“The theory and practice of getting fitter and stronger”

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- All the presentations are accessible at:

- https://onlineacademiccommunity.uvic.ca/elderacademy/

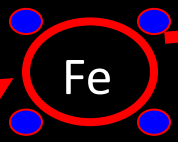
Four part series

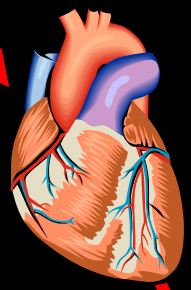
1. ***Developing aerobic (cardiovascular) fitness (March 3rd)***
2. **Developing strength and muscular endurance (March 10th)**
3. **Developing the core or back stability (March 17th)**
4. **Effective warm up and developing flexibility (March 24th)**

Factors affecting aerobic power

Ventilation
VE
VA/Q
Diffusion

Hb
O2 affinity





Q
SV
HR
BP

Continuous vs
Interval training

Metabolism
Substrate delivery
Muscle mass (fibre size & #)
Energy stores
Myoglobin
Mitochondria

Peripheral circulation
Muscle blood flow
Capillary density
Diffusion
O2 extraction

Training to Enhance Aerobic Energy System

Continuous

- ✓ **Maximize load on heart and lungs**
- ✓ **Extend duration > 30 min**
- ✓ **Sub-Threshold**
- ✓ **Maximize blood changes**
- ✓ **Increase utilization of fat**

Interval

- ✓ **Maximize load on metabolic machinery**
- ✓ **Maximize buffering capacity**
- ✓ **Above threshold**
- ✓ **Optimum time is 3 min at VO_2max?**
- ✓ **Total work > ? min**

Original aerobic interval training guidelines.

- 1:1 work to recovery ratios
- 1-3 min work intervals
- Active recovery (60% VO2 max)
- Number of work intervals (6-10)
- Optimal 30-35 min at or close to VO2 max.

Astrand ,Rodahl, Dahl, & Stromme, 2003, Bell and Wenger, 1986

More recent approaches
(high intensity interval training:HIIT)

- What is HITT?
- High intensity efforts with short recovery periods

  10 maximum efforts of 60s work with 60s active recovery (total time=20 min)

  4-6 maximum efforts of 30s work with 4 min active recovery (total time=20-27 min)

  ***8 maximum efforts of 20s work with 10s active recovery (total time=4 min!)**

  3 maximum efforts of 20s work with 2 min active recovery (total time=2 min!)

*McMaster Group, *Tabata group.*

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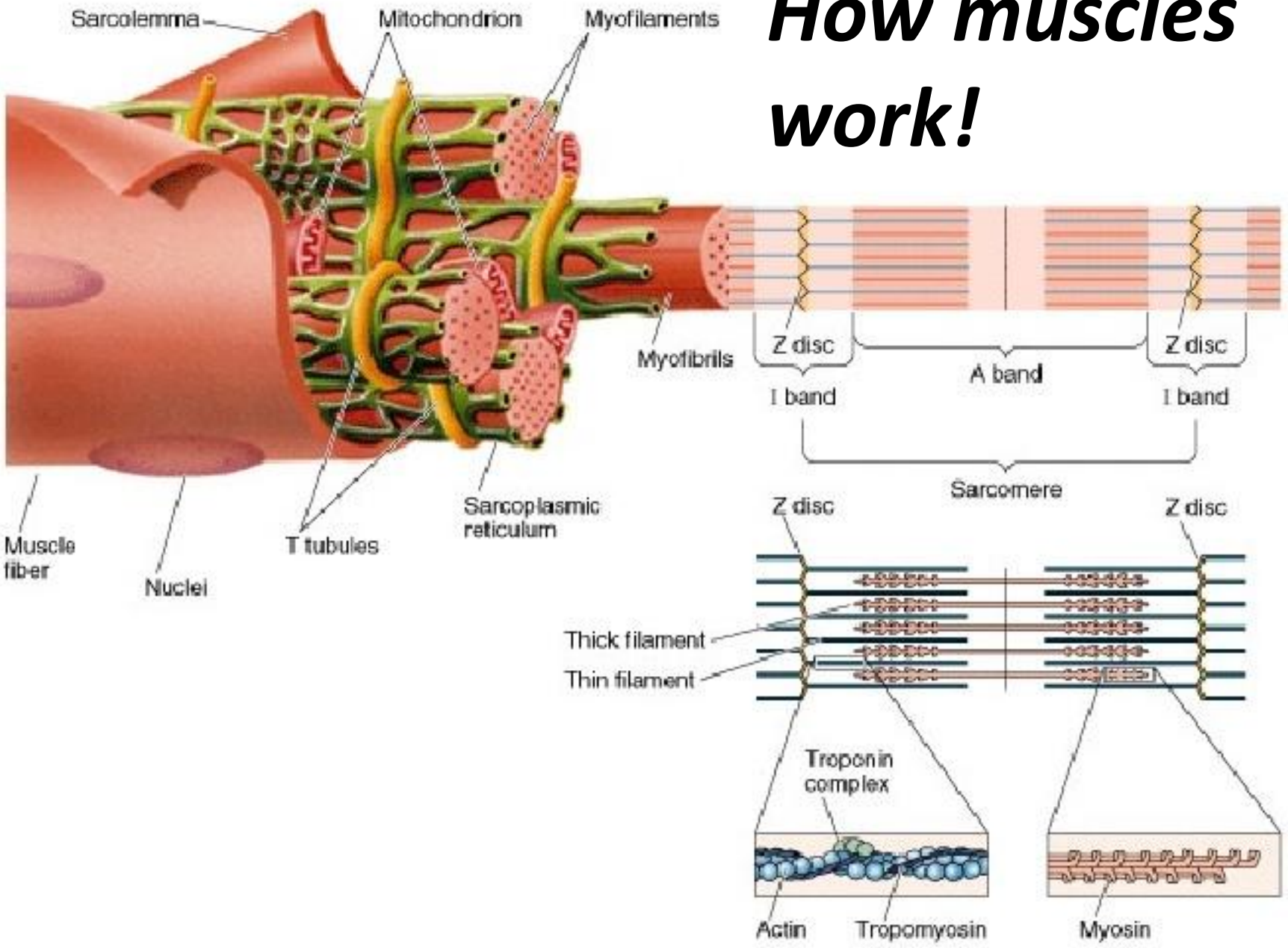
Strength and aging

- 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

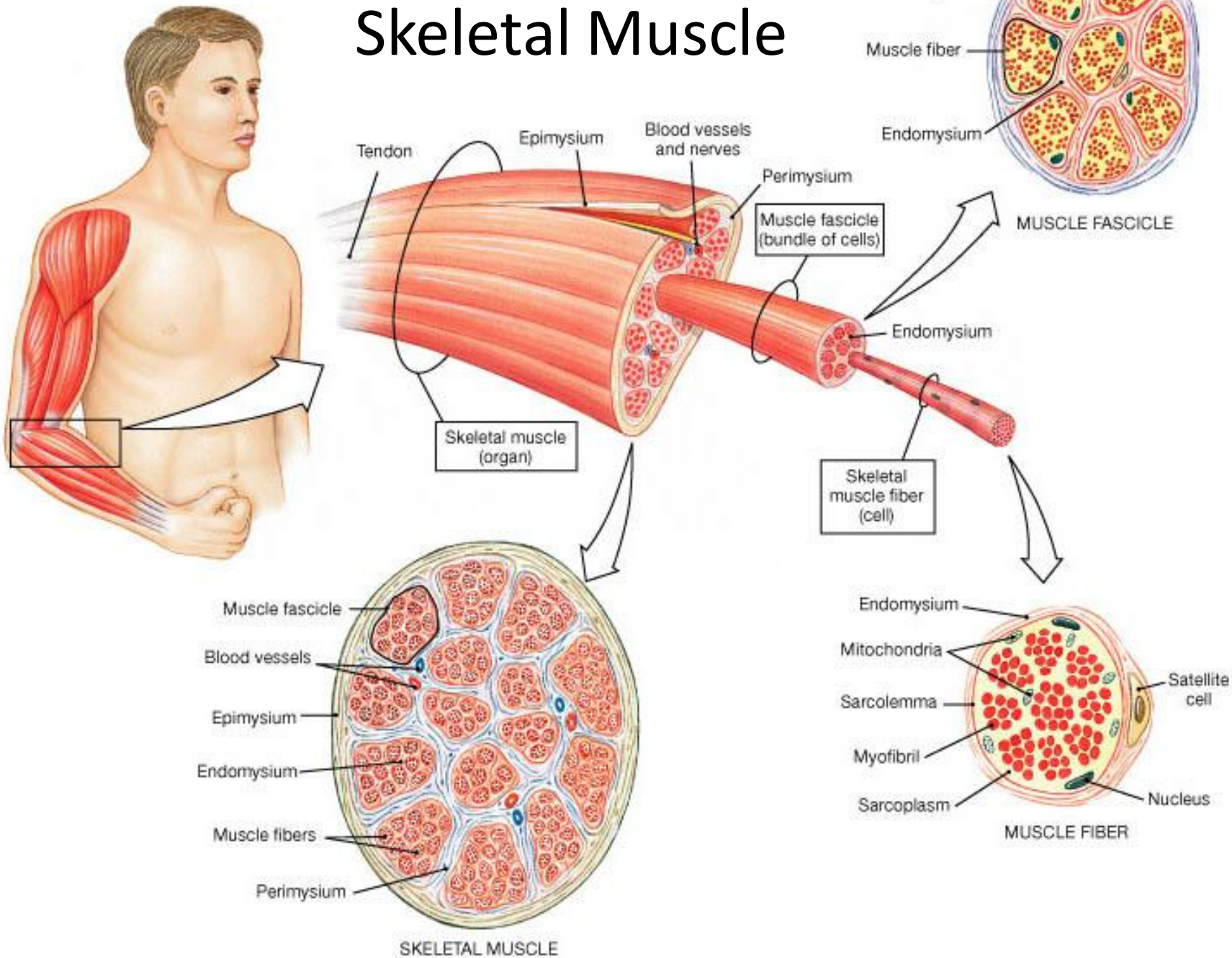
[1] Bickel et al., 2011, Breen et al., 2012, Macaluso & de Vito, 2003

► **Organization of a Muscle Fiber**

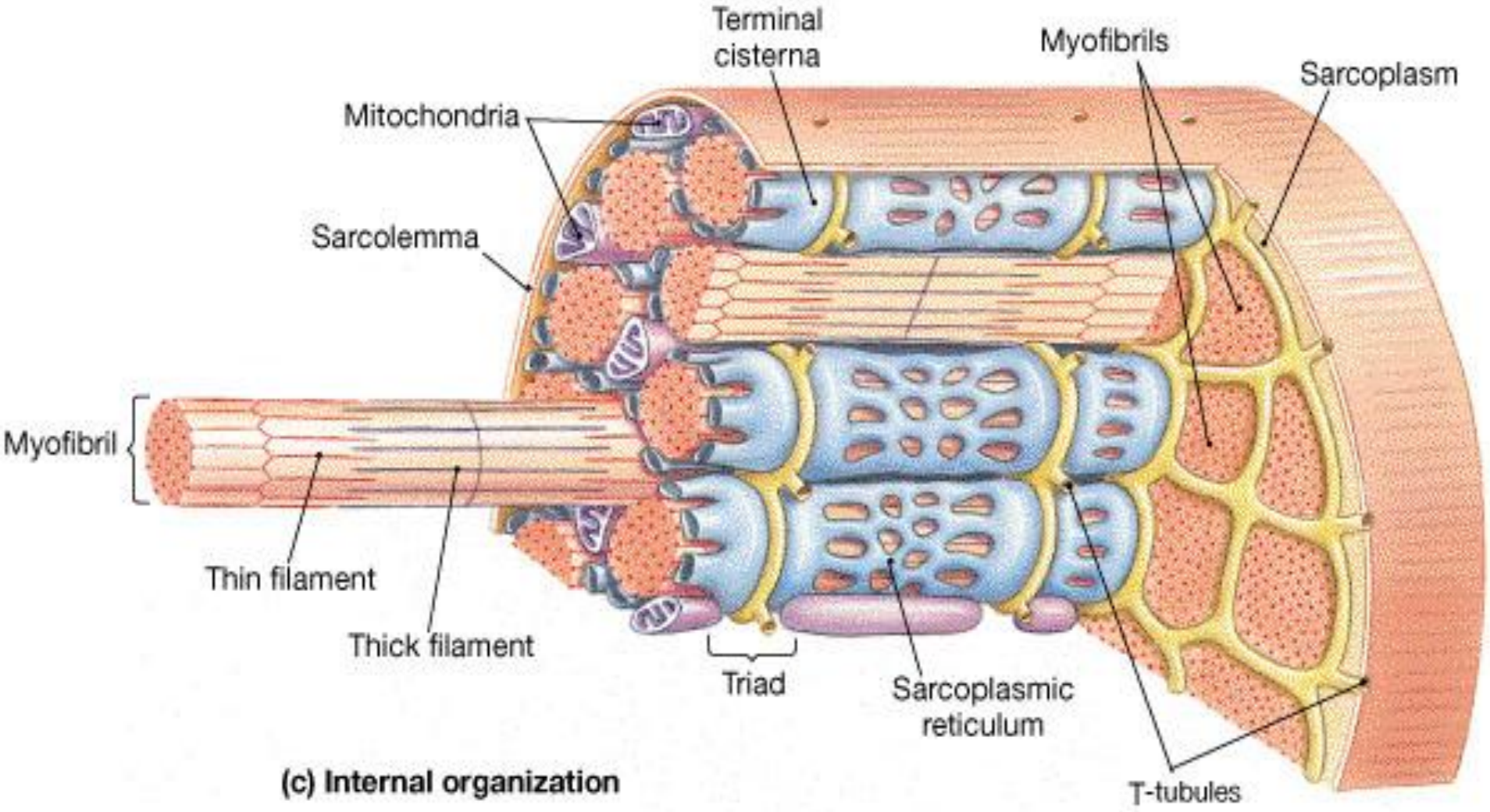
How muscles work!



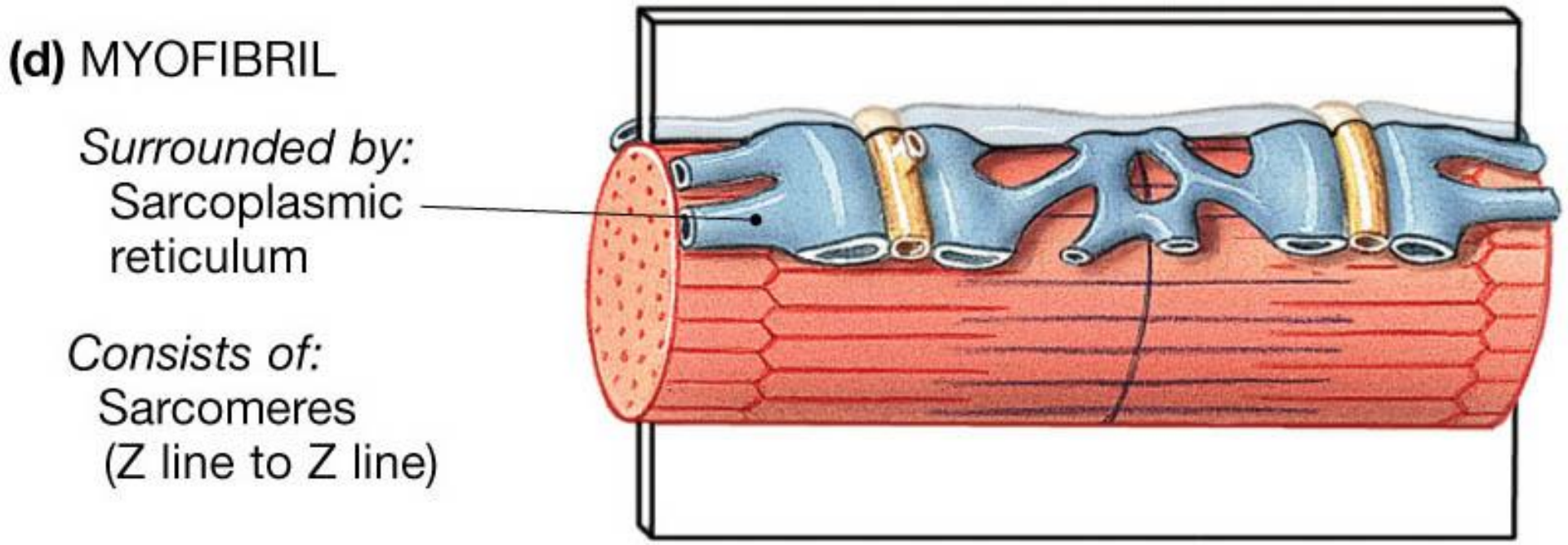
Skeletal Muscle



Cross section of a muscle fibre



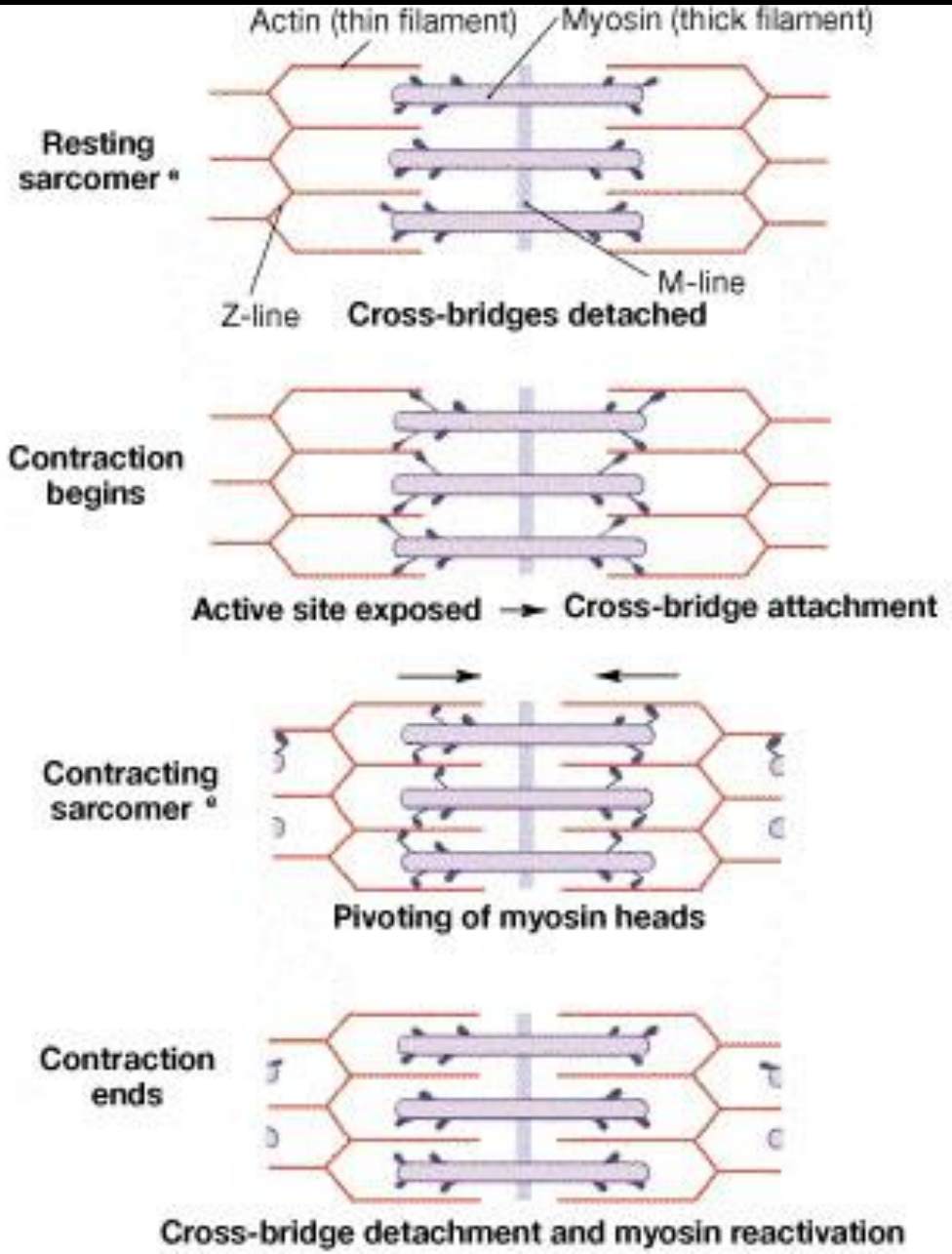
A myofibril


(d) MYOFIBRIL
Surrounded by:
Sarcoplasmic reticulum
Consists of:
Sarcomeres
(Z line to Z line)

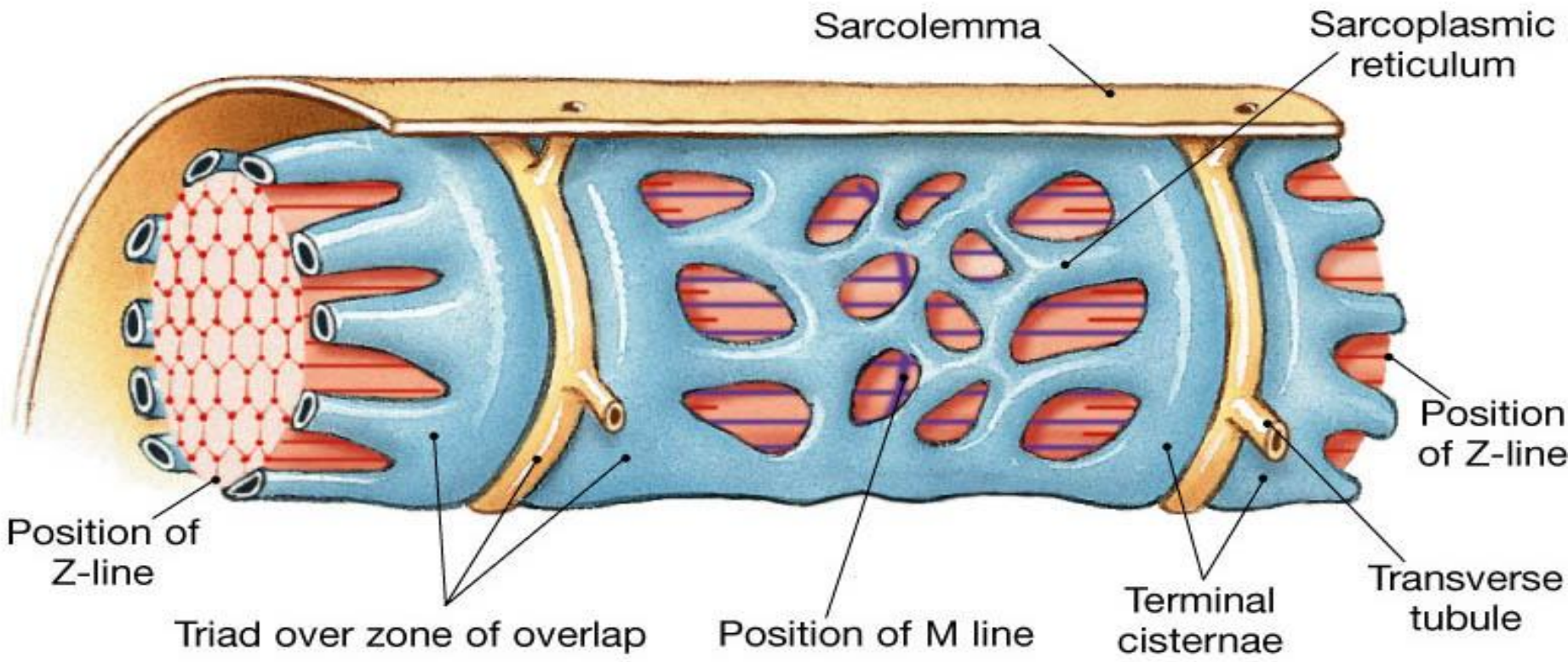
Sliding filament theory

Resting

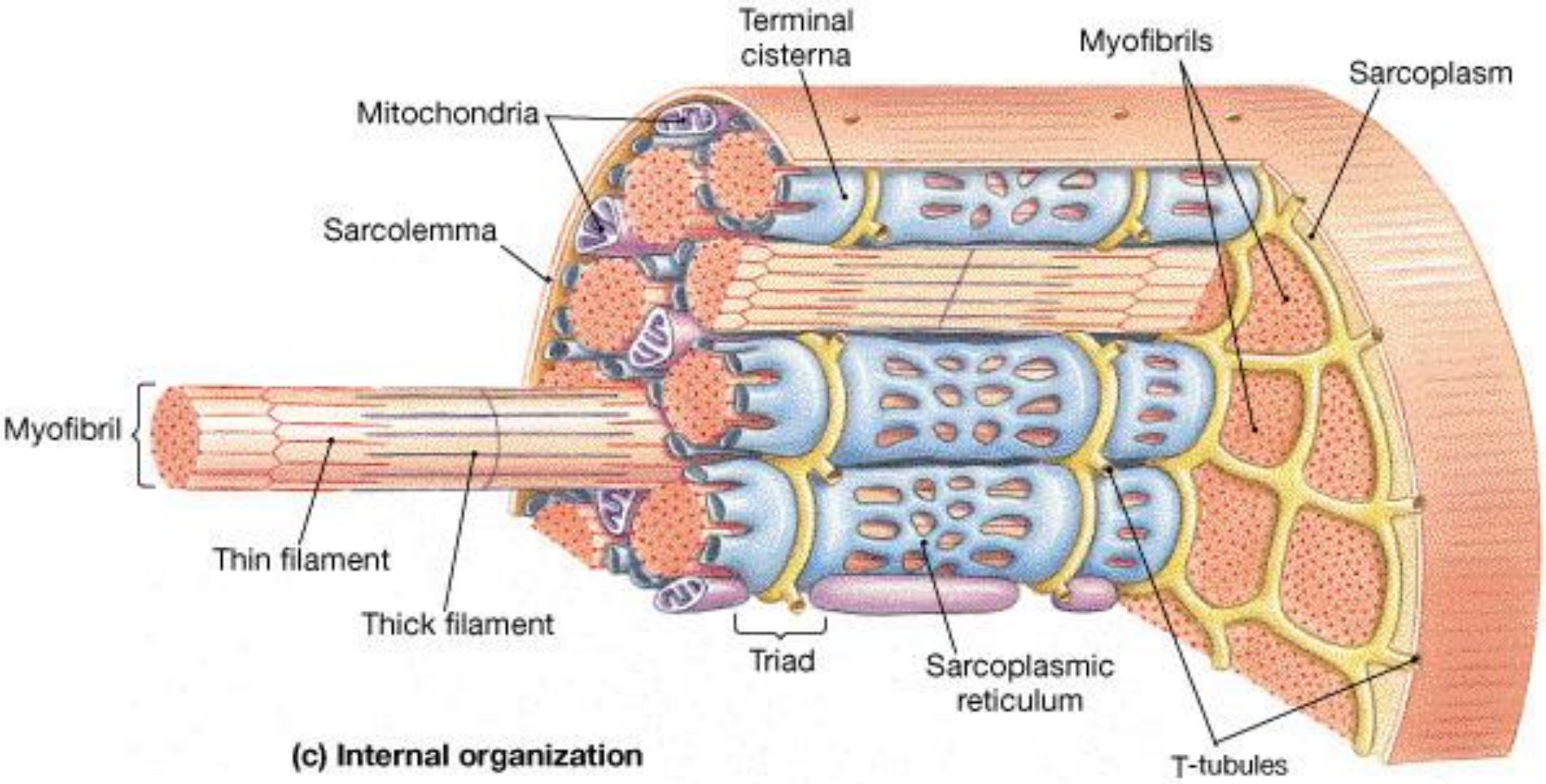
Contraction



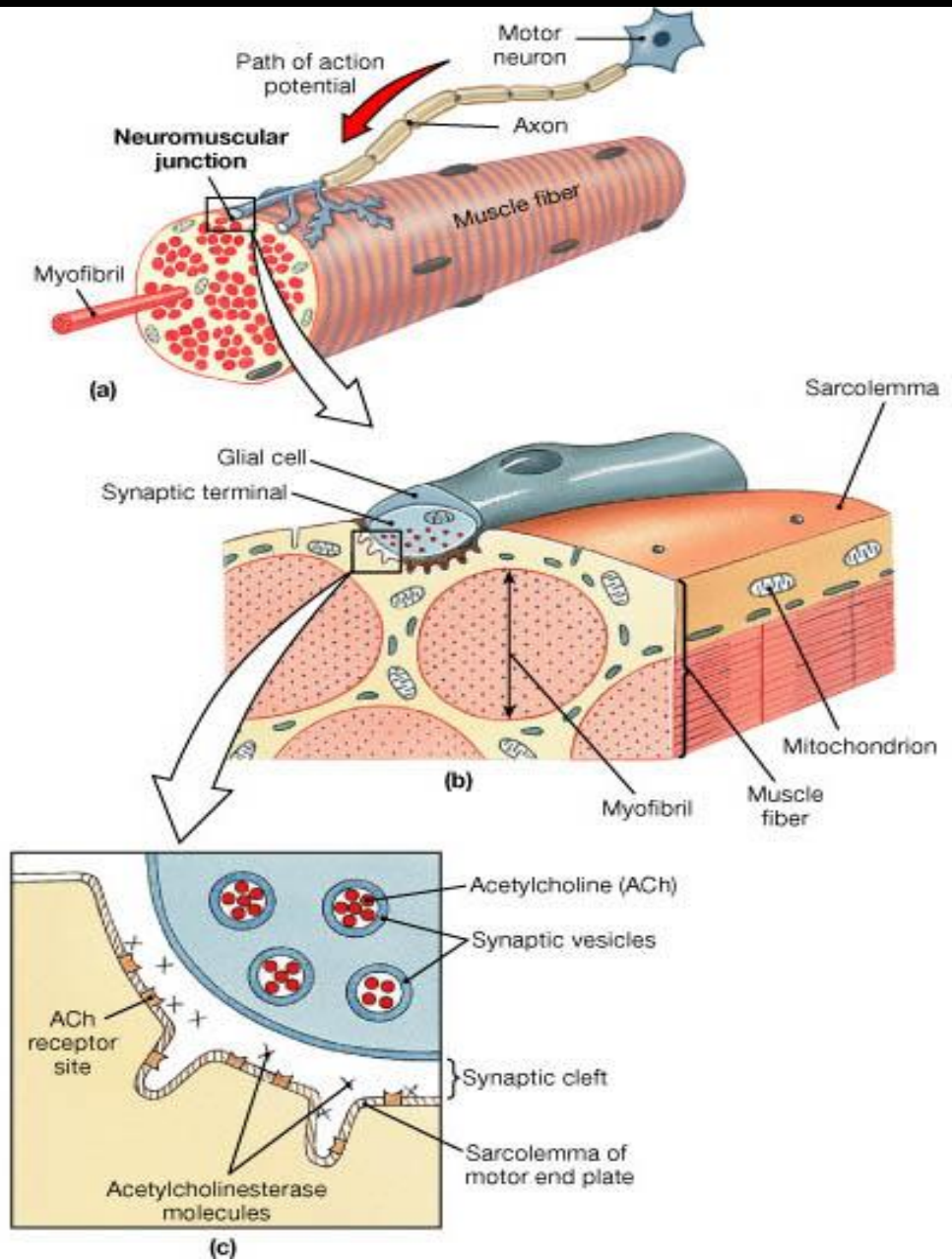
Sarcoplasmic Reticulum &T-Tubules



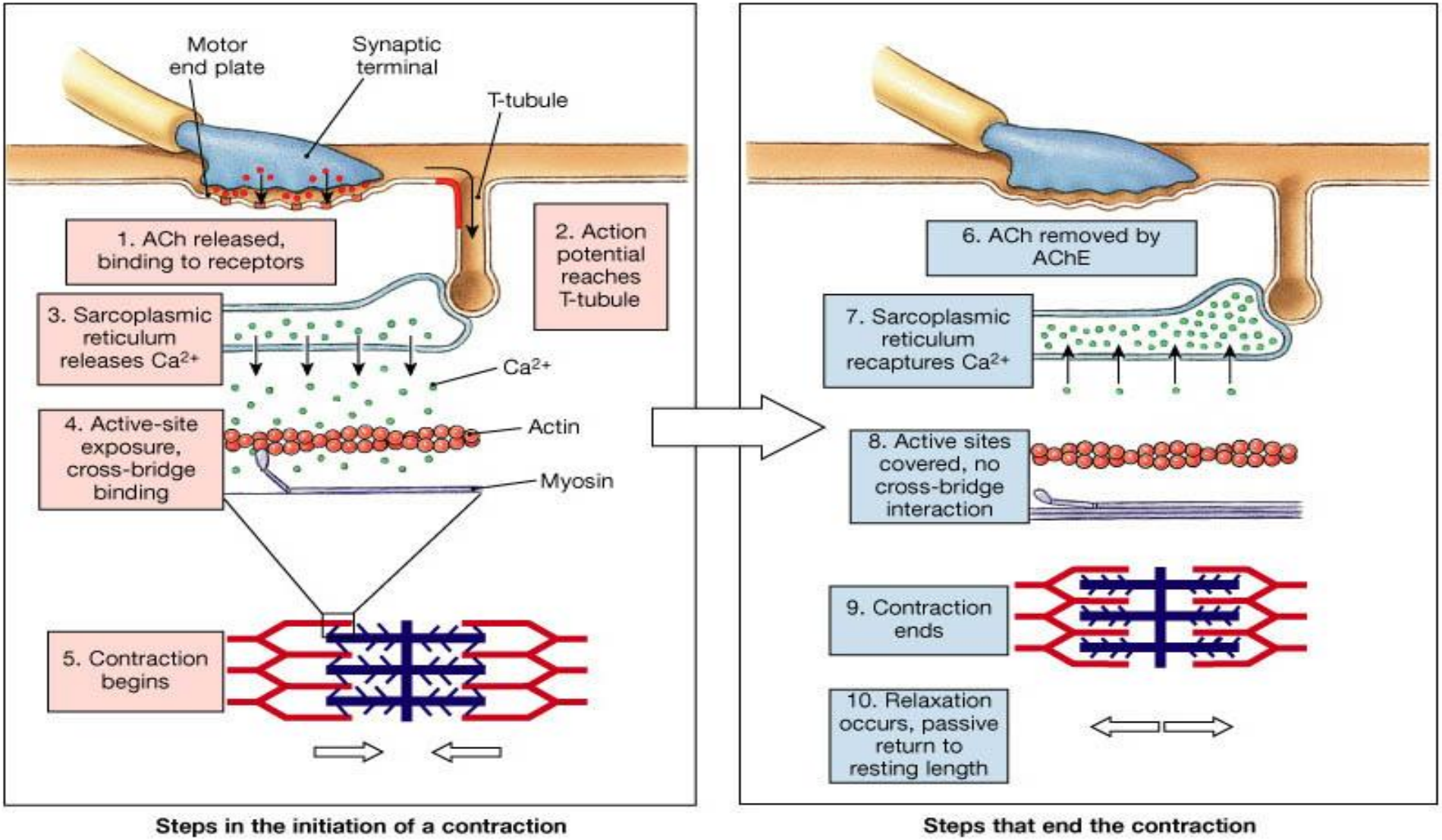
Muscle fiber (internal organization)



Neuromuscular junction



Motor End Plate & Initiating Contraction



Steps in the initiation of a contraction

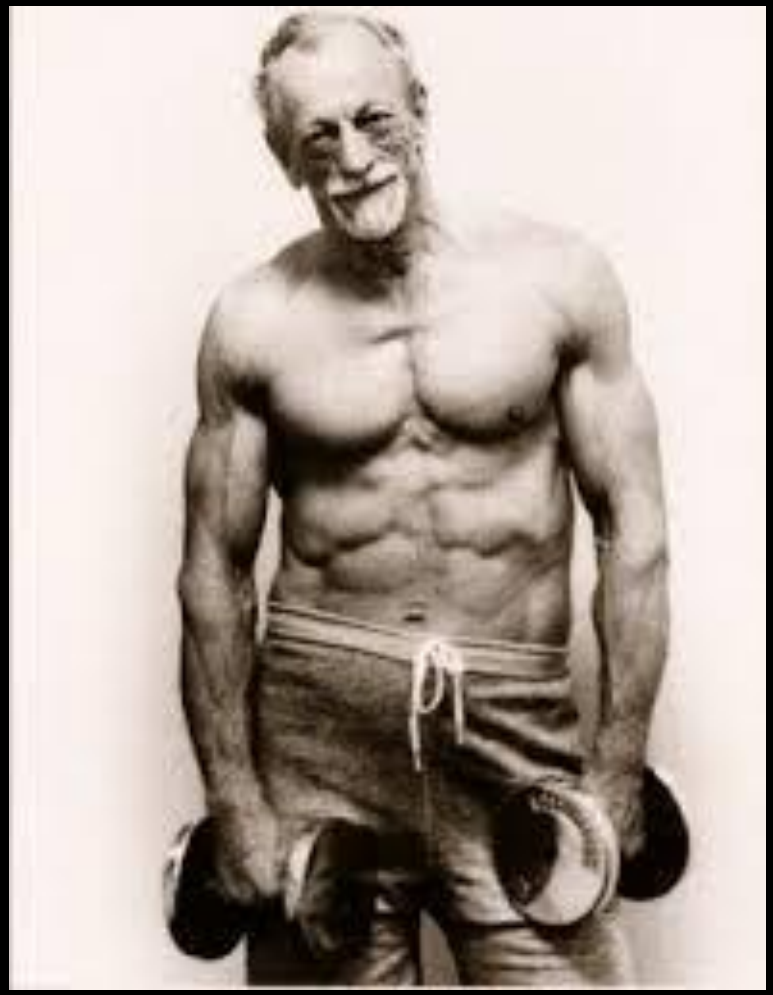
Steps that end the contraction

How muscles contract: "The Sliding Filament Theory"

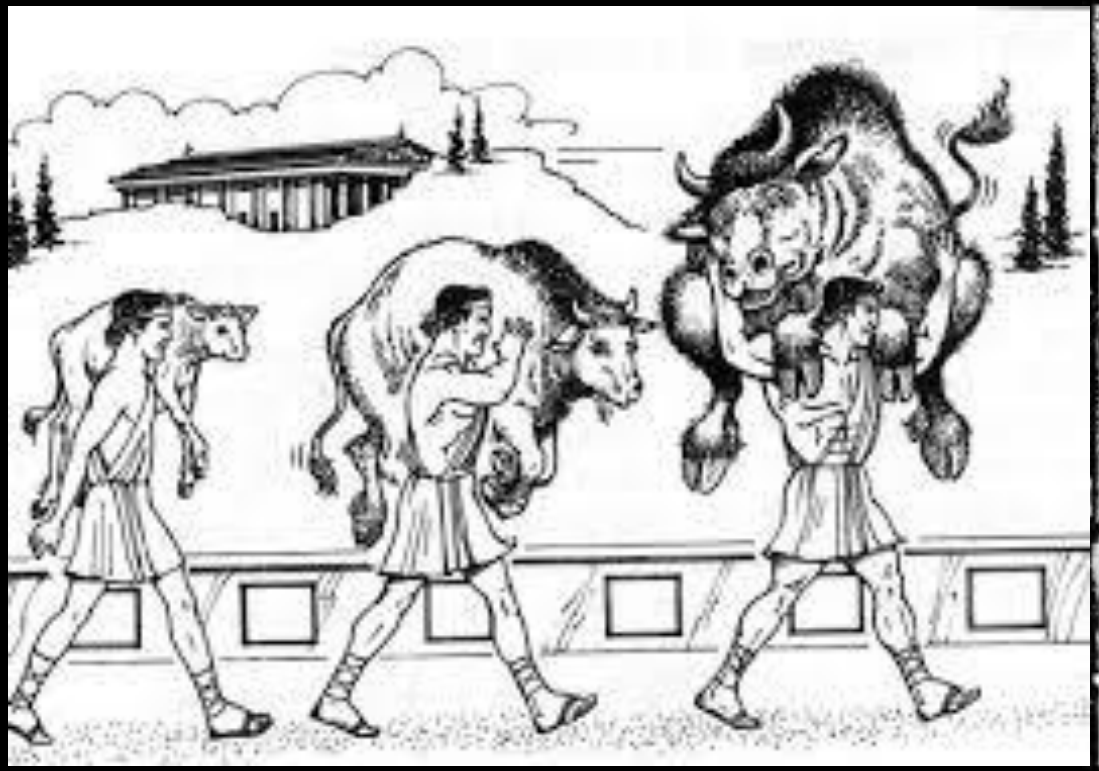
- https://www.youtube.com/watch?v=BVcgO4p88AA
- https://www.youtube.com/watch?v=BVcgO4p88AA
- https://www.youtube.com/watch?v=0kFmbrRJq4w

- "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



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

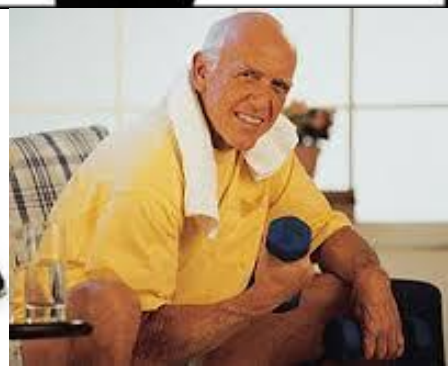


What is resistance training?



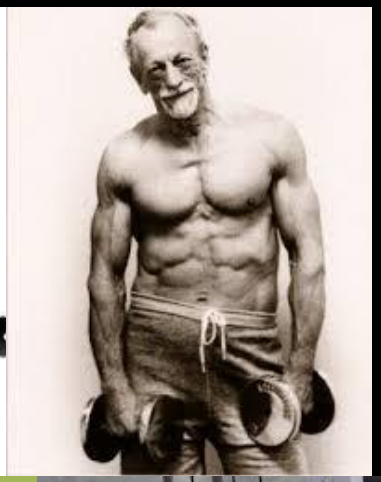




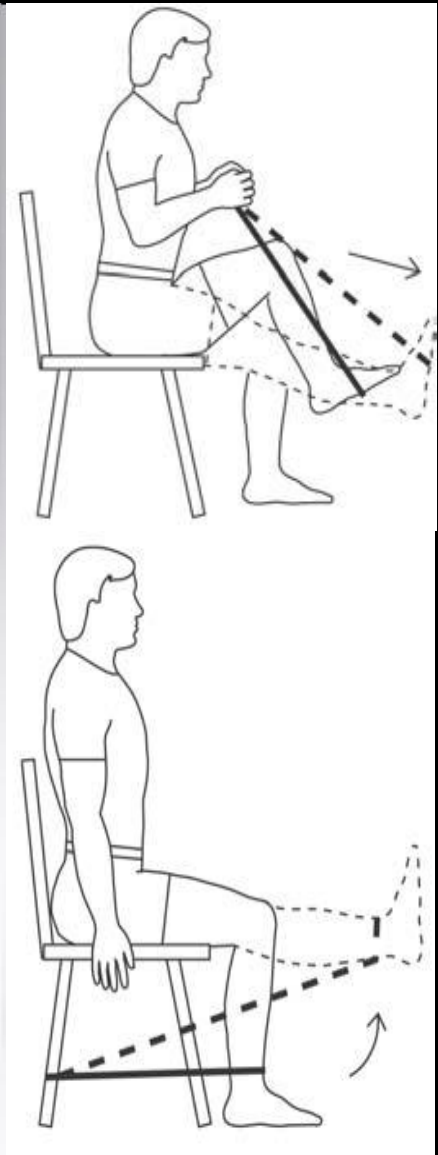
Types of resistance training

- 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.

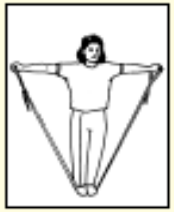
Color_____ Reps_____

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

Color_____ Reps_____

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.

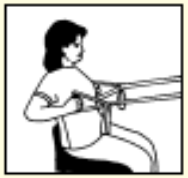
Color_____ Reps_____

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

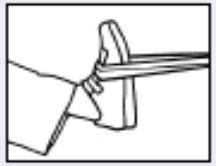
Thera-Band® Lower Body Exercises

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.

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

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_____

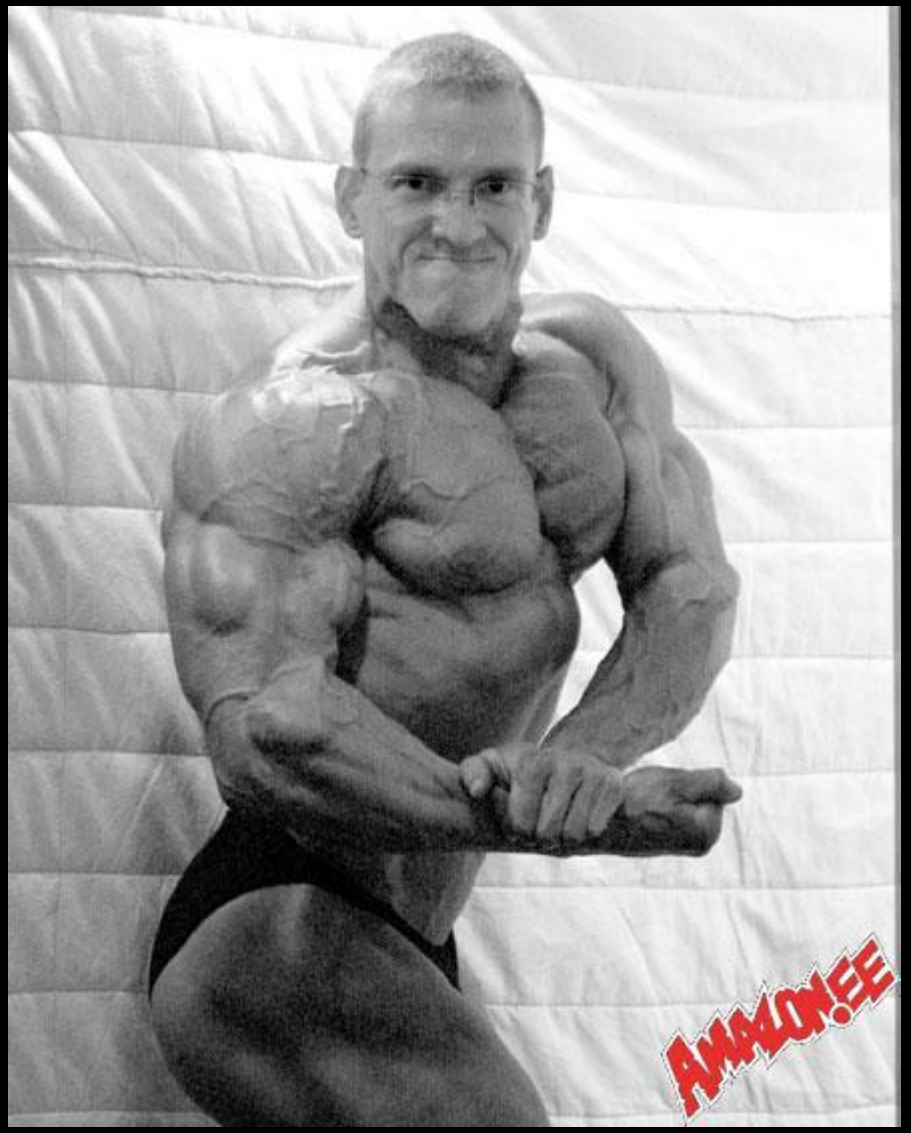
HIP FLEXION: Lift hip upward toward ceiling. Hold & slowly return.

Color_____ Reps_____

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!



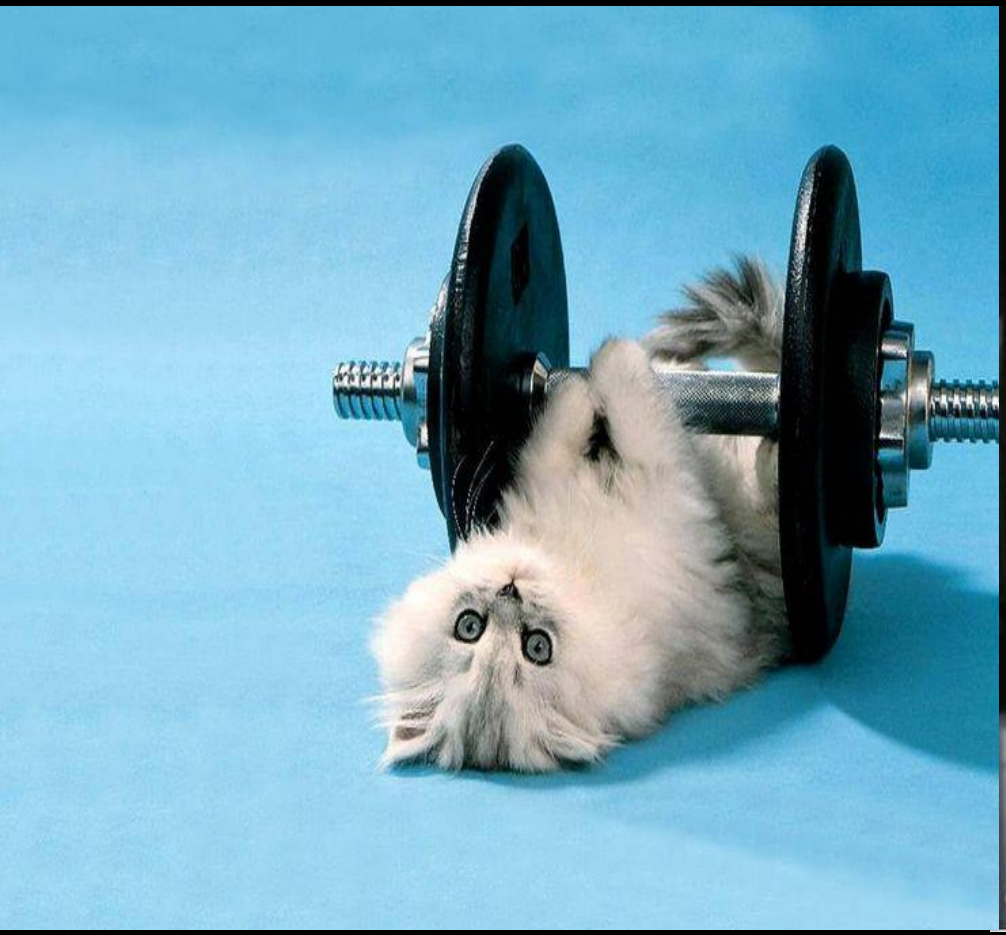
That’s a lot of bull!!!!!

(Belgium Blue)

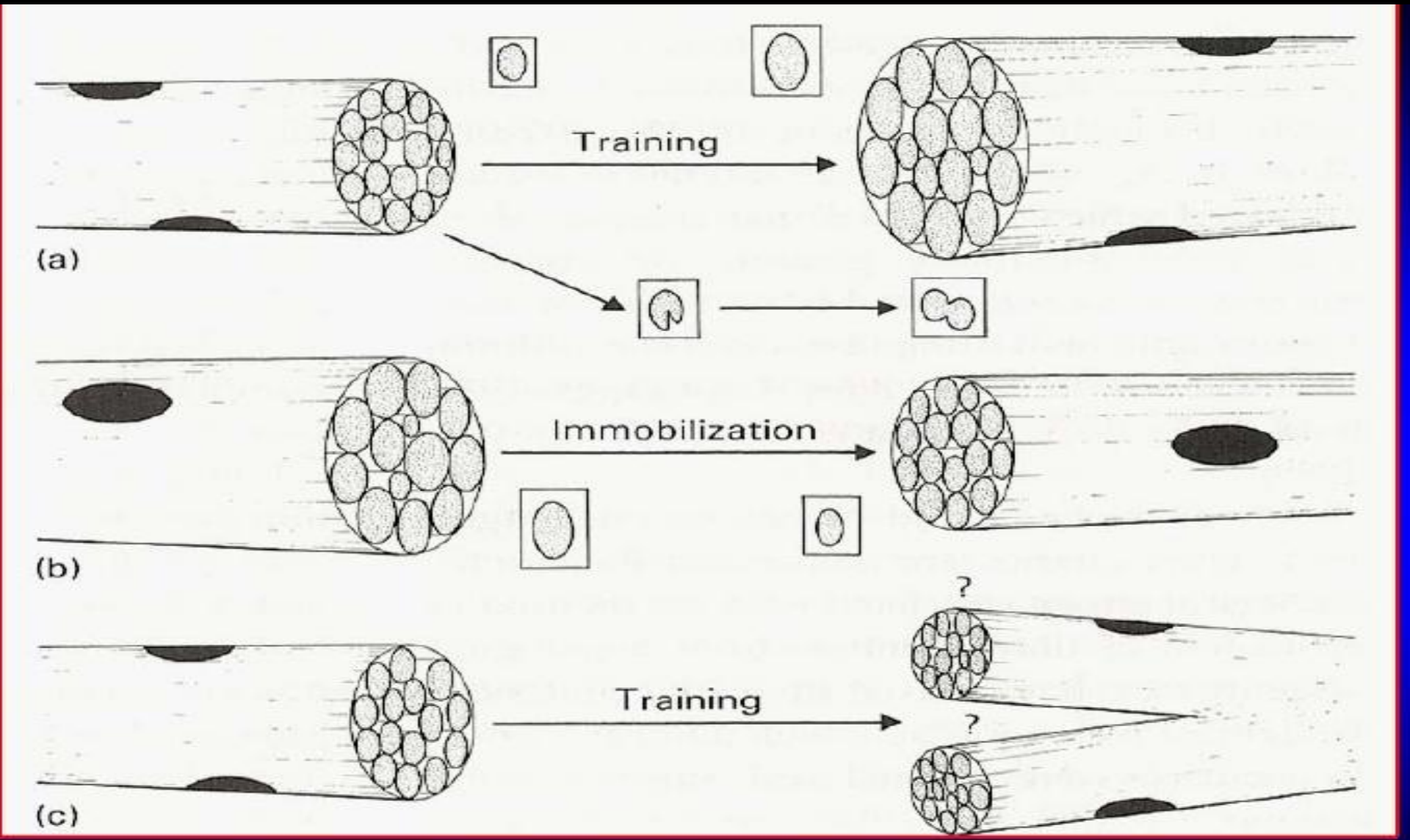
The role of myostatin (inhibitor of muscle growth)


Birth
7 months

Hypertrophy v hyperplasia?



Changes in a muscle fibre size:



Morphological changes with training and detraining

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).

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

Designing strength programs?

Figure 9.3a Muscle-Base Workout Program A

	Week 1	Week 2	Week 3	Week 4
1a. Barbell front squat	2 sets x 6-8 reps	2 sets x 8-10 reps	3 sets x 6-8 reps	3 sets x 12, 10, 8 reps
1b. One-arm free-standing dumbbell row	2 sets x 8-10 reps (each side)	2 sets x 10-12 reps (each side)	3 sets x 8-10 reps (each side)	3 sets x 14, 12, 10 reps (each side)
2a. Dumbbell reverse lunge	2 sets x 6-8 reps	2 sets x 8-10 reps	3 sets x 6-8 reps	3 sets x 12, 10, 8 reps
2b. Chin-up or machine lat pull-down	2 sets x 6-8 reps	2 sets x 8-10 reps	3 sets x 6-8 reps	3 sets x 12, 10, 8 reps
3a. Dumbbell bench step-up (alternate legs)	2 sets x 6-8 reps (each side)	2 sets x 8-10 reps (each side)	3 sets x 6-8 reps (each side)	3 sets x 12, 10, 8 reps (each side)
3b. Dumbbell plank row	2 sets x 6-8 reps	2 sets x 8-10 reps	3 sets x 6-8 reps	3 sets x 12, 10, 8 reps
4a. Barbell calf raise	2 sets x 8-10 reps	2 sets x 10-12 reps	3 sets x 8-10 reps	3 sets x 15, 12, 10 reps
4b. Dumbbell biceps curl	2 sets x 6-8 reps (each side)	2 sets x 8-10 reps (each side)	3 sets x 6-8 reps (each side)	3 sets x 12, 10, 8 reps (each side)
5a. Ball roll-out	2 sets x 10-12 reps	2 sets x 12-14 reps	3 sets x 10-12 reps	3 sets x 12-14 reps
5b. Stability-ball knee tuck	2 sets x 8-10 reps	2 sets x 10-12 reps	3 sets x 8-10 reps	3 sets x 10-12 reps

Human Kinetics

Training variables and terminology

- Load (intensity): repetition maximum ?
- 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)

- 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.

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?

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

(e.g. NSCA, ACSM)

Training parameters to increase muscle size *hypertrophy*

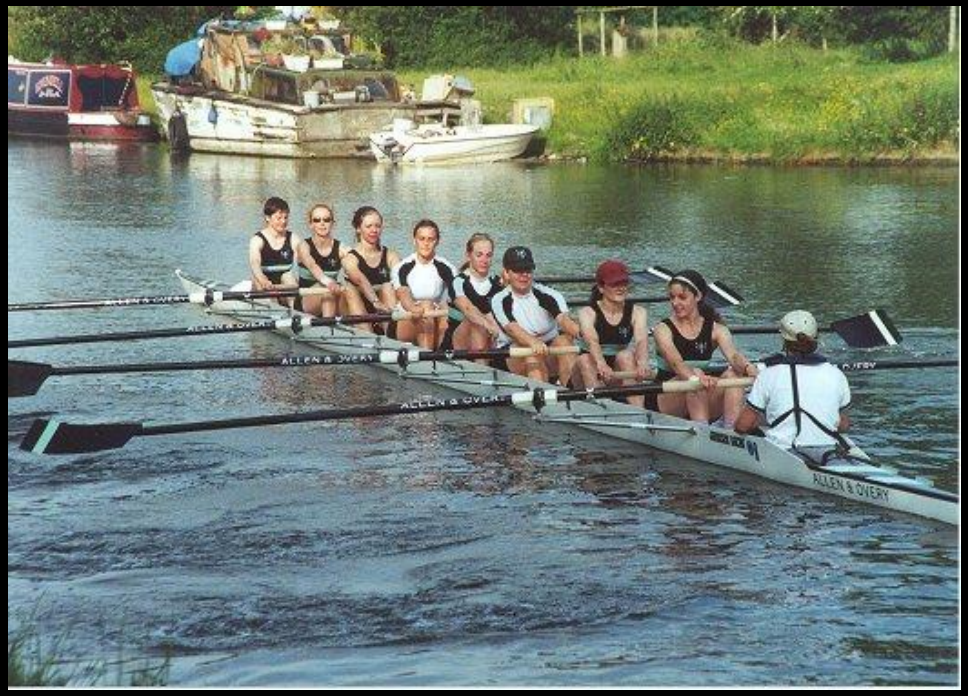
- Repetitions between 8-12 RM (65-80%1RM)
- Sets in the range of 8-12 per muscle group
- Rest between sets of 30s-2.5 min
- Muscle actions in the slow tempo range
- 2-4 exercises per muscle group (could be up to 144 reps per muscle group in one session) and could be unilateral, single joint
- Usually each muscle group is worked twice per week
- Need for eccentric component

Training parameters to increase strength without size

- Repetitions in the range of 3-5 RM (loads in the range of 80-95 % 1RM)
- Reduced volume (3-6 sets)
- Rest between sets 3-5 mins
- Tempo reasonably quick, especially the concentric action
- Multiple joint exercises

Training parameters to increase muscular power

- Traditional weight training with heavy loads (80-90% 1RM with ‘think fast”)
- Plyometric training
- Dynamic weight training (light loads @ 30-50% 1RM)
- Ballistic resistance training (light loads @ 30% 1RM)
- Complex training



Traditional weight training

- Rationale:
  - To train the fast twitch motor units, which are used predominantly in dynamic performance, heavy loads must be used
    - Load (80-90% 1RM)
    - Repetitions 4-8
    - Sets 3-6
    - Tempo (think fast especially the concentric action)

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!

The good news/bad news

- Bad news
  - We do not have definitive information in prescribing training programs for high performance athletes
- Good news
  - There are many questions remaining to be answered (for grad students and faculty)
  - There seems to be several ways in which strength, size, power, and speed can be enhanced

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

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

If it sounds too good to be true..

In fact, the preponderance of resistance-training studies suggest that simple, low-volume, time-efficient, resistance training is just as effective for increasing muscular strength, hypertrophy, power, and endurance—regardless of training experience—as are the complex, high-volume, time-consuming protocols that are recommended in the Position Stand.

Carpinelli, Otto and Winnett, 2007

Evidence-based resistance training recommendations

Variables:

- Intensity
- Load and repetition
- Resistance mode/type
- Repetition duration
- Volume and frequency

Recommendations:

- Persons should train to momentary muscular failure
- Weight >80% 1RM and perform repetitions to failure (8-12 reps)
- Use either free or stacked weights
- Maintain steady force
- 1 set is adequate; 1X or 2 X per week

From: Fisher et al., 2011

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 muscle failure (i.e. need to feel tired by the last repetition)

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)

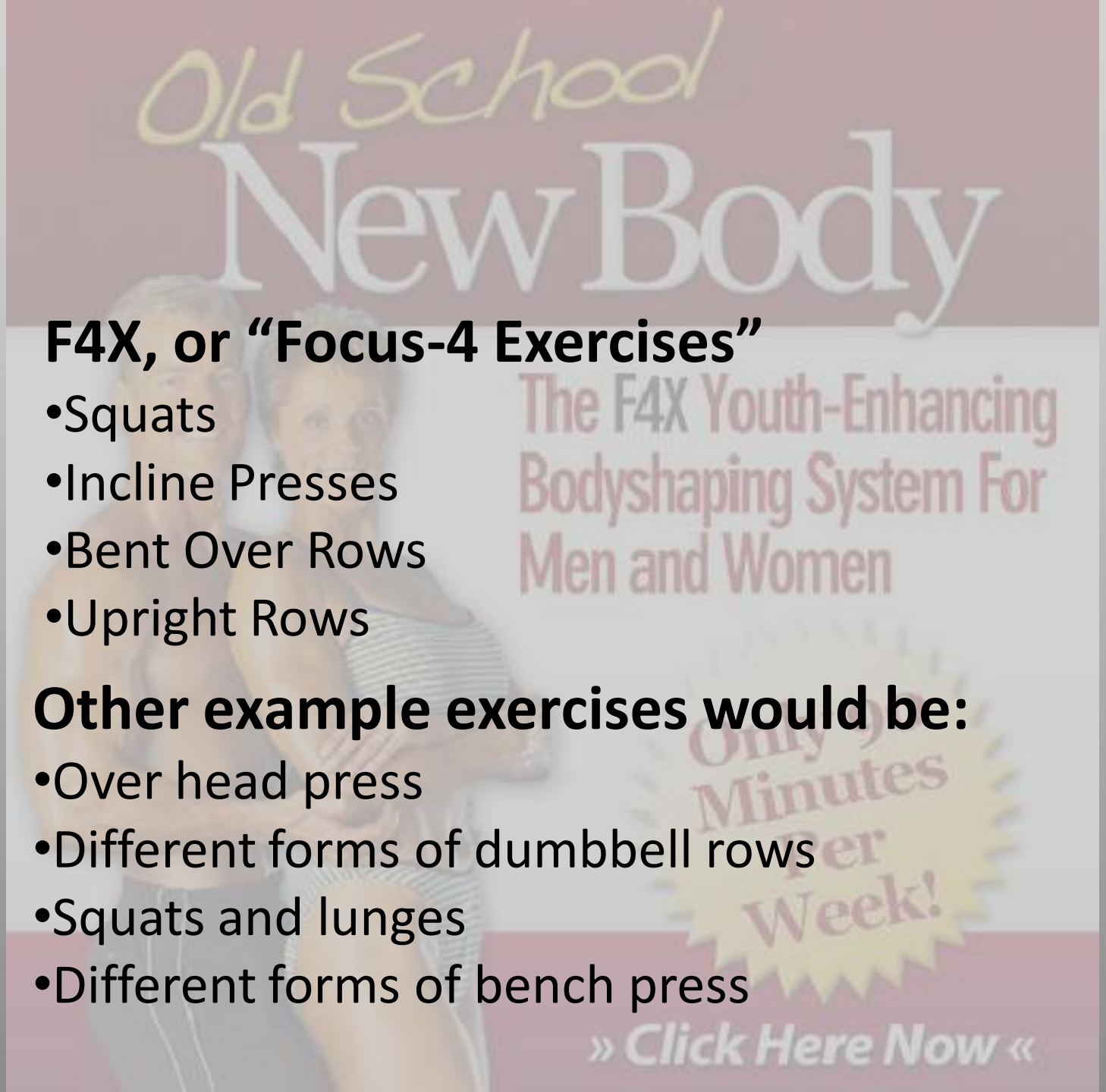
- C. An exercise for chest (bench press or push up)
- D. An exercise for back (e.g. lat pull downs, arm pulls, or seated row)

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.***



F4X, or "Focus-4 Exercises"

- Squats
- Incline Presses
- Bent Over Rows
- Upright Rows

Other example exercises would be:

- Over head press
- Different forms of dumbbell rows
- Squats and lunges
- Different forms of bench press

The F4X Method

Set 1: Pick a weight with which you can get 15 repetitions, but only do 10 (this set will not be taxing).

- Rest 30 to 40 seconds.

Set 2: Do 10 more repetitions with the same weight.

- Rest 30 to 40 seconds.

Set 3: Do 10 more repetitions with the same weight.

- Rest 30 to 40 seconds.

Set 4: Do as many repetitions as you can—until you can't do another.

If you get 10 reps on your last set, slightly increase the weight at your next workout—or go for 11 reps on each set, denoted as 4 x 11.

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

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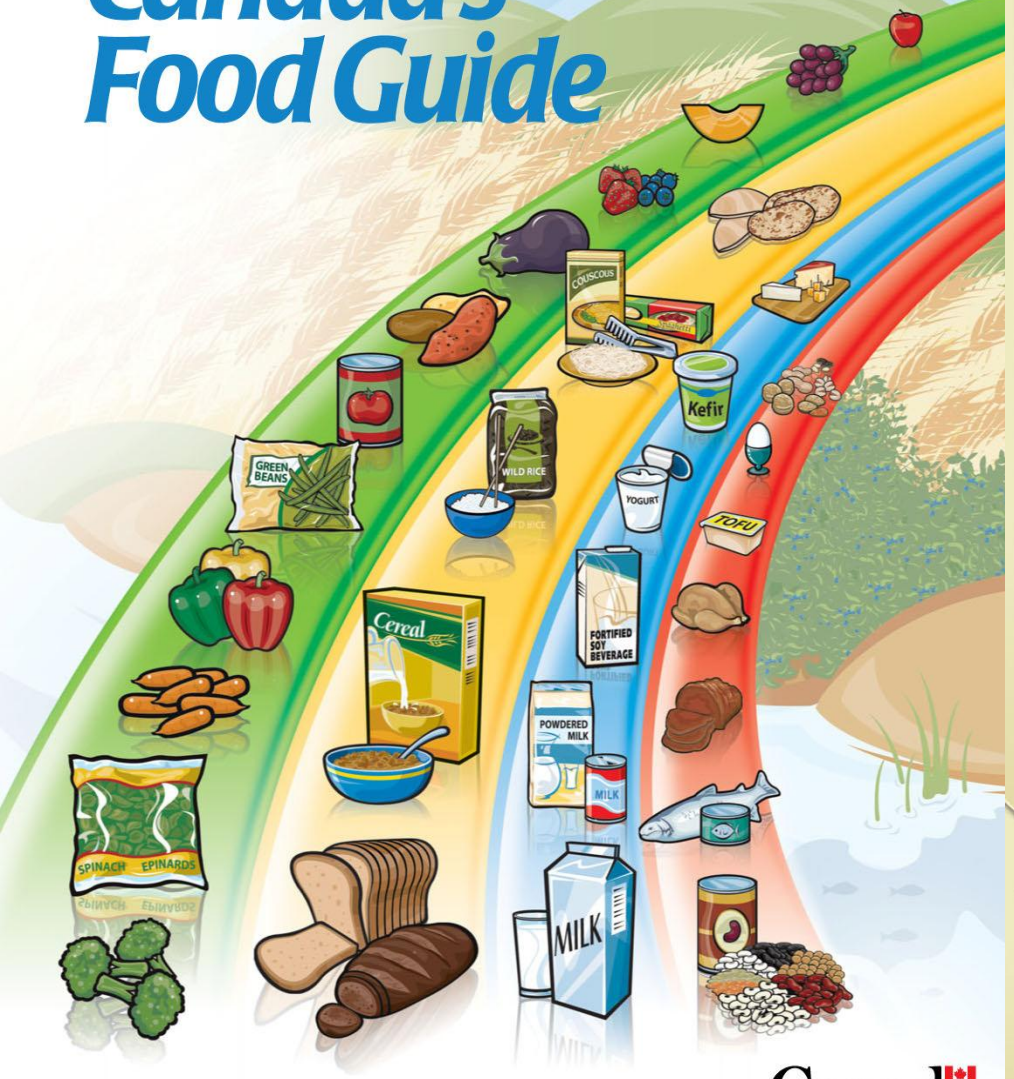
Eating Well with

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.

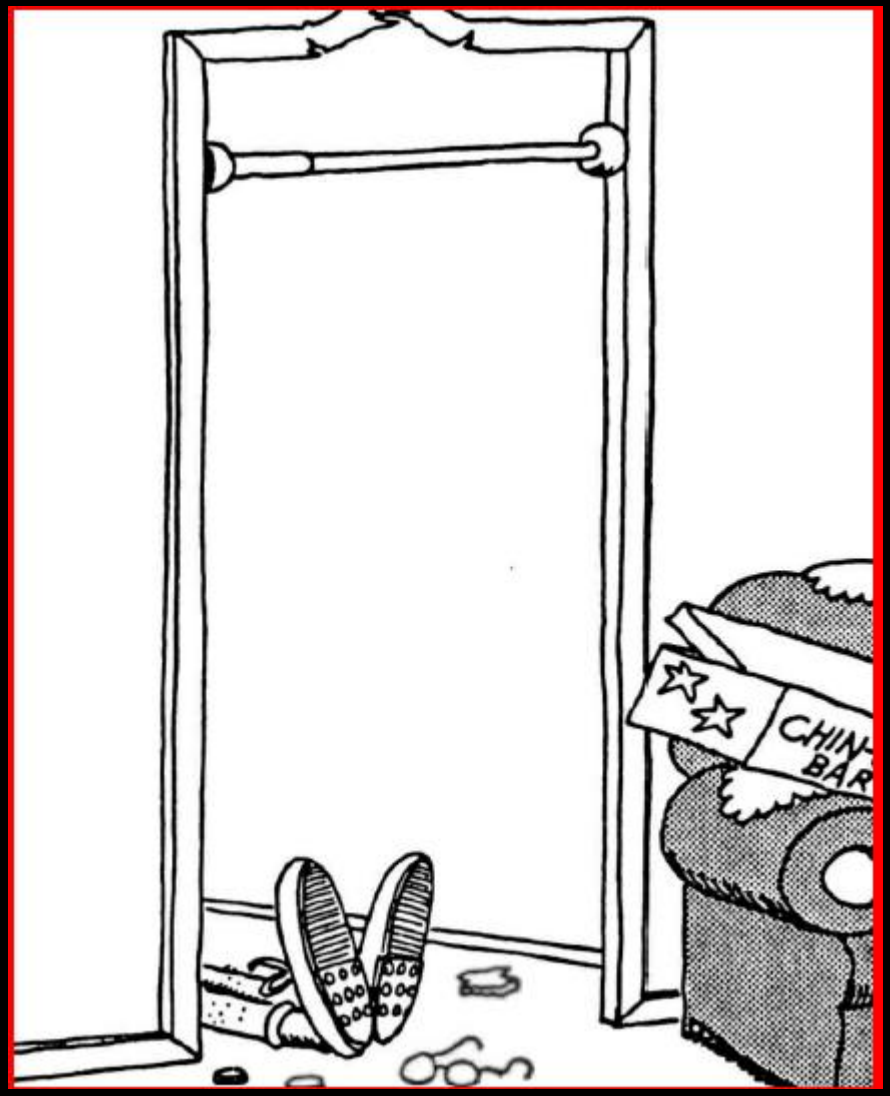
Having the amount and type of food recommended and following the tips in *Canada's Food Guide* will help:

- 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?

Plyometrics

- Rationale:
  - Plyometrics are considered to bridge the gap between strength and power. Plyometric training enhances the stretch shortening cycle and can replicate sport performance
    - Loads typically body weight (can add weight e.g. weighted vests, ankle weights etc.)
    - Repetitions 8-12 (until speed is compromised)
    - Sets 3-5
    - Tempo (as fast as possible with minimum contact/amortization time)

Dynamic weight training

- Rationale
  - Power requires neuromuscular coordination so movement should approximate sport performance. The lifting of relatively light loads produces the highest mechanical power output
    - Loads (30-50% 1RM)
    - Repetitions 15-18
    - Sets 3-4
    - Tempo (as fast as possible)

Ballistic resistance training

- Rationale
  - The 30% 1RM load produces the optimal load to generate mechanical power. Special system allows the weight (and body) to be released at the end range of the exercise so the limb(s) continues to accelerate through the full ROM
    - Loads 30% 1RM
    - Repetitions 6-10
    - Sets 3-6
    - Tempo (as fast as possible)

Complex training: has usually involved performing a weight training exercise with a plyometric or explosive exercise

Complex training:

- Rationale
  - High load weight training increases motor unit excitability and reflex potentiation (PAP) which may create the optimal training conditions for subsequent plyometric training
    - Loads (weight training @ 80-90% 1RM; plyometrics body weight)
    - Repetitions (weight training 2-8 reps; plyometrics 5-15)
    - Sets (weight training 2-5; plyometrics 2-5)
    - Recovery: the plyometrics should be performed within 30 secs after weight training exercise. Rest between complex pairs should be 2-10 mins.

Points to consider:

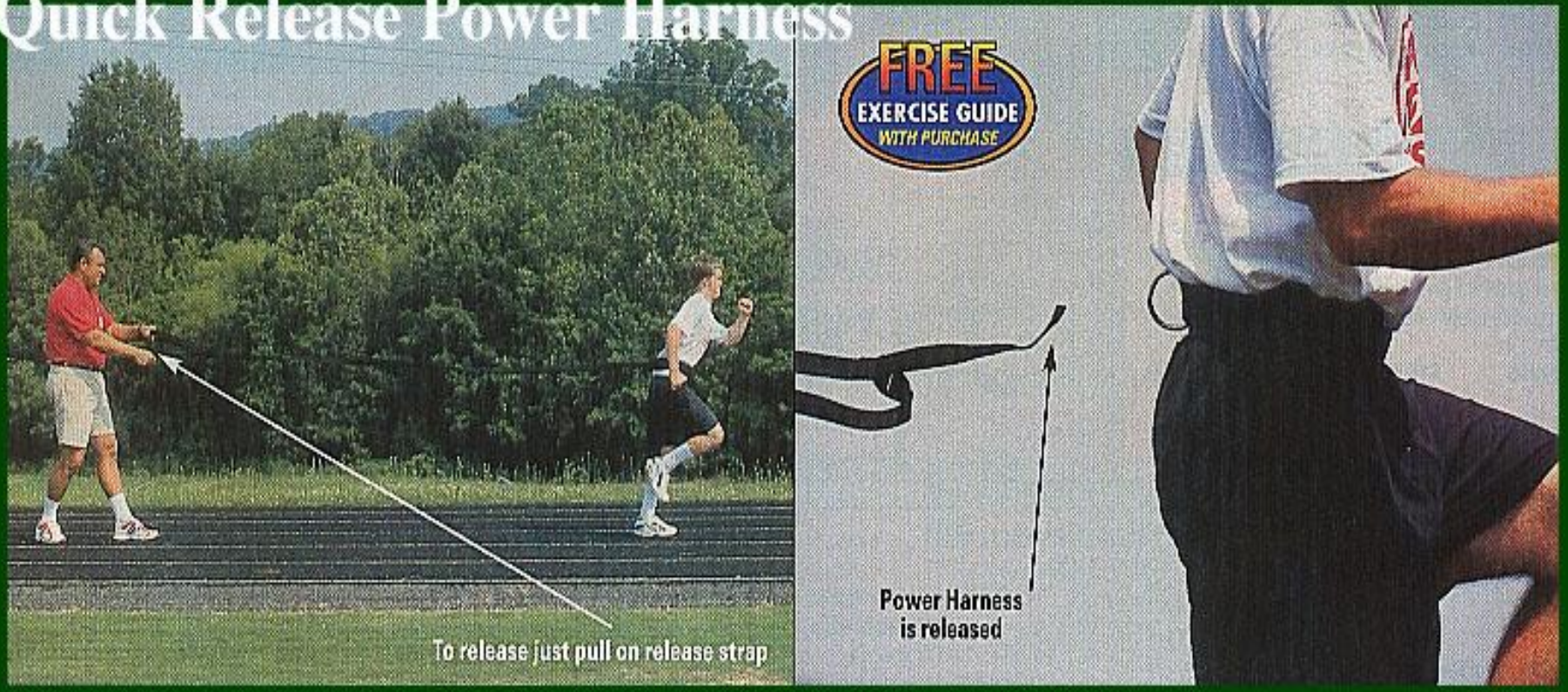
- The concept of PAP has been proposed to increase performance and provide an enhanced training effect through “Complex” training protocols
- All studies to date have looked at acute responses and inferred chronic adaptation or training effect.
- To date there has not been one chronic/training study to demonstrate the efficacy of “Complex training”
- Limited support has been provided by research that has used contrast training protocols but not in the same training session and not as paired exercises as described for “Complex training”

Training to improve speed

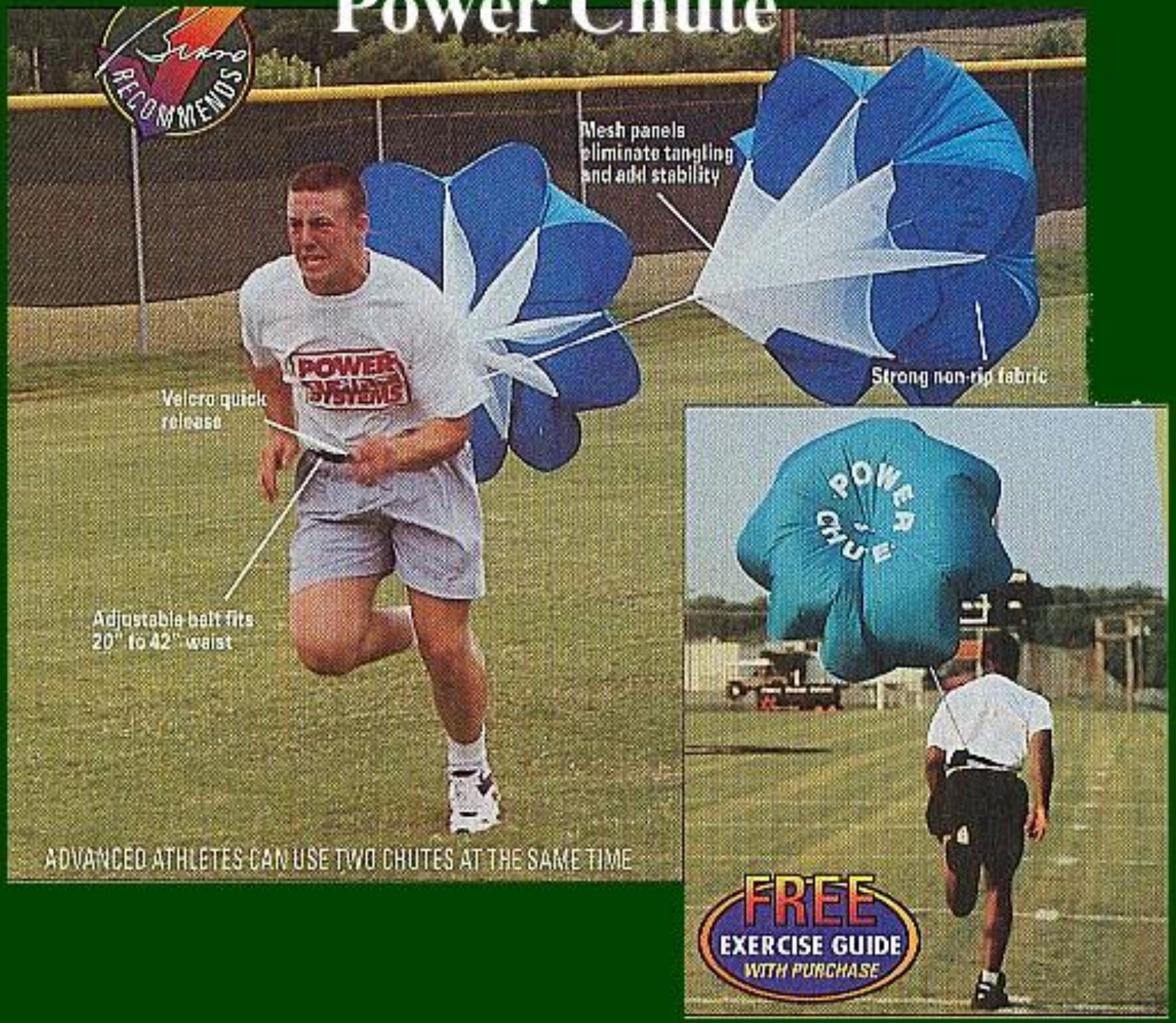
- Foot speed drills (including ladder work)
- Sprint training (A's, B's and C's)
- Downhill "overspeed" training, stretched tubing
- Resistance drills (power harness with partner resistance, ,tubing, partners, power sleds, power chutes etc.)

Power Sled with Shoulder Harness

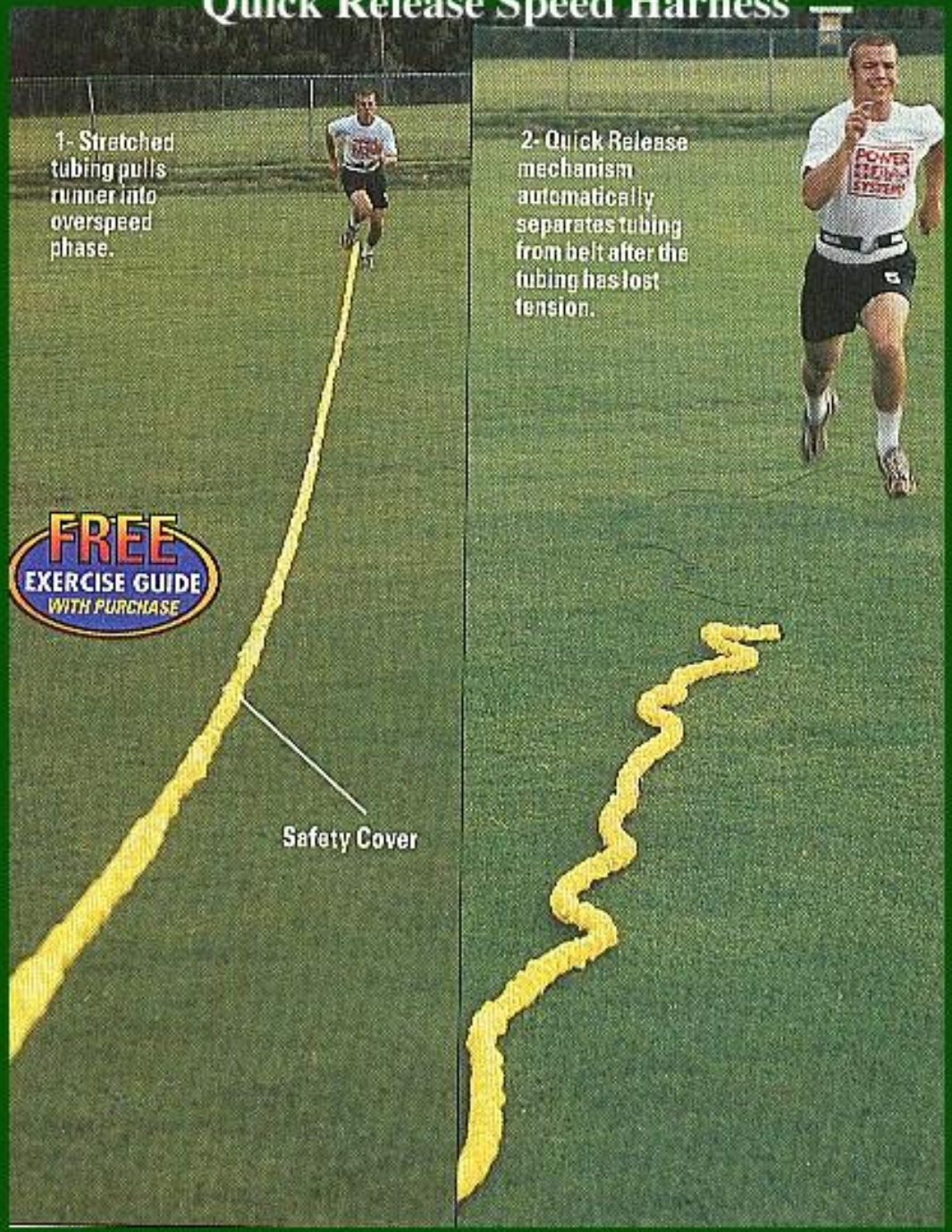
Quick Release Power Harness



Power Chute

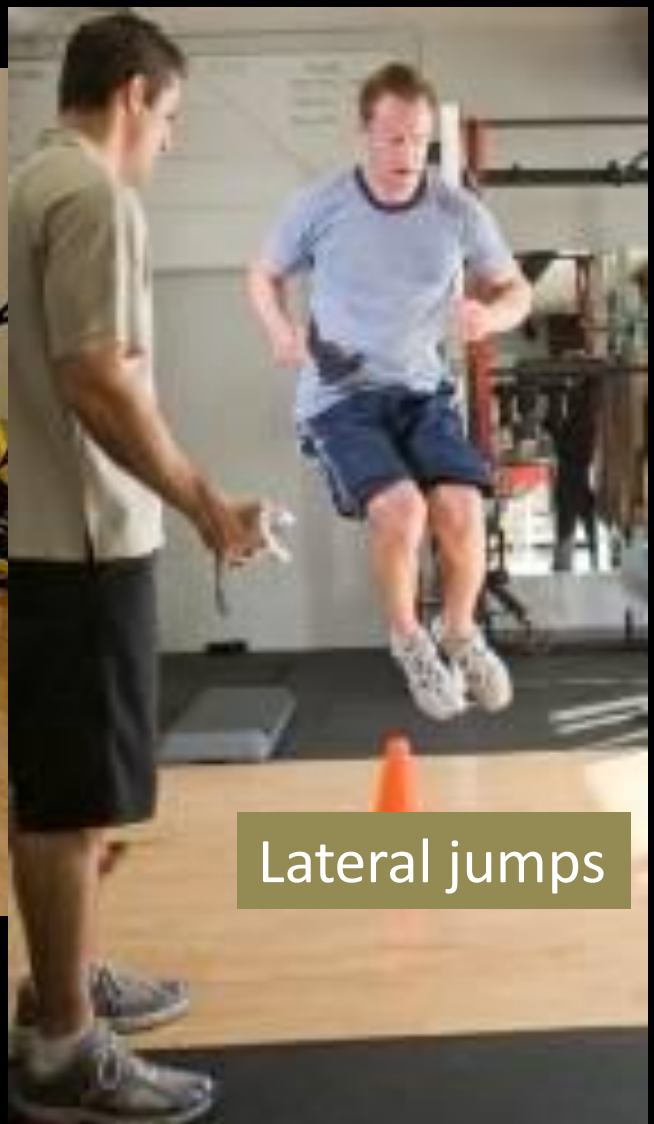

Jump RECOMMENDS
Mesh panels eliminate tangling and add stability
Strong non-rip fabric
Velcro quick release
Adjustable belt fits 20" to 42" waist
POWER SYSTEMS
ADVANCED ATHLETES CAN USE TWO CHUTES AT THE SAME TIME
POWER CHUTE
FREE
EXERCISE GUIDE
WITH PURCHASE

Quick Release Speed Harness



Agility and quickness

Agility and quickness



Reactive agility

Closed skills

Open skills

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)

Olympic lifts!

Contrary to popular belief and the practices of many athletes, the peer reviewed evidence does not support the view that such exercises are more effective than traditional, slow and heavy weight training in enhancing muscle power and athletic performance. In fact, such exercises do not appear to be any more effective in this regard than weight training at a relatively slow cadence, and some evidence suggests they are less so. Also, such explosive exercises do not transfer well (if at all) to athletic performance on the sports field, and present a significant injury risk.

Bruce-Lowe and Smith, 2007