



Successfully Aging in a Modern World

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Xwsepsum(ko-SAP-sum) (Esquimalt) and Songhees



Esquimalt

BRIAN JUSTIN 2020 3

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Objectives

Aging Curves – How can we bend them?	Senescent Changes with Aging	Chronic Pain and the Older Adult in Brief
Muscle/ Mobility/ Balance/ Movement/ NMR/ Stamina	Function Assessment	Programming Essentials

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Senescent Changes

Ahh \$\$\$@ time!

Interesting how tablets were picked by Co-pilot for the pic.

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Aging Curves: Muscle Fiber Changes

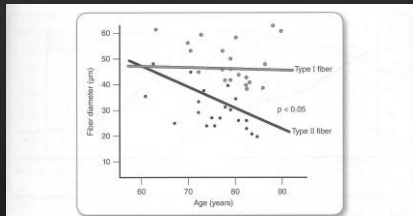


Figure 1.3 The age-associated patterns of change in mean cross-sectional areas of type II (fast-twitch) and type I (slow-twitch) muscle fibers. Data are from the vastus lateralis muscles of men 15 through 83 years of age. (Data from Leibel, DeLuca, and Slemmon 1988.)

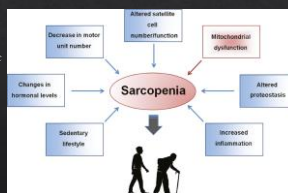
Signorile, J., 2011)

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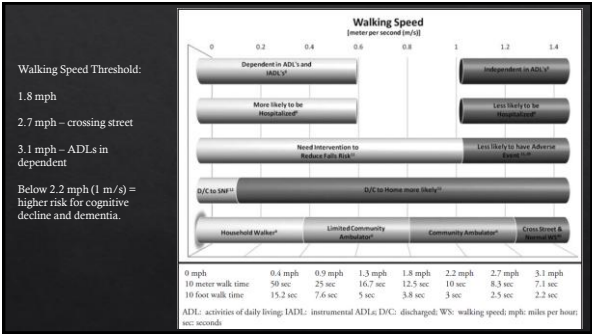
Implications of Muscle Amount, Strength, and Power loss

❖ Sarcopenia

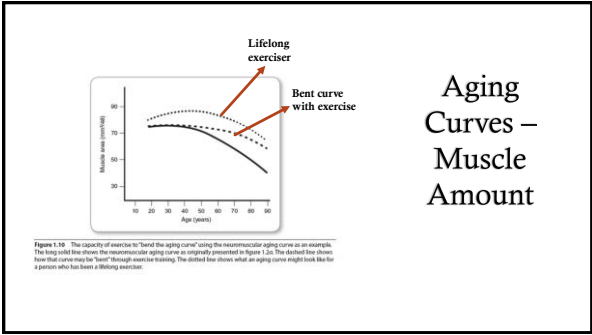
- Type 2 muscle fibers denervated and then reinnervation by type I motor units + decreased use of powerful movements + the other items in the pic to the right = **strength and power loss**
- Inability to complete ADLs.
- **Muscle power** loss affects the ability to prevent a catastrophic fall.
- **Slow walking speeds**, inability to rise from a chair, poor endurance and higher risk of disability.
- Muscles are the body's primary reserve of amino acids. Loss of muscle mass will affect your **immune system**.
 - 10% depletion = higher infection risk
 - 20% depletion = decreased wound healing/weakness / greater risk of infection.
 - 30% depletion = catch pneumonia / bed sores/ even less healing capacity
 - 40% depletion = death looms / pneumonia overtakes



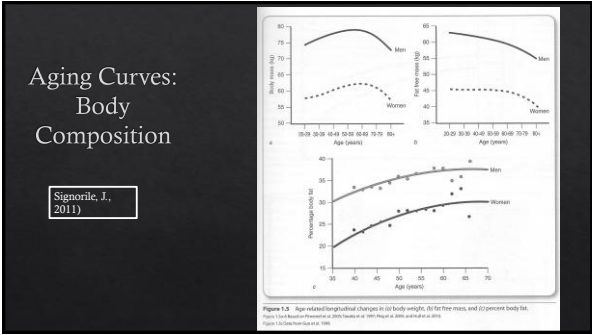
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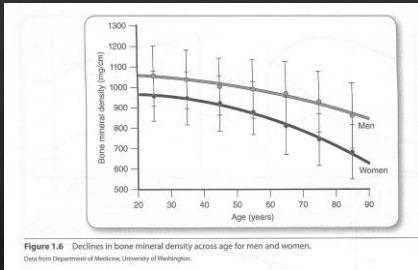
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Aging Curves: Bone Mineral Changes

Signorile, J.,
2011)

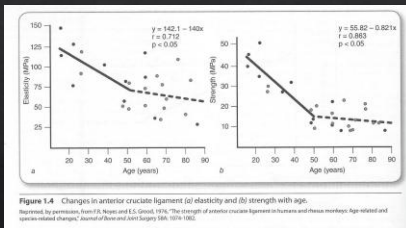


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Aging Curves: Ligament Strength

Load at failure is
less in ligaments
with age.

Signorile, J.,
2011)

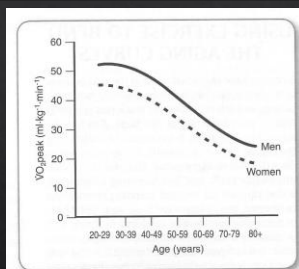


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Aging Curves: Cardiovascular fitness (VO_2 Peak)

Signorile, J.,
2011)

VO_2 Max declines 10% per decade
after the age of 40.



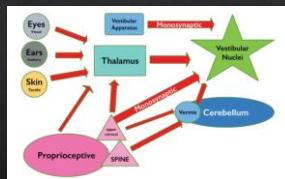
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- Between the ages of 35-60 there is a steady loss of brain volume of approximately 0.2%/ year. Then accelerates to 0.5% after age 60!

Changes include (but not limited to):

- Decreased brain blood flow increasing stroke risk.
- Changes in neurotransmitters.
- Decreased BDNF (Brain-derived neurotrophic factor)
- Decline in proprioception** from decreased inputs to the Vestibular nuclei which is the information hub.
- Changes in nervous system function are affected by nutrition status and physical inactivity.**

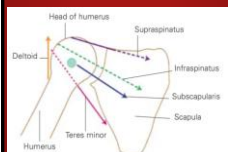
Nervous System Changes



Pic: Original Strength

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Senescent Changes: Shoulders



Depth of the glenoid labrum decreases with age.

Decrease in range of motion by a few degrees.

Degeneration of rotator cuff tendons. Leads to pain and weakness in the acromion region, biceps anteriorly, deltoid, or mid humerus.

Active and passive range of motion in internal rotation decreases with age.

Degenerative changes in the **acromioclavicular joint** are common with increasing age.

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Senescent Changes: Knee

Declining vascular supply and nutrition in the meniscus — gives rise to complex tears.

Osteoarthritis may be an issue.

Important to observe the mobility of the hip and ankle joints.

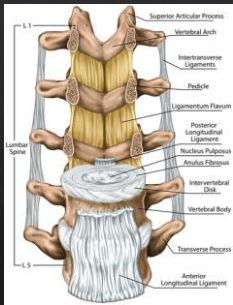
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Senescent Changes: Spine

Segmental
Instability

Bony overgrowth
attempts to restore
stability but also
leads to spinal
stenosis.

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Chronic Pain

- ◆ **1 in 5** Canadians (18 years and older) are affected by Chronic Pain. That is 8 million people!!
- ◆ **1 in 3 people** over 65 years of age experience chronic pain. This will grow as the elderly population grows. **What can you as a trainer do?**
- ◆ **Check out the Pain to Gainz lecture for more details on persistent pain management strategies!**



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Holy #\$\$%&+*!!! What does this all mean?



Training Goals:

- ◆ Increase available muscle and bone mass.
- ◆ Increase overall strength (in particular, grip strength, rotator cuff)
- ◆ Improve hip and ankle mobility.
- ◆ Increase power
- ◆ Improve balance and body awareness.
- ◆ Improve gait.
- ◆ Improve reactivity.
- ◆ Improve core/back control and fundamental motor programs.
- ◆ Improve cardiovascular fitness.
- ◆ Improve Pain Management

TRAIN AROUND SYMPTOMS..... NOT DIAGNOSES

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Increase Available
Bone and Muscle
Mass
Assessment and
Prescription

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Assessment of Muscle and Bone Mass

- ◆ Bone Mass – DEXA-Scan.
- ◆ Muscle Mass – Circumferences. However, can be problematic as we do not know the exact tissue increasing.
- ◆ Skinfold corrected girths?



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Scores ≥ 4 had:

- More IADL deficits
- Slow chair stand times
- Lower grip strength
- Gait speed of < 0.8 m/s

Valid for detecting those at risk for adverse outcomes from sarcopenia.

(Malmstrom et al, 2016)

SARC-F

Sensitivity: 3.9%
Specificity: 97.3%

Component	Question	Scoring
Strength	How much difficulty do you have in lifting and carrying 10 pounds?	None = 0 Some = 1 A lot or unable = 2
	Assistance in walking	How much difficulty do you have walking across a room?
Rise from a chair	How much difficulty do you have transferring from a chair or bed?	None = 0 Some = 1 A lot or unable without help = 2
	Climb stairs	How much difficulty do you have climbing a flight of 10 stairs?
Falls	How many times have you fallen in the past year?	None = 0 1-3 falls = 1 4 or more falls = 2

From Malmstrom TK, Morley JE. SARC-F: a simple questionnaire to rapidly diagnose sarcopenia. J Am Med Dir Assoc 2013;14:531; with permission.

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Bone Development

- ◆ Bone itself is piezoelectric and the charges/potentials it generates in response to **mechanical activity** can enhance bone growth.
- ◆ Bone develops along the lines of stress.



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Specific Exercises for Osteoporosis Prevention

Resistance Training can be very useful at reducing the risk of osteoporosis.

Osteogenesis is mediated by the force of muscle contraction at the site of the tendon attachment to the bone.

Vulnerable Bone Sites	Specific Exercises
Femoral Neck	Hip abduction/adduction Jumping, stepping.
Proximal femur	Same as above Squatting and leg press
Spine	Deadlifts, back ext., rows, cleans, lat. pull-down
Wrist	Arm curls, chin-ups, pull-overs, Reverse wrist curls, boxing

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Building Muscle Mass – Schoenfeld, B. (2010) – Mechanisms of Muscle Hypertrophy and Their Application to Resistance Training

- ❖ Moderate degree of muscle tension that produces metabolic stress (make it burn!).
- ❖ 6-20 reps per set with rest intervals of 60-90 seconds between sets.
- ❖ Exercises should be varied in a multiplanar, multiangled fashion to stimulate all muscle fibers.
- ❖ Multiple sets/split training routine. Periodization
- ❖ Alternating sets to failure with some not to failure to minimize overtraining.
- ❖ Tempo (1-3 sec/2-4 sec – Con/Ecc.)

3 Primary Mechanisms for Hypertrophy:

1. Muscle Tension: Mechanotransduction – mechanical signals turn into chemical activity – turns on anabolic pathways.

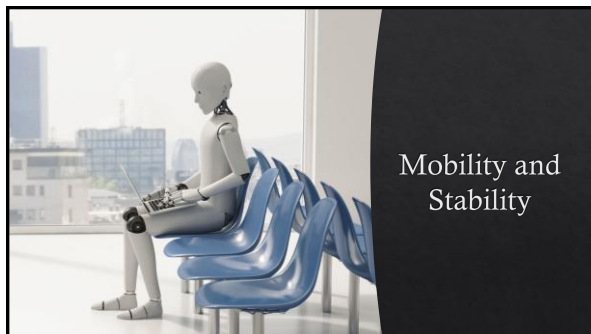
2. Muscle Damage:

Localized inflammation (source of DOMS) leads to a growth response that strengthens the muscle ability to withstand future muscle damage.

3. Metabolic Stress:

Metabolites indirectly mediate cell signaling. This increases water content causing cell swelling. This leads to protein synthesis as a way to preserve its structure. So, get the pump!

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Mobility - Joint by Joint Philosophy (Cook and Boyle)

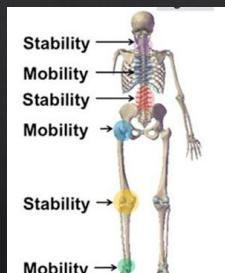
- ❖ Sedentary life leads to predictable changes in mobility and stability of key joint areas

Joints that tend to need mobility are:

- ❖ Ankle
- ❖ Hip
- ❖ Thoracic spine
- ❖ Shoulder Joint
- ❖ Upper cervical region

Joints that tend to need stability are:

- ❖ Knee
- ❖ Lumbosacral region
- ❖ Middle and lower cervical regions
- ❖ Scapular region



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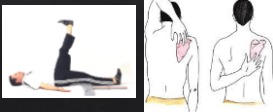
- ◊ Ankle Mobility
- ◊ Overhead Reach
- ◊ Apley's Scratch Test
- ◊ Active Straight Leg Raise



Ankle Mobility Screen



Feet Flexed (dorsiflexion)Feet Flexed (plantar flexion)Heels Raised (dorsiflexion)



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Simple Mobility Drills









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Simple Stability/Motor Control Drills







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Balance and Body Awareness

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Assessment of Balance

- ◆ CSEP – Single Leg Balance Test (any age)
- ◆ Multi-directional Functional Reach Test (any age)
- ◆ Hurdle Step Test (45-60 years of age)

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Balance – Postural Triad

- ◆ **Somatosensory** - Receives information on the relative location of body parts in static positions (called proprioception) and in dynamic positions (called kinesthesia) from peripheral sources such as muscles, joint capsules and soft tissue receptors (i.e. muscle spindles, ruffini endings and paciniform corpuscles etc.). **Ankle/Hip ROM!**
- ◆ **Vestibular** - The vestibular system detects information regarding the **orientation of the head in space and on acceleration**. Any head movement (including weight shifts to adjust position) stimulates the vestibular receptors.
- ◆ **Visual** - Receives information about **the body's position and movement in space, in particular, the position of the head relative to the environment**. **Most important input!**

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Ankle Mobility Check (FMS, 2026)

Why do we care?

Limited ankle mobility will cause someone to bend over too much during a squat, knee to cave in from pronating feet or limit sway capabilities.

Green Knee moves beyond the medial malleolus of the front leg while the heel stays down.	
Yellow The knee resides within the width of the medial malleolus of the front leg while the heel stays down. Potential ankle mobility limitation. Should be addressed in the program.	
Red The knee does not reach the medial malleolus of the front leg while the heel stays down. Potential ankle mobility restriction. Should be addressed in the program.	

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Hip mobility

- ◆ Several Tests are possible!
- ◆ Thomas Test
- ◆ Faber Test
- ◆ FMS – Active Straight Leg Raise
- ◆ Hip Rotation ROM
- ◆ SFMA – MSF/ MSE/ MSR

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Balance Progression:

- ◆ Phase 1a – Joint mobility of ankle and hip.
- ◆ Phase 1b - Joint stability in quadruped, tall kneel, and half-kneel, heel walk, toe walk, foot drivers Somatics inversion/eversion of feet.
- ◆ Phase 2 – Balance Stabilization –Labile surfaces Sitting/ Kneeling/prone/ supine/ Standing
- ◆ Phase 3 – Primal Pattern Loaded Stability
- ◆ Phase 4 – Balance Power Exercises

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Somatics - Inversion and Eversion of Feet



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Fundamental
Motor Patterns
and
Neuromuscular
Reflexes



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Muscle Endurance/Strength/Power - Restore Fundamental
Movement Patterns and then load them!

- Squatting
- Lunging
- Bend patterns
- Rotation and Anti-rotation (control of rotation)
- Push and Pull (horizontal and vertical)
- Locomotion (walking, stepping, crawling, and running)
- Non-locomotion (balance and body sway)
- **Anti-fragile Matrix** (P. Nickleston)
- Manipulative skills (throw, catch, squeeze/carries)

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Assessment of 3 Neuromuscular Stress Reflexes

Stems from Selye's "eustress and "distress"

Red Light Reflex – The withdrawal (fear) reflex.

Green Light Reflex – The Landau Reaction (effort).

Trauma Reflex – Usually as a result of injury/surgery.

Reflexes focus around the middle of the body where the COG is

More on this in the Hanna Somatics Presentation later today!

Green Light Reflex vs. Red Light Reflex



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Motor Control - Somatic Movement Patterns

- ♦ Somatic Movement Patterns decrease sensory motor amnesia in various body regions. What is sensory motor amnesia?
- ♦ Sensory Motor Amnesia, as defined by Thomas Hanna, PhD, refers to a condition in which muscles become habitually tight in response to injuries (e.g., soft-tissue injuries), physical shocks (e.g., falls or blows), repetitive use (e.g., overtraining) or on-going stress.
- ♦ The exercises teach how to activate the muscles of the core and integrate them with the periphery. It also teaches a client how to relax them.
- ♦ This is **EDUCATION NOT THERAPY! IF YOU CAN'T SENSE IT, YOU CAN'T STRENGTHEN IT**



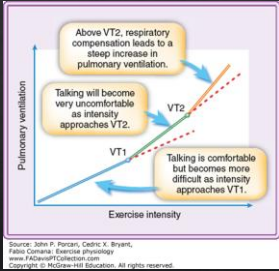
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Stamina/ Aerobic Fitness

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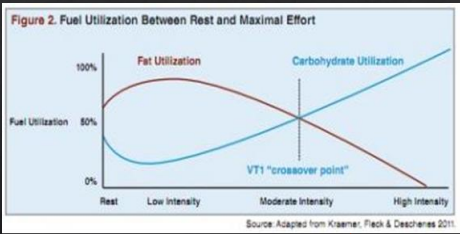
Aerobic Endurance: VT1 Assessment

This assessment works with anyone and on any piece of equipment!!



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Crossover point



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Intensity - VT1 (Ventilatory Threshold)

- Warm up for 3 minutes till HR is within 117-120 BPM or 110 BPM for Seniors. Start Test.
- First 2 minutes— Move intensity up 15-20 watts or 0.5 mph or 0.5-1% grade depending on what you are using.
- Check HR at 1 min...Then check again at 1:30. If HR is steady (they are within 5 beats of each other). Recite the alphabet. Then ask the question – Can I talk comfortably?
- Check table to see what that means. If you did not reach VT1 move intensity up by above suggested increments till you reach VT1 and record the HR. **Do this twice and average.**

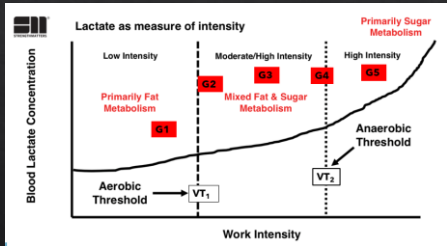
You can then estimate your max. heart rate by dividing this HR by 0.8. If extremely fit divide by 0.85. If in development stages divide by 0.75.

- HR varies between modalities so it is important to conduct this test on the modalities they are using for training.
- Re-Test VT1 every 4-6 weeks or 12-16 sessions.

Answer	Explanation	Threshold	Corresponding Heart Rate number
Yes	No undue stress on your breathing pattern. Can recite a 30-second passage with little effort.	Not yet	Pre-threshold heart rate therefore keep going on the test.
Uncertain	Not sure; equivocal. You are on the verge of not being able to talk. Saying a 30-second passage takes some effort.	VT1	Threshold Heart Rate
No	Cannot talk comfortably. Typically, this is at or above 90% of Maximum Heart Rate. You are unable to produce comfortable speech. You cannot recite a 30 second passage without labored breathing. <i>If your client is a beginner, unfit, or returning to fitness, do not push them to this point.</i>	VT2	VT2 Heart Rate

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Thresholds/ Fuels and Intensity



Ignore the G1, G2....

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How do you use the VT1 info to Program?



Phase 1 – Steady State in Zone 1

Phase 2 – Aerobic intervals alternating between Zone 1 and Zone 2 to push the VT1 heart rate up – Become more aerobic/metabolically efficient – burn more fat at higher intensities = more calories burnt and from fat (better caloric quality)

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Function Assessment
(Fulton, S., 2026)

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Fitness vs Function

- ❖ **VO₂ Max** is touted as the gold standard predictor for lifespan. It is a powerful one!
- ❖ It is a composite metric (captures many systems at once) – reflects performance of the lung, heart, blood vessel, mitochondria, muscle and psychological tolerance of effort.
- ❖ However, it is not about one metric but an integration of the 5 main domains that improve longevity otherwise we would see elite performers dominating longevity stats.
- ❖ **Find the blind spots!**

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	Domain	Tier 1 - Essentials	Tier 2 – Greater Insight	Tier 3 – Avenger Advanced Integration
FUNCTION Tier of Tests (Fulton, 2026)	Strength and Power	30 sec. Chair Stand Stair Climb**	Vertical Jump Push – ups Grip Strength	Weighted Carry Dead Hang Hand grip Endurance
	Cardiovascular and Recovery	6- min. Walk** Resting Heart Rate	3-minute Step Rockport 1 mile Walk 12- minute Run/Walk	Submaximal Treadmill VO ₂ VO ₂ Max Field Test Lab VO ₂ Max Test Heart Rate Recovery
	Mobility and Balance	Single leg stand Gait speed	Timed Up and Go Sit-Rise Tandem Walk	SLB (eyes closed) 360 deg. Turn Tri-toe reach Single leg squat
	Flexibility and Structure	Hamstring Flexibility Spinal Rotation	Shoulder Flexibility Chest Expansion Seated Sit and Reach	Standing forward reach Hip Flexor Length Deep Squat Mobility
	Neuromotor and Cognition	Ruler Drop Reaction Time Color-Card ** not today	Walk and Talk Finger Tap Speed Clock Drawing	Ball Toss/Catch with Cognitive Load Dual Task Gait Target Reaction Go/No-go Trail Making A or B

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How to Improve the Tier 1 Domain Tests		
Domain	Tests	Physical Activities to Improve
Strength and Power	30 sec. Chair Stand	Squats, Step ups, lunges, Chair stands (5 reps to start.
	Stair Climb	Use stairs regularly.
Cardiovascular and Recovery	6-Minute Walk	Brisk walks (3-5x /week)
	Resting Heart Rate	Aerobic conditioning, sleep, hydration
Mobility and Balance	Single Leg Stand	Foot/ankle strength and single leg activity
	Gait speed	Walk with purpose (aerobic intervals), leg strength, and balance activities
Flexibility and Structure	Hamstring Flexibility	Posterior leg flexibility / ab and gluteal strength
	Spinal Rotation	Gentle Spinal Twists
Neuromotor and Cognition	Ruler Drop Reaction Time	Practice catching small objects/ Walk and respond drills/ boxing target mitt drills
	Color card	Stroop activities / Timed puzzles/ Concentration grids

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What the Percentiles Mean

Percentiles are forecasts showing :

- ◆ How much reserve you have
- ◆ Above the minimum needed for daily life
- ◆ How long that reserve is likely to last as normal age-related decline unfolds

The lower your percentile the earlier you reach the critical threshold that may affect your independence for an activity. GOAL for each Test is to eventually reach the 75th percentile and stay there or rise above.

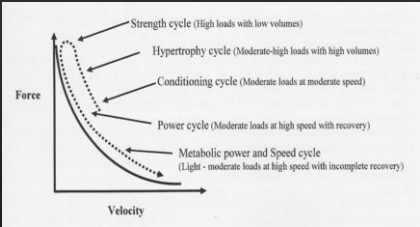
Percentile	Time for a flight of stairs	Speed to safely cross the street	Rising from a chair with no hands	Standing on one leg to dress oneself
25th	Mid 70s	Early 70s	Early 70s	Mid 70s
50th	Early 80s	Early 80s	Early 80s	Late 80s
75th	Mid 90s	Early 90s	Late 80s / Early 90s	In to their 90s

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Programming Essentials

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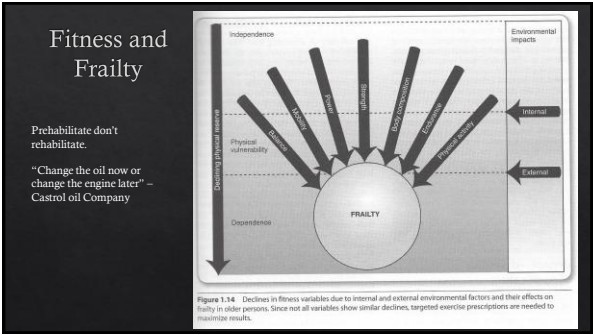
Surfing the Force-Velocity Curve (Linear Periodization)



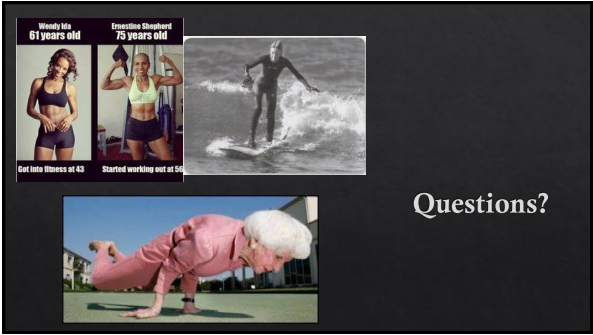
Roughly 4-6 weeks per block.

Ref. - Santana, J.C. (2004)

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