EXCI 352 **FALL 2019**

ESSENTIALS OF EXERCISE TESTING & TRAINING IN ATHLETIC POPULATIONS

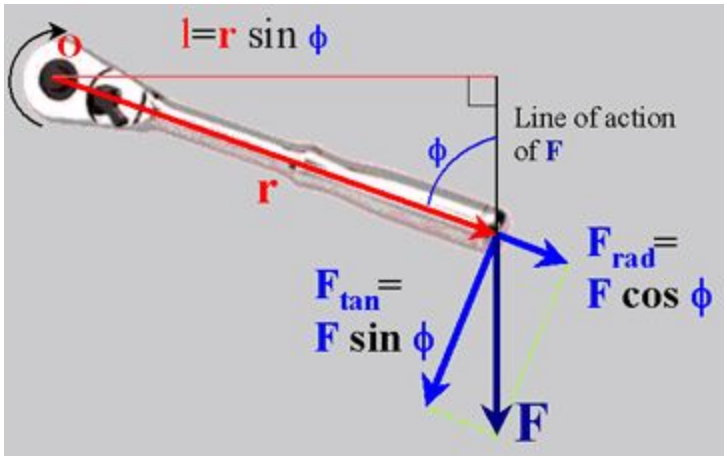
STUDY CONTENT GUIDE FOR THE MIDTERM EXAM

CHAPTER	TITLE	PAGES
2	The Biomechanics of Resistance Exercise	19-42
17	Needs Analysis	441-443
Article	Physiology of Soccer: An Update	502-536
12	Principles of Test Selection & Administration	249-258
Article	Statement of the Third International Exercise-Associated Hyponatremia Consensus Development Conference, Carlsbad, California, 2015.	303-320
13	Administration, Scoring, & Interpretation of Selected Tests	259-294
21	Periodization	583-604
14	Warm-Up & Flexibility Training	317-350
Article	Stretching & Injury Prevention: An Obscure Relationship	443-449
15	Exercise Technique for Free Weight & Machine Training	351-408

Chapter 2: The Biomechanics of Resistance Exercise

(Pages 19 to 42)

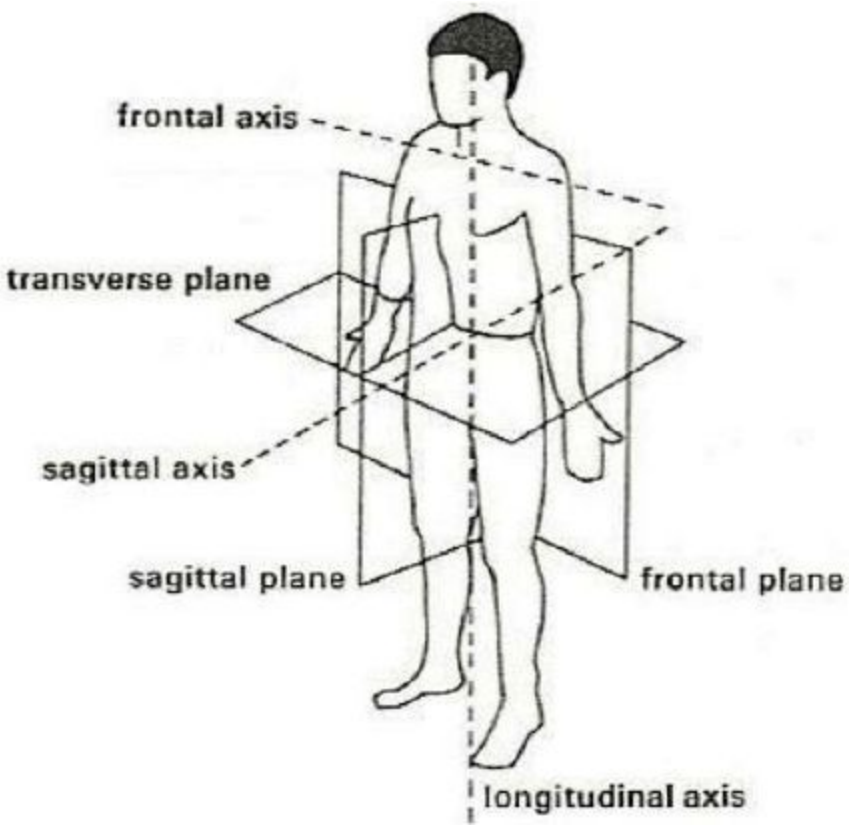
- **MUSCULOSKELETAL SYSTEM**
  - Skeleton
    - axial vs appendicular
      - axial = spine, ribs, cranium
      - appendicular = everything else
        - shoulder girdle = clavicle, scapula
        - pelvic girdle = ischium, ilium, pubis
  - Skeletal Musculature
    - origin
      - proximal attachment
      - end of the muscle that is most fixed, usually
        - eg tricep
        - origin: infraglenoid tubercle of scapula (long), anterior to radial groove (lateral groove), below radial groove (medial)
        - insertion: olecranon process of ulna
        - innervation: radial nerve, axillary nerve for long head
    - insertion
      - distal attachment
      - end of the muscle that is the least fixed
  - Levers of the Musculoskeletal System
    - moment arm
      - distance between an end of a lever and the fulcrum
    - torque = moment
      - rotary force
      - = radius*torque*sin(theta)



- Note: pulleys simply elongate the lever and increase moment arm
- Mechanical advantage
  - moment arm, applied force / moment arm, resisted force
  - MA > 1
    - advantageous
    - favors high strength, low velocity
      - powerlifters
  - MA < 1
    - disadvantageous
    - favours low strength, high velocity
      - olympic lifters
- Classes of levers
  - 1st class lever
    - Disadvantageous
    - Seesaw orientation, but moment arm of resisted force is largest
    - Triceps is a classic example
      - resisted force is coming from the palm
      - applied force is coming from the distance between the olecranon/humerus and the musculotendinous junction of the triceps.
  - 2nd class lever
    - Advantageous
    - Wheelbarrow orientation
    - Resisted force is between the fulcrum and the applied force
    - Eg, calf raises / gastrocnemius
      - fulcrum is toes, resisted force is mid foot, and applied force is achilles tendon insertion
  - 3rd class lever
    - Most abundant in human body
      - allows for speed rather than strength
      - Forces in the muscles and tendons is greater than the forces between hands/feet and ground

- Disadvantageous
- Fishing rod orientation
- applied force is between resisted force and fulcrum

- Variations in Tendon Insertion
  - Moment arm of the applied force is almost always dynamic throughout the joints of the human body
    - Exception being the patellar bone
      - maintains the distance of the patella tendon from the fulcrum of the knee
  - Tendon insertion being farther from the joint
    - advantageous for strength
    - disadvantageous for speed
  - Tendon insertion being closer to the joint
    - advantageous for speed
    - disadvantageous for strength
- Anatomical Planes & Major Body Movements
  - Planes of the human body
    - Frontal/coronal, sagittal, and transverse
      - sagittal is two mirrored halves, front is not
  -



HUMAN STRENGTH AND POWER

- Basic Definitions
  - Strength

- exert force at <u>any given speed</u>
- associated with slower speeds

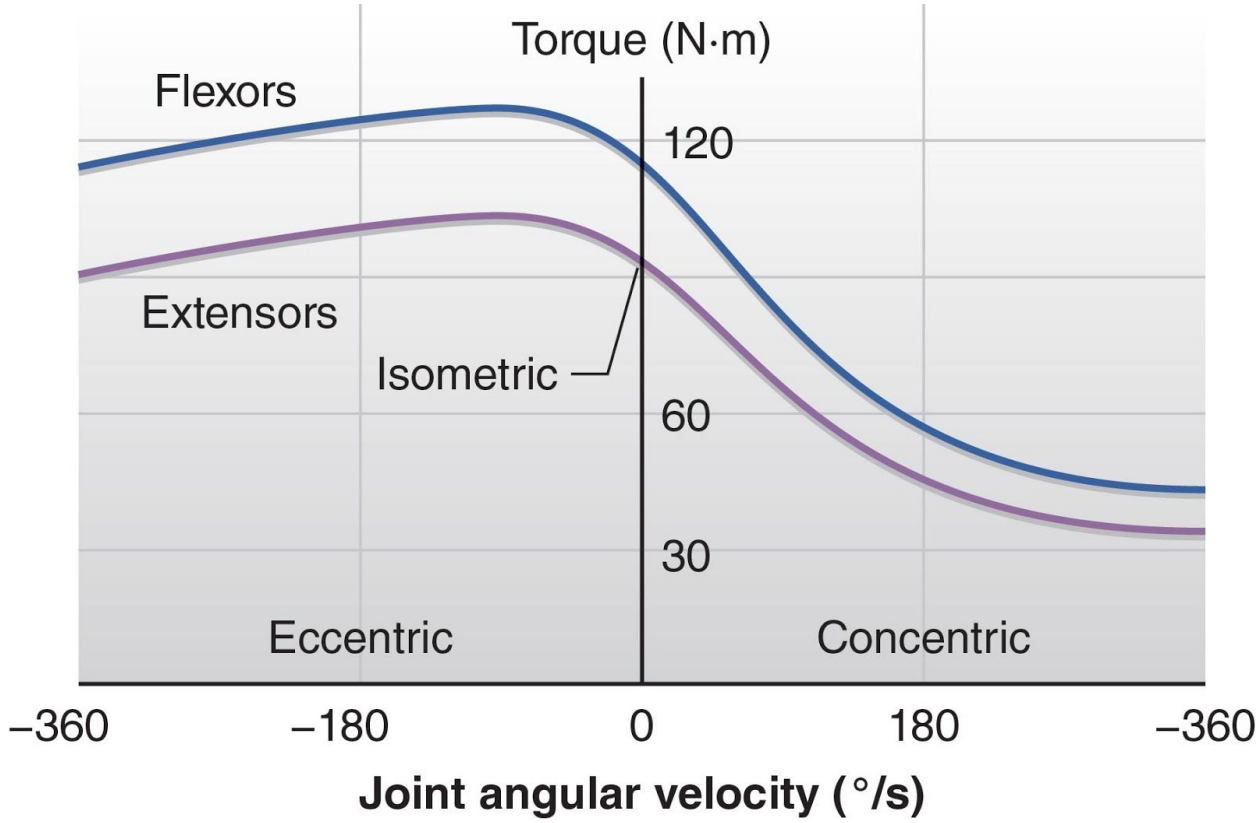
- Power
  - exert force quickly
  - Work/time
  - associated with quick movements

- **Do not study Table 2.1.**
- Strength Versus Power
- **You are not responsible for any calculations in this section but you need to understand the concepts of positive work, negative work, angular work, and power are & how they are interrelated.**
- Biomechanical Factors in Human Strength
  - Neural Control
    - relationship between CNS and muscle
    - speed of contraction and ability to recruit muscle fibres
    - Greater muscle force when:
      - more motor units are involved in a contraction
      - larger motor units are involved
        - slow twitch vs fast twitch
          - soleus is 80% slow twitch and mostly involved in standing posture
          - Fast twitch muscles are larger
      - rate of firing is faster
  - Muscle Cross-Sectional Area
    - the force a muscle fibre can exert is related to the cross-sectional area and not the volume
      - weight of the muscle means nothing. See: bodybuilders and their respective strength
  - Arrangement of Muscle Fibers
    - Pennation
      - resistance training increases pennation of a muscle
        - and increases strength
      - featherlike arrangement of fibres
        - in most muscles, have an angle of pennation of < 15° or = 15°
      - allow for increased force production but smaller ROM
        - increasing pennation = decreasing speed
  - Type of Muscle Fibres (bonus)
    - Slow twitch recap: require more oxygenation, but reach exhaustion slower.
      - Have red fibres because they have more myoglobin. When slow twitch muscles finally tire, fast twitch will take over.
    - Fast twitch are white fibres and are the exact opposite of slow

twitch
- eye muscles are 85% fast twitch

- IIa Fast Twitch is a moderate-fast muscle fibre.

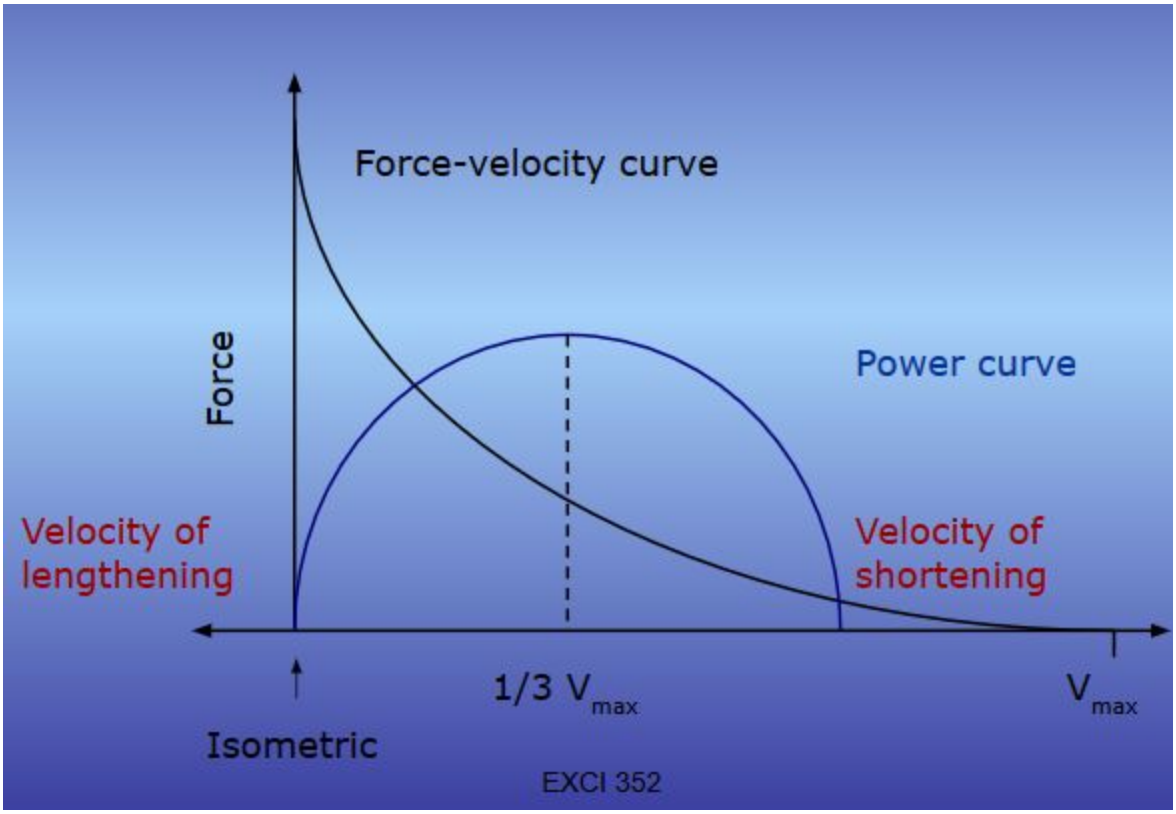
- Muscle Length (Length-Tension Relationship)
  - Muscles can produce the most amount of force in their resting state / mid way through ROM
- Joint Angle
  - the amount torque produced will vary throughout the ROM
- Muscle Contraction Velocity
  - Force-Velocity Relationship
    - muscles can produce a greater force at slower speeds
      - max force is generally at ⅓ max velocity
      - This is seen in the disparity between powerlifting totals vs olympic lifting totals
    - non linear relationship
      - steepest decline between slow speeds to moderate speeds
        - the moment you speed up, you lose force



Reprinted from Jorgensen 1976.

- In this chart: eccentric strength is stronger than concentric and loses strength less drastically than concentric strength

- Force-Velocity & Power Relationship



- **In this diagram:**
  - a well planned strength-power training program will attempt to align the power upwards (bringing power closer to max force) and force/velocity curve to the right to bring the curve closer to ⅓ Vmax

- Joint Angular Velocity
  - muscle torque varies with each kind of contraction
    - isokinetic eccentric
      - maximal torque capability increases until about 90° of angular velocity and then a sharp decrease occurs
    - concentric
      - isokinetic concentric contractions
        - isokinetic = same force, constant speed
        - torque capability declines as angular velocity increases
          - decrease in force as speed increases
          - powerlifting v olympic lifting concept
    - eccentric contractions > isometric > concentric
- Strength-to-Mass Ratio
  - force exerted / mass of the athlete

        - reflects athlete's ability to accelerate
    - body size will increase more rapidly than body strength
- Body Size
    - smaller athletes will always have a higher strength/mass relationship
        - smaller wrestlers will perform better than larger wrestlers

SOURCES OF RESISTANCE TO MUSCLE CONTRACTION

- Gravity
    - Applications to Resistance Training
        - moment arm of an object is always horizontal/perpendicular in relation to gravity
            - when the moment arm is horizontally closer to the weight, it exerts less force
                - bicep curl: easier at the beginning of the bicep curl because the R in torque = r*force*sinTheta
                - horizontally = shorter
    - Weight-Stack Machines
        - traditional gym machines
        - gravity is the source of the resistance
        - machines provide increased control over the direction and pattern of resistance
        - Cam based machines
            - variable r = variable resistance
            - Chain / pulley will increase in length as a person goes through the full ROM
        - Free weights:
            - constant r = constant resistance
- Inertia
    - tendency of a body to resist acceleration
    - Newton's first law
        - a body in motion tends to stay in motion
        - body at rest tends to stay at rest
            - unless acted upon by another force
    - acceleration and deceleration are universally characteristic of almost all natural movements
        - inertial force can act in any direction
    - application in weightlifting
        - inertial means that there will be more force upon a muscle at the start ROM than at the end ROM
            - initial = force greater than weight being lifted
            - end ROM = force less than weight being lifted
    - Bracketing technique
        - training with either a lighter load than normal to increase speed of the movement

- training with a heavier load than normal to increase greater than normal force during the acceleration phase of a movement
- Both techniques should be utilized in training

- Friction
  - Ff = uFn
  - Type of resistive force
  - exists when two objects are in contact with each other
  - two different types of u
    - Static u
      - because of inertia, static u is always greater
    - dynamic/sliding u
- Fluid Resistance
  - type of resistance found when:
    - an object moves through a fluid
    - a fluid moves around an object
    - a fluid moves past an object
    - a fluid moves through an orifice
  - two sources of fluid resistance
    - surface drag
      - from fluid passing along the surface of an object
    - form drag
      - from the way a fluid presses against the back or the front of an object that is moving through the fluid
  - seen in the gym
    - hydraulic machines recruit fluid resistance
    - pneumatic machines recruit gas resistance
  - Fr = k * v
    - k = constant that reflects the properties of the fluid or gas
    - v = piston velocity relative to the cylinder
  - Properties of hydraulic/pneumatic machines
    - acceleration is faster in the early ROM, slower in the end ROM
      - probably from pressure on the gas or liquid
      - little acceleration can be added after higher speeds are achieved
      - Inherently incapable of isokinetic movement
    - Most machines will not be able to produce an eccentric contraction phase
      - exception being machines with an internal pump
- Elasticity
  - Fr = k * x
    - k = physical characteristics of the specific elastic object
    - x = stretched distance
  - Characteristics
    - the more an elastic band is stretched, the greater the resistance is

- elastic bands can't really be adapted
- exercise movements will start with low resistance and end with high resistance
    - kind of mimics the natural ROM torque patterns

- Negative Work & Power
    - work = force * distance
    - negative work
        - applying work against a moving object and being overpowered
        - eccentric contractions?
    - with negative work, negative power can be produced
    -

Paper: JOINT BIOMECHANICS: CONCERNS IN RESISTANCE TRAINING

- **Study:**
    - Back, Back Injury, & Intra-Abdominal Pressure & Lifting Belts

- **Do Not Study:**
    - Shoulders
    - Knees
    - Elbows & Wrists

Chapter 17: Needs Analysis

(Pages 441 to 443)

- What is a needs analysis?the necessary assessment of an athlete's current and historical physical conditioning
  - the analysis of the demands of an athlete's sport
  - using the analysis of the athlete and sport to create a workout program
- What are the stages of a need analysis?
  - Evaluating the sport for the physical demands
  - Evaluating the physical conditioning of the athlete
- What are the minimum attributes that should be considered when evaluating a sport?
  - Movement analysis
  - Physiological analysis
  - Injury analysis
- Are there any other attributes of a sport that need to be evaluated?
  - Psychological attributes
- What factors are considered when assessing an athlete?
  - Training status
  - Injury status
  - Physical assessment
  - Exercise goals
- How does one assess an athlete's training status or training background?
  - background training assessment
    - type of exercise training
    - length of the exercise training
    - intensity of training programs
    - ability to perform exercises with correct technique
- What are the criteria for the physical testing and evaluation of an athlete?
  - test selection
    - specific or applicable to athlete's sport
    - consistent to the athlete's level of skill
    - doable with the equipment available
- What is the importance of a needs analysis in the development of an athlete's training program?
  - movement analysis is important when choosing fitness tests
  - physiological analysis is important when choosing exercise goals
  - injury analysis is important when choosing exercise goals
- What factors determine an athlete's primary resistance training goal?
  - athlete's test results
  - movement and physiological analysis of the sport
  - priorities of the sport season

- **What kind of needs analysis would you perform for a professional soccer player?**
- **Definitely read the review article on the physiology of soccer. You are not responsible for the material regarding soccer referees.**

Physiology of soccer: An Update.

(2005). Sports Medicine 35(6): 501-536. Stolen, T., Chamari, K., Castagna, C., & Wisloff, U.

- What factors affect soccer performance?
  - technical
  - tactical
  - physical
  - physiological
  - mental
- What are the physical demands of soccer?
  - Distance covered
    - different for goaltenders vs players
  - Sprint bouts
    - Different for each position
- How does player position affect physical demands of soccer?
  - Distance
    - Goalies = 4km
    - Players = 10-12km
      - Midfielders run the longest distances
    - Professional players cover more distance than casual players
    - Distance and intensity of the game decreases in the second half
      - 5-10% less distance
  - Sprint bouts
    - happens every 90 secs
    - lasts 2-4 secs
    - 96% of sprints are less than 30m
    - 49% of sprints are less than 10m
    - sprints are worth 1-10% of total distance covered
  - Distribution of sprints
    - Fullbacks/attackers > midfielders > central defenders
      - Fullbacks covered 2.5x more distance during sprints than central defenders
      - midfielders cover 1.5x more distance than central defenders
  - Short endurance activities
    - 1000-1400 short endurance activities occur in the game
      - one short activity every four to six seconds
- Which activities are performed during a soccer game?
  - sprints
    - 10-20sec
  - high intensity running
    - every 70 seconds

- tackles
  - fifteen per game
- headers
  - 10 per game
- involved with the ball
  - 50 interactions with the ball
- passes
  - 30 passes per game
- changing pace
  - always

- Which components of physical fitness are important to soccer?
  - Health
    - Cardiorespiratory
    - Muscle strength
    - Muscle endurance
  - Skill
    - Power
    - Speed
    - Agility
    - Reaction time
  - Critical skills
    - sprinting
    - turning
    - changing pace
- How are the components of physical fitness affected by a soccer player's position?
  - VO2 max
    - midfielder
      - 50-75 ml/kg/min
    - goalie
      - 50-55 ml/kg/min
  - Fullbacks and attackers sprint the most, followed by midfielders and then central defenders
- What is the physiological profile of soccer players?
  - Adult male players
    - 50-75 ml/kg/min
  - adult female players
    - 38-57 ml/kg/min
  - adult male goaltenders
    - 50-55 ml/kg/min
  - anaerobic threshold of male players
    - 76-90% HR max
- Does soccer involve aerobic and anaerobic metabolism?
  - both
  - HR is generally close to the aerobic threshold
    - 80-90% HR max

Chapter 12: Principles of Test Selection & Administration

(Page 249 to 258)

- REASONS FOR TESTING
  - Assessment of Athletic Talent
  - Identification of Physical Abilities in Need of Improvement
  - Setting Realistic Goals
  - Evaluation of progress
  - Identification of physical staleness, burnout and overtraining

- **TESTING TERMINOLOGY**
  - Test, Field Test, Measurement, Evaluation, Pretest, Midtest, Formative Evaluation, Posttest
    - pretest
    - midtest
    - formative evaluation
      - monitors an athlete's progress
      - allows for adjustment of training for an athlete
      - allows for evaluations of different training methods
      - collects normative data
    - post test
      -

- **EVALUATION OF TEST QUALITY**
  - Validity
    - degree to which a test measures what it is supposed to measure
  - Construct Validity
    - ability of a test to measure its underly construct
    - construct
      - theory developed to explain the underlying knowledge and observations
    - refers to overall validity
    - Contains content, criterion-referenced, and face validity as secondary degrees of construct validity
  - Face Validity
    - face value of a test
    - what it appears to both examiners and casual observers in terms of measuring what it is expected to
    - usually informal and non quantitative
  - Content Validity

- expert assessment
- idea that the test covers all of the components that it ideally should
- In terms of soccer, a test battery should include:
  - sprinting speed
  - agility
  - coordination
  - kicking power
- experts need to be able to verify that a portion of a test is adequately representative in the total scores to the test in a proportionate manner

- Criterion-Referenced Validity
  - the ability of a criterion to apply towards the expected future outcome
    - eg in soccer, a VO2 max test applying towards cardiovascular fitness
  - Concurrent Validity
    - when the predictor and criterion data are assessed simultaneously/concurrently.
    - one test can replace the other
      - beep test replacing the angstrom test with a metabolic cart because of cost reasons
    - panenic: has to do with test scores relating to test results that measure the same ability
  - Convergent Validity
    - component of concurrent validity
    - gold standard
    - evidence by high correlation of the test results and the recognized measure of the construct
  - Predictive Validity
    - extent of a test measuring a future performance
    - can be measured by comparing test scores to a certain extent
  - Discriminant Validity
    - ability of a test to distinguish between two different constructs
    - indicated by a low correlation score
- Reliability
  - refers to retesting ability or consistency of a test
  - valid tests must be reliable
  - Components that may lead to unreliable tests
    - intrasubject variability
    - lack of interrater consensus and agreement
      - variations in calibration of measuring devices
      - variations in preparing athletes
      - variations in administration of the tests
    - intrarater variability
      - ability of a single rater to repeat a test with reliable results

- failure can be caused by unintentional leniency, lack of training, lack of concentration and attentiveness, and failure to follow procedures
- failure of a test to produce reliable results

- Test-Retest Reliability
- Typical Error of Measurement
- Intrasubject Variability
- Interrater Reliability
- Objectivity
- Interrater Agreement
- Intrarater Variability

TEST SELECTION

- Metabolic Energy System Specificity
  - a valid test must mimic the energy system used in the sport
  - phosphagen, glycolytic, or oxidative energy systems
- Biomechanical Movement Pattern Specificity
  - does a test mimic the movement patterns of the sport being tested
  - may be specific to the player's position
- Experience and Training Status
- Age and Sex
- Environmental Factors
- Acclimatization to Heat and Humidity, and Altitude
  - temperature fluctuation can interfere with reliable test scores
  - altitude can affect cardiovascular exams
    - will not affect strength or power exams
  - each component can be risky to an athlete's health in extreme conditions

TEST ADMINISTRATION

- Health & Safety Considerations
  - environmental factors that can harm an athlete
  - be observant and attentive of the athlete performing a test to discern if an athlete is in harmful physical distress
- Selection and Training of Testers
  - testers need to be well trained for reliable tests
  - testers need to thoroughly understand the tests and their components/procedures/protocols
  - trained to explain and administer exams
- Recording Forms
  - must be developed before testing
  - have space for recording notes

Aerobic Endurance Testing in the Heat

- **Study the material in the box on page 256, which is new.**

- Hew-Butler, T., Rosner, M.H., Fowkes-Godek, S., Dugas, J.P., Hoffman, M.D., Lewis, D.P., Maughan, R.J., Miller, K.C., Montain, S.J., Rehrer, N.J., Roberts, W.O., Siegel, A.J., Stuempfle, K.J., Winger, J.M., and J.G. Verbalis.
- **Statement of the Third International Exercise-Associated Hyponatremia Consensus Development Conference**, Carlsbad, California, 2015. Clin J Sport Med. 25(4): 303-20, 2015.
  - What is hyponatremia?
  - What is EAH used to describe?
  - What is the definition of EAH?
  - What are the main determinants of serum [Na+]?
  - What are 3 ways EAH can occur?
  - Which of the 3 exercise-associated hyponatremias are classified dilutional and depletional EAH?
  - What are the 2 forms of EAH?
  - What are the major risk factors for the development of asymptomatic and symptomatic EAH?
  - What is the single most important risk factor for EAH?
  - Which form is the most dangerous to an athlete's health?
  - What is arginine vasopressin (AVP)?
  - What is another name for AVP?
  - What is non-osmotic AVP secretion?
  - How is non-osmotic AVP secretion different from osmotic AVP secretion?
  - What is SIADH?
  - What is EAHE?
  - What is the difference between asymptomatic and symptomatic EAH?
  - In which activities has Symptomatic EAH been reported?
  - What are the etiology & pathophysiology of EAH?
  - What are the etiologies of the 3 types of EAH?
  - What is the role of thirst?
  - What is the misconception of thirst as a guide to fluid replacement?
  - Is EAH best classified by clinical severity or by the absolute numerical concentration of Na+?
  - What are the signs & symptoms associated with Mild EAH, and Severe EAH & EAHE (Table 5)?
  - Do the signs & symptoms of EAH overlap with other conditions associated with exercise-associated collapse?
  - What are some of these other causes of collapse?
  - What is orthostatic hypotension?
  - What is the Trendelenburg position?
  - What is obtundation, decorticate posturing, mydriasis, and frothy sputum?

- What is osmotic demyelination syndrome?
- What is non-cardiogenic pulmonary edema?
- What is the cause of neurological signs & symptoms of severe symptomatic EAH?
- Is severe symptomatic EAH always accompanied by CNS-triggered non-cardiogenic pulmonary edema?
- What are the onsite treatments for Asymptomatic & Symptomatic EAH?
- What is HTS?
- What is the concentration range for HTS?
- What are the recommended treatments for Mild or Severe EAH (Table 6)?
- What is the treatment for athletes with signs & symptoms of EAHE?
- What are the 3 types of fluids that can worsen the degree of hyponatremia?
- How can EAH be prevented?
- According to laboratory and field studies, what percentages of normal body mass and total body water can be tolerated without a reduction in endurance performance or muscular power when in cool to temperate temperatures?
- In most cases, will drinking to thirst prevent both dilutional EAH & performance decrements due to excessive dehydration?
- Refer to the Summary of Recommendations on page 316 of the article.

- Test Format
  - are athletes tested individually or in a group?
  - same tester should administer a test for all athletes
  - only one test should be run at a time, especially if the test involves complex movements
- Testing Batteries and Multiple Testing Trials
  - duplicate setups can be used for large groups
  - complete rest must occur between multiple testing trials
- Sequence of Tests
  - fundamental principle
    - one test should not be able to interfere with the results of any subsequent tests
  - Sequence
    - non fatiguing tests first
    - agility tests second
    - strength and power testing third
    - sprinting tests last
  - sequence should also be arranged so that a minimal amount of rest time is required between tests, allowing for maximum efficiency
- Preparing Athletes for Testing
  - date, time, purpose of test needs to be announced ahead of scheduled test

- athletes should be briefed on each test well before the test is completed
  - practice trials should be done 1-3 days in advance
- clear and simple instructions need to be given
- motivation should be given for all athletes

Chapter 13: Administration, Scoring, & Interpretation
of Selected Tests
(Pages 259 to 292)

- **MEASURING PARAMETERS OF ATHLETIC PERFORMANCE**
  - Maximum Muscular Strength
    - (Low-Speed Strength)
  - Anaerobic Power/Maximum Muscular Power
    - (High-Speed Strength)
  - Anaerobic Capacity
  - Local Muscular Endurance
  - Aerobic Capacity
  - Agility
  - Speed
  - Flexibility
  - Balance & Stability
  - Body Composition
  - Anthropometry
  - Testing Conditions

- **Only study the Procedures of the tests that are indicated below. Pay close attention to** the number of trials to be performed, how these tests are **scored** (e.g., to the nearest 1 cm), and **any reasons for disqualification**, if applicable. **Do not study** the equipment and personnel requirements for these tests.
  - Maximum Muscular Strength (Low-Speed Strength)
    - 1 RM Bench Press
      - disqualifications
        - bouncing bar off of chest
        - lifting hips off of the bench at any point in the exercise
        - spotter helping with lift
        - inability to fully extend arms
    - 1 RM Back Squat
      - disqualifications
        - loss of balance
        - inability to descend deeply enough into the squat
        - spotter helps with the lift
        - inability to rise to standing
  - Anaerobic Power/Maximum Muscular Power (High-Speed Strength)
    - 1 RM Power Clean

- end pose: bar at clavicle/shoulder, wrists fully extended with elbows fully flexed, shoulder at 90° flexion
- disqualifications
  - stopping during the lift
  - bringing the bar to anywhere other than at the shoulders
  - inability to hold up the barbell during the lift
  - inability to maintain balance

- Vertical Jump
  - uses commercial vertec device
  - Measured to nearest 1cm/0.5inch
  - best of three trials
  - disqualifications:
- Static Vertical Jump
  - hands on hips at all times, no reach
  - knee angle should be 110° (slightly above 90°) and held for 2-3sec before jumping
  - height is measured by contact mat
  - best of three trials
- What is the Eccentric Utilization Ratio?
- Reactive Strength Index
  - drop off of a 20/30/40 cm box, hit a contact mat and jump, hands on hips
    - mat needs to be at least 20cm in front of box
  - score is height/reaction time
  - best of three trials
- Margaria-Kalamen Test
  - ability to run up nine stairs
    - start timer mat is on stair 3, end timer mat is on stair 9
    - measured to nearest 0.01s
    - recovery time between trials is 2-3 minutes
  - measures power
  - Weight(kg) x gravity x distance (vertical distance) / time

- Anaerobic Capacity
  - phosphagen and anaerobic glycolytic energy systems
    - used between 30-90sec of work
  - 300-Yard Shuttle
    - aka suicides
    - 25 yards x 12 repeats
    - timed to closest 0.1sec
    - two trials, five minutes rest
- Aerobic Capacity
  - 12-Minute Run
  - Yo-Yo Intermittent Recovery Test (IRT)
    - Beep test, but with recovery zone on one side only
    - all beep test rules apply here

- Two types of yoyo tests:
  - Yo-yo IRT level 1 / IRT1
    - evaluates ability to exercise intermittently before leading to the takeover of the aerobic system
    - Adjusted beep test:
      - Round 1-4: 10-13kmh
      - 5-11: 13.5-14 kmh
      - adds 0.5kmh every 8 levels after the 11th round
    - has a different formula than L2
  - IRT2
    - evaluates ability to exercise intermittently before activating anaerobic system
    - Traditional beep test
      - Round 1: 13kmh
      - 2: 15kmh
      - 3: 16kmh
      - 3+ = earlier level +0.5kmh
    - has a different VO2max formula than L1

- Agility
  - Old meaning:
    - stop, start, change direction of body quickly
  - New version:
    - quick, whole body movement that changes direction in response to a sport stimulus
  - T-Test
    - T is completed from left to right
    - Hand touch pattern: right left right left
    - Best of 2 trials, scored to nearest 0.1
  - Hexagon Test
    - Double leg hopping in clockwise direction
    - 18 hops
    - always facing forwards
    - start in the center and end in the center
    - scored to the nearest 0.1sec
  - Pro Agility Test (20-Yard Shuttle)
    - Three point stance in the center
    - hand OR foot needs to make contact with a line
    - scored to nearest 0.01
    - best of two trials
  - 505 Agility Test
    - Run 10m, get one foot over the line, turn and go back five meters
    - best of two trials, scored to nearest 0.1

- Balance and Stability
  - Balance
    - ability to maintain stance homeostasis
  - Stability
    - ability to return to a given position after being jolted out of place
  - Balance Error Scoring System (BESS)
    - Hold stance, hands on hips, 20sec with eyes closed
    - two feet, one foot, tandem foot
      - stable surface or foam pad
    - Disqualifications here just mean a point is given
      - opening eyes
      - hands off of hips
      - breaking stance for more than five seconds
      - touchdown on non stance foot
      - stepping, hopping etc
      - more than 30° of hip flexion or abduction
      - lifting forefoot or heel
  - Star Excursion Balance Test (SEBT)
    - stand in center of eight point star
    - stand on one leg
      - start direction and support leg is chosen randomly
      - reach as far out as possible with other leg in each direction, then return to bilateral position
      - Hold end and start position for one second each
      - distance from one touch point to the center is measured
        - this is what matters
      - Three trials are done and averaged
      - 15 sec rest between trials
    - Trials are discarded if athlete:
      - does not touch the line
      - lifts stance foot from center grid
      - loses balance
      - does not maintain start and end positions for 1s

- Speed
  - Straight-Line Sprint Tests (40-Yard Sprint)
    - Three or four point start
    - can sprint either 10, 20, 30, or 40m
    - best split time of two tests to the nearest 0.1s

- **Read the material on the soccer tests in the review article on the physiology of soccer. You are not responsible for the material regarding soccer referees.**
  - **Stolen, T., Chamari, K., Castagna, C., & Wisloff, U. Physiology of soccer: An Update. (2005). Sports Medicine 35(6): 501-536.**
    - Field tests

- Continuous multistage fitness test
  - Beep test
  - starts at 8kmh
    - increases by 0.5kmh per hour
  - test result is expressed as a distance not a VO2 max
  - r = 0.92
  - +/- 15% accuracy
- yoyo IRT
- Hoff's soccer specific VO2 max testing (2002)
  - increase running intensity to 95% HRmax and then maintain for 3 minutes
    - running speed is then upped to an intensity that leads to exhaustion after 6 mins
    - equipped with portable metabolic test system
      - CosMed
  - Most advanced and useful test to monitor an athlete's on field aerobic capacities
- Hoff test: aerobic testing with the ball, 2002, Kemi 2003

STATISTICAL EVALUATION OF TEST DATA

- Types of Statistics
  - Descriptive Statistics
    - Central Tendency
    - Variability
    - Percentile Rank
  - Inferential Statistics
  - Magnitude Statistics
    - Smallest Worthwhile Change
      - refers to the ability of a test to measure the smallest practically important change in improvement
        - SWC = 0.2 SD between subjects, usually
    - Effect Size
      - used for comparing stats before testing and after testing and in between subjects
      - ES = (x posttest - x pretest) / SD pretest

Developing an Athletic Profile.

- choose tests that reflect the sport that an athlete plays
  - measure specific parameters of a sport
- choose valid and reliable tests
  - arrange tests in an appropriate manner
- administer the test battery with as many possible athletes as you can
- determine the smallest worthwhile change for the tests
- compare to normative data where appropriate
  - develop your own norms when testing athletes

- conduct repeat testing, do comparisons
- identify strengths and weaknesses of athletes to determine an appropriate workout plan

Chapter 21: Periodization
(Pages 583 to 604)

- **GOALS OF PERIODIZATION**
  - optimizing performance at predetermined points in time
    - or maintaining performance capacity
  - structure an exercise program to target development of specific physiological and performance outcomes
    - like all exercise programs…
  - managing training stressors to minimize chances of developing overtraining syndrome
  - promoting an athlete's long term development
    - like all exercise programs
- **CENTRAL CONCEPTS RELATED TO PERIODIZATION**
  - **General idea: shaking up exercise programs is essential to a successful exercise program because bodies get used to stimuli and will taper off**
  - **Periodization is central to effective training programs**
    - **Includes planned periods of rest to augment restoration and recovery**
  - General Adaptation Syndrome
    - Hans Seyle, Canadian endocrinologist and biologist
    - Alarm, Resistance, and Exhaustion Phases
      - can be applied to any kind of stress
      - Alarm
        - first response the body has to a new kind of stress
        - results in accumulation of fatigue, soreness, stiffness, or reduction in energy stores
        - characteristic: temporary physical setback
        - can last several hours to weeks depending on the magnitude of stressor
      - Resistance
        - Has two components
          - the body adapting to the stressor and reverting to normal life, albeit with improved resistance to the stressor
          - if the program is structured adequately, adaptive responses within the body can further elevate the body's ability
        - aka supercompensation phase
      - Exhaustion

- reached if the body is subjected to a stressor for an extended period of time
- inability to adapt to stressors
- will present some of the same complications as seen in the alarm phase

- Stimulus-Fatigue-Recovery-Adaptation Theory
  - Extension of GAS
  - Fatigue, Recovery, and Adaptation Phases
    - suggests that training stimuli will produce a general response that is dictated by the intensity of the stimuli
  - Supercompensation Cycle
    - another term for SFRA theory
    - deals with the association between training load and regeneration as the biological basis for physical arousal
    - Potential supercompensations
      - increase in energy systems
      - hypertrophy
      - neuromuscular adaptations
      - hormonal alterations
  - Stimulus phase
    - exercise
    - homeostasis is distrubed
  - Fatigue
    - first phase?
    - the greater the exercise stimulus that is produced, the more fatigue that will build up
  - Recovery
    - Second phase
    - homeostasis is restored
    - the more fatigued that is built up, the longer recovery takes
    - recovery does not necessarily need to be full before moving onto the next training session
  - Adaptation
    - Third phase of supercompensation / SFRA cycle
    - new, higher level of homeostasis is reached
  - Glycogen Supercompensation
    - With training and tapered carb consumption, a max of 175-200 mmol/kg wet weight can be accumulated in the muscle
    - classic method = server method
    - modified method
- Restoration
  - process of returning to normal
  - achieved via:
    - decreased frequency of exercise stimuli

- lower volumes of exercise
- passive or active rest
- restoration techniques
    - hydrotherapy, massage therapy, sleep

- rested athletes always perform better

- Peaking
    - can only be maintained for 7-14 days
        - inversely related to the intensity of the training program
    - attempt to achieve maximum fitness at a specific time during training
- Fitness-Fatigue Paradigm
    - Fitness, Fatigue, and Preparedness
    - fitness and fatigue act upon preparedness
    - idea: fatigue dissipates faster than fitness, so we utilize this concept in increase preparedness in an athlete
    - therefore, the sequence of training loads need to be well managed
- Overtraining
    - burnout
    - chronic fatigue syndrome
    - overtraining syndrome
    - unexplained underperformance syndrome, UPS
    - long term chronic decrease in performance capabilities
    - inability to tolerate or adapt to a new load
    - Accumulation of training load
- Overreaching
    - intentional overtraining sydrome, but with mild and short term results
        - basically: working harder, crashing harder, but then rebounding harder
    - athlete will return to their original training status after the OR phase while they wait for the supercompensation phase to hit
- Overtraining Continuum
    - Function Overreaching, FOR
        - excessive training that leads to short term detriments in training but eventually leads to increase in performance
    - Nonfunctional overreaching, NFOR
        - which is excessive training that does not lead to any increased performance
    - Overtraining syndrome
        - prolonged maladaptation
            - sympathetic OTS- at rest
            - parasympathetic OTS- at rest and with exercise
- Signs & Symptoms of Overtraining
    - body shuts down
    - misery sets in

PERIODIZATION HIERARCHY

- Periodization Cycles (Table 21.1)
  - multi-year plan
  - annual training plan
  - Macrocycle
    - months to a year
  - Mesocycle
    - weeks to months
    - more mesocycles can mean better gains
  - Microcycle
    - several days to two weeks
    - most important phase of training
    - changes in the acute program that define the mesocycle and cause variations in the training program
  - Training day
  - Training session
- Periodization Periods
- Preparatory Period
  - Preparatory Period
    - longest period of a training program
    - start low intensity, high volume
    - idea: build up a base fitness level so that the athlete can tolerate much more intense fitness programs
      - General preparatory program
        - high training volume, low intensity
        - target is usually creating a general fitness base
      - specific preparatory phase
        - expands an athlete's training base
        - increased emphasis on sport specific training programs
  - Two components of preparatory program
    - Hypertrophy/Strength Endurance Phase
      - increase lean body mass
      - build up a tolerance for exercise
    - Basic Strength Phase
      - increase strength of muscles that are necessary to the demands of the sport
  - First Transition Period
    - links preparatory and competitive phases
    - shifts focus from building up an athlete to strength and power
    - last week of this period should be restful and designed to allow for active rest
    - Strength/Power Phase

        - main phase of first transition stage
        -
    - Competition Period
        - increase the strength and power exercises via increase in intensity but decrease the volume
        - practices with heavy emphasis on sports skills increases and training sessions for increased physical fitness decreases
    - Second Transition Period (Active Rest)
        - lasts 1 to 4 weeks
            - greater than four is utilized only when injured
        - no structure, no sport specific exercises, might not involve resistance training
        - time off
        - unloading week
            - week off in between phases or periods
            - idea is to make athletes less susceptible to overtraining syndrome

- **APPLYING SPORT SEASONS TO THE PERIODIZATION PERIODS**
    - Off-Season
        - preparatory phase
    - Preseason
        - first transition phase
            - leads into the strength and power component of resistance training
    - In-Season
        - peaking program or maintenance program
    - Postseason
        - second transition period
            - active rest
        - then move into preparatory phase

- **UNDULATING VS LINEAR PERIODIZATION MODELS**

- **EXAMPLE OF AN ANNUAL TRAINING PLAN**
  - Preseason
  - In-Season
  - Postseason (Active Rest Period)
  - Off-Season

- **REVIEWING THE ANNUAL PLAN EXAMPLE**

- **MOST COMMON PERIODIZATION MODELS**
  - **periodization works best to increase strength, power, and performance in male and female athletes vs non periodized fitness programs**
  - Classic Linear Periodization Model
    - linear only in the idea that the intensity slowly increases while the volume decreases in the SC program at the mesocycle level
    - has nonlinear variation in microcycle level
    - most commonly used when increasing strength and power
  - Reverse Linear Periodization Model
    - main goal is to maximize hypertrophy or strength endurance
    - best for increasing strength endurance
  - Undulating Nonlinear Periodization Model
    - lots of fluctuation
    - for sports that have many in season contests
    - one study says more effective than classic linear, another study says equally effective

- **RESEARCH ON PERIODIZATION MODELS**

- **MACROCYCLE FOR AN INDIVIDUAL SPORT**
  - **increase, increase, increase until hit the competition of the year**

- **MACROCYCLE FOR A TEAM SPORT**
  - **fluctuates based on seasonal demands**

- **AN OUTLINE OF THE ANNUAL PHASES OF THE SOCCER CALENDAR**

- **ENERGY EXPENDED BY PROFESSIONAL SOCCER PLAYERS DURING TRAINING**
  - **they expended the most amount of energy on wednesdays and the least amount of energy on fridays**

Chapter 14: Warm-Up & Flexibility Training
(Pages 317 to 350)

- **WARM-UP**
  - Temperature & Non-Temperature Related Effects of Warm-Up
    - Temperature related
      - increased neural function
      - disruption of transient connective tissue bonds
    - Non-temperature related
      - increased baseline O2 consumption
      - increased post-activation potentiation
        - causes acute increase in power
        - "force exerted by a muscle increases due to its previous contraction"
      - increased blood flow to the extremities
  - Positive Effects of the Warm-Up on Performance
    - improvements in the rate of force development and reaction time
    - improvements in muscle strength and power
    - lowered viscous resistance in muscles and joints
      - synovia is non-newtonian in property
    - Bohr effect
    - enhanced metabolic reactions
  - Setup
    - Last 10-20 minutes
    - End no later than 15mins before gametime
  - Components of a Warm-Up
    - General warmup
      - 5mins slow aerobic activities
      - stretching with sport specific movements and motions
    - Sport specific warmup
      - has sport specific motions
      - should include a skill rehearsal
  - Targeted & Structured Warm-Ups
    - RAMP Protocol
      - Raise
        - elevate key physiological components
      - Activate and Mobilize
        - stretching phase
        - perform key mobility movements that are sport specific
        - focus is mobility
        - Static stretches suck, don't perform them
          - shorter than 45sec holds might not be detrimental

- Potentiate
    - specific component phase
    - this component determines the optimal length of the warmup
    - necessary for strength, power and speed related activities
        - long distance, not so much

Stretching and injury prevention: An obscure relationship: Witvrouw, E., Mahieu, N., Danneels, L., & McNair, P. (2004). . Sports Medicine 34(7): 443-449.

- **STRETCHING & INJURY PREVENTION**
- What are the main conclusions of the review article by Witvrouw et al. (2004)?
    - Overview:
        - Every sport has different needs in relation to how much and what kind of stretching should be done
        - Literature has argued in either direction in terms of static stretching being effective and important
            - contraindications can be chalked up to the type of sports activity and its demands upon the athlete
        - Stretch-shortening cycling
            - active stretch followed immediately by a shortening of the muscle
                - eccentric contraction followed by a concentric contraction
        - Sports disparities
            - Gymnastics
                - a ton of stretching is necessary
            - Football
                - high intensity of SSCs
                - requires a decent amount of stretching
            - Jogging and endurances sports
                - stretching is not really necessary
                - no stretching is okay

- **FLEXIBILITY**
    - Flexibility and Performance
        - static flexibility
            - key component is passive movements
            - the range of possible movements around a joint dictated by soft and hard tissues
        - dynamic flexibility

- key component is AROM
- refers to ROM during active movements

- Normal ROM does not equate to normal movement patterns

- Mobility
  - an athlete's ability to move through a ROM
- Motility
  - an organism's ability to move independently
  - not really related to sport stretching at all
- Flexibility and sport
  - force needs to be applied outside the ROM
  - key technical positions of the sport need to be addressed and prepared via stretching
- Risks of injury that flexibility can address:
  - hyperflexibility, inflexibility, and imbalance within flexibility

- Factors Affecting Flexibility
  - Joint Structure
  - Age & Sex
    - older people are less flexible
    - women are more flexible
  - Muscle & Connective Tissue
    - elasticity and plasticity of connective tissues affect ROM
  - Stretch Tolerance
    - ability to tolerate the discomfort of stretch
    - the more flexible a person is, the more they seem to be able to tolerate uncomfortable stretches
  - Neural Control
    - athlete's control of a stretch is found in the CNS and PNS
  - Resistance Training With Limited Range of Motion
    - heavy loads with low ROM may decrease flexibility
      - quarter squats with heavy weights
    - to prevent loss:
      - exercise throighout the full ROM
      - develop both agonist and antagonist muscles
  - Muscle Bulk
    - large muscles can limit flexibility, eg calf muscles and ability to touch butt to heels
  - Activity Level
    - active people are more flexible than inactive people
    - activity level does not equal flexibility tho

- Frequency, Duration, & Intensity of Stretching
  - acute affects of stretching are seen most directly after stretching
    - three minutes to 24hrs after stretching
  - Program creation
    - minimum 5 weeks long

        - 2 days week minimum
      - stretches should be 15s to 30s long
    - stretch muscles within 5-10 minutes after exercising or practicing
    - can be used as a separate session if flexibility is lacking and needs to be addressed
      - can also be used as a rest day after a competition
- When Should an Athlete Stretch?
  - Following Practice & Competition
    - 5-10 minutes after
  - As a Separate Session
    - to address flexibility deficits
    - rest after competition
- Proprioceptors and Stretching
  - Intrafusal muscle fibres
    - proprioceptors that react to sensory and motor neurons
    - muscle spindles
  - extrafusal muscle fibres
    - muscle fibre
  - Muscle Spindles
    - These are intrafusal muscle fibres
    - lay parallel to extrafusal muscle fibres
    - activated by increasing muscle length
      - are designed to make a muscle contract to prevent the muscle from being stretched to the point of tearing
    - causes antagonist muscle to relax: stretch reflex
  - Golgi Tendon Organs
    - attached in series at the end of the extrafusal muscle fibre
      - musculotendinous junction
    - reflexive muscle relaxation
    - inverse stretch reflex
      - tension in the tendon is relieved by forcing the stretched muscle to relax
  - Stretch Reflex
  - Autogenic Inhibition
    - when the muscle being stretched/acted upon is released
    - GTOS
  - Reciprocal Inhibition
    - when the opposing muscle to being stretched is released
    - muscle spindles

TYPES OF STRETCHING

- Active Stretch
- Passive Stretch

- Static Stretch
  - does not trigger stretch reflex
  - appropriate for novices and still improves flexibility
  - Warning: do not combine movements that involve the spine
    - eg: extension and lateral flexion. it's how you strain your back
  - stabilizing muscles need to be active in order for stretches to be functional
- Ballistic Stretch
  - usually triggers the stretch reflex
  - increases the risk of injury at the end ROM especially if there has been a previous injury
- Dynamic Stretch
  - sometimes referred to as mobility drills
  - emphasis is placed on the sport specific motion and movements, not the actual muscles being used individually
  - Requirements:
    - 5-10 repetitions of the movement
    - increase in both speed and ROM of the movement but always stay in control
    - no bouncing- and do not sacrifice proper technique for extra ROM
- Proprioceptive Neuromuscular Facilitation Stretch
  - Guidelines:
    - -10 sec prestretch
    - 6 sec contraction or contraction that goes through the full ROM
    - move to new joint position and stretch passively for thirty seconds
  - Hold-Relax
    - Vanilla af
    - autogenic inhibition
  - Contract-Relax
    - slightly spicy
    - isotonic contraction
  - Hold-Relax With Agonist Contraction
    - totally spicy
    - prestretch
    - actively move to end ROM
    - contract 6sec
    - move to next ROM
    - passive stretch for 30s
    - repeat 3-5x or until no new ROM can be reached

 Guidelines for Static Stretching (p. 329)

 Precautions for Static Stretching (p. 329)

- Static Stretching Techniques (p. 330 - 340)
  - **Only study** which muscles & body areas are affected by these stretches? For example, the Chicken Wing stretches the triceps brachii & latissimus dorsi muscles, & the posterior area of the upper arm. Make a table that summarizes this information.
  - You do not have to study the technical descriptions of the static stretches.

- Guidelines for Dynamic Stretching (p. 341)

- Precautions for Dynamic Stretching (p. 341)

- Dynamic Stretching Techniques (p. 342 - 349)
  - **Only study** which muscles are affected by these stretches?
  - You do not have to study the technical descriptions of the dynamic stretches.

Chapter 15: Exercise Technique for Free Weight & Machine Training

(Pages 351 to 408)

- **FUNDAMENTALS OF EXERCISE TECHNIQUE**
  - Hand Grips
  - Stable Body & Limb Positioning
  - Range of Motion & Speed
  - Breathing Considerations
  - Weight Belts
  - Lifting a Bar off the Floor
  - What is the correct preparatory body position before lifting a weight off the floor?

- **SPOTTING FREE WEIGHT EXERCISES**
  - Types of Exercises Performed & Equipment Involved
    - free weight exercises that are performed
      - over the head
      - with the bar on the back
      - with the bar on the clavicles or shoulders
      - with the bar over the face
    - dumbbells are harder to spot because there are two pieces of equipment to observe and spot
    - never spot power exercises
  - Spotting Overhead Exercises & Those with the Bar on the Back or Front Shoulders
    - perform in a power rack whenever possible
    - spotter needs to be equal or stronger than the athlete and also the same height or taller
  - Spotting Over-the-Face Exercises
    - always use an alternated grip that is narrower than the athlete's own grip to pick up the bar and place on the ground
    - with curved trajectories:
      - skullcrushers
      - use supinated hands to spot the bar so it doesn't roll out of athlete's hands
    - dumbbell exercises
      - spot either at the wrist or at the dumbbell itself
      - idea: spot as close to the dumbbell as possible
        - if elbows collapse, the spotter isn't in an ideal position to stop the dumbbells from landing on the athlete's body

- Do Not Spot Power Exercises
- Number of Spotters
  - Depends on athlete's experience lifting and with the amount of weight they are lifting
  - experienced athletes at low weights only require one spotter
  - the more spotters, the increased chance of poor coordination between the spotters and athlete occurs
- Communication Between Athlete & Spotter
  - Use of a Liftoff
    - "establish safewords to communicate when an athlete wants help at the beginning and throughout the movement"
  - Amount & Timing of Spotting Assistance
    - "take it" indicates that the athlete cannot carry any of the weight

Answer the following questions based on the RESISTANCE TRAINING EXERCISES described on pages 359 to 407 in your textbook.

- Which resistance exercises use:
  - a closed, pronated grip
    - front squat with parallel arm position
    - lying barbell triceps extension: skullcrushers
  - a closed, supinated grip,
  - a closed, neutral grip,
  - a closed, alternated grip
    - deadlift
  - a closed, hook grip
    -
  - an open or false grip
    - front squat with crossed arm position
      - deltoids and biceps stabilize the bar
  - a Clean grip
    -
  - a Snatch grip
    - the snatch

- Which free weight exercises require a spotter?

- Which resistance exercises are spotted overhead, with the bar on the back or front shoulders, and over the face?

- Which resistance exercises do not require a spotter?

- How are dumbbell exercises spotted?

- Study the spotting techniques in depth for the following exercises:

- Flat Barbell Bench Press
- Back Squat
- Front Squat
- Forward Step Lunge
- Step-Up
- Seated Barbell Shoulder Press
- Lying Barbell Triceps Extension

- Which resistance exercises should be performed inside a power rack?
  - overhead exercises
  - exercises with the bar on the back or front

- Which resistance exercises require a liftoff?
  - stiff legged deadlift

- Which resistance exercises involve the use of the 5-point body contact position?
  - seated chest press
  - bench press

- What types of grips do spotters use for the various resistance exercises?
  - alternated
  - supinated during the movement phases of any arcing/circulatory trajectories, ie lying overhead tricep extension

- What are the grip widths for the following resistance exercises?
  - Barbell Biceps Curl
    - actually shoulder width
  - Flat Barbell Bench Press
    - slightly wider than SW
  - Back Squat
    - low bar = wider than SW
    - high bar = slightly wider than SW
  - Front Squat
    - crossed arms = shoulder width kinda? but hand on each shoulder
    - parallel arms = slightly wider than SW
  - Forward Step Lunge
    - slightly wider
  - Step-Up
    - slightly wider
  - Deadlift
    - slightly wider
  - Stiff-Leg Deadlift
    - slightly wider

- Romanian Deadlift
  - slightly wider
- Seated Barbell Shoulder Press
  - slightly wider
- Lying barbell triceps extension
  - hand grip = one foot wide
- Push Press
  - slightly wider
- Push Jerk
  - slightly wider
- Power Clean
  - slightly wider
- Hang Power Clean
  - slightly wider
- Snatch
  - fist to opposite shoulder OR elbow to elbow measurement system
- Hang Power Snatch
  - fist to opposite shoulder or elbow to elbow measurement
- Bent over row
  - wider than shoulder width

- It is very important that you study the following Power exercises in detail:
  - Push Press
    - throw the bar upwards
  - Push Jerk
    - throw the bar upwards but duck underneath and then hip extension up (jerk)
  - Power Clean
    - end ROM is bar at shoulder height
  - Hang Power Clean
    - bar does not touch the ground between reps
    - begins positioned at the just above the thighs
    - end ROM is bar at shoulder height
  - Snatch
    - throw the bar up and get below it, stand up
  - Hang Power Snatch

- For the previously indicated Power exercises, create a table that includes the following information:
  - Beginning Position
  - Initial bar position
  - Grip type
  - Grip width
  - Feet position
  - Final Bar Position
  - Phases (e.g., Dip, Drive, Catch, First Pull, Second Pull, Scoop)
  - Exercise Actions (e.g., hip extension, knee extension)