HOW PHYSICAL ACTIVITY CAN IMPROVE YOUR HEALTH AND YOUR LIFE!

UVic Elder Academy, October, 2017

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Series of presentations.

1. ~~The effects of physical activity on the cardiovascular system~~
2. ***The effects of physical activity on strength***
3. The effects of physical activity on retaining memory and cognition
4. The effects of physical activity on balance/falls

Focus: *The theory, rationale (research), and practices to achieve positive outcomes.*

- 2. The effects of physical activity on strength

  Focus: *The theory, rationale (research), and practices to achieve positive outcomes.*

The importance of retaining or increasing strength

- It helps balance which reduces the incidence of falls
- It maintains or increases bone and muscle mass
- Improves some cardiovascular risk markers (increase in HDL)
- Can help or control Type II diabetes
- Helps do daily activities
- Can help aerobic fitness
- It improves cognition more than aerobic activity alone

In addition…….

"The No. 1 reason people are admitted into nursing care is a loss of leg strength. Exercising can restore that [strength], mobility, balance, allow you to get out more and exercise and stay independent."

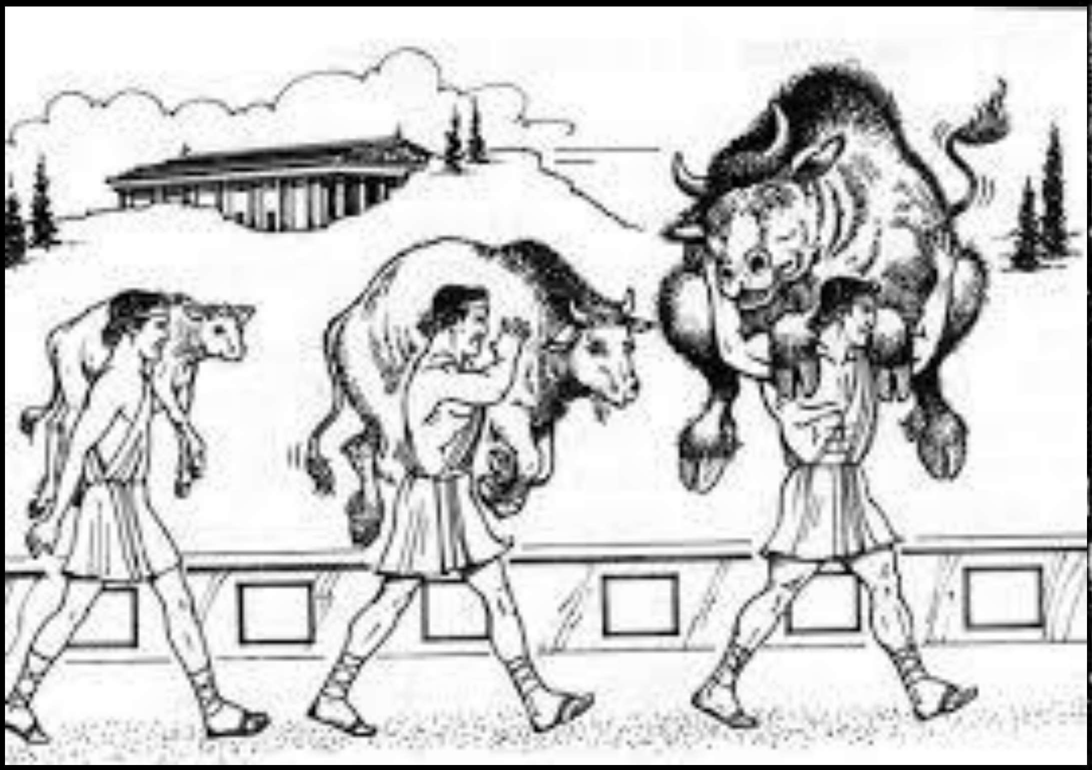
(Colin Miller, CEO, International Council on Aging, Times Colonist, Oct. 15th, 2005)

Strength and aging

- There is a progressive decline in muscle mass (sarcopenia)
- There is a subsequent loss of strength
- However, many studies[1] have demonstrated an increase in mass (4.2 v 5.6%) and strength (35-40%) following Resistance Training (RT) programs with older populations (60-75 years) similar to younger populations (20-35 years)
- Strength was retained over a 16 week follow up period with once per week training but higher volume training seemed necessary for the older group to retain mass

[1] Bickel et al., 2011, Breen et al., 2012, Macaluso & de Vito, 2003

Start of Resistance Training: Milo (600 BC Greek wrestler)



What is resistance training?

Tai Chi also helps to improve balance and decrease falls

Other forms of strength training

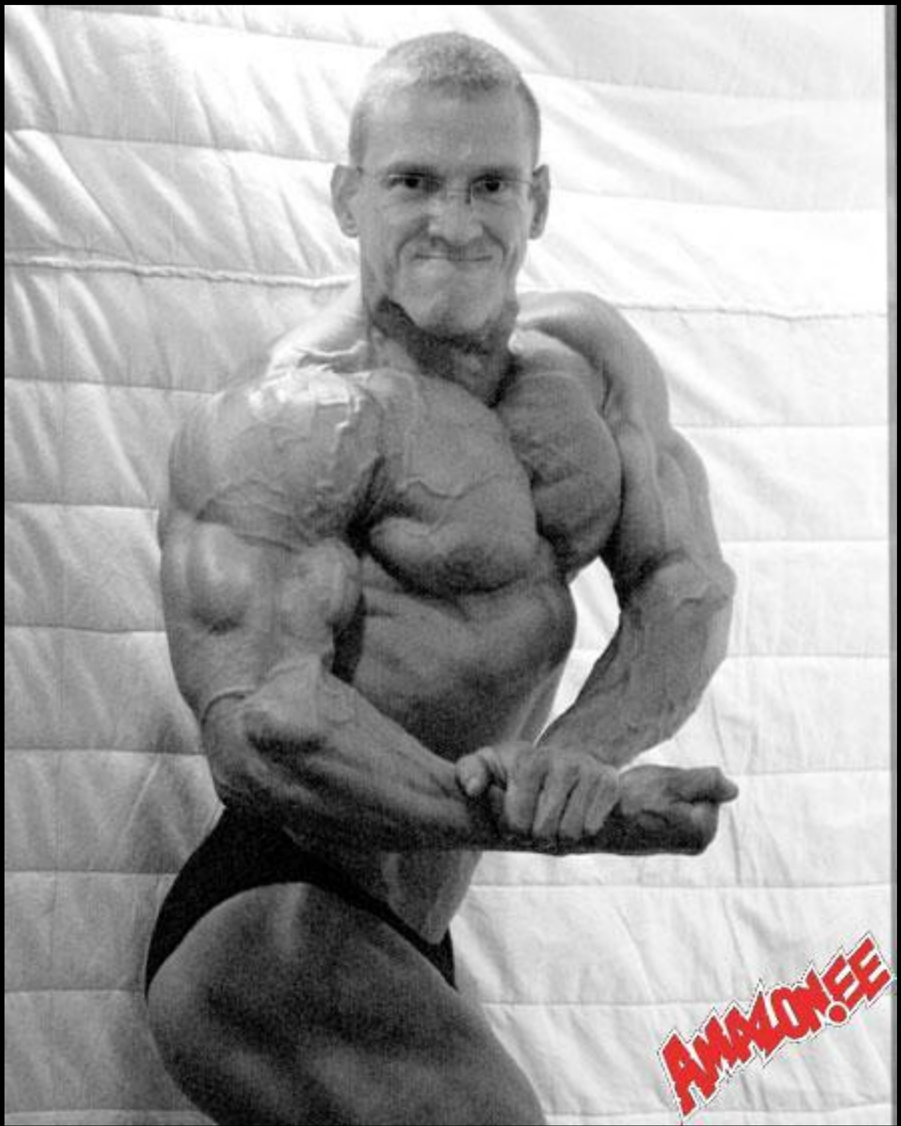
Pilates

Chair Yoga

Increases in strength from resistance training have been attributed to:

- An increase in the cross sectional area of the muscle (fibres) or contractile components (hypertrophy)
- An increase in the neural input (drive) to the muscle without an increase in the muscle cross sectional area
- Energetic changes
- Combination of some or all of the above

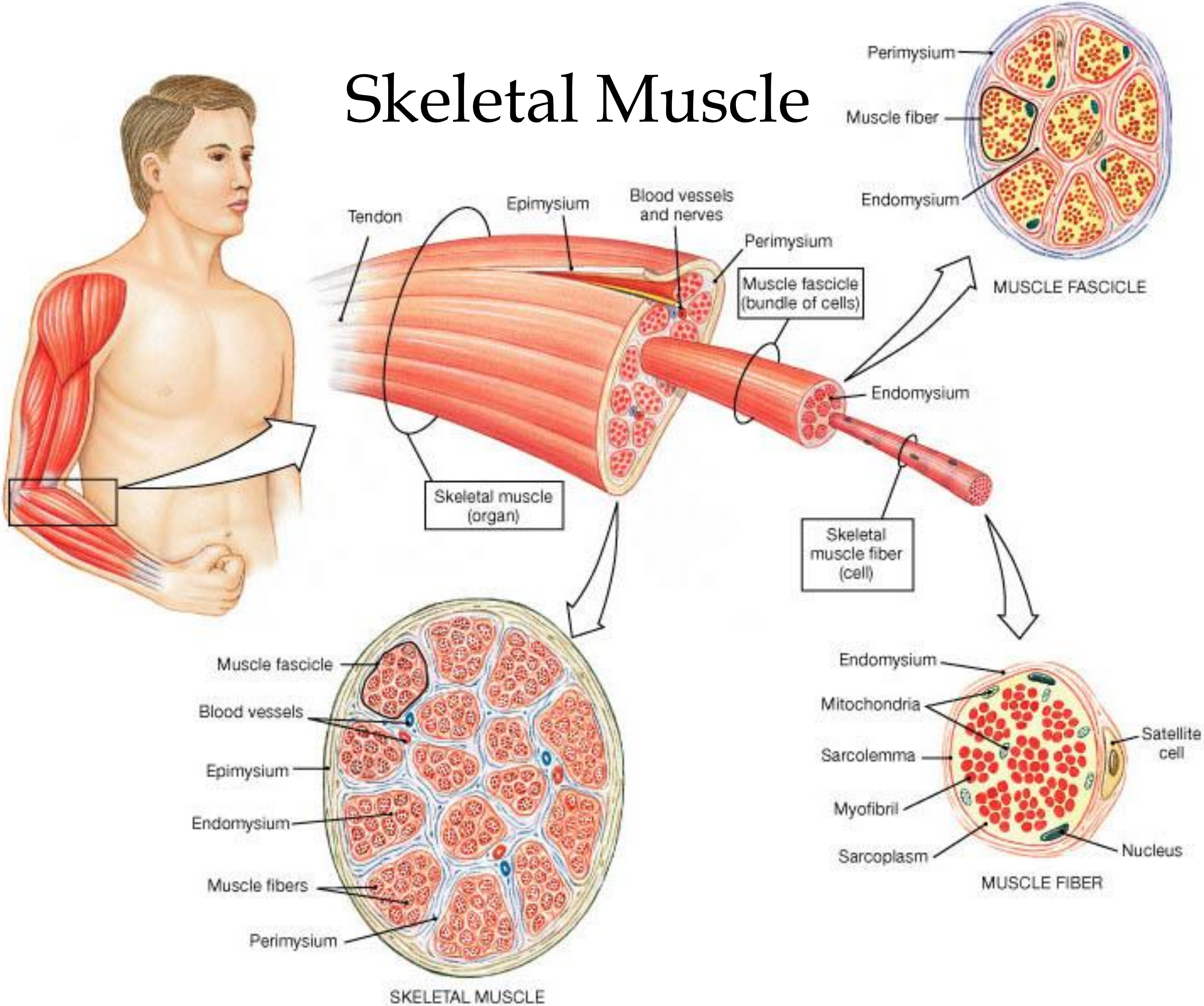
Increase in muscle size!



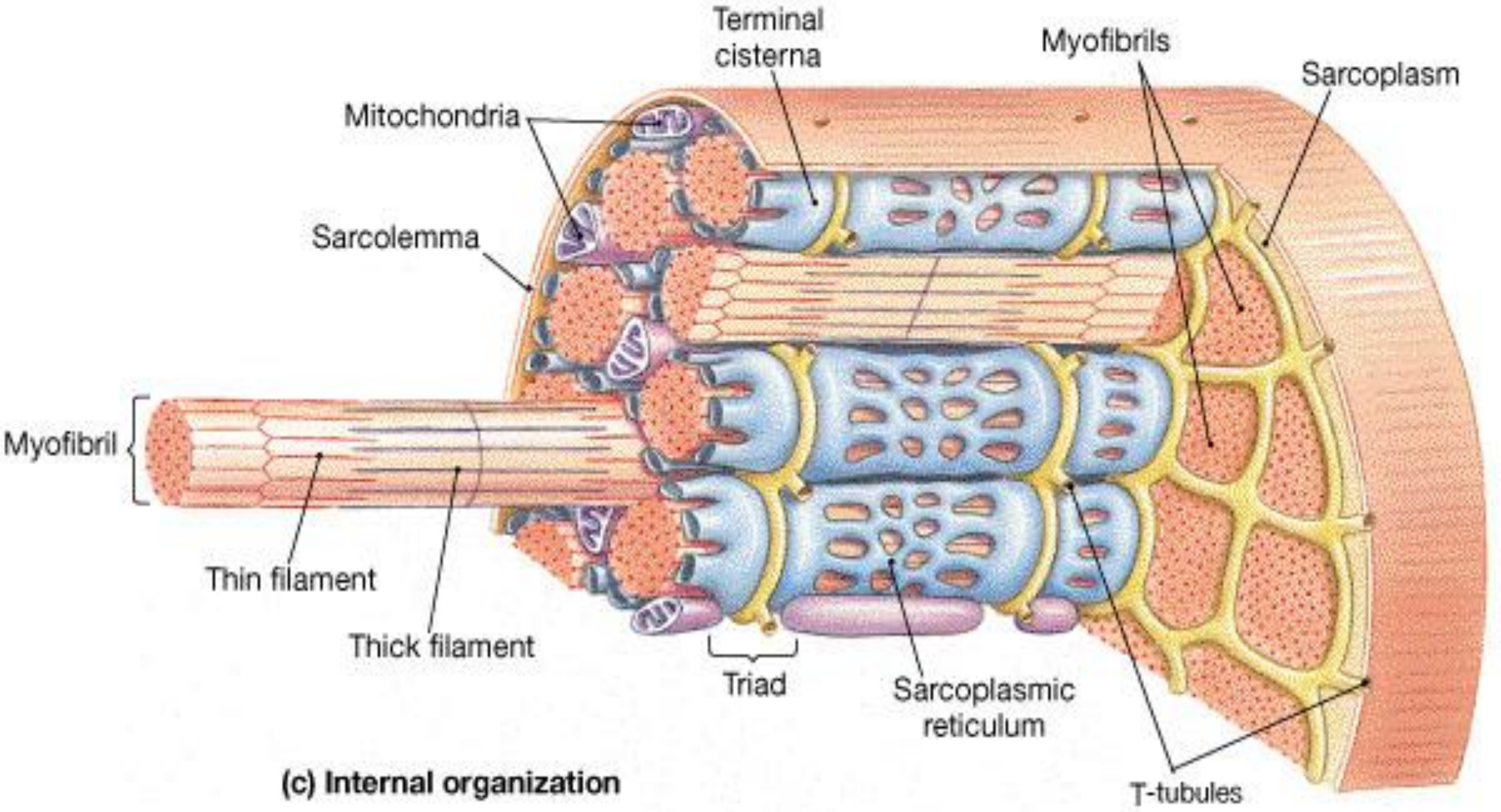
That's a lot of bull!!!!!
(Belgium Blue)
The role of myostatin
(inhibitor of muscle growth)


Birth
7 months

Skeletal Muscle



Cross section of a muscle fibre



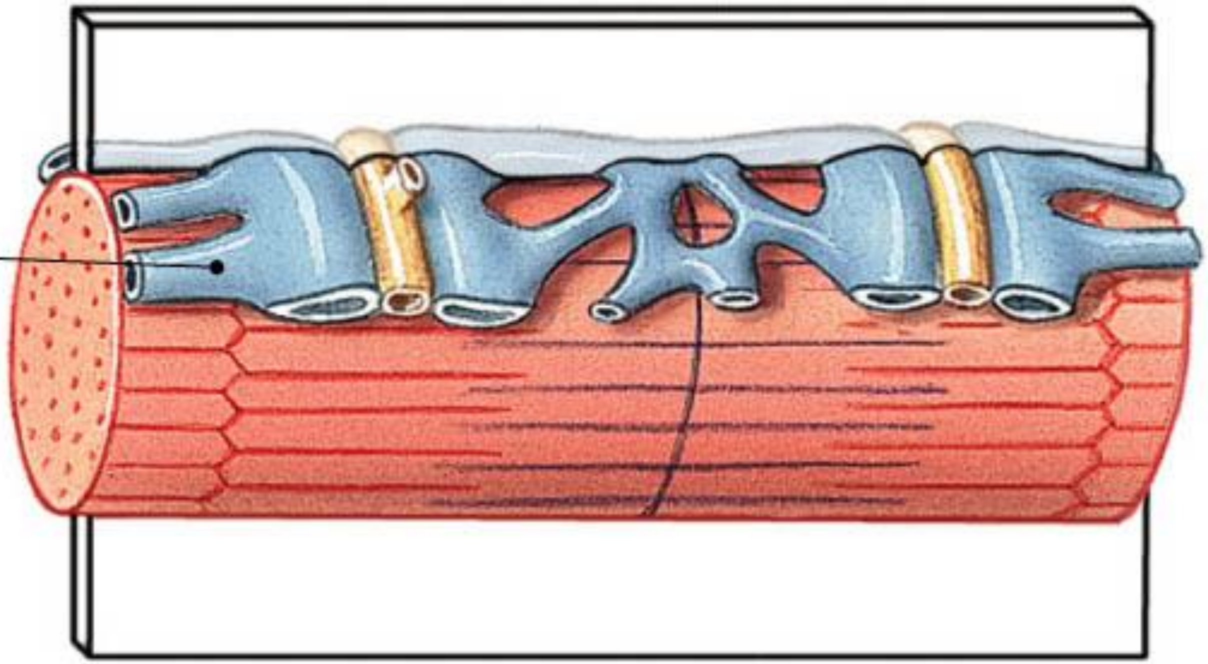
(c) Internal organization

A myofibril

(d) MYOFIBRIL

Surrounded by:
Sarcoplasmic reticulum

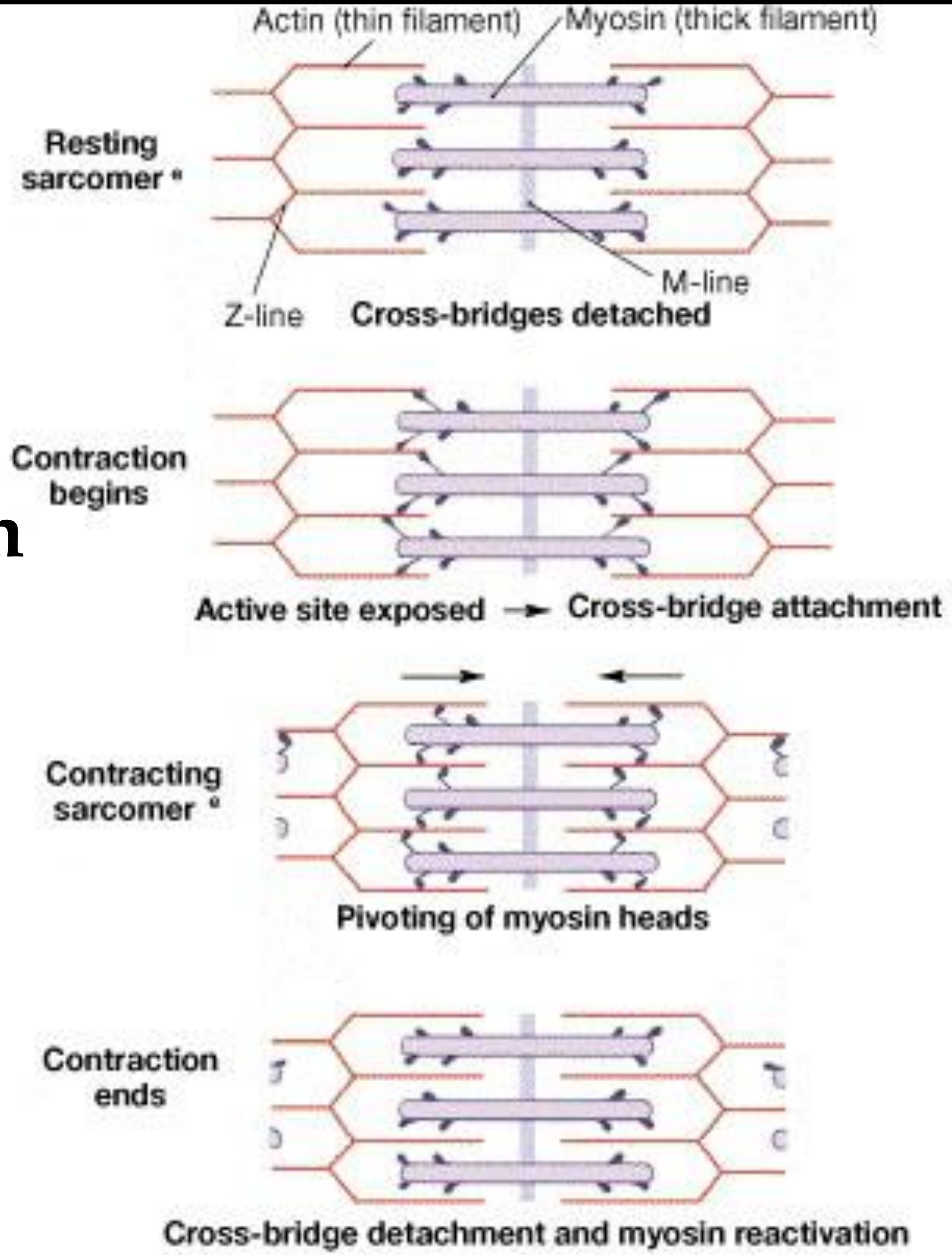
Consists of:
Sarcomeres (Z line to Z line)



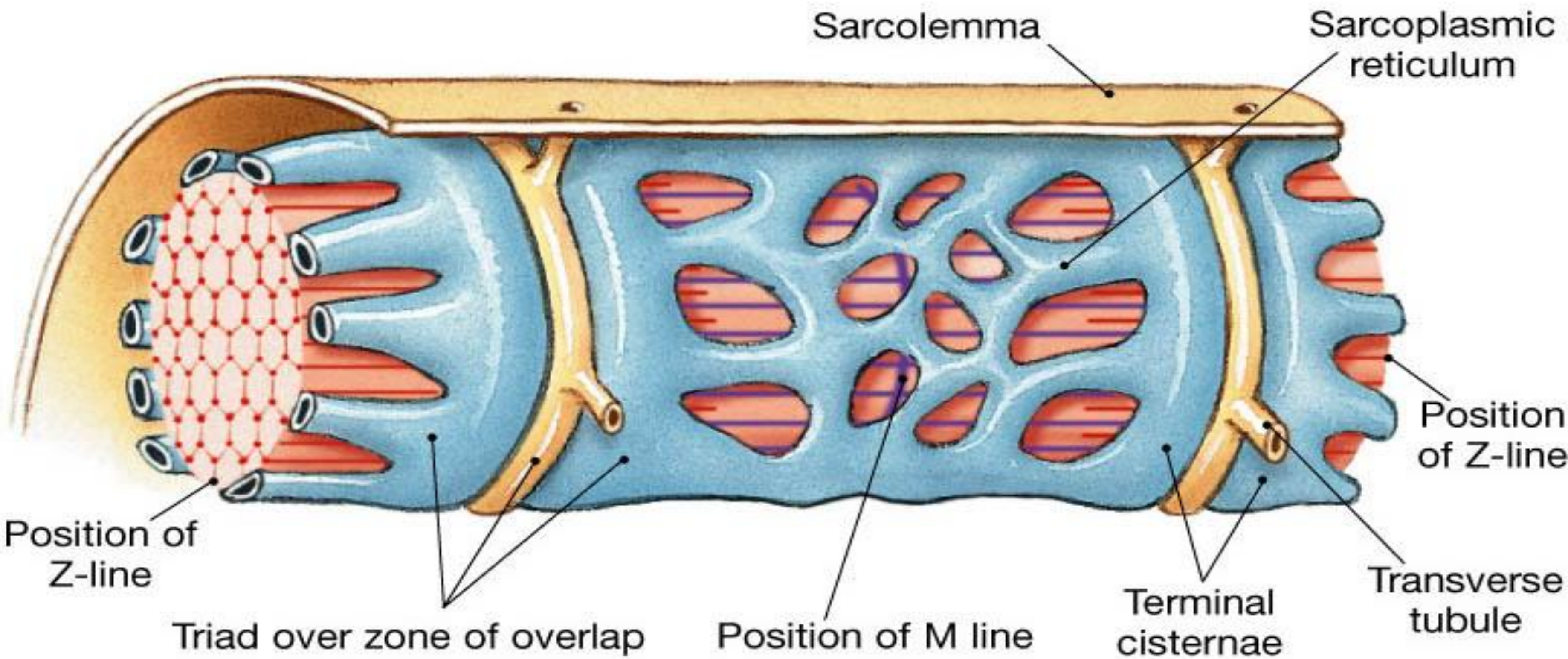
Sliding filament theory

Resting

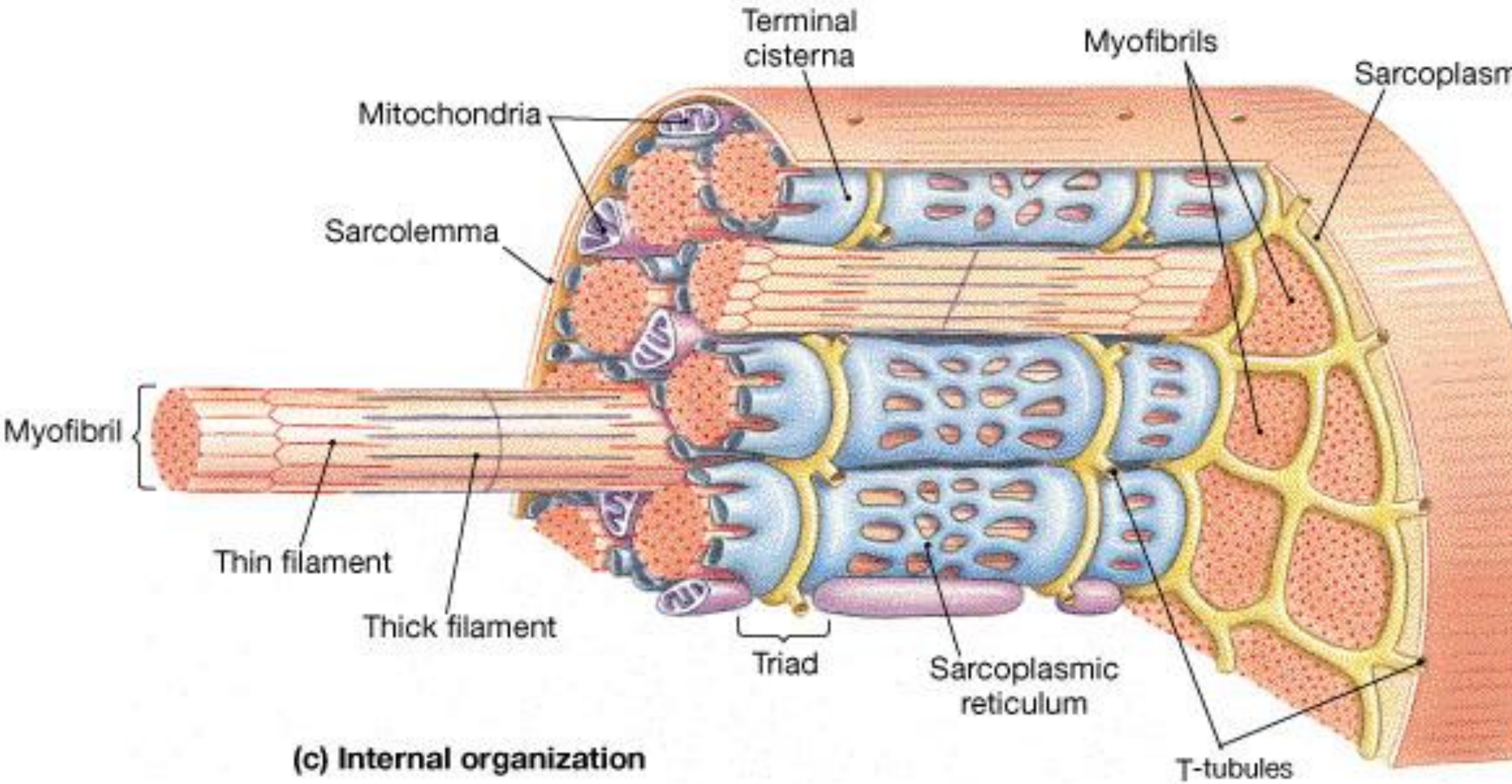
Contraction



Sarcoplasmic Reticulum &T-Tubules

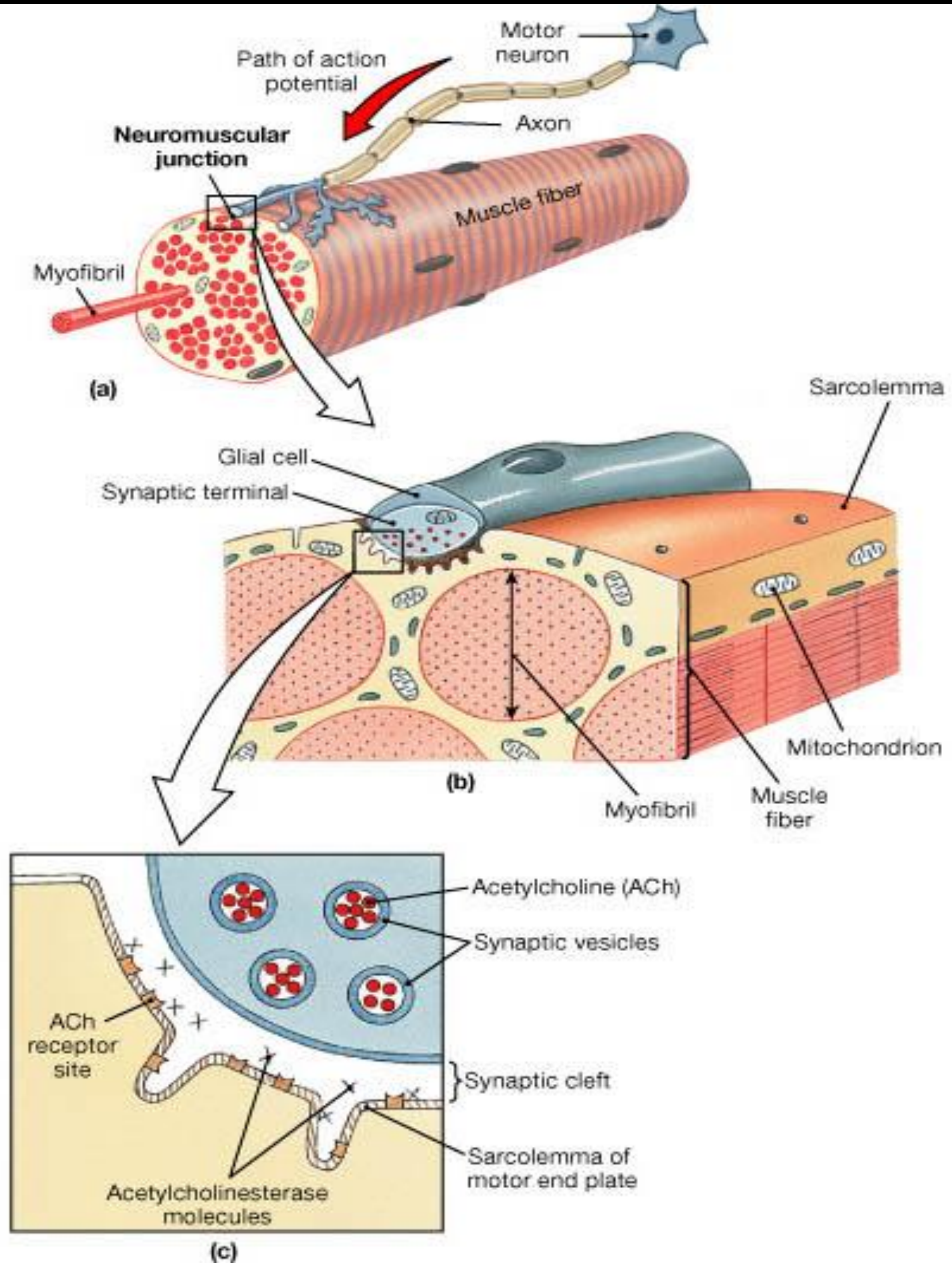


Muscle fiber (internal organization)

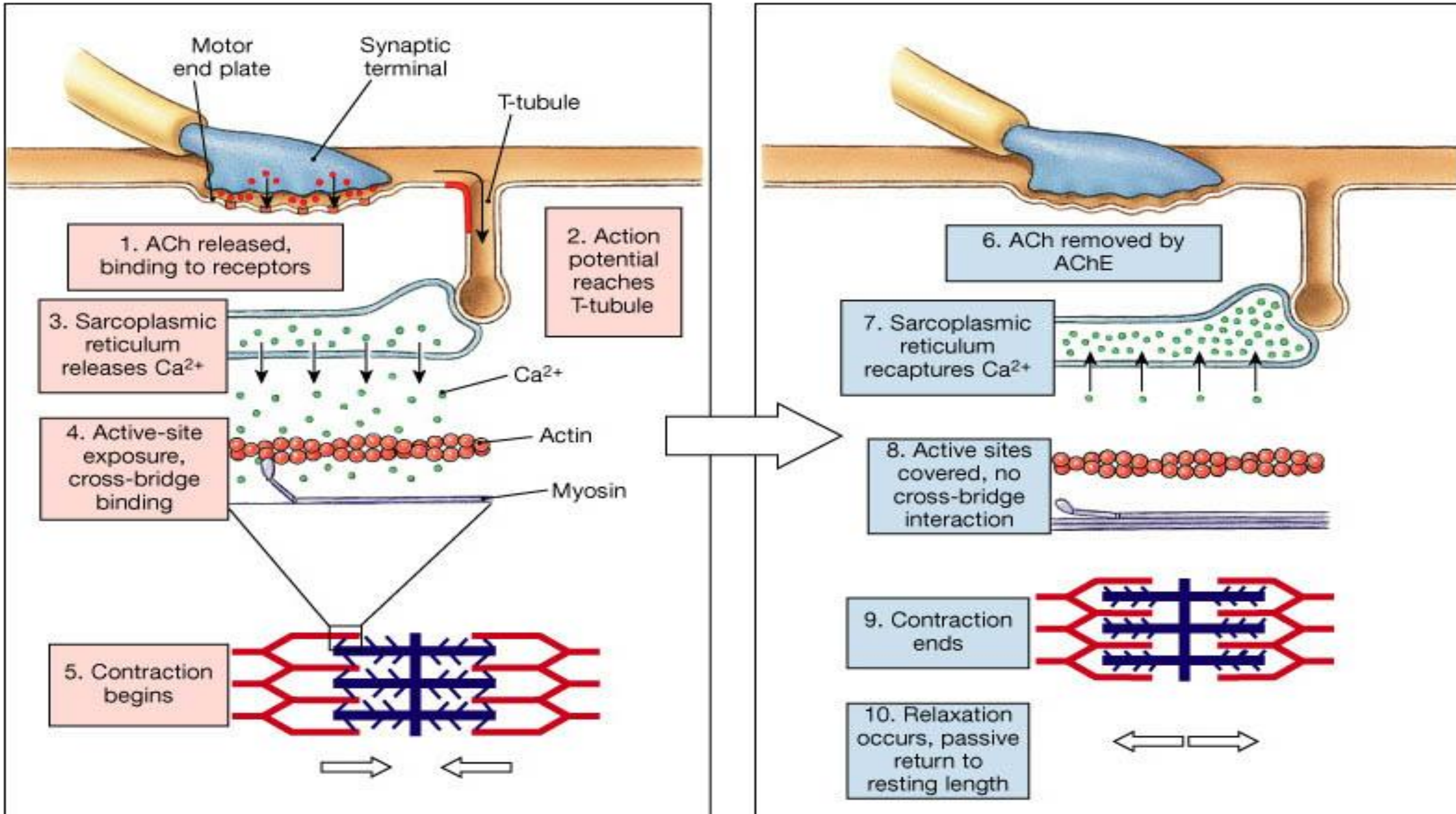


(c) Internal organization

Neuromuscular junction



Motor End Plate & Initiating Contraction



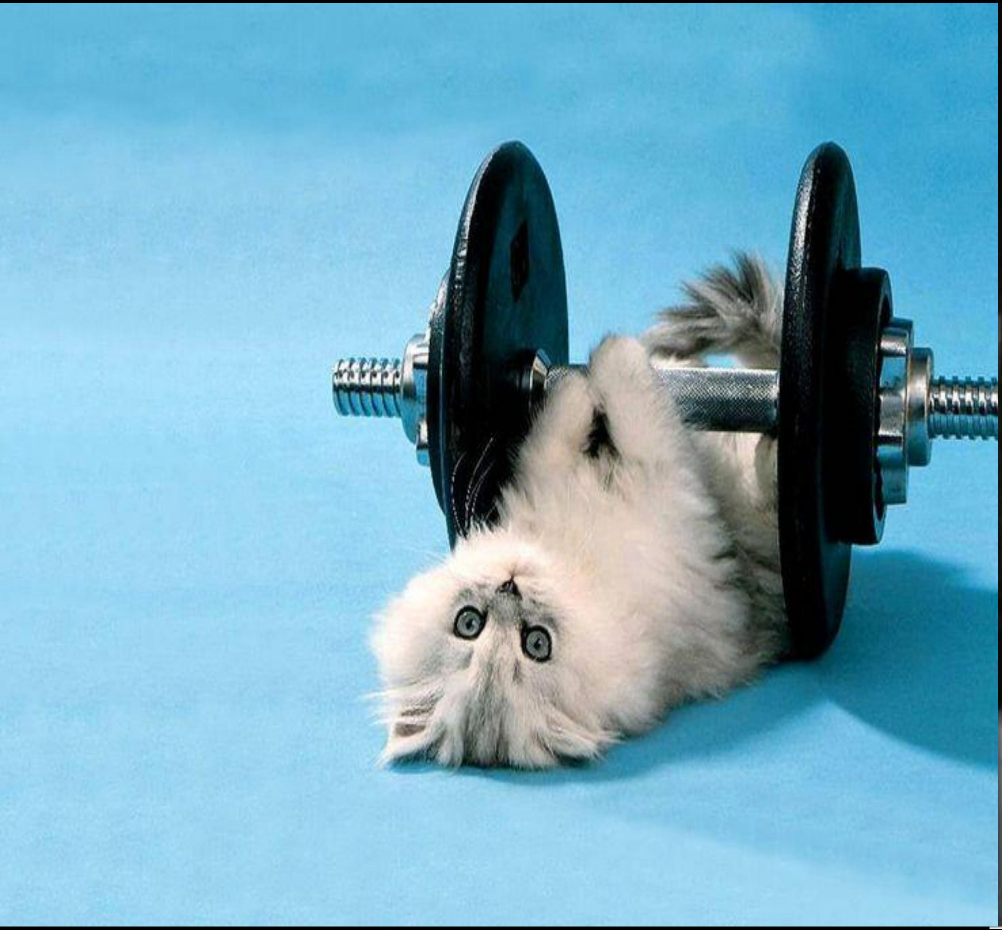
Steps in the initiation of a contraction

Steps that end the contraction

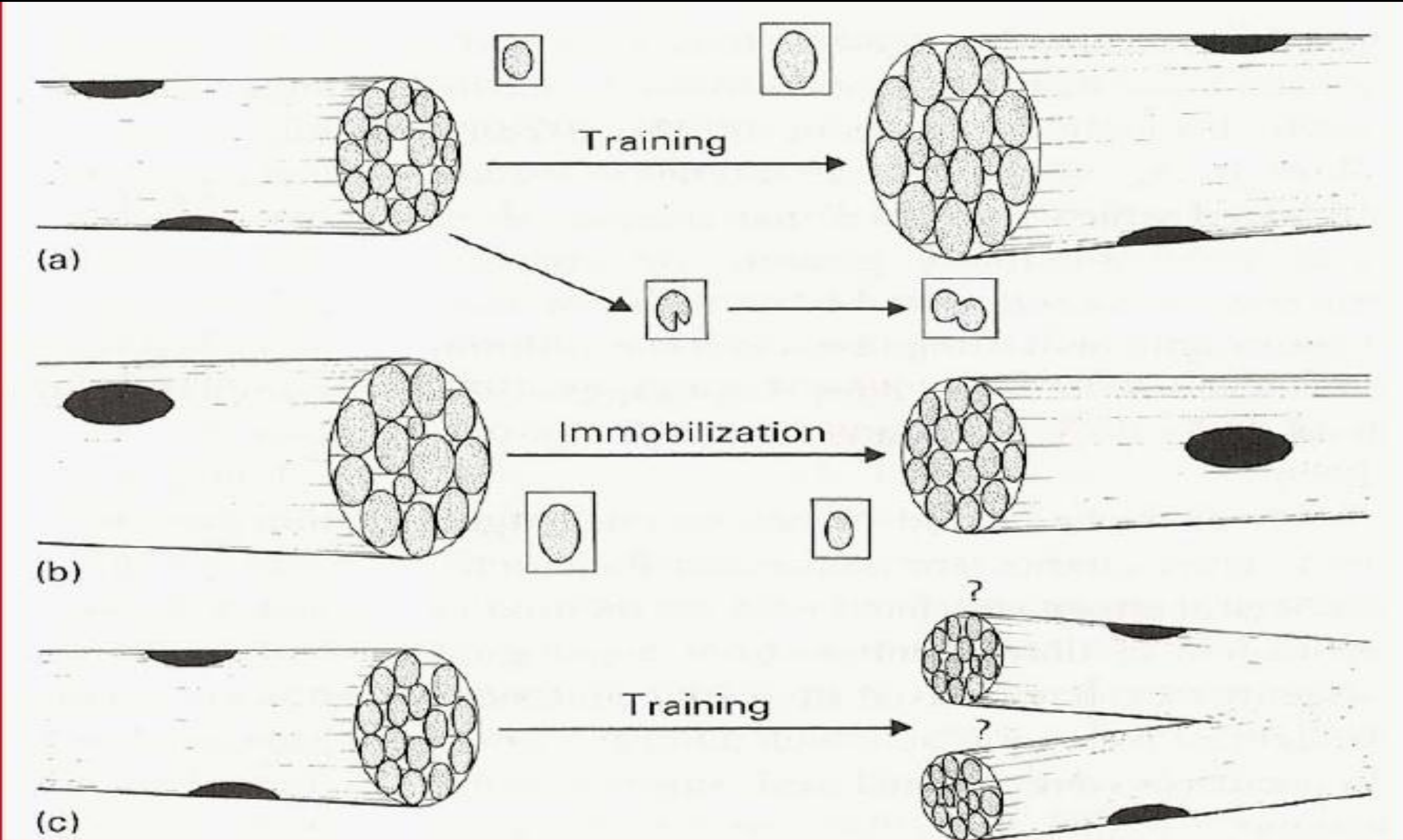
How muscles contract: "The Sliding Filament Theory"

- https://www.youtube.com/watch?v=jUBBW2Yb5KI

Hypertrophy v hyperplasia?



Changes in a muscle fibre size:



Morphological changes with training and detraining

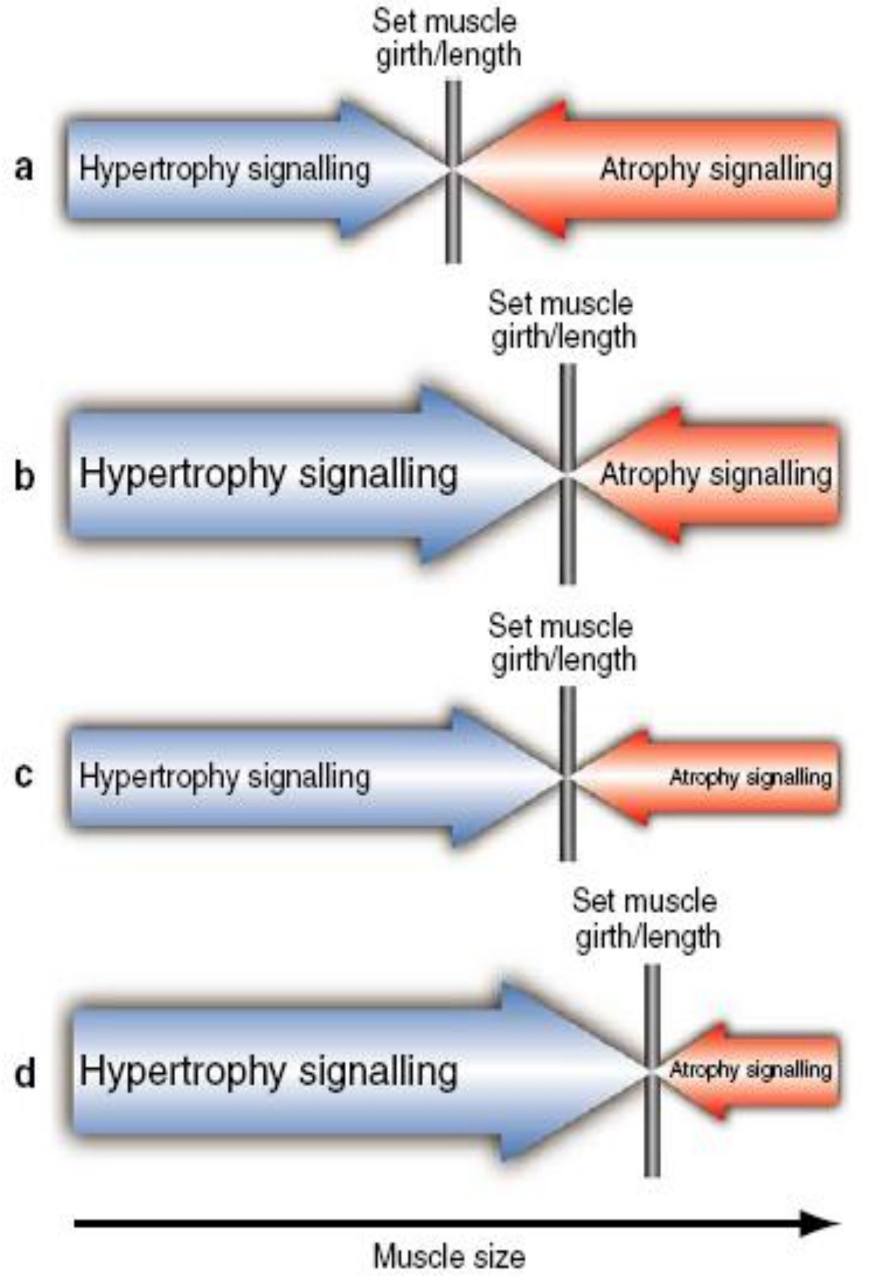


Fig. 2 Simplified model for the relationship between muscle fibre size and the balance between anabolic and catabolic stimuli. Muscle size (girth and/or length) is set by the balance between activity-induced hypertrophy (anabolic) (*blue*) and counteracting atrophy (catabolic) (*red*) signals. In normal muscle, subjected to some amount of tear and wear, hypertrophy and atrophy signals are in balance (**a**). Resistance exercise perturbs the balance by inducing hypertrophy signals over atrophy signals (**b**), or by inhibiting atrophy signals (**c**), or both (**d**), thus driving hypertrophy. This model does not take into account changes in the contractile and metabolic profile that may occur following resistance exercise

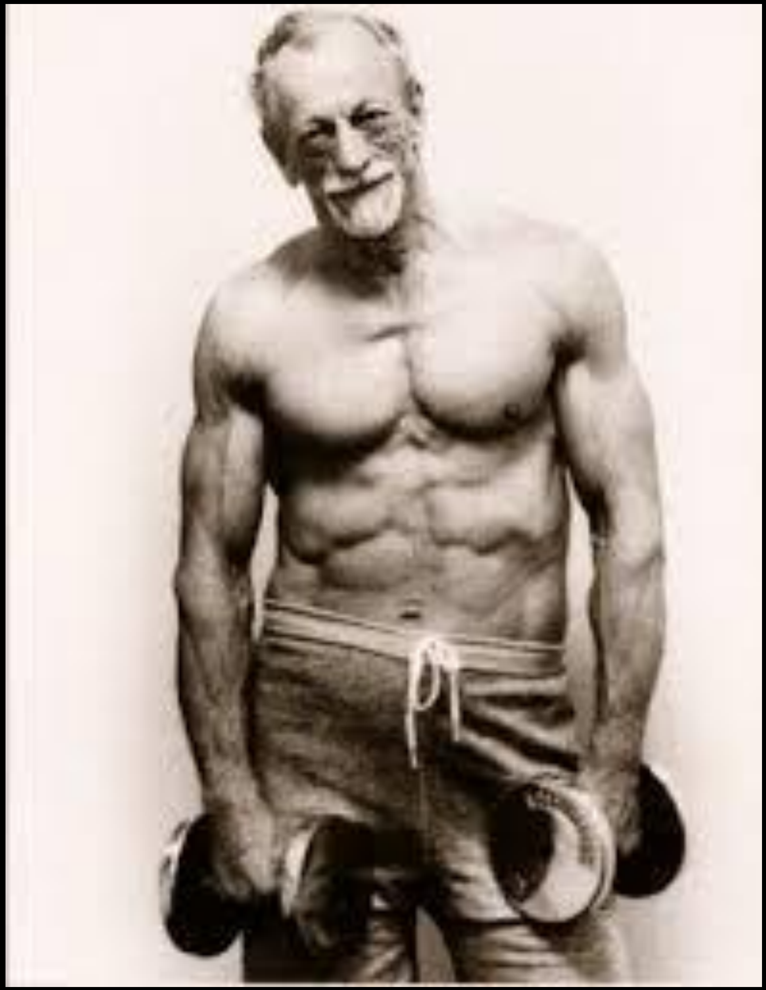
Toigo and Boutellier (2006)

Effect of hormones on hypertrophy

- Testosterone is a strong anabolic steroid that enhances muscle growth
- It declines in males with age (after 30!)
- However, hypertrophy of skeletal muscle is still possible in women and older individuals through the release of Growth hormone (GH), IGF-1
- Skeletal muscle can also synthesize testosterone, estradiol, dehyroepiandrosterone (DHEA), and dihydrotestosterone (DHT).

- "Resistance-training–induced increased muscular sex steroid hormones may positively affect age-related concerns such as accidental falls, diabetes, sarcopenia, and osteoporosis and may improve the quality of life for older individuals,"

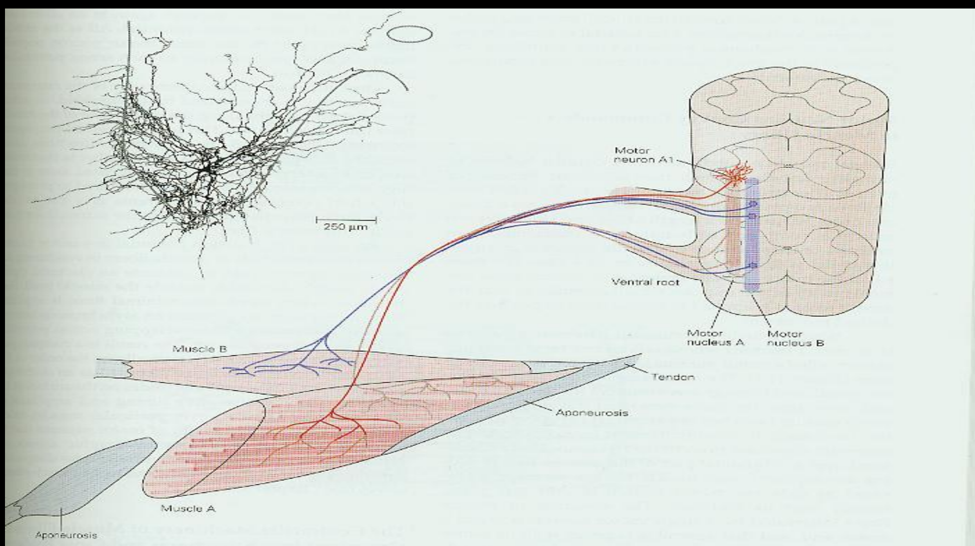
Sato et al., 2014



Possible mechanisms related to neural adaptations (Aagaard, 2003)

- Greater MU recruitment (activation)
- Greater rate coding (firing frequency)
- Greater synchronization (?)
- Greater synergistic activity
- Changes in co-contraction
- Reflex potentiation
- Decrease in pre-synaptic inhibition (PSI)

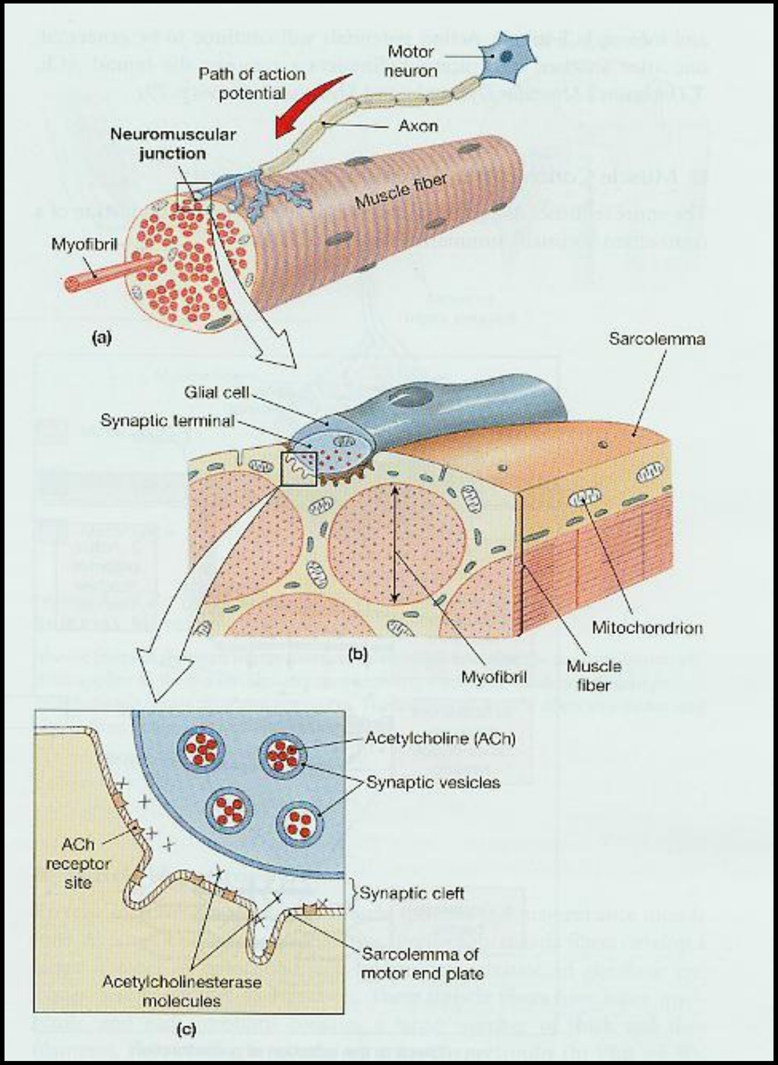
Motor unit (MU)



- Functional unit of movement
- Consists of a αMN & the muscle fibers it innervates

(Kandel et al., 2000)

Motor neuron to muscle fiber



(Martini et al., 2003)

- AP propagated down αMN to NMJ
- αMN releases ACh
- Sarcolemma transmembrane potential altered → AP

Evidence of neural adaptations

- Cross training/education effects (changes in strength, iEMG, but no hypertrophy)
- Increase in specific tension (force/CSA)
- Specificity of movement pattern and contraction type
- Interpolated twitch torque cp to MVC
- Hypnosis and special sensory stimuli
- Peak force v rate of force development
- Strength gains in the absence of muscle hypertrophy

Some things to consider in developing a strength training program

- Progression
  - Need to continue to challenge the muscle group to increase strength (5-10% increase each week)
- Performing the exercises
  - Do the exercise slowly (2s) in both parts (the concentric and eccentric parts)
- Do complimentary exercises
  - Do a pull and push exercise for each joint
- Try to exercise major muscle groups (8-10 exercises)
- There is a need to go to fatigue (i.e. need to feel tired by the last repetition)

There are several published guidelines on the training protocols that produce specific neuromuscular adaptations from resistance training

(e.g. NSCA, ACSM)

Scientific support?

- Unfortunately scientific support for the these guidelines and techniques is lacking
  - Typically populations used in research are not high performance athletes
  - Most training periods are relatively short term
  - Often well controlled research lacks ecological validity
  - Many studies lack important details in regard to the training parameters
  - The studies just haven't been done!

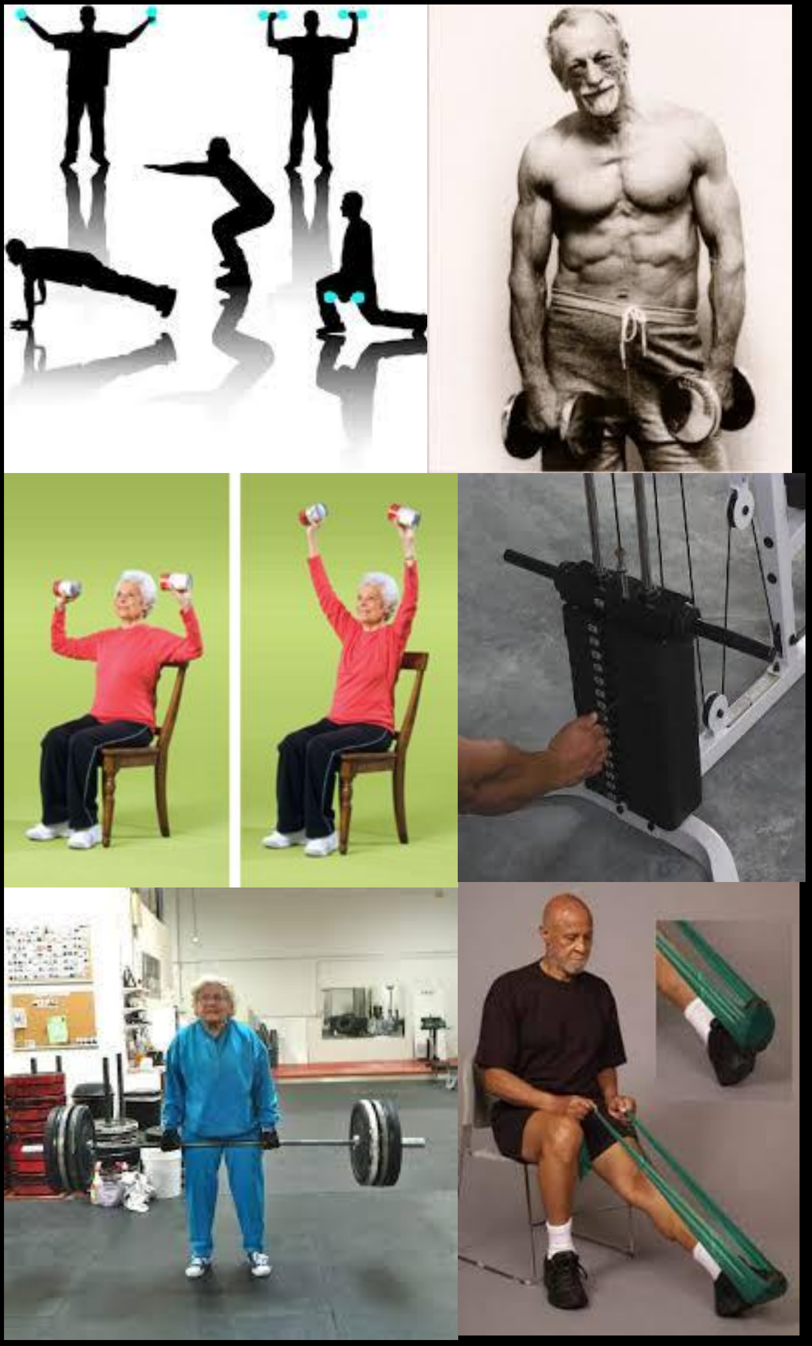
Conclusions

- There is limited support for the notion that resistance training programs emphasizing low-to-moderate intensity and high volume of work …. promote greater muscle hypertrophy than programs with high intensity and low volume of work.

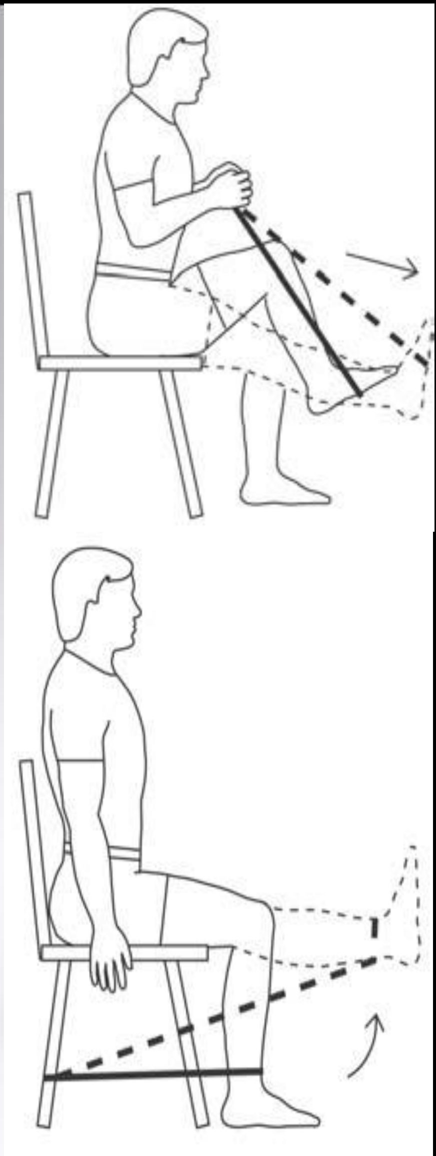
Hrysomallis, 1997

Types of resistance training

- Body weight exercises
- Can of soup (bag of spuds)
- Weight training exercises (free v stacked weights)
- Tubing (therabands)



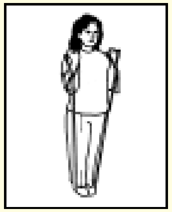
Therabands: http://www.thera-bandacademy.com/



Exercises for Older Adults

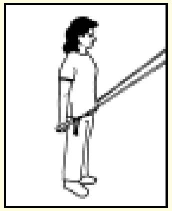
PERFORM ALL THESE EXERCISES SLOWLY AND REMEMBER TO BREATHE DURING EACH REPETITION.

Thera-Band® Upper Body Exercises



BICEPS CURLS: Grasp band at waist-level. Bend elbows, bringing hands to shoulders. Keep back straight. Hold & slowly return.

Color__________ Reps_________



TRICEPS EXTENSION: Grasp band with elbows bent. Keep elbows at side. Straighten elbows, bringing hands to hips. Hold & slowly return.

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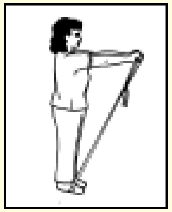
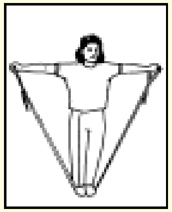


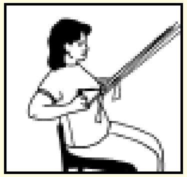
FRONT RAISE (FLEXION): Grasp band at waist-level. Keep elbows straight and lift arms forward to shoulder level. Keep back straight. Hold & slowly return.

Color__________ Reps_________



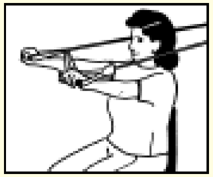
LATERAL RAISE (ABDUCTION): Grasp band at waist-level. Keep elbows straight and lift arms outward to shoulder level. Hold & slowly return.

Color__________ Reps_________



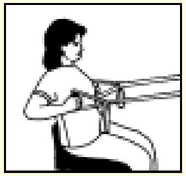
LAT PULL DOWN: Attach band overhead and grasp band in front of you. Bend elbows, bringing hands to chest and elbows backward. Hold and slowly & return.

Color__________ Reps_________



CHEST PRESS: Grasp band at shoulder-level. Straighten elbows, pushing hands away from body. Hold and slowly & return.

Color________ Reps_________

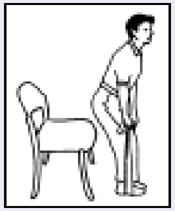


SEATED ROW: Grasp band at chest-level. Bend elbows, bringing hands to chest and elbows backward. Hold & slowly return.

Color________ Reps_________

ALWAYS CONSULT YOUR PHYSICIAN BEFORE BEGINNING ANY EXERCISE PROGRAM

Thera-Band® Lower Body Exercises

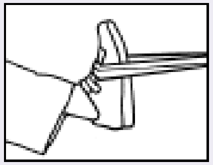


CHAIR SQUATS: Hold band at waist. Keep elbows straight. Slowly lower to chair by bending knees and hips; keep back straight. Hold & slowly return to standing.

Color__________ Reps_________

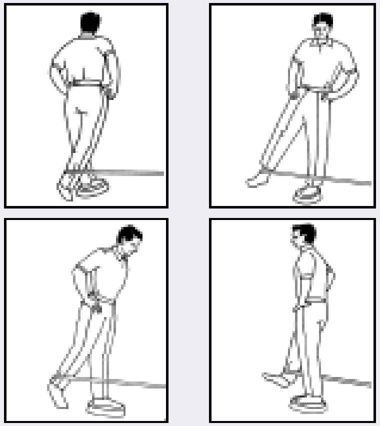
CALF RAISES: Hold band at waist. Keep elbows straight. Go up onto your toes. Hold and slowly return.

Color__________ Reps_________



ANKLE DORSIFLEXION: Pull toes back toward head against band. Hold and slowly return.

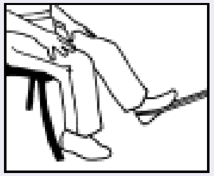
Color________ Reps_________



4-DIRECTION KICK: Perform kicks in 4 directions against the band. Hold & slowly return. Repeat on other leg. Use chair for support if needed.

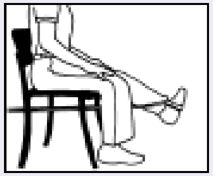
Color_____________ Reps_____________

PERFORM THESE KICK EXERCISES ON A FIRM SURFACE FIRST; PROGRESS TO A STABILITY TRAINER AS BALANCE IMPROVES.



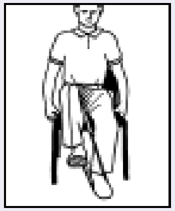
KNEE FLEXION: Bend knee and pull leg back toward chair. Hold & slowly return.

Color________ Reps_________



KNEE EXTENSION: Extend knee and point foot toward ceiling. Hold & slowly return.

Color________ Reps_________



HIP FLEXION: Lift hip upward toward ceiling. Hold & slowly return.

Color__________ Reps_________

References: Mikesky et al. Eur J Appl Physiol. 69(10):316-320, 1994
Topp et al. Gerontology 33(4):501-506, 1993
Topp et al. Rehabil Nur 19(5):266-273,1994

Evidence-based resistance training recommendations

VARIABLES:	RECOMMENDATIONS:
Intensity	Persons should train to momentary muscular failure
Load and repetition	Weight >80% 1RM and perform repetitions to failure (8-12 reps)
Resistance mode/type	Use either free or stacked weights
Repetition duration	Maintain steady force
Volume and frequency	1 set is adequate; 1X or 2 X per week

From: Fisher et al., 2011

Important point

- ……lower, than previously realized, intensity high-volume resistance exercise can stimulate a robust muscle protein synthetic response similar to traditional high-intensity low volume training, which may be beneficial for older adults

Breen & Phillips, 2011

Sample Program

- In general do a program of about 8-10 exercises and try to do at least twice per week.
- A simple program would consist of:
- A. An exercise for biceps (e.g. bicep curl)

  B. An exercise for triceps (e.g. forearm extension, dumbbell press overhead, Arnie press)
- C. An exercise for chest (bench press or push up)
- D. An exercise for back (e.g. lat pull downs, arm pulls, or seated row)

Sample program (continued)

- E. An exercise for quads (leg extension on a machine or front lunge or the single leg squat that Anna showed you. You can do these holding dumbbells)
- F. An exercise for hamstrings (leg curl machine or back lunges or walking lunges. You can also do these with dumbbells).

- G. Side arm lifts
- F. Side arm pull downs

- ***Note: These exercises are in pairs as it is important to work the muscles both sides of a joint. The suggestion is to do them in pairs.***

Exercises for the back/core:
The big three

https://www.youtube.com/watch?v=033ogPH6NNE

Stuart McGill

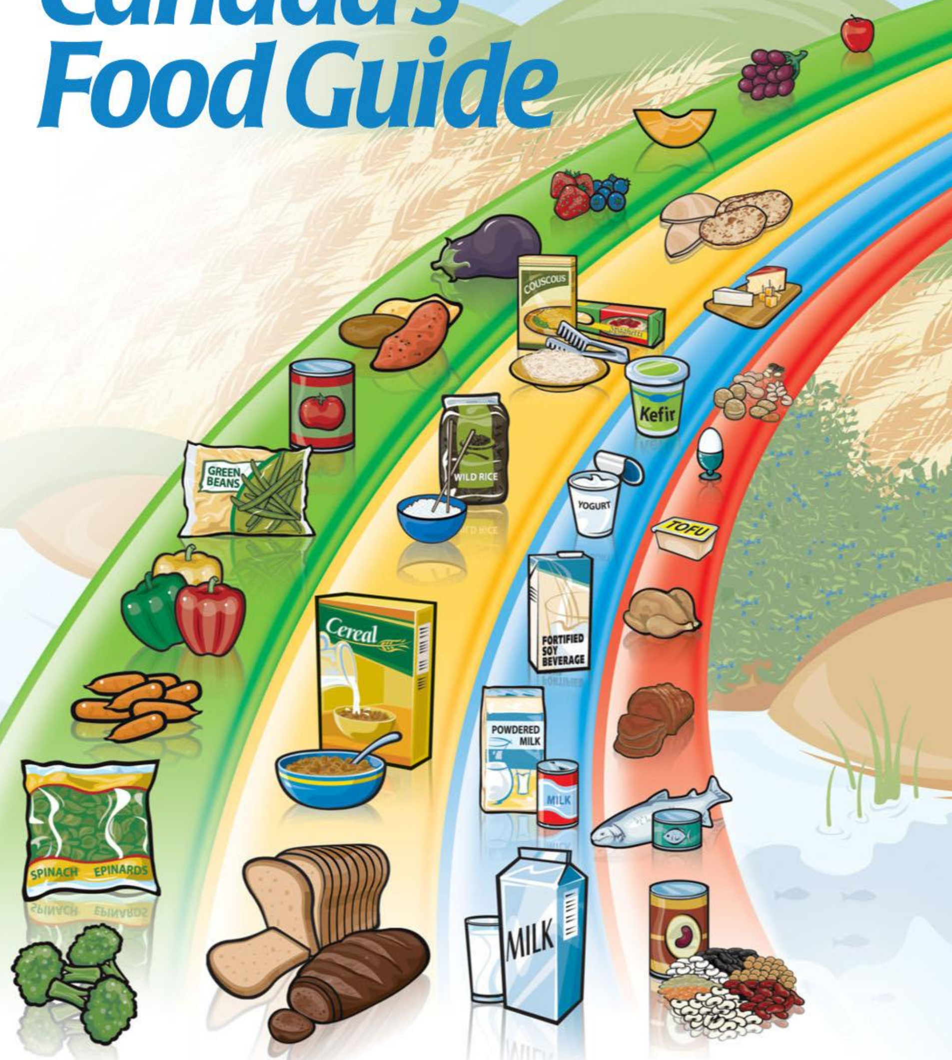
Nutrition is important

- Need adequate protein intake
- Number of studies have examined the addition of whey protein (40 grams) to changes in protein synthesis in the muscle with significant results
- The timing of protein supplement ingestion seems to be important, especially in preventing protein degradation
- Need to check with physician to see if this is necessary
- Most North Americans exceed the NDR for protein intake

Health Canada Santé Canada

Your health and safety… our priority. *Votre santé et votre sécurité… notre priorité.*

Eating Well with Canada's Food Guide



Canada

Recommended Number of Food Guide Servings per Day

	Children			Teens		Adults			
Age in Years	2-3	4-8	9-13	14-18		19-50		51+	
Sex	Girls and Boys			Females	Males	Females	Males	Females	Males
Vegetables and Fruit	4	5	6	7	8	7-8	8-10	7	7
Grain Products	3	4	6	6	7	6-7	8	6	7
Milk and Alternatives	2	2	3-4	3-4	3-4	2	2	3	3
Meat and Alternatives	1	1	1-2	2	3	2	3	2	3

The chart above shows how many Food Guide Servings you need from each of the four food groups every day.

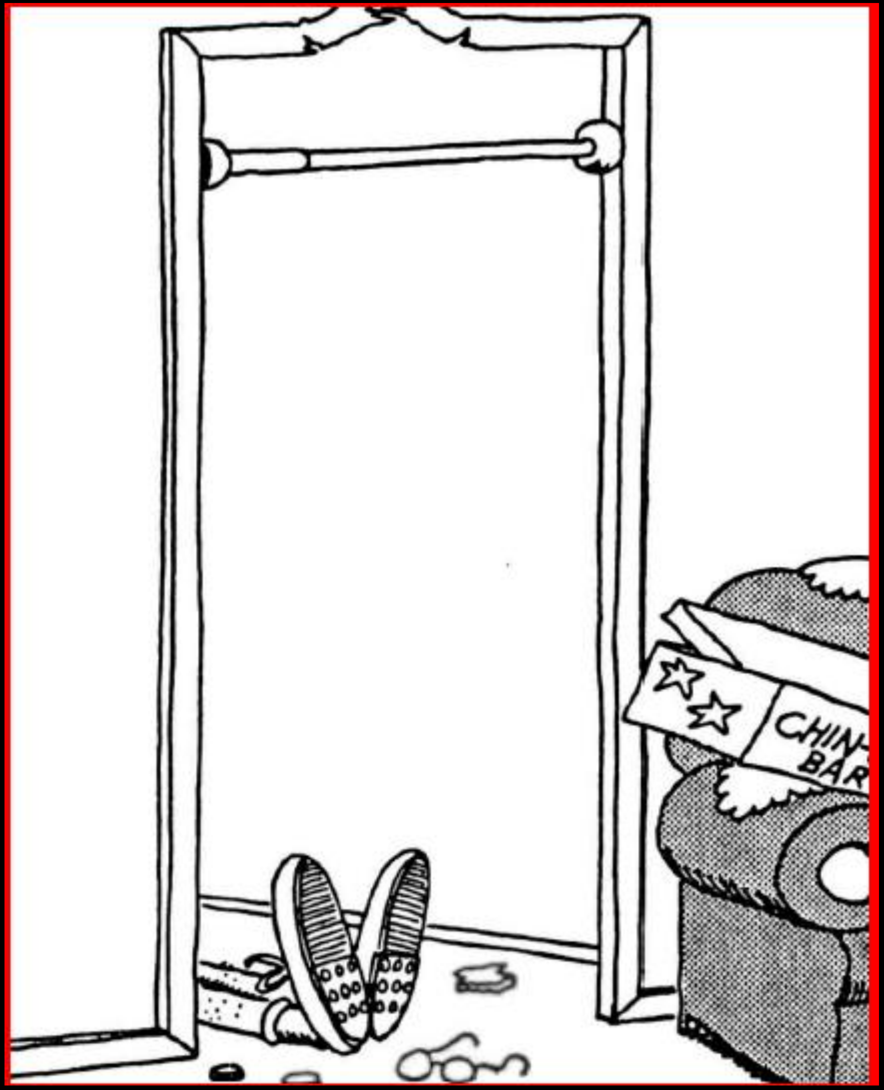
Having the amount and type of food recommended and following the tips in *Canada's Food Guide* will help:

- Meet your needs for vitamins, minerals and other nutrients.
- Reduce your risk of obesity, type 2 diabetes, heart disease, certain types of cancer and osteoporosis.
- Contribute to your overall health and vitality.

Take home message

- Try to incorporate some form of strength training at least once (twice) per week
- Many programs currently available in Recreation and Seniors Centres (e.g. Stretch and Strength) or personal trainers
- Include at least three aerobic training sessions or combine with strength training
- Eat right! Ensure you are consuming enough protein and calories (follow the Canada's Food Guide)

THE END



Thank you

Questions?

Important information in regard to the design of the training programs

- Time under tension (TUT)
- Volitional muscular fatigue
- Number of sets
- Rest in-between sets
- Rest in-between repetitions
- Number of exercise interventions per week
- Duration of experimental period

Should be reported in order to assess the stimulatory effect of the training on muscular protein synthesis.

Toigo and Boutellier (2006)

Training variables and terminology

- Load (intensity)
- Volume load (reps x sets)
- Rest between sets (recovery in training session)
- Frequency of training (how much is enough?)
  - Times per week
- Duration (how long?)
  - Length of each session?
  - Number of weeks/?

Training variables and terminology (continued)

- Mesocycle structure (e.g. 3:1, 4:1, 2:2)
- Number of exercises per muscle group
- Variation in training
- Exercise order
- Periodized model (linear, constant volume etc.)
- Type of workout (triset, superset etc.)
- Loading strategy (drop sets, forced reps etc.)
- To failure/not to failure?

Training variables and terminology (continued)

- Concentric, eccentric, and isometric
- Time under tension (TUT) and the way the time is achieved (e.g. a TUT of 120s can be achieved by 4 reps x 30s actions v 3 sets x 10 reps at 4s per action)
- Also the time for the concentric, eccentric contractions and pause (e.g. 214;21*)
- Movements/actions: flexion/extension, rotation (pronation/supination), abduction/adduction, dorsi/plantar flexion, pull/push.

Meat Sci. 2012 Nov;92(3):174-8. doi: 10.1016/j.meatsci.2012.04.027. Epub 2012 Apr 28.
Nutrient-rich meat proteins in offsetting age-related muscle loss.
Phillips SM.
Author information
Abstract
From a health perspective, an underappreciated consequence of the normal aging process is the impacts that the gradual loss of skeletal muscle mass, termed sarcopenia, has on health beyond an effect on locomotion. Sarcopenia, refers to the loss of muscle mass, and associated muscle weakness, which occurs in aging and is thought to proceed at a rate of approximately 1% loss per year. However, periods of inactivity due to illness or recovery from orthopedic procedures such as hip or knee replacement are times of accelerated sarcopenic muscle loss from which it may be more difficult for older persons to recover. Some of the consequences of age-related sarcopenia are easy to appreciate such as weakness and, eventually, reduced mobility; however, other lesser recognized consequences include, due to the metabolic role the skeletal muscle plays, an increased risk for poor glucose control and a predisposition toward weight gain. What we currently know is that two stimuli can counter this age related muscle loss and these are physical activity, specifically resistance exercise (weightlifting), and nutrition. The focus of this paper is on the types of dietary protein that people might reasonably consume to offset sarcopenic muscle loss.

Resistance training restores muscle sex steroid hormone steroidogenesis in older men

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Abstract

Skeletal muscle can synthesize testosterone and 5α-dihydrotestosterone (DHT) from dehydroepiandrosterone (DHEA) *via* steroidogenic enzymes *in vitro*, but hormone levels and steroidogenic enzyme expression decline with aging. Resistance exercise has been shown to increase in plasma sex steroid hormone levels. However, it remains unclear whether resistance training can restore impaired steroidogenic enzyme expressions in older individuals. Six young and 13 older men were recruited, and muscle biopsies were taken from the vastus lateralis at basal state. The same group of older subjects underwent resistance training involving knee extension and flexion exercises for 12 wk, and post-training biopsies were performed 4–5 d after the last exercise session. Muscular sex steroid hormone levels and sex steroidgenesis-related enzyme expressions were significantly lower in older subjects than younger ones at baseline, but 12 wk of resistance training significantly restored hormone levels (DHEA: 432±26 at baseline, 682±31 pg/μg protein, DHT: 6.2±0.9 at baseline, 9.8±1.4 pg/μg protein). Furthermore, the steroidogenesis-related enzymes such as 3β-hydroxysteroid dehydrogenase (HSD), 17β-HSD, and 5α-reductase expressions were significantly restored by resistance training. We conclude progressive resistance training restores age-related declines in sex steroidogenic enzyme and muscle sex steroid hormone levels in older men.—Sato, K., Iemitsu, M., Matsutani, K., Kurihara, T., Hamaoka, T., Fujita, S. Resistance training restores muscle sex steroid hormone steroidogenesis in older men.

Br J Nutr. 2012 Nov 28;108(10):1780-8. doi: 10.1017/S0007114511007422. Epub 2012 Feb 7.

Resistance exercise enhances myofibrillar protein synthesis with graded intakes of whey protein in older men.

Yang Y[1], Breen L, Burd NA, Hector AJ, Churchward-Venne TA, Josse AR, Tarnopolsky MA, Phillips SM.

Abstract

Feeding stimulates robust increases in muscle protein synthesis (MPS); however, ageing may alter the anabolic response to protein ingestion and the subsequent aminoacidaemia. With this as background, we aimed to determine in the present study the dose-response of MPS with the ingestion of isolated whey protein, with and without prior resistance exercise, in the elderly. For the purpose of this study, thirty-seven elderly men (age 71 (sd 4) years) completed a bout of unilateral leg-based resistance exercise before ingesting 0, 10, 20 or 40 g of whey protein isolate (W0-W40, respectively). Infusion of l-[1-13C]leucine and l-[ring-13C6]phenylalanine with bilateral vastus lateralis muscle biopsies were used to ascertain whole-body leucine oxidation and 4 h post-protein consumption of MPS in the fed-state of non-exercised and exercised leg muscles. It was determined that whole-body leucine oxidation increased in a stepwise, dose-dependent manner. MPS increased above basal, fasting values by approximately 65 and 90 % for W20 and W40, respectively ($P < 0{\cdot}05$), but not with lower doses of whey. While resistance exercise was generally effective at stimulating MPS, W20 and W40 ingestion post-exercise increased MPS above W0 and W10 exercised values ($P < 0{\cdot}05$) and W40 was greater than W20 ($P < 0{\cdot}05$). Based on the study, the following conclusions were drawn. At rest, the optimal whey protein dose for non-frail older adults to consume, to increase myofibrillar MPS above fasting rates, was 20 g. Resistance exercise increases MPS in the elderly at all protein doses, but to a greater extent with 40 g of whey ingestion. These data suggest that, in contrast to younger adults, in whom post-exercise rates of MPS are saturated with 20 g of protein, exercised muscles of older adults respond to higher protein doses.

Eur J Prev Cardiol. 2012 Feb;19(1):81-94. doi: 10.1177/1741826710393197. Epub 2011 Feb 21.

Effect of combined aerobic and resistance training versus aerobic training alone in individuals with coronary artery disease: a meta-analysis.

Marzolini S[1], Oh PI, Brooks D.

Author information

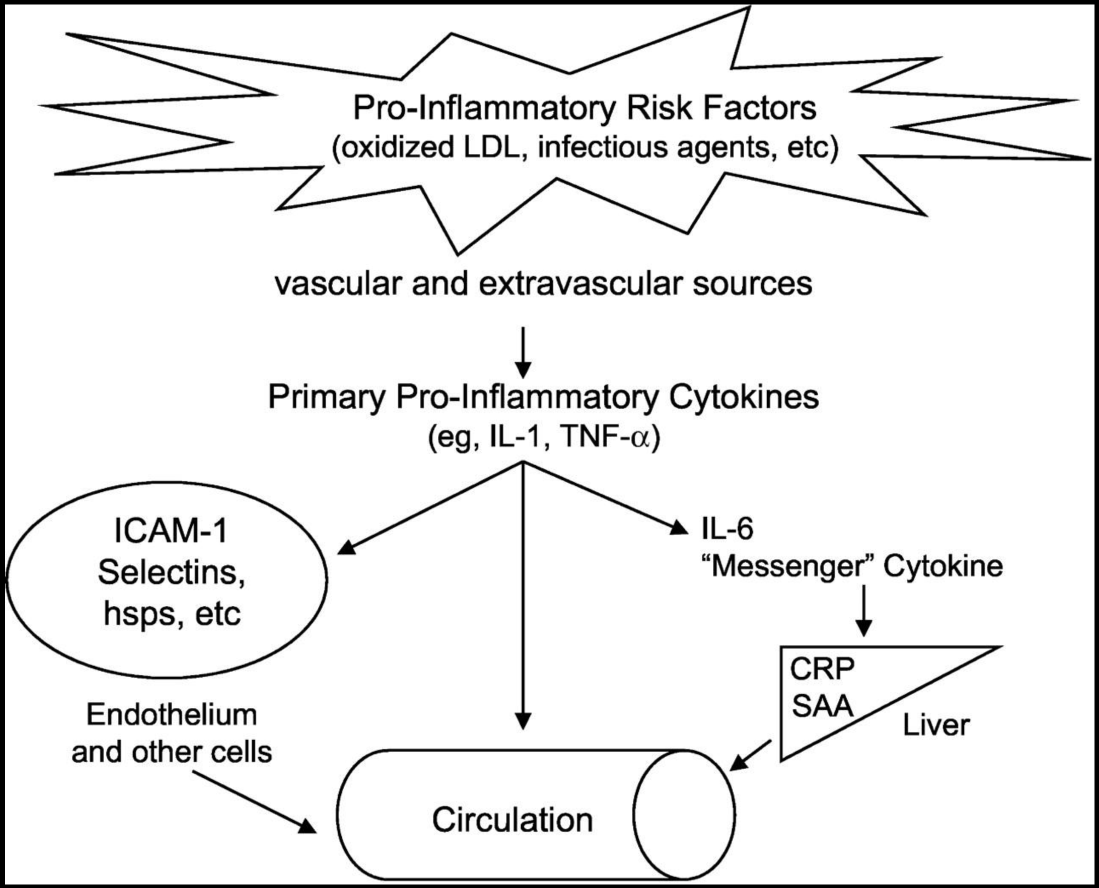
Abstract

BACKGROUND:

Resistance training (RT) has only a permissive role as an adjunct to aerobic training (AT) in cardiac rehabilitation.

DESIGN AND METHODS:

To compare the effect of AT with combined RT and AT (CT) we searched MEDLINE, Cochrane Controlled Trials Register, EMBASE, PreMedline, SPORT DISCUS, CINAHL (from the earliest date available to October 2009) for randomized controlled trials (RCTs), examining effects of CT versus AT on body composition, cardiovascular fitness (VO(2peak)), strength, and quality-of-life (QOL) in coronary artery disease (CAD) (excluding heart failure). Two reviewers selected studies independently.


Pro-Inflammatory Risk Factors
(oxidized LDL, infectious agents, etc)
vascular and extravascular sources
Primary Pro-Inflammatory Cytokines
(eg, IL-1, TNF-α)
ICAM-1
Selectins,
hsps, etc
IL-6
"Messenger" Cytokine
CRP
SAA
Liver
Endothelium
and other cells
Circulation

RESULTS: (Marzolini S[1], Oh PI, Brooks D.)

Twelve studies met the study criteria (229 AT patients, 275 CT patients). Compared with AT, CT decreased percent body fat by -2.3% (WMD (weighted mean difference); 95% CI: -3.59 to -1.02), decreased trunk fat (SMD (standardized mean difference): -0.56; 95% CI: -0.96 to -0.15) and increased fat-free mass by 0.9 kg (WMD; 95% CI: 0.39 to 1.36) in three studies (n = 106). Similarly CT was associated with larger increases in lower body strength (seven studies, n = 225, SMD: 0.77; 95% CI: 0.49 to 1.04) and upper body strength (eight studies, n = 262, SMD: 1.07; 95% CI: 0.76 to 1.38). Compared to AT, CT improved peak work capacity (three studies, n = 92, SMD: 0.88; 95% CI: 0.45 to 1.31) and there was a trend for CT to increase VO(2peak) by 0.41 ml/kg/min (nine studies, n = 399, WMD; 95% CI: -0.05 to 0.88). Qualitative analysis of QOL data favors CT. Study withdrawals were similar for AT (14.2% ± 13.2) and CT (11.5% ± 15.5). No serious adverse events were reported.

CONCLUSIONS:

CT is more effective than AT in improving body composition, strength, and some indicators of cardiovascular fitness, and does not compromise study completion or safety when compared to AT.

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Nutr Metab (Lond). 2011 Oct 5;8:68. doi: 10.1186/1743-7075-8-68.

Skeletal muscle protein metabolism in the elderly: Interventions to counteract the 'anabolic resistance' of ageing.

Breen L[1], Phillips SM.

Abstract

Age-related muscle wasting (sarcopenia) is accompanied by a loss of strength which can compromise the functional abilities of the elderly. Muscle proteins are in a dynamic equilibrium between their respective rates of synthesis and breakdown. It has been suggested that age-related sarcopenia is due to: i) elevated basal-fasted rates of muscle protein breakdown, ii) a reduction in basal muscle protein synthesis (MPS), or iii) a combination of the two factors. However, basal rates of muscle protein synthesis and breakdown are unchanged with advancing healthy age. Instead, it appears that the muscles of the elderly are resistant to normally robust anabolic stimuli such as amino acids and resistance exercise. Ageing muscle is less sensitive to lower doses of amino acids than the young and may require higher quantities of protein to acutely stimulate equivalent muscle protein synthesis above rest and accrue muscle proteins. With regard to dietary protein recommendations, emerging evidence suggests that the elderly may need to distribute protein intake evenly throughout the day, so as to promote an optimal per meal stimulation of MPS. The branched-chain amino acid leucine is thought to play a central role in mediating mRNA translation for MPS, and the elderly should ensure sufficient leucine is provided with dietary protein intake. With regards to physical activity, lower, than previously realized, intensity high-volume resistance exercise can stimulate a robust muscle protein synthetic response similar to traditional high-intensity low volume training, which may be beneficial for older adults. Resistance exercise combined with amino acid ingestion elicits the greatest anabolic response and may assist elderly in producing a 'youthful' muscle protein synthetic response provided sufficient protein is ingested following exercise.

The acute metabolic and molecular responses to resistance training to momentary muscular failure do not differ from that of traditional endurance training. Myocardial function appears to be maintained, perhaps enhanced, in acute response to high intensity resistance training, and contraction intensity appears to mediate the acute vascular response to resistance training. The results of chronic physiological adaptations demonstrate that resistance training to momentary muscular failure produces a number of physiological adaptations, which may facilitate the observed improvements in cardiovascular fitness. The adaptations may include an increase in mitochondrial enzymes, mitochondrial proliferation, phenotypic
54 conversion from type IIx towards type IIa muscle fibers, and vascular remodeling (including capillarization). Resistance training to momentary muscular failure causes sufficient acute stimuli to produce chronic physiological adaptations that enhance cardiovascular fitness. This review appears to be the first to present this conclusion and, therefore, it may help stimulate a changing paradigm addressing the misnomer of 'cardiovascular' exercise as being determined by modality.

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Steele J, Fisher J, McGuff D, Bruce-Low S, Smith D.

Resistance Training to Momentary Muscular Failure Improves Cardiovascular
Fitness in Humans: A Review of Acute Physiological Responses and Chronic Physiological Adaptations. **JEPonline 2012;15(3):53-** 80.

Research demonstrates resistance training produces significant improvement in cardiovascular fitness (VO2 max, economy of movement). To date no review article has considered the underlying physiological mechanisms that might support such improvements. This article is a comprehensive, systematic narrative review of the literature surrounding the area of resistance training, cardiovascular fitness and the acute responses and chronic adaptations it produces. The primary concern with existing research is the lack of clarity and inappropriate quantification of resistance training intensity. Thus, an important consideration of this review is the effect of intensity.

Recommendations Presentation 1:

- Do some form of moderate *aerobic activity* for 30 min, 5 days per week (it can be in increments of 10 min)

or

- Do some form of vigorous *aerobic activity* 3 days a week for 20 min continuous

or

- Some form of HIIT 3 days per week!

or

- combination

HIIT options

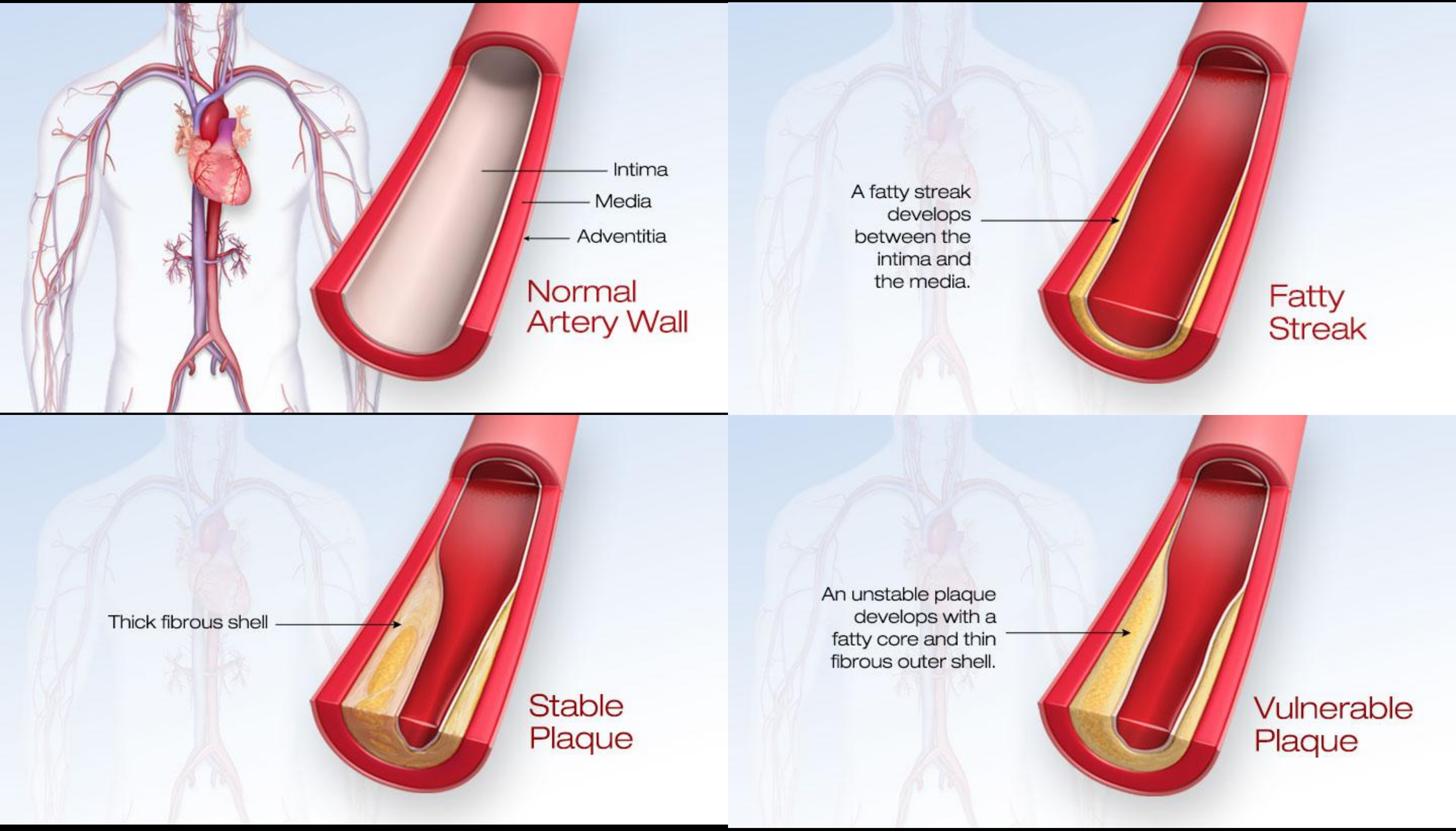
High Volume:

- *Astrand mod*el of 5-10 repeats of 1-3min high intensity work with equal parts active recovery (1:1). Can build to 30 min of high intensity work (athletes)
- *McMaster model* of 10 repeats of 1 min high intensity work followed by 1 min active recovery or 10 min of high intensity work

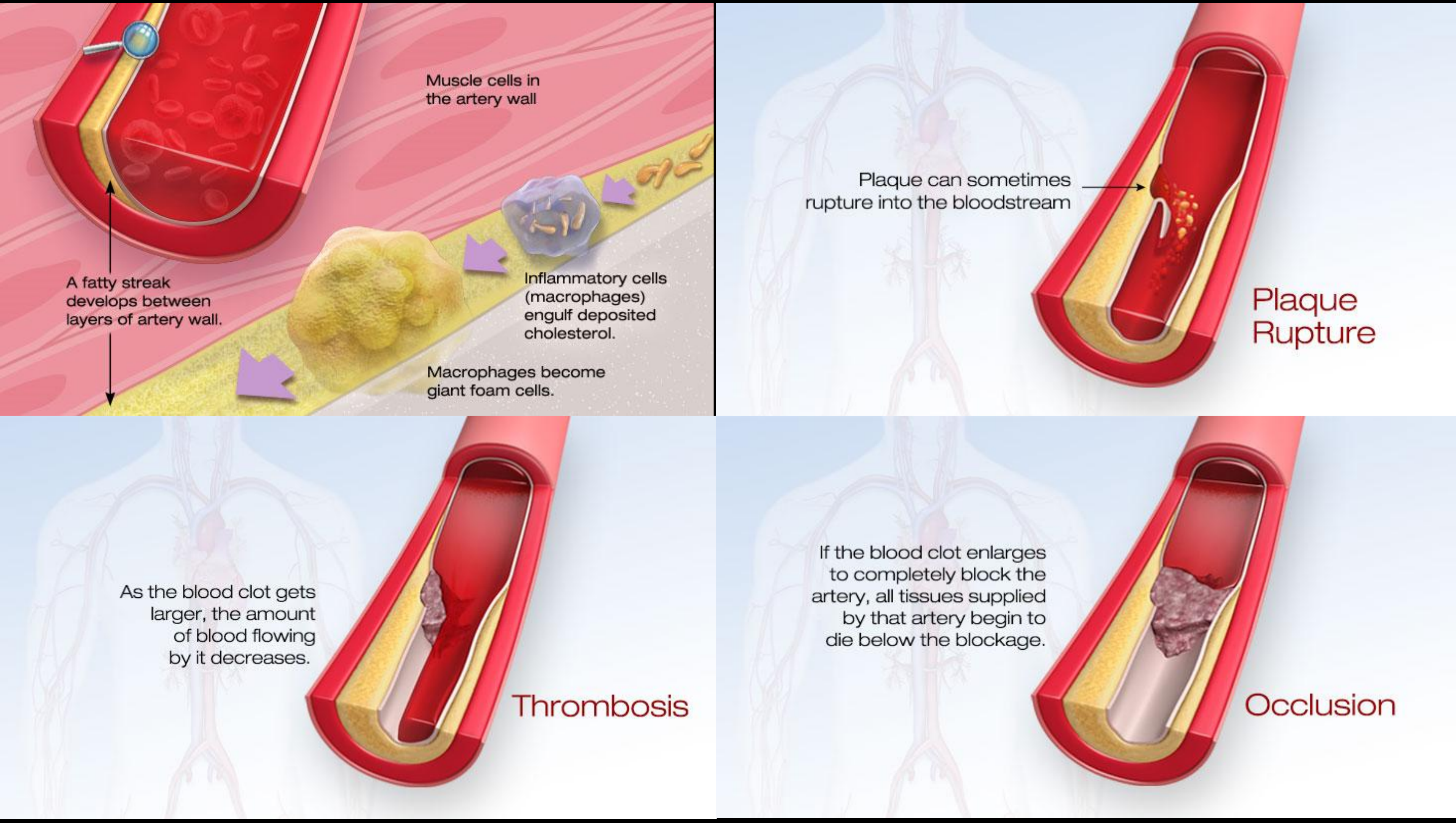
Low Volume:

- *Tabata model* of 8 repeats of 20s high intensity work followed by 10s active recovery.

Inflammation (coronary arteries)



http://watchlearnlive.heart.org/CVML_Player.php?moduleSelect=athero



Inflammation occurs in the vasculature as a response to injury, lipid peroxidation, and perhaps infection. Various risk factors, including hypertension, diabetes, and smoking, are amplified by the harmful effects of oxidized low-density–lipoprotein cholesterol, initiating a chronic inflammatory reaction, the result of which is a vulnerable plaque, prone to rupture and thrombosis.

Inflammation as a Cardiovascular Risk Factor,) James T. Willerson, MD; Paul M. Ridker, MD, MPH

http://circ.ahajournals.org/content/109/21_suppl_1/II-2.full