carbohydrates because of inadequate insulin (Type I) or a resistance to insulin (Type II)
6. **Diastolic blood pressure** – the pressure exerted by the blood on the vessel walls during the ventricular relaxation, measured in millimeters of mercury (mmHg) by a sphygmomanometer
7. **Dynamometer** – a device that is used to measure static force to assess muscular strength
8. **Ergometer** – an instrument used to measure work and power output
9. **Family history** – a review of the major health problems found in a person’s grandparents, parents, uncles, aunts, and siblings
10. **Flexibility** – range of motion possible about a joint or series of joints
11. **Health history** – information about a person’s past health record
12. **Heart rate** – number of contractions (beats) of the heart per unit of time; typically expressed as beats per minute
13. **High density lipoprotein (HDL)** – A plasma lipid protein complex containing relatively greater amounts of protein and less cholesterol and triglycerides; it is desirable to have this value higher
14. **Hypertension** – higher than normal arterial blood pressure
15. **Informed consent** – a procedure used to obtain a person’s voluntary permission to participate in a program
16. **Maximal oxygen uptake (VO\textsubscript{2 max})** – the greatest rate of oxygen utilization attainable during heavy work expressed; in L/min or ml/kg/min
17. **Maximal tests** – tests that continue until a person has reached a maximal level or voluntary exhaustion
18. **Medical history** – a person’s previous health (e.g., problems, signs, and characteristics)
19. **Objectivity** – the degree to which multiple corers agree on the magnitude of scores
20. **Palpation** – Examination by touch (e.g., determining heart rate by feeling the pulse at the wrist)
21. **Percent fat** – the percentage of the total body weight that is fat tissue
22. **Physician referral** – a recommendation that a person obtain medical attention, tests, or an opinion about a characteristic, symptom, or a test result to determine if medical treatment is needed, and/or to determine whether it is safe to participate in specified activities
23. **Reliability** – the degree to which the same text score will be achieved on separate administrations of a test

24. **Risk factor** – a characteristic, sign, symptom, or assessment score that is associated with an increased probability of developing a health-related problem

25. **Skinfold** – a measurement to determine body composition by which calipers are used to measure the thickness of subcutaneous fat

26. **Systolic blood pressure** – the pressure exerted on the vessel walls during ventricular contraction, measured in millimeters of mercury (mmHg) by the sphygmomanometer

27. **Tachycardia** – a heart rate greater than 100 beats per minute at rest

28. **Testing protocol** – a particular testing scheme/method

29. **Total cholesterol:HDL** ratio – The ratio between the total cholesterol and high density lipoprotein

30. **Validity** – the degree to which a test measures what it is supposed to measure
XIII. **Terminology**

A. Biomechanics- term currently used to include both functional anatomy and the application of mechanical concepts to analyze human movement. Functional anatomy focuses on the structure and function of the “musculoskeletal machine,” that is, the skeletal and neuromuscular aspects rather than the anatomy of the cardiovascular, respiratory, digestive, etc. systems. Biomechanics focuses on the mechanisms through which the components of the musculoskeletal system interact with each other and the external world to perform work and produce movement.

B. Axial Skeleton- the bones of the head, spinal column, and ribcage

C. Appendicular skeleton- the bones of the arms, shoulders, legs, and pelvis

D. Muscle origin (proximal attachment)- the proximal (towards the center of the body) connective tissue attachment of the muscle to the bone.

E. Muscle insertion (distal attachment)- the distal (away the center of the body) connective tissue attachment to the bone.

F. Agonist (prime mover)- the muscle that is most directly involved in creating movement.

G. Antagonist- a muscle that can slow down or stop the movement.

H. Synergist- a muscle that assists indirectly in a movement.

I. Neutralizer- a muscle that inhibits/prevents undesired movement.

J. Stabilizer- a muscle that holds a bone in position so that the involved muscles can cause the desired movement.

XIV. **Movement Terminology**

A. Anatomical reference position and planes of motion

   1. Frontal plane (and major movements)
      a. Definition- divides the body into front and back sections
      b. Extremities- abduction and adduction
      c. Spinal column- lateral flexion to the right and left

   2. Sagittal plane (and major movements)
      a. Definition- divides the body into right and left sections
      b. Extremities- flexion and extension
      c. Spinal column- forward (flexion) and backward (extension) bending

   3. Transverse plane (and major movements)
      a. Definition- divides the body into upper and lower sections
      b. Extremities- external and internal rotation AND transverse abduction and adduction
      c. Spinal column- rotation to the right and left
XV. Lever Systems
A. Definitions
   1. Lever
      a. Rigid object (e.g., a bone)
      b. Point of rotation/axis/fulcrum (e.g., a joint)
   2. Effort force- tends to create the desired movement
   3. Resistance force- tends to oppose the desired movement
   4. Effort lever arm (moment)- the perpendicular distance from the pivot to the effort force
   5. Resistance lever arm (moment)- the perpendicular distance from the pivot to the resistance force

B. “Laws of Levers”; torque is the turning effect (force x lever arm)
C. Classification and examples of lever systems
   1. First class lever system
   2. Third class lever system- elbow flexor mechanism
   3. Another example – first class lever system- elbow extension
   4. Ankle joint as a second class lever
   5. Ankle joint as a first class lever
   6. The effect of musculoskeletal geometry on level arm length and mechanical advantage
      a. Knee joint (patella)

XVI. Other Mechanical Factors Related to Muscle Tension and External Force Production
A. Muscle fiber architecture in whole muscle
B. Muscle (fiber) length
   1. The “length-tension” relationship
   2. Elastic (stretch) tension
   3. Application to evaluating two common calf muscle exercises
      a. Standing calf (heel) raise versus seated calf (heel) raise
      b. Role of the gastrocnemius versus the soleus due to the starting position
C. Muscle length and lever arm length interaction to produce joint torque

XVII. Variable resistance Exercise Machines
A. Gravitational (weight) torque variations with joint angle
B. “Cam” variable resistance exercise machine concept to match resistance (weight) and effort (muscle) torque
C. Variable effort lever arm length machine (example: Universal bench press exercise)
D. Do these types of resistance machines balance or equate to the human strength curves?
XVIII. Muscle “Force-Velocity” Relationship
A. The faster that a muscle shortens, the less maximum tension it can produce
B. Three dimensional, rotational interpretation

XIX. Biomechanical vs. Physiological Considerations for Exercise Selection
A. Biomechanical
   1. Range of motion/joint position
   2. Speed of motion (force-velocity relationship)
   3. Load forces- magnitude (intensity) and direction
B. Physiological
   1. Volume (number of exercises and number of reps)
   2. Intensity (% of IRM)
      a. Work/rest intervals
   3. Frequency (sessions per day or per week)

XX. Types of Load Forces During Dynamic Weight Training Exercises
A. Axial loading- forces directed primarily parallel to the long axis of supporting bones (e.g., tension and compression loads). This is the most desirable type of loading since the architecture of bone tissue and joints can best support this type. Tension and compression loads commonly occur during normal activities (e.g., locomotion, walking up stairs, and weight support).
   1. Exercises that emphasize axial loading (functional multi-joint or kinetic chain exercises):
      a. Presses (overhead shoulder press; flat and incline bench press)
      b. Squat
      c. Leg press
      d. Hack squat

B. Exercise that emphasize shear loading- forces directed primarily perpendicular to the long axis of supporting bones. The risk of joint injury during exercise is often related to the magnitude of shear loading (e.g., knee and intervertebral joints). Shear loads occur infrequently during normal activities.
   1. Leg extension, all types
   2. Hip abduction

C. Kinetic chain exercises

XXI. Lifting Safety- The Low Back
A. Maintain normal anatomical spine position (with normal curvatures) for most lifting exercises
B. Intra-abdominal pressure helps reduce load forces on the low back, and minimize or eliminate dependence on a weight belt.
Many “ab” exercises involve forceful hip flexion that can produce excessive lumbar curvature, especially the psoas major, a strong hip flexor muscle.

**ANAEROBIC AND AEROBIC TRAINING ADAPTATIONS**

I. Adaptations to Training

A. Chronic exercise provides a stimulus for the systems of the body to change to better meet the demands placed upon them.
B. These systems will adapt according to the level, intensity, and volume of exercise and training.

II. Factors that Affect Adaptations to Training

A. Specificity of training (Figure 1)
   1. Metabolic differences between (aerobic vs. anaerobic) activities.
   2. Metabolic differences within an activity.
B. Genetic endowment
   1. Fiber type patterns
   2. Somatotype
C. Environmental factors
D. Fitness training status
   1. Time course of adaptations
   2. Magnitude of expected changes
   3. Mechanism of adaptations
E. Gender
   1. Mechanism of adaptations
F. Age
   1. Children vs. adults vs. older adults

III. Metabolic Contributions to Exercise Training

A. Anaerobic metabolism (Figure 2)
   1. High intensity, short duration exercise that is performed using energy derived PRIMARILY from stored phosphagens and ATP.
   2. Stored phosphagens (creatine phosphate, CP) are molecules with high energy chemical bonds that, when broken down, provide energy for immediate use.
3. Anaerobic glycolysis (Figure 2) is utilized at the beginning of sustained exercise (no matter what the intensity of the exercise)

B. Aerobic metabolism
   1. Most of the energy needed for prolonged physical activity lasting more than about 3 minutes is provided primarily (50+%%) by aerobic metabolism.
   2. Krebs Cycle (Figure 3) degrades acetyl CoA into CO$_2$ and H$^+$ ions and electrons
   3. Electron Transport Chain (Figure 3) receives electrons from the Krebs Cycle and these are used for oxidative-phosphorylation and regeneration of ATP.
   4. Also, free fatty acids enter the mitochondria and undergo beta oxidation (Figure 3) in the Krebs Cycle (fats yield the most energy)

C. Relative contribution of the aerobic and enaerobic systems (Figures 4A and 4B)
   1. All energy systems are active at a given time
   2. The extent to which energy system is used depends on:
      a. Intensity (primary)
      b. Duration (secondary)

IV. Adaptations Following Exercise Training

A. Neuromuscular adaptations (Figure 5) (Previously this was labeled Figure 2)
   1. Neural adaptations are due to:
      a. Changes occurring in the activation of the motor unit.
      b. Improved recruitment patterns.
      c. Improvement in neural drive.
      d. “Learning” how to perform the activity.
   2. “Disinhibition” is also one of the limiting factors in the development of muscular force, serving as a protective mechanism.
      a. Golgi tendon organ (GTO)
   3. Exercise training may lead to a reduction in the sensitivity of these receptors to allow for greater force production.

B. Muscle fiber type adaptations
   1. Normal recruitment pattern: (Type) I $\rightarrow$ IIa $\rightarrow$ IIb
   2. Exercise training results in a more precise and efficient mode of recruitment.
      a. Following training, less neural activity is required to produce any level of submaximal force measured by electromyography (EMG)
b. Following training, increased synchronization of motor unit firing increases the amount of time that maximal force output can be sustained.

c. Fiber “transformation” (IIb → Ila) may also result in increased or altered recruitment patterns.

3. Fiber type characteristics (Figure 6) and examples of sport events (Figure 7) (Previously these were labeled Figures 3 and 4, respectively)

4. Changes in fiber area are (example of a staining, Figure 8) (Previously this was labeled Figure 5)

   a. Type II fibers will increase in area more than Type I fibers.

   b. Increases in fiber area are mediated by the addition of actin and myosin myofilaments to the outside of the myofibril.

   c. Hypertrophy vs. hyperplasia
      i. Research is still inconclusive in humans
      ii. Hypertrophy model is still most commonly supported.

      iii. Difficulty in biopsy technique.

   d. Muscle fiber “transformations”
      i. Exercise training will result in a decrease in the Type IIb fibers with a concomitant increase in the IIa fiber.

      ii. Type IIb fibers are the “couch potato” fibers that are inversely related to the individual’s maximal oxygen consumption and the intensity of training stimulus.

      iii. Type I fibers will show some percent increase after resistance training, but significantly more changes after aerobic training.

      iv. “Transformations” based on intensity and state of training—detraining causes a “reversal” of Type IIa → Type IIb

   e. Enzymes (creatine phosphate and myokinase) increase due to exercise training.

C. Neuroendocrine adaptations

1. Amount of synthesis and storage of hormones
2. Transport of hormones
3. Time needed for clearance in tissues
4. Amount of hormonal degradation
5. Number of hormone receptors in the tissues
6. Magnitude of signal sent to cell nucleus by receptor complex
7. Interaction with cell nucleus.
D. Endocrine responses to exercise (Figure 9) (Previously this was labeled Figure 6)

E. Biochemical changes seen in skeletal muscle induced by training (list included in Figure 10) (Previously this was labeled Figure 7)

F. Skeletal adaptations (Figure 11) (Previously this was labeled Figure 8)

1. Bone is a type of connective tissue that becomes mineralized to provide a rigid structure to support the muscular system.
2. Bone is an active tissue and it is sensitive to gravitational and muscular forces.
3. Bone will adapt with exercise training
   a. Increases in bone mineral density and bone matrix
   b. Decrease in bone density with reduction of exercise
   c. Rapid removal of calcium = loss of bone mineral content; occurs with immobilization after only few weeks of bed rest.
   d. Osteoporosis in the elderly, post-menopausal women.
   e. Resistance training has proven to be effective in increasing bone mineral content and bone matrix (figure12 ) (previously this was labeled Figure 9)

G. Connective tissue adaptations.

1.) Related to mechanical forces created during physical activity.
2.) Degree of adaptation related to the intensity of the exercise stimulus.
3.) Adaptation occur.
   a. At the junctions between the tendon or ligament and the bone surface.
   b. Within the body of the tendon or ligament.
   c. In the network of fascia within the skeletal muscle.

H. Cardiovascular adaptations (Figure 13) (Previously this was labeled Figure 10)

1.) Increase in cardiac output due to an enhanced or improved stoke volume
   a.) Increase in heart weight/volume occurs primarily with aerobic training.
   b.) Cardiac hypertrophy is characterized by an increase in the size of the left ventricular cavity and a thickening of the myocardium.
2.) Increase in cardiac output.
   a. Stoke volume increases.
   b. Greater percent of the ventricular volume that is pumped out with each beat (ejection fraction)
c. Typical values of ejection fraction.
   i. Average individual – 65%
   ii. Aerobically trained athlete – 85-90%
   iii. Individual with cardiovascular disease – 12%

3.) Maximal heart rate may be increase or may even decrease with exercise training.
   a.) Increase may be related to a learning effect – possibly never achieved maximal heart rate prior to training; can do more exercise.
   b.) Decrease may be related to an increased vagal tone.
   c.) Decreased resting heart rate due to more parasympathetic influence.
   d.) Decreased heart rate at any given sub maximal intensity.

4.) Increased capillarization in tissue after training
5.) Increased plasma volume and total hemoglobin after training.

I.) Respiratory adaptations (figure 13) (Previously this was labeled Figure 10)

II.)
   1. Increased maximal exercise ventilation
   2. Increased maximal oxygen consumption (VO2 Max)
   3. Increased tidal volume
   4. Increased extraction of oxygen (14-15% O2 in expired air after training versus 18% in untrained person)
   5. Onset of blood lactate accumulation (OBLA) occurs at a higher percentage of the trained person’s aerobic capacity (55% untrained vs. up to 90% trained) as a result of an increased ability to generate a high lactate after training

V. Specific Adaptations from Resistance Training (Figure 14) (Previously this was labeled Figure 11)

   A. Changes in fiber area
   B. Hypertrophy vs. hyperplasia of muscle fibers
   C. Muscle fiber “transformation” – Type 11b → Type Ila fibers
   D. Increased high energy phosphate pool
   E. Improved synchronization of motor unit firing
   F. Improved neural function

VI Specific Adaptation from Aerobic Training (Figure 14) (Previously this was labeled Figure 11)

   A. Increased myoglobin content
   B. Increased oxidation of carbohydrates (glycogen)
      1.) Increased capacity for muscle to generate energy
C. Increased oxygen consumption (VO2) and oxygen extraction (a-vo2) difference
D. Increased biochemical changes in Type 1 and II muscle fibers
E. Increased heart size and efficiency.

VII Combination of Resistance and Aerobic Endurance Training

G. Combined maximal training interferes primarily with strength and power performance

VIII. Overtraining

A. Markers of anaerobic overtraining (Figure 15) (Previously this was labeled Figure 12)
   1. Psychological effects: decreased desire to train; decreased joy from training
   2. Acute epinephrine and norepinephrine increases beyond normal exercise-induced levels.
   3. Performance decrements, although these occur too late to be a good predictor

B. Markers of aerobic overtraining (Figure 15) (Previously this was labeled Figure 12)
   1. Decreased performance
   2. Decreased percentage of body fat
   3. Decreased maximal oxygen uptake
   4. Decreased muscle glycogen
   5. Decreased lactate levels
   6. Increased muscle soreness
   7. Increased sub-maximal exercise heart rate
   8. Altered blood pressure and resting heart rate

C. Stages of overtraining (Figure 16) (Previously this was labeled Figure 13)
   1. 1st (no effect on performance)
   2. 2nd (probably no effect on performance)
   3. 3rd (Probably decreased performance)
   4. 4th (Decreased performance)
GLOSSARY

Adenosine triphosphate (ATP) – a high energy phosphate molecule required to provide energy for cellular function; produced both aerobically and stored in the body

Aerobic metabolism – catabolism of energy substrate with the utilization of oxygen energy transfer resulting from involvement of glycolysis, beta oxidation, Krebs cycles and Electron Transport System

Anaerobic metabolism – catabolism of energy substrates without the utilization of oxygen

Collagen – the main constituent of most connective tissues

Connective tissue – the tissue that binds together and supports various structure of the body

Creatine Phosphate (CP) – a high-energy phosphate molecule by calories derived from carbohydrates, fat or protein

Energy – the potential to do work and activity; measured by calories derived from carbohydrates, fat or protein

Ergometer – measurement of work and power; using standardized equipment to measure work and power during exercise

Fast-twitch fiber – a Type II muscle fiber characterized by its fast speed of contraction and a high capacity for anaerobic glycolsis

Hyperplasia – proliferation of cells

Hypertrophy – increased size of an organ or tissue, usually caused by increased size of cells or tissue elements

Lactic acid – an acidic metabolite that is the end-product of anaerobic glycolsis

Ligament – a connective tissue that connects two bones

Motor unit – a motor nerve and all the muscle fibers it innervates

Slow-twitch fiber – a Type I muscle fiber characterized by its slow speed of contraction and a high capacity for aerobic glycolysis

Tendon – strong, fibrous connective tissue that attaches muscle to bone
### Signs and Symptoms of Cardiovascular and Pulmonary Disease

- Pain, discomfort (or other anginal equivalent) in the chest, neck, jaw, arms, or other areas that may be due to ischemia (lack of blood flow)
- Shortness of breath at rest or with mild exertion
- Dizziness or syncope
- Orthopnea (the need to sit up to breathe comfortably or paroxysmal (sudden, unexpected attack) nocturnal dyspnea (shortness of breath at night)
- Ankle edema (swelling/water retention)
- Palpitations or tachycardia (rapid heart rate)
- Intermittent claudication (calf cramping)
- Known heart murmur
- Unusual fatigue or shortness of breath with usual activities


### Recommendations for Current Medical Exam and Exercise Testing and Physician Supervision for Exercise Testing

<table>
<thead>
<tr>
<th></th>
<th>Low Risk</th>
<th>Moderate Risk</th>
<th>High Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medial Exam* and Exercise Testing prior to Participation?</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Moderate Exercise**</td>
<td>Not Necessary €</td>
<td>Not Necessary</td>
<td>Recommended</td>
</tr>
<tr>
<td>Vigorous Exercise***</td>
<td>Not Necessary</td>
<td>Recommended</td>
<td>Recommended</td>
</tr>
<tr>
<td>Physician Supervision?</td>
<td>Not Necessary</td>
<td>Not Necessary</td>
<td>Recommended</td>
</tr>
<tr>
<td>Submaximal Test</td>
<td></td>
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<tr>
<td>Maximal Test</td>
<td>Not Necessary</td>
<td>Recommended €</td>
<td>Recommended</td>
</tr>
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*Within the past year.
**Absolute
***Vigorous
€ The
€ When
## Cardiovascular Exercise Prescription Guidelines

### Based on Fitness Level

**(Table 7)**

<table>
<thead>
<tr>
<th>Maximal Oxygen Uptake Rate</th>
<th>Fitness Classification</th>
<th>Exercise Intensity</th>
<th>Exercise Duration (min/session)</th>
<th>Exercise Frequency (day/week)</th>
</tr>
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<tbody>
<tr>
<td>≤ 34 ml/kg/min</td>
<td>Low</td>
<td>65-75% of HRmax</td>
<td>20-30 min.</td>
<td>3 days</td>
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<td>50-60% of HRR</td>
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<tr>
<td></td>
<td></td>
<td>50-60% of VO2 max</td>
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<tr>
<td></td>
<td></td>
<td>RPE = 11-13</td>
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<td></td>
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<tr>
<td>35-49 ml/kg/min</td>
<td>Moderate</td>
<td>75-85% of HRmax</td>
<td>30-45 min.</td>
<td>4 days</td>
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<tr>
<td></td>
<td></td>
<td>60-75% of HRR</td>
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<tr>
<td></td>
<td></td>
<td>60-75% of VO2 max</td>
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<tr>
<td></td>
<td></td>
<td>RPE = 13-15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥ 50 ml/kg/min</td>
<td>High</td>
<td>85-90% of HRmax</td>
<td>45-60 min.</td>
<td>5 days</td>
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<tr>
<td></td>
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<td>75-85% of HRR</td>
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<tr>
<td></td>
<td></td>
<td>75-85% of VO2 max</td>
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<tr>
<td></td>
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<td>RPE = 15-17</td>
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</table>

*NOTE: the VO2 max values above are for a 35 year old male; subtract 5 ml/kg/min for a comparable value for a female (of the same age)*
Initial Risk Stratification

**Low Risk**
Younger individuals (Men<45 years of age and women<55 years of age) who are asymptomatic and meet no more than one risk factor threshold from Figure 9.

**Moderate Risk**
Older individuals (men ≥ 45 years of age and women ≥ 55 years of age) or those who meet the threshold for two or more risk factors from Figure 9.

**High Risk**
Individuals with one or more signs/symptoms listed in following figure or known cardiovascular (cardiac, peripheral vascular, or cerebrovascular), pulmonary (COPD, asthma, interstitial lung disease, or cystic fibrosis), or metabolic disease (Type 1 or 2 diabetes mellitus, thyroid disorder, renal or liver disease).

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**Coronary Artery Disease Risk Factor Thresholds**

<table>
<thead>
<tr>
<th>POSITIVE RISK FACTORS</th>
<th>DEFINING CRITERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Family History</strong></td>
<td>Myocardial infarction, coronary revascularization, or sudden death before 55 years of age in father or other male first-degree relative (i.e., brother or son), or before 65 years of age in mother or other female first-degree relative (i.e., sister or daughter)</td>
</tr>
<tr>
<td><strong>Cigarette Smoking</strong></td>
<td>Current cigarette smoker or those who quit within the previous 6 months</td>
</tr>
<tr>
<td><strong>Hypertension (High Blood Pressure)</strong></td>
<td>Systolic blood pressure of ≥140 mm Hg or diastolic ≥90 mm Hg, confirmed by measurements on at least 2 separate occasions, or on antihypertensive medication</td>
</tr>
<tr>
<td><strong>Hypercholesterolemia (High Cholesterol)</strong></td>
<td>Total serum cholesterol of &gt; 200 mg/dl (5.2 mmol/L) or high-density lipoprotein cholesterol &lt; 35 mg/dl (0.9 mmol/L) or on lipid lowering medication. If low density lipoprotein cholesterol is available, use &gt; 130 mg/dl (3.4 mmol/L) rather than total cholesterol of &gt; 200 mg/dl</td>
</tr>
<tr>
<td><strong>Impaired Fasting Glucose</strong></td>
<td>Fasting blood glucose of ≥ 110 mg/dl (6.1 mmol/L) confirmed by measurements on at least 2 separate occasions</td>
</tr>
<tr>
<td><strong>Obesity</strong></td>
<td>Body Mass Index of ≥ 30 kg/m2, or waist girth of &gt; 100cm</td>
</tr>
<tr>
<td><strong>Sedentary Lifestyle</strong></td>
<td>Persons not participating in a regular exercise program or meeting the minimal physical activity recommendations from the US Surgeon General report</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NEGATIVE RISK FACTOR</th>
<th>DEFINING CRITERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High Serum HDL Cholesterol</strong></td>
<td>&gt;60 mg/dl (1.6 mmol/L)</td>
</tr>
</tbody>
</table>