醫療科技及資訊學系
Department of Health Technology and Informatics

The Hong Kong Polytechnic University
香港理工大學

75th

凝聚智慧 創建未來
INNOVATION AND APPLICATION FOR THE FUTURE

Nutrition and Resistance Training

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http://www.usfitnessproductsinc.com/nutrition.html


http://activeaussies.wordpress.com/2009/08/10/monday-motivator-3/dietandexercise/

1) Mechanism of Skeletal Muscle Adaptation from Resistance Training

http://www.angrytrainerfitness.com/2012/06/ask-alfonso-how-does-muscle-confusion-work/

http://www.flavoreddelights.com/2010/08/30-delectable-food-crafts-examples-yummy-sandwiches/

2) Nutrition and Ergogenic Supplement on Adaptive Response of Skeletal Muscle to Resistance Training

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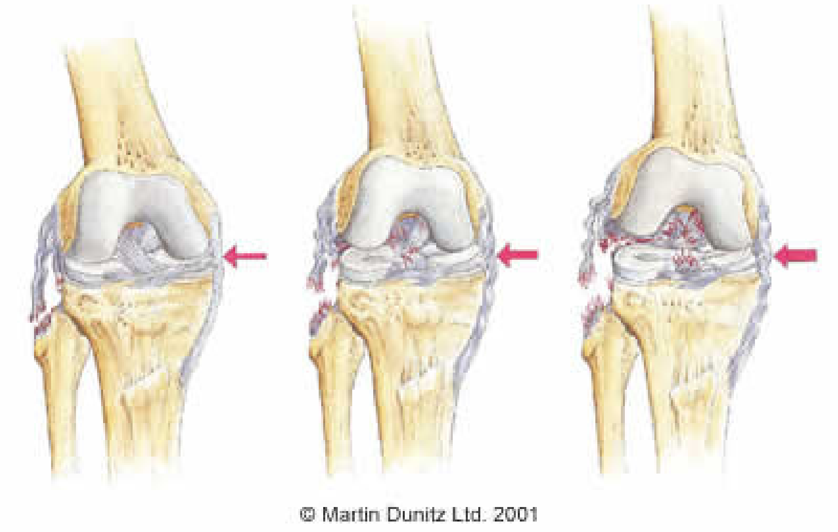
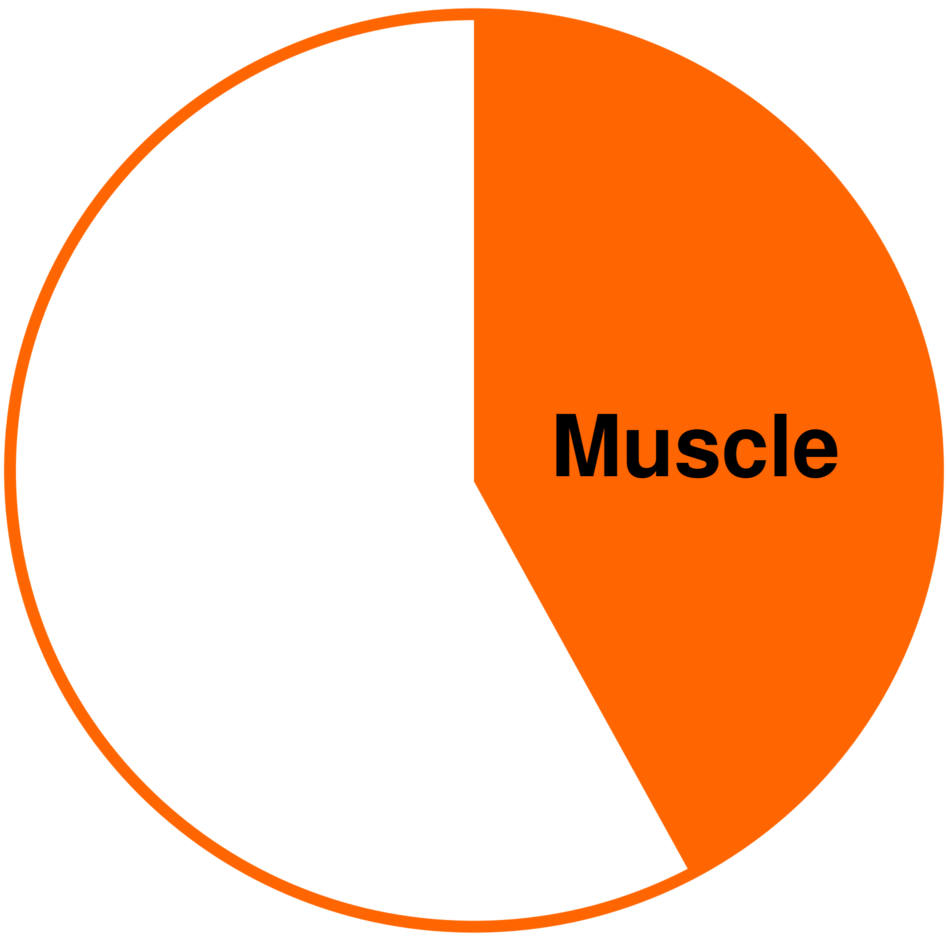
肌肉功用

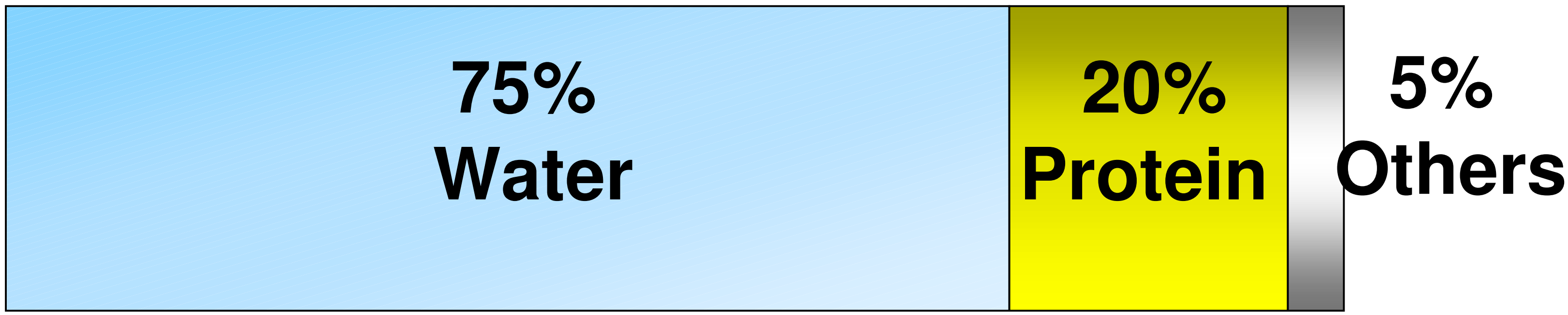
1. 產生活動
2. 保持姿勢
3. 穩定關節
4. 產生熱能

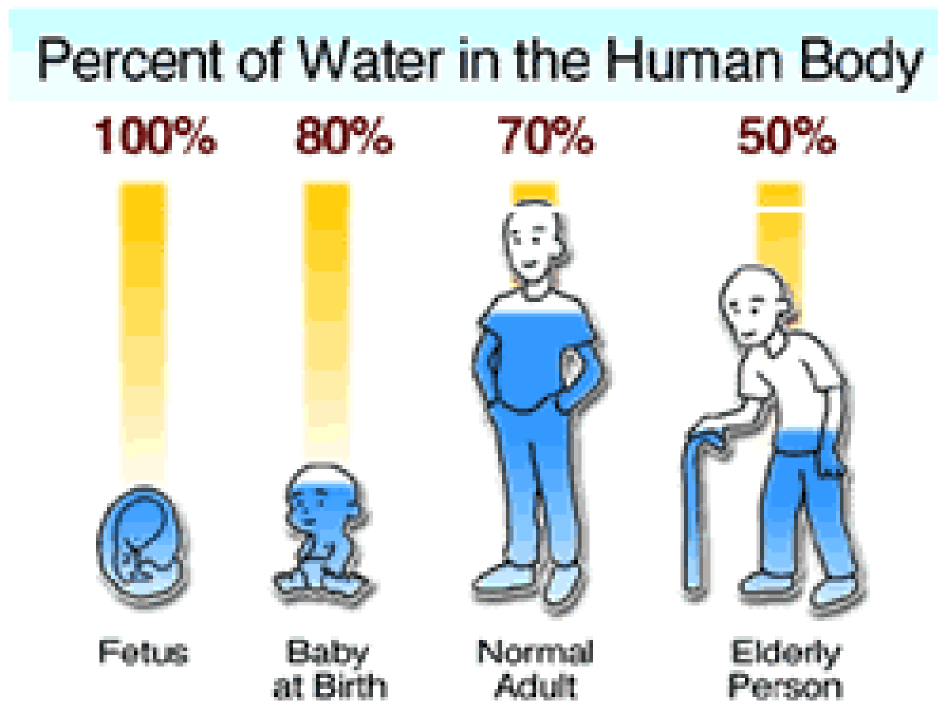


Skeletal Muscle Contributes to 40 - 50% of Body Weight



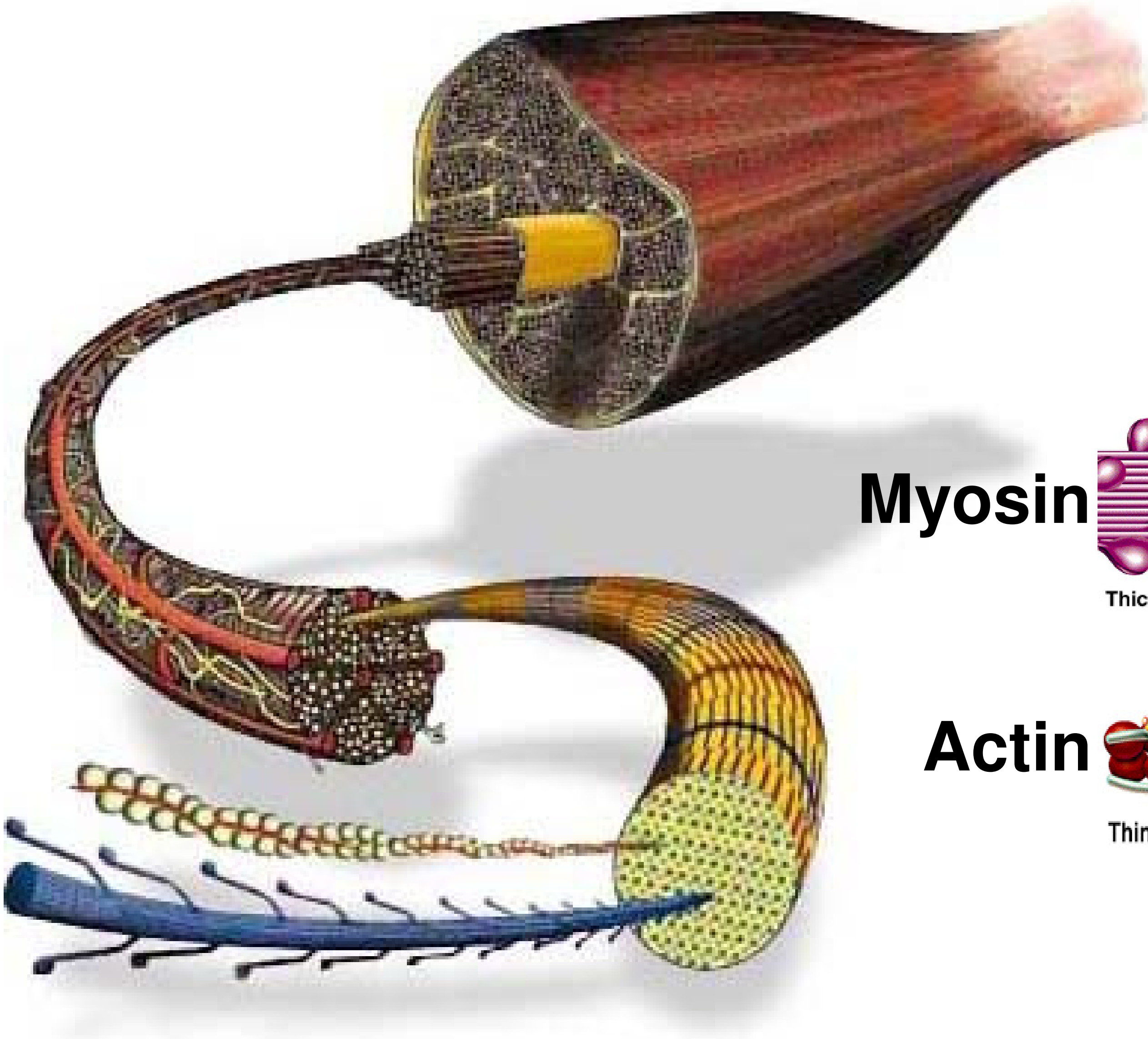
What Make Up the Muscle?

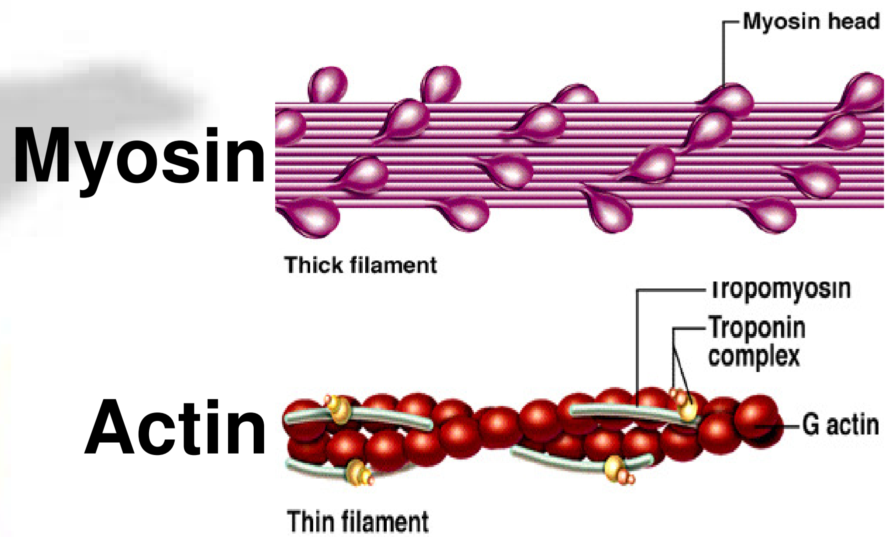


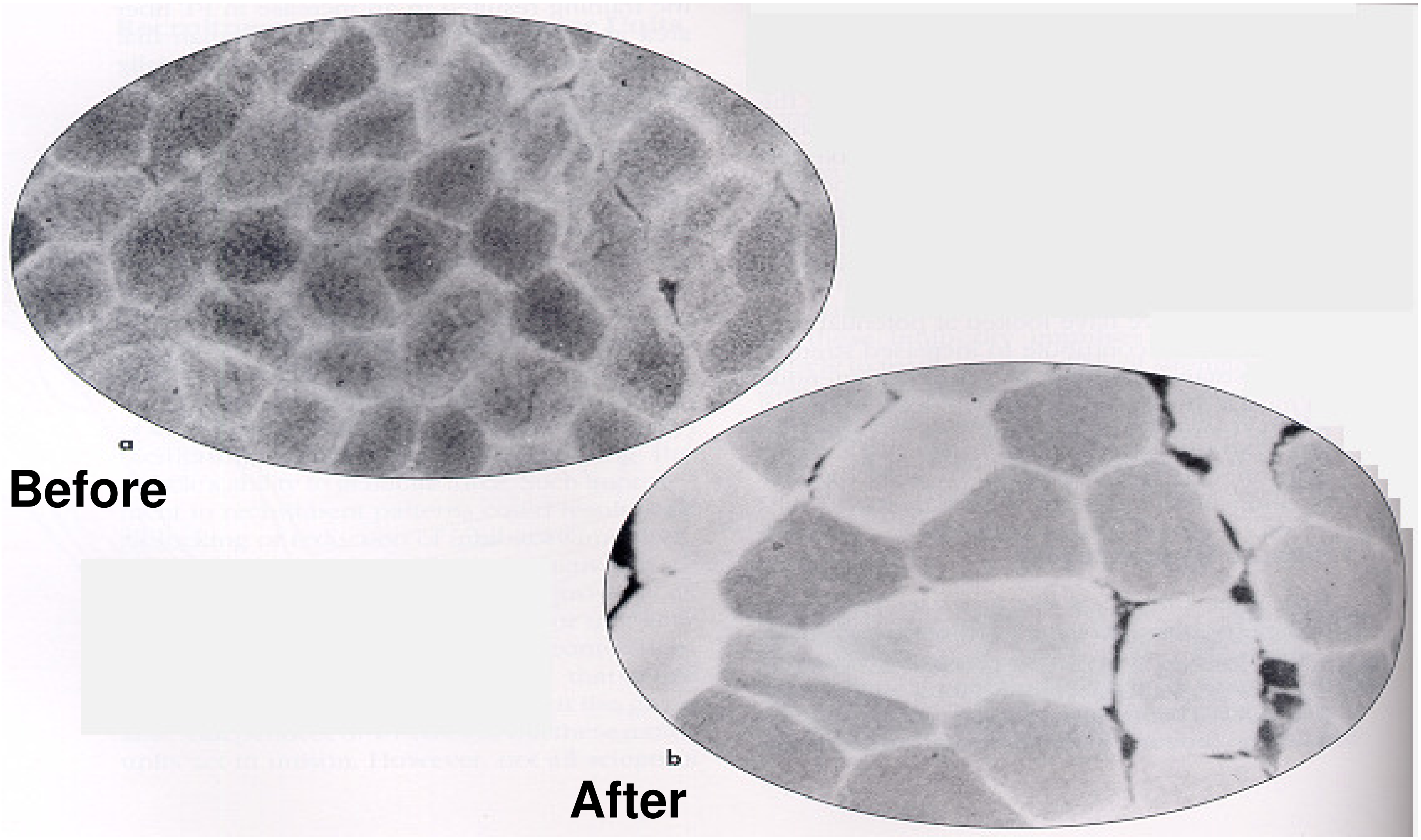


http://www.revivenaturally.com/dr-yoshitaka-ohno-md-phd/maintaining-intracellular-hydration-water.html

Myofiber

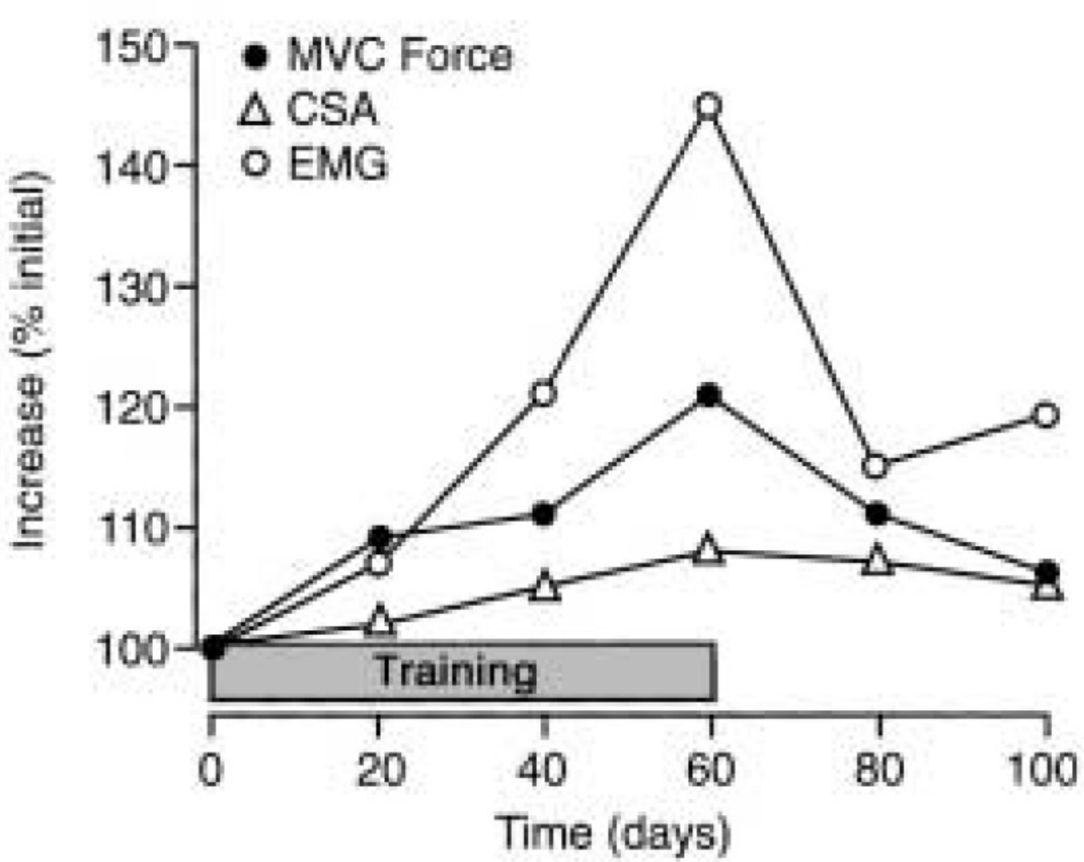



Myosin head
Myosin
Thick filament
Tropomyosin
Troponin complex
Actin
G actin
Thin filament



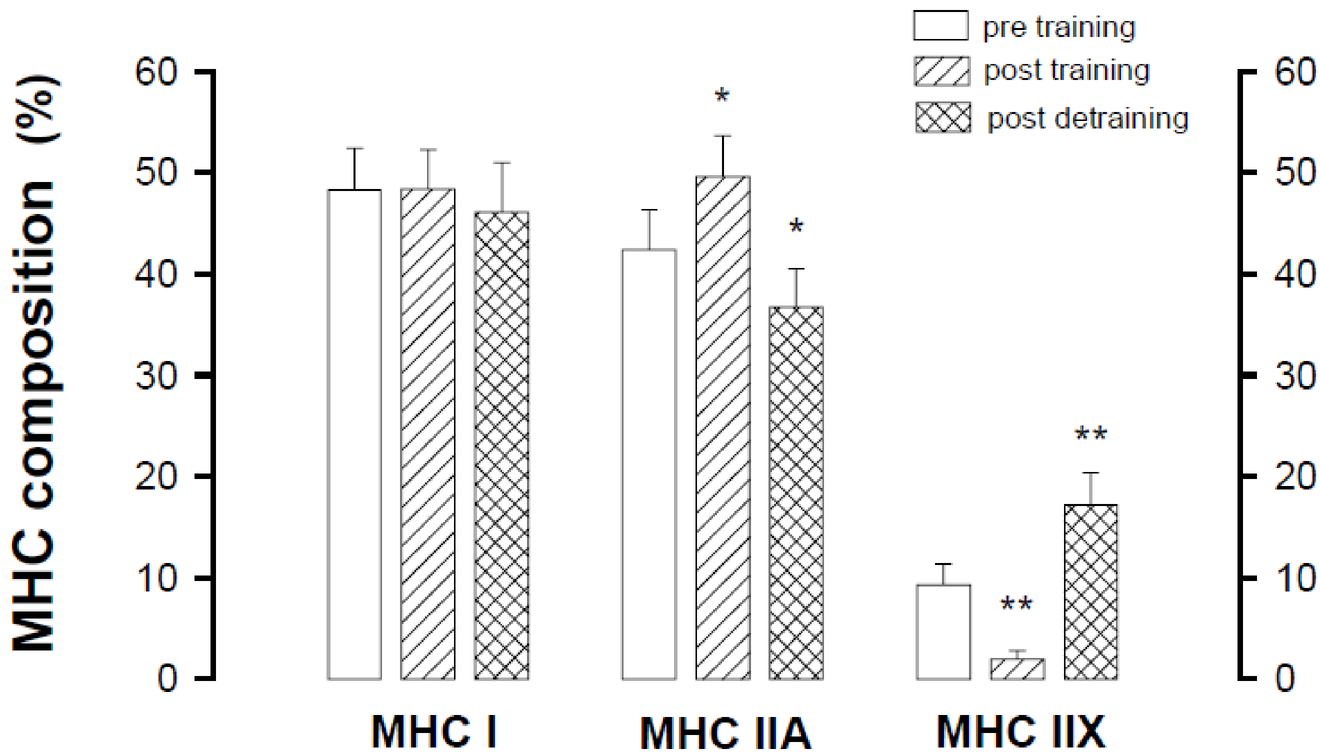
Microscopic views of muscle cross-sections taken from the leg muscle of a man who had not trained during the previous two years (a) before he resumed training and (b) after he completed 6 months of dynamic strength training. Note the significantly larger fibers (hypertrophy) after training.

Muscle Force & Muscle Size after Resistance Training



Enoka (2002) Neuromechanics of Human Movement, Human Kinetics

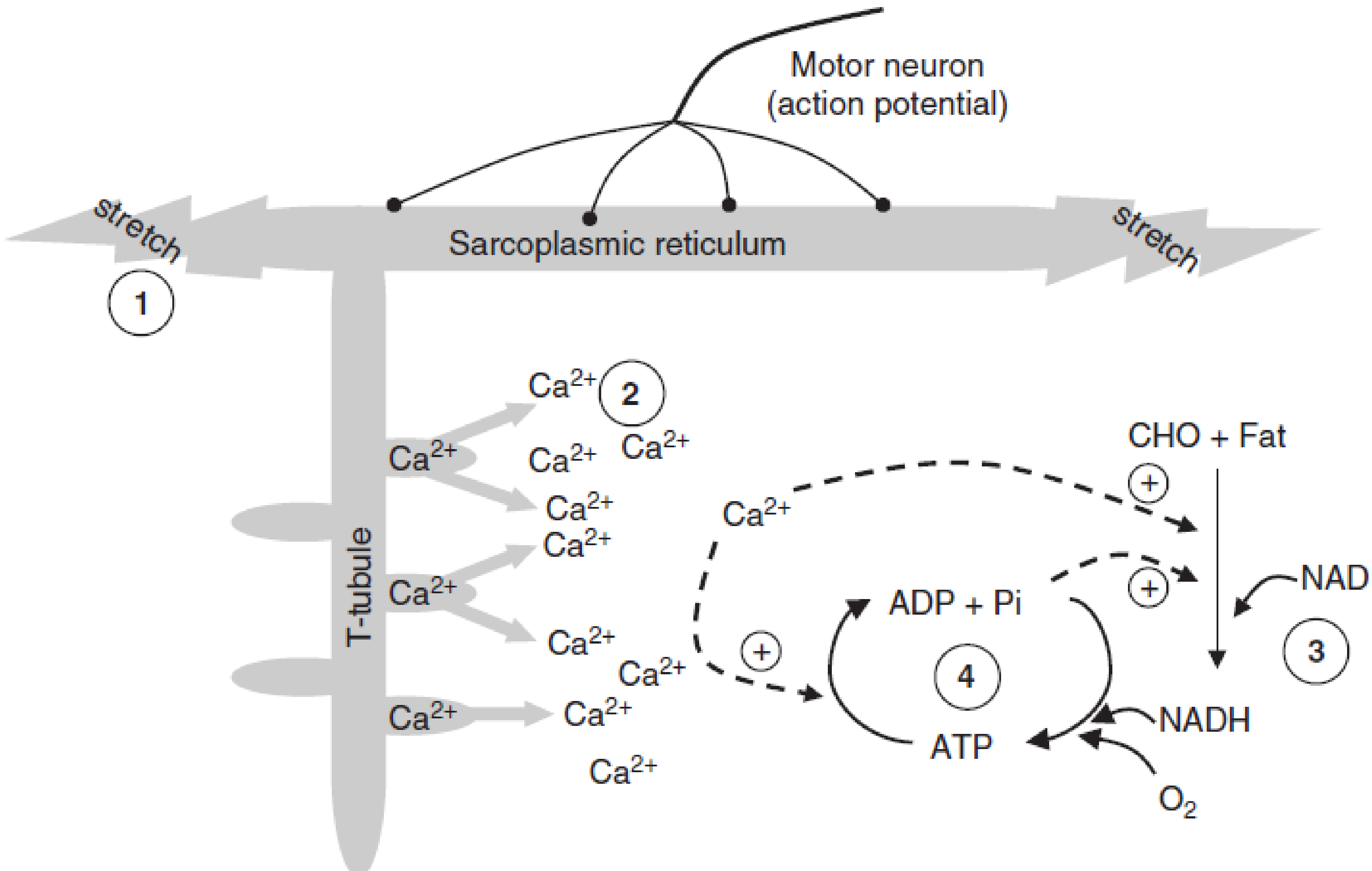
Fiber Type Shifting after Resistance Training



* MHC IIA: post training > pre training > post detraining ($p<0.05$)
** MHC IIX: post training < pre training < post detraining ($p<0.01$)

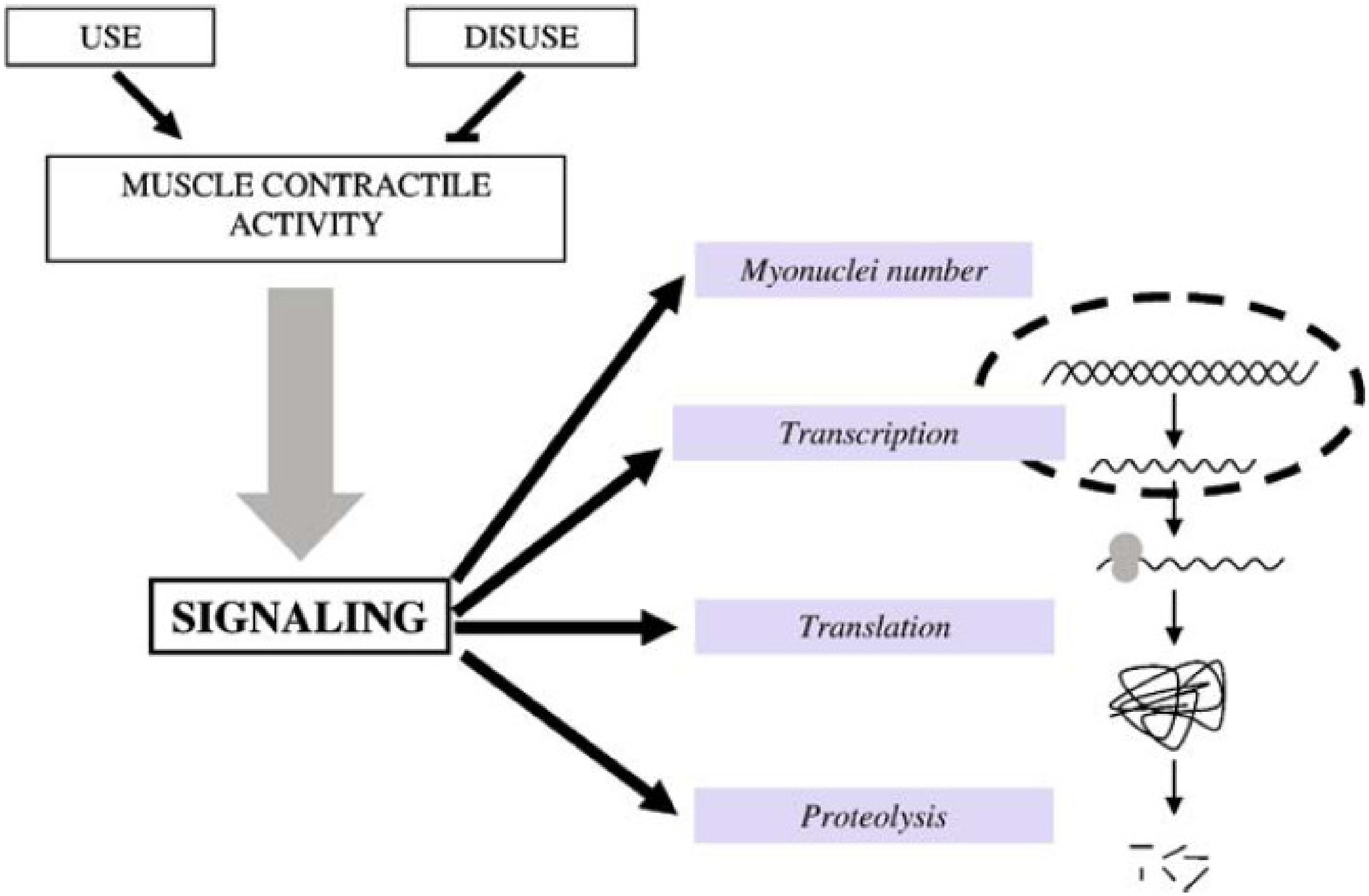
Andersen et al. (2000) Muscle Nerve

Messengers in Mechanotransduction



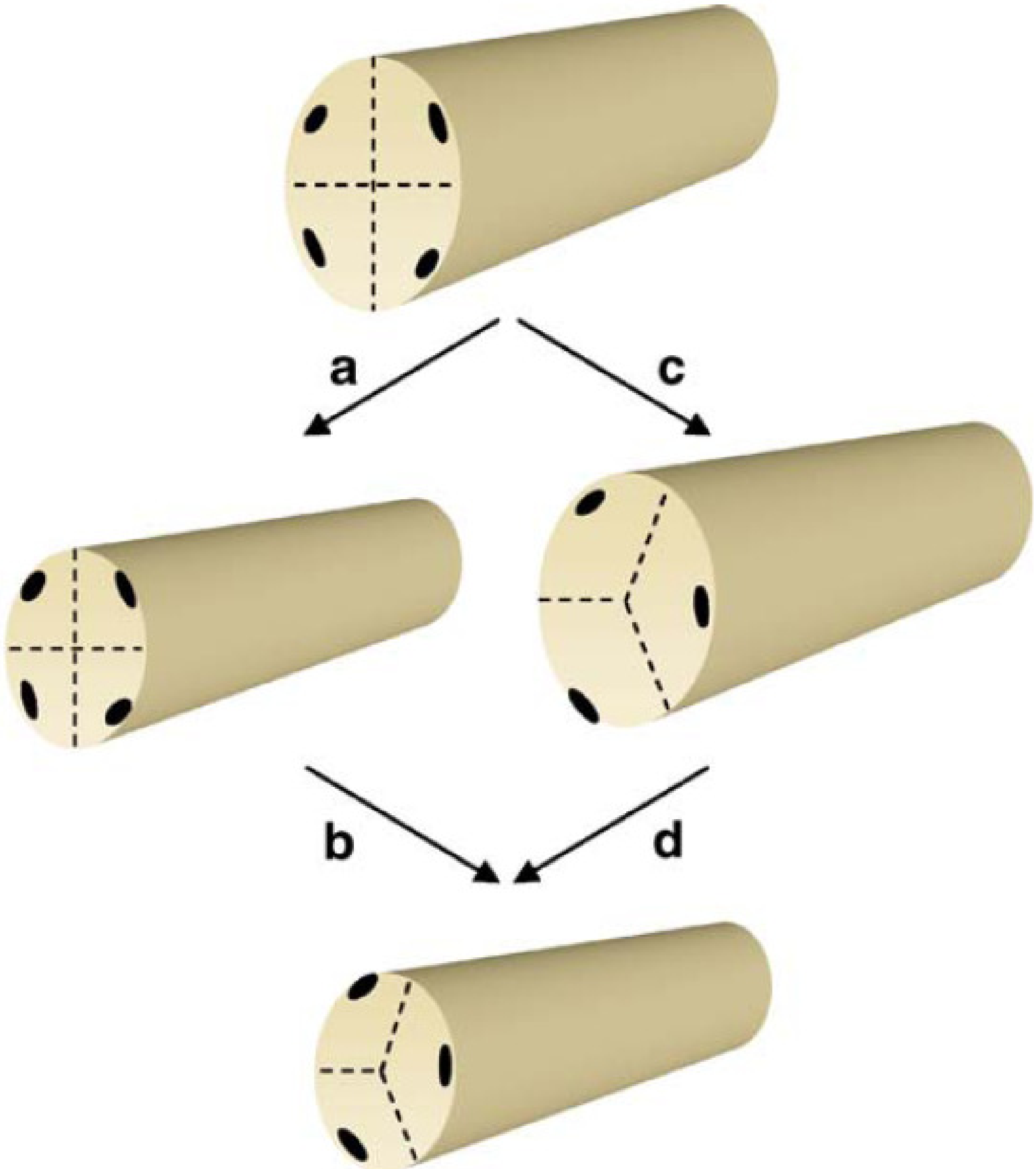
Coffey and Hawley (2007) Sports Medicine

How Muscle Mass is Controlled?



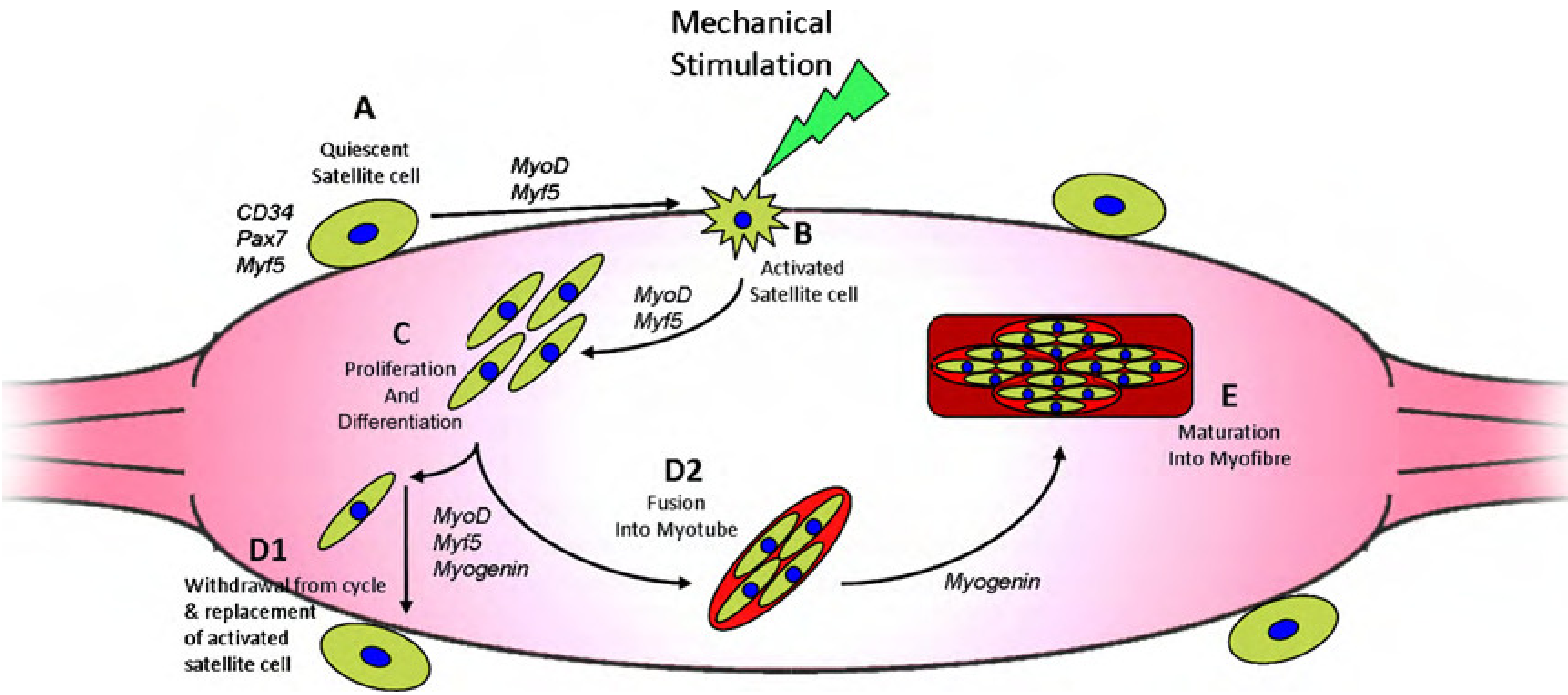
Favier et al. (2008) Pflugers Arch - European Journal of Physiology

Myonuclear Domain Hypothesis



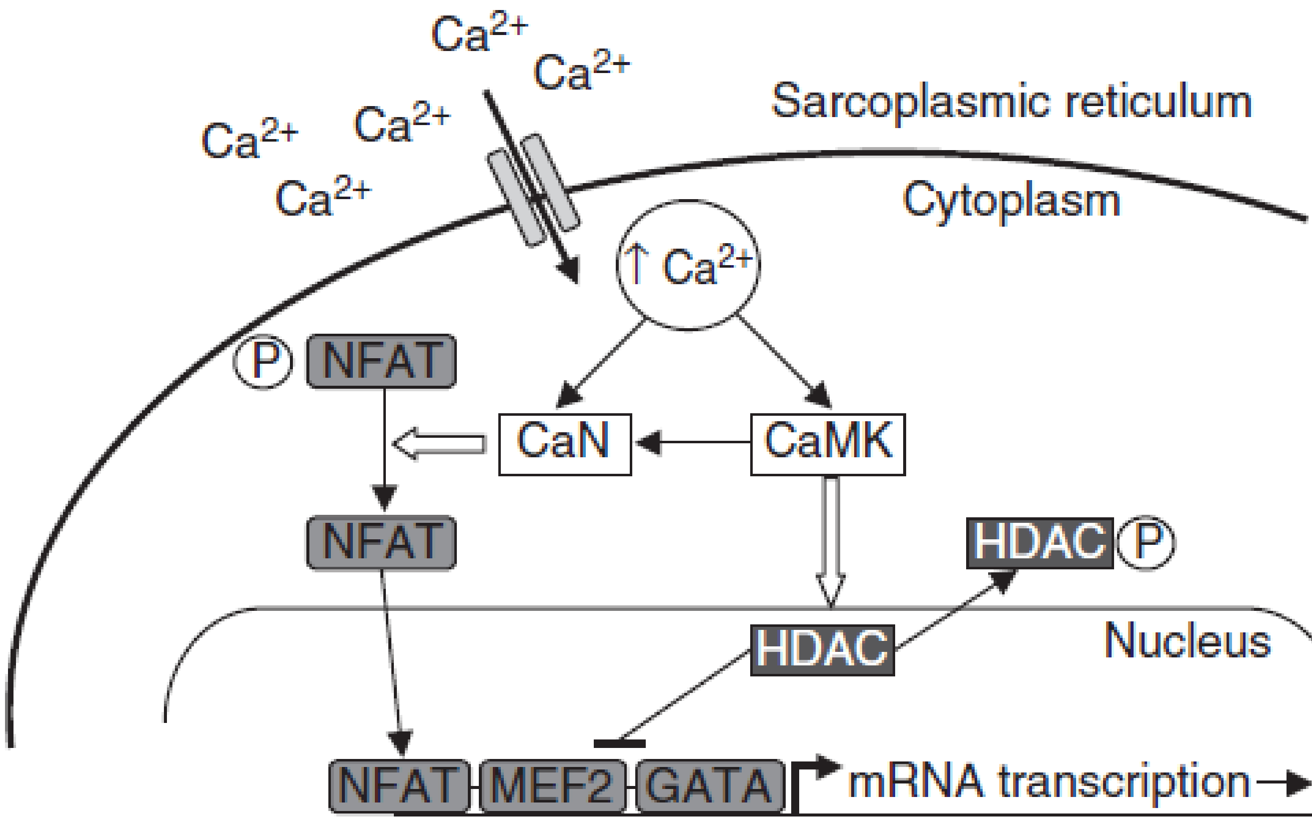
Favier et al. (2008) Pflugers Arch

Satellite Cell Activation



Karagounis and Hawley (2010) International Journal of Biochemistry and Cell Biology

Calcium-dependent Signaling



CaMK: Calmodulin Kinase
CaN: Calcineurin
NFAT: Nuclear factor of activated T cells

HDAC: Histone deacetylase
MEF2: Myocyte enhancer factor 2
GATA: Glutamyl-tRNA amidotransferase

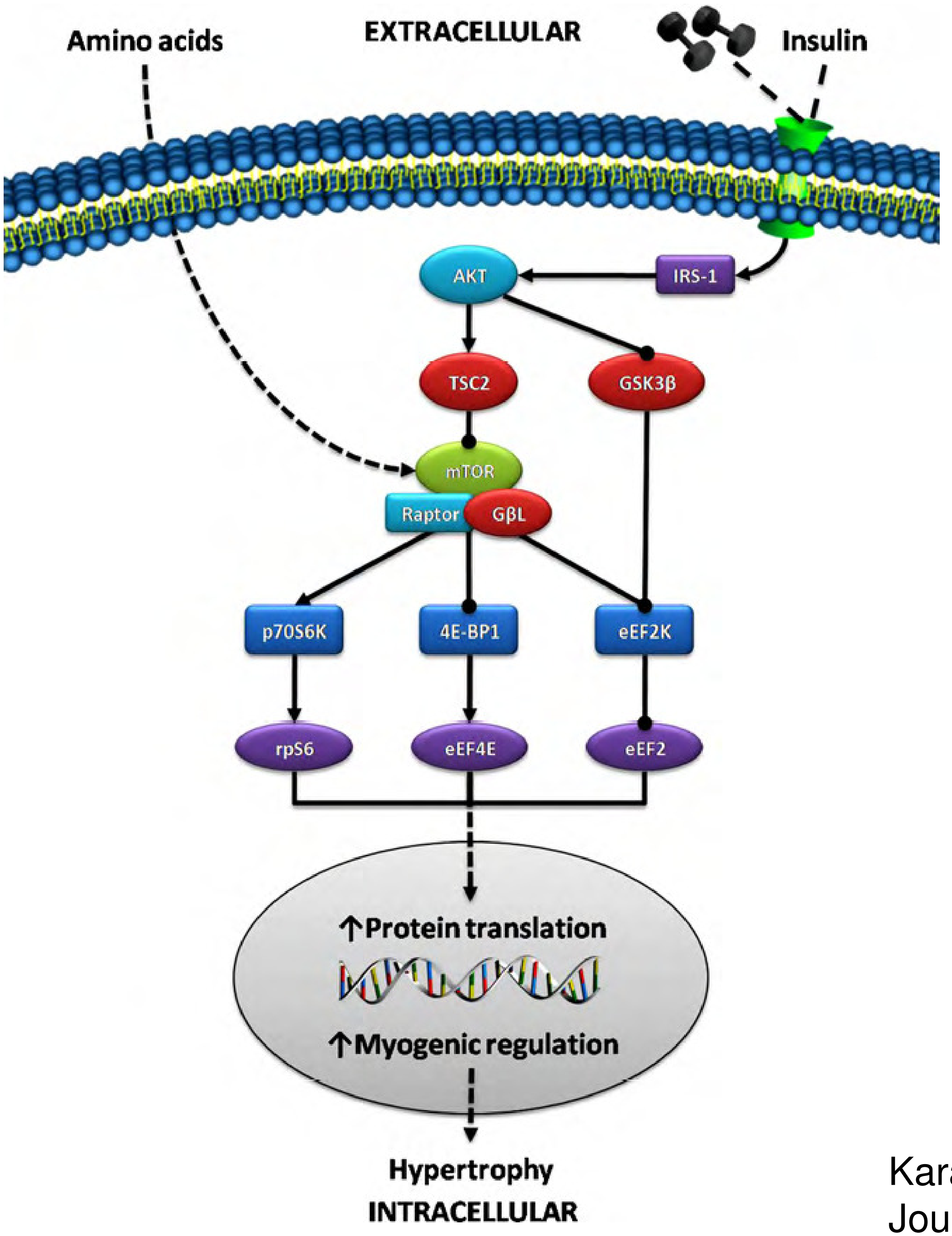
Coffey and Hawley (2007) Sports Medicine

Myogenic Regulatory Factors (MRFs) & Muscle Use

Model	Muscle	Species	Myf5	MyoD	Myogenin	MRF4
Acute						
HFES	VL	Human		↑	↑	
HFES	MG	Rat			↑	
RE	VL	Human	ns	↑	↑	↑
RE	VL	Human	ns	↑	ns	↑
RE	VL	Human		ns		
Chronic						
RT (16 weeks)	VL	Human		↑	↑	
RT (10 weeks)	VL	Human	ns	ns	↑	ns
RT (8 weeks) rest	VL	Human		ns	ns	
post-ex				ns	↑	
Compensatory overloading (3 months)	Pla	Rat			↑ 1st to 3rd day	
Stretch overload (6–72 h)	ALD	Quail	↑	↑		↑
	Pat			↑		↑
Compensatory overloading (3 days)	Sol	Rat		↑ (1st day)		
	Pla					
Stretch (2–3 weeks)	ALD	Chicken		ns	↑	
Stretch (2 days)	Sol	Rat			ns	↑
	Pla				↑	ns

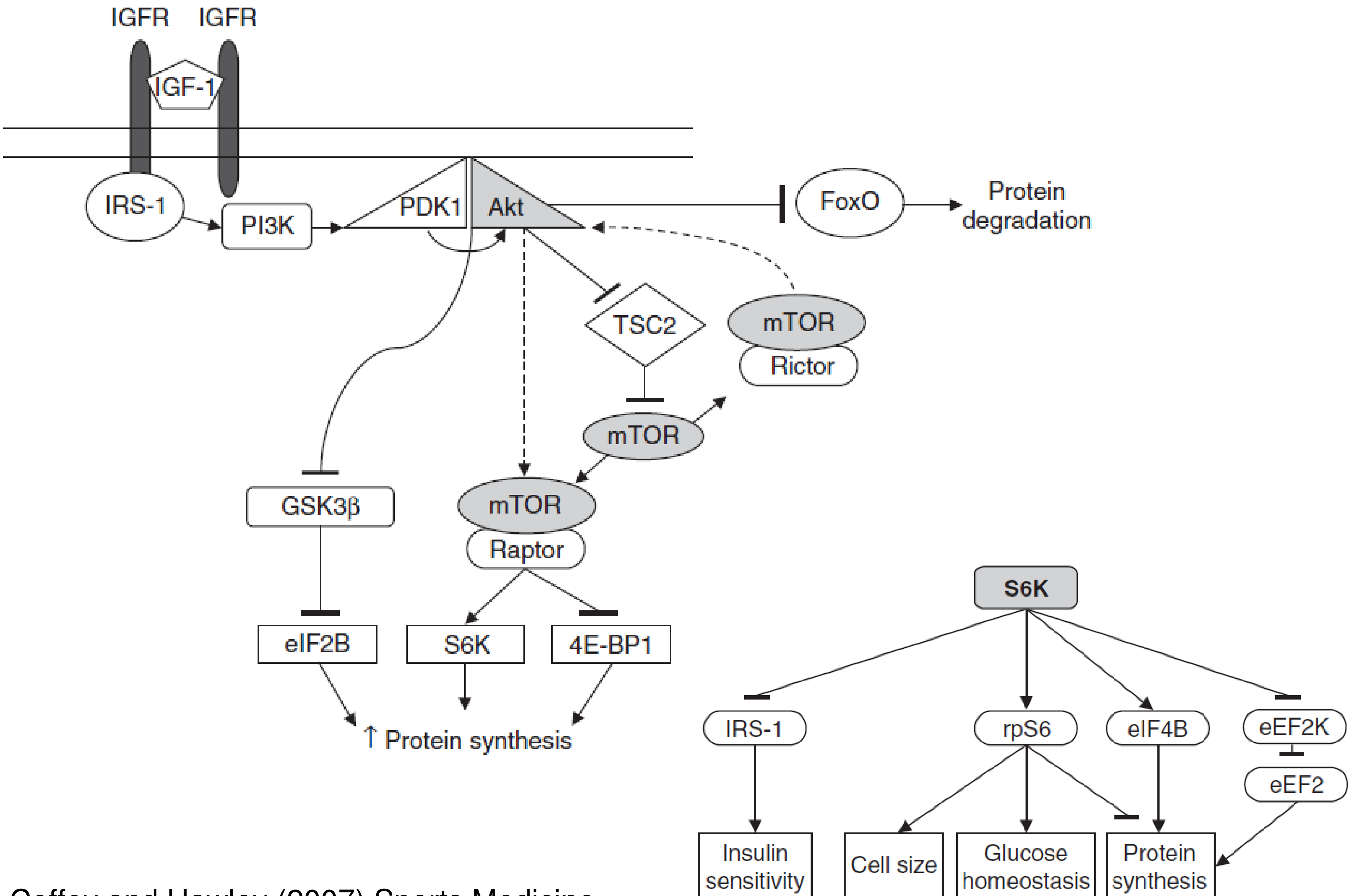
Favier et al. (2008) Pflugers Arch

Akt/mTOR Signaling



Karagounis and Hawley (2010) International Journal of Biochemistry and Cell Biology

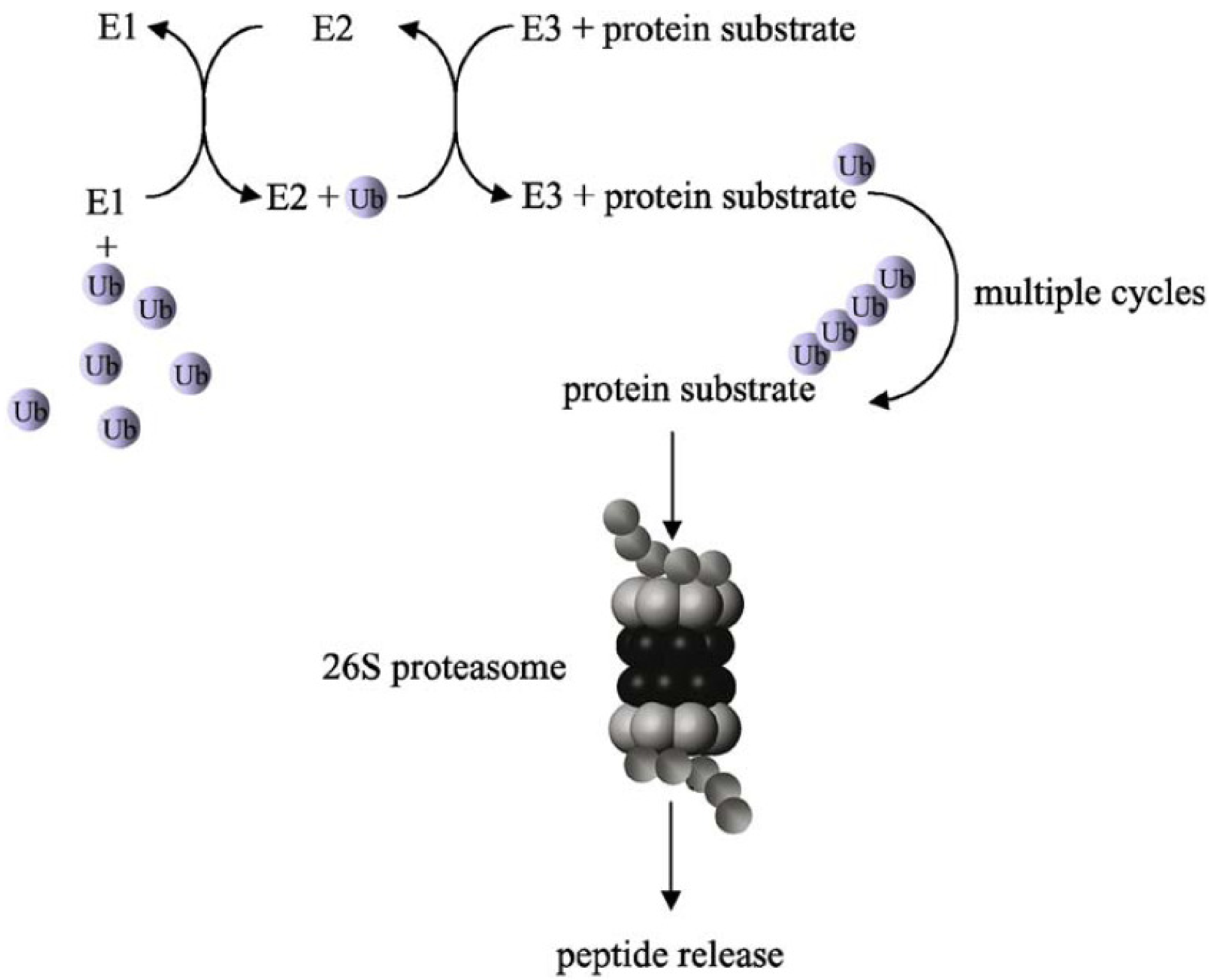
IGF-1/Akt/FoxO/mTOR Signaling Pathway



Coffey and Hawley (2007) Sports Medicine

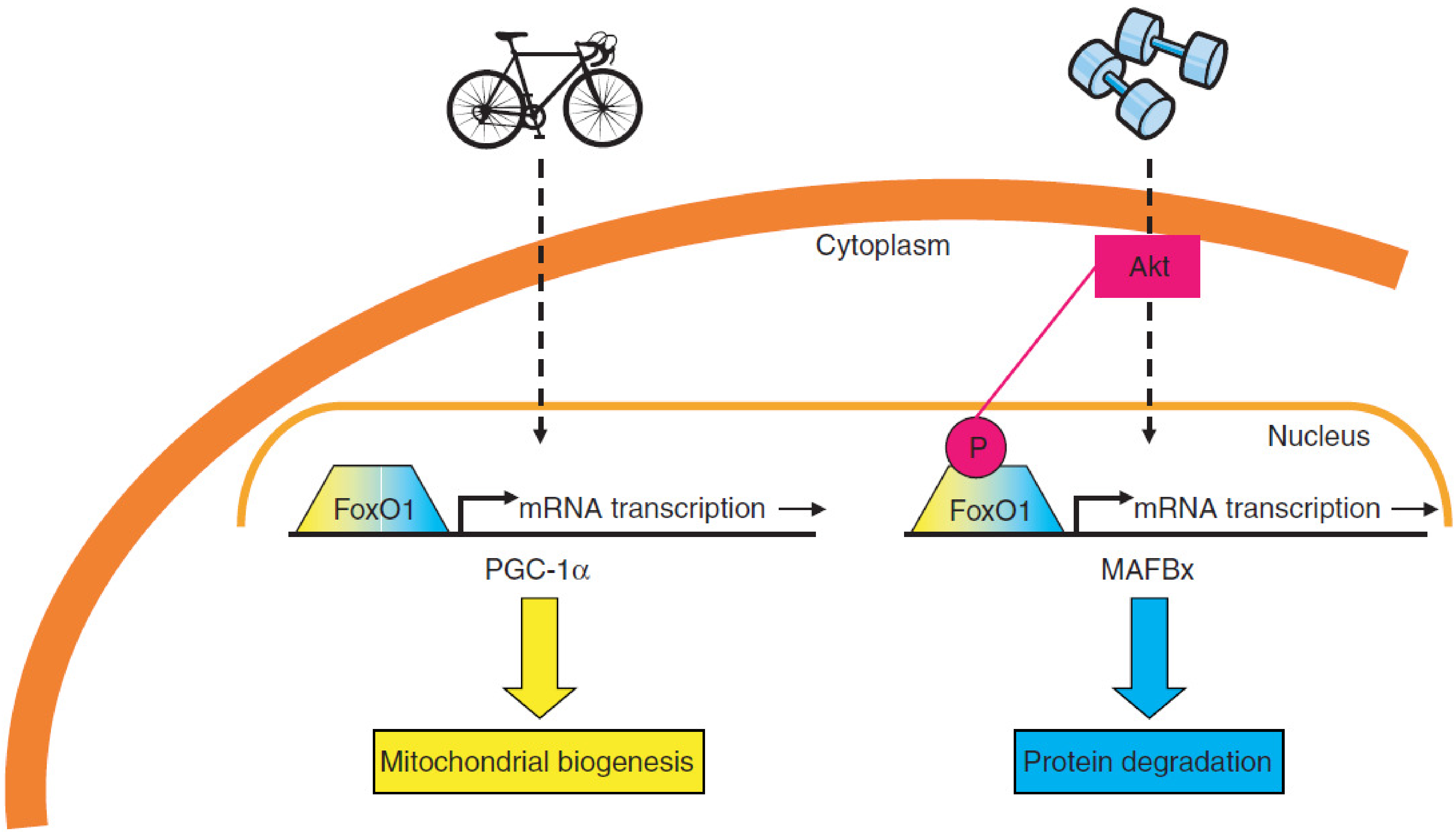
Ubiquitin Proteasome System

Atrogenes: MuRF & MAFBx



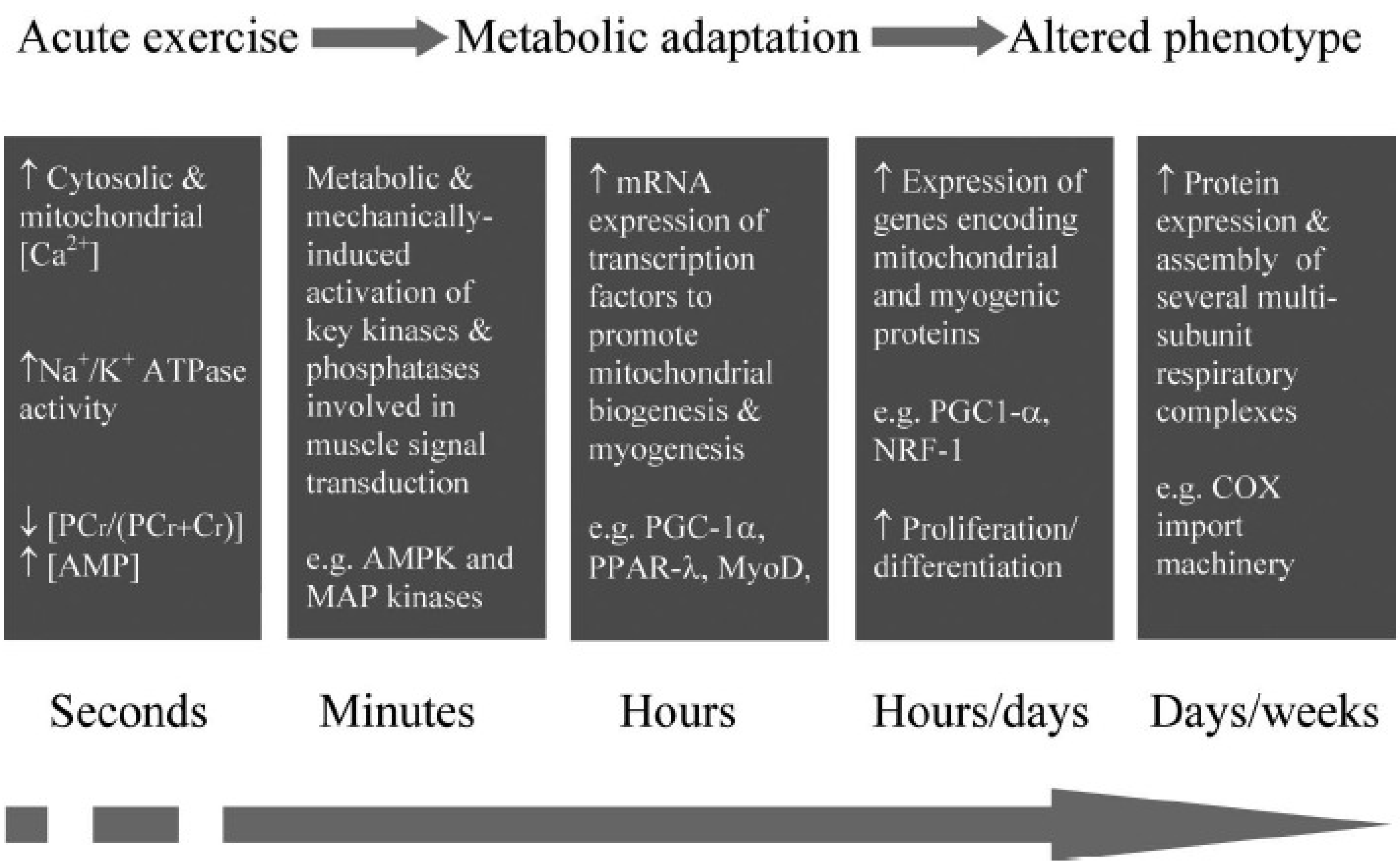
Favier et al. (2008) Pflugers Arch

Forkhead box O1 (FoxO1) & Exercise



Coffey and Hawley (2007) Sports Medicine

Training Adaptation: Time Course Change



Hood (2001) Journal of Applied Physiology

Dietary Strategies and Nutrients for Promoting Muscle Accretion during Resistance Training

Overfeeding

- 500 – 2,000 kcal/day
- An effective means of increasing body mass
- BUT only 30-40% of the mass gained is fat-free mass
- Not seem to be effective to promote lean tissue accretion during resistance training

Kreider (1999) Sports Medicine

CHO/Protein Before and/or After Exercise

- CHO/Protein before exercise may help to decrease exercise-induced catabolism
- CHO/Protein after exercise may help to promote a more favorable hormonal environment to promote muscle growth (modestly increase growth hormone following resistance training)
- Long term training periods?

Kreider (1999) Sports Medicine

Protein

- Common belief:

  Diet must be supplemented with large amount of protein

- Increase intake of protein above that necessary to maintain nitrogen balance (e.g., >1.3 to 2 g/kg/day):

  Not affect muscle growth during resistance training

Kreider (1999) Sports Medicine

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Role of Protein in Exercise Training

Muscle Mass: balance between muscle protein synthesis (MPS) & muscle protein breakdown (MPB)

→ Net muscle protein balance (NPB) = MPS – MPB

Post-exercise protein ingestion reduces indices of muscle damage (e.g., creatine kinase)

Post-exercise protein feeding <u>might</u> support enhanced performance in both resistance exercise (muscle protein accretion) and aerobic exercise (mitochondrial protein synthesis)

"Protein serves both as a substrate and a trigger for adaptation"

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Quantity of Protein

US Dietary Reference Intakes (RDI) for all individual aged 19 years and older → 0.8 g/kg bw protein (36/56 g protein for a person with 45/70 kg bw)

"RDA covers protein losses with margins for inter-individual variability and protein quality, but the notion of consumption of extra protein above these levels to cover increased needs due to physical activity is not considered"

Expected because "extra" dietary protein to synthesize new muscle or repair muscle damage

ISSN Position Stand: 1.4 to 2.0 g protein/kg bw/day →

Endurance / Intermittent / Strength

0.8 g/kg bw protein
(70 kg bw needs 56 g protein daily)

High Protein Poultry
Domesticated duck meat - ½ duck - 52 grams of protein
Chicken breasts - ½ chicken breast - 35 grams of protein

High Protein Seafood
Salmon - ½ fillet - 42 grams protein
Haddock - 1 fillet - 37 grams protein

Glutamine

- Common ingredient found in weight-gain supplements in market
- Suggested to promote muscle growth based on animal studies that examined the effects of glutamine on protein synthesis and cell volume
- Need more human data and long term studies

Kreider (1999) Sports Medicine

Leucine

- Leucine regulates muscle protein metabolism by stimulating protein synthesis and inhibiting protein degradation

- Efficacy to improve muscle mass in various physiological conditions is still controversial
- Need long term studies

Balagea and Dardevet (2010) Current Opinion in Clinical Nutrition and Metabolic Care

Creatine

- A popular nutritional strategy by resistance-trained athletes
- ~20 g/day for 6 days then ~5 g/day for 2-3 months
- Increase in fat-free mass, single-effort, strength/power, and maximal muscle effort during resistance training
- Stimulate protein synthesis and/or quality of training leading to greater gain in strength and fat-free mass
- Need long term studies to evaluate safety

Kreider (1999) Sports Medicine

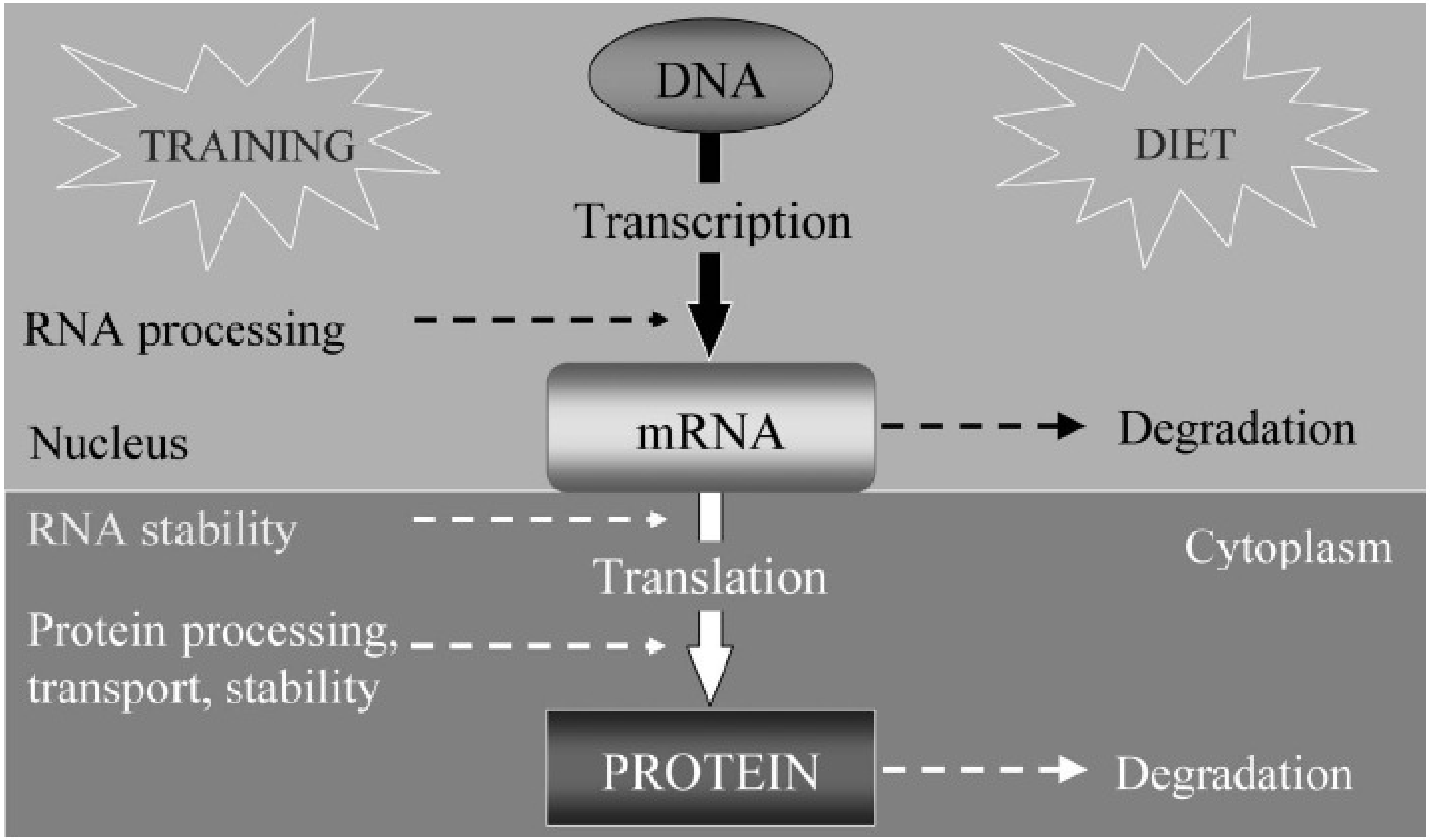
Chromium & Vanadyl Sulfate

- Chromium - Trace mineral
- Vanadyl Sulfate - Inorganic compound of Vanadium

- Not affect muscle growth during resistance training

Kreider (1999) Sports Medicine

Effects of Training and Diet



Williams and Neufer (1996) Handbook of Physiology: Exercise: Regulation and Integration of Multiple Systems, American Physiological Society

Nutrition & Resistance Training

http://donnafit.blogspot.hk/2011_04_01_archive.html

http://www.seniorhealth365.com/2011/11/20/cardiovascular-exercises-and-weight-training-in-the-elderly/

http://www.mensfitness.com/training/build-muscle/strength-training-boosts-seniors-brains

http://bestsourcesofprotein.net/

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