Week 2

Agenda

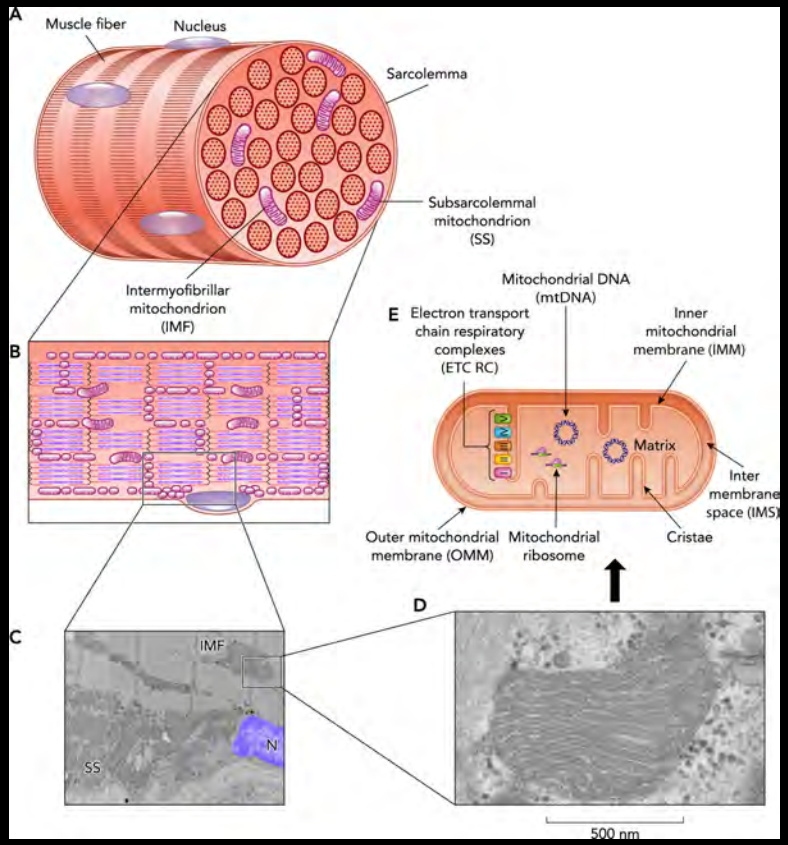
- Section 1: Announcements
- Section 2: SISS Session Example
- Section 3: Mitochondrial Health
- Section 4: Questions

Week 2 Mitochondrial Health

Why so important?

- **‘Controls’ metabolism**
- **High correlation to health & disease**
- **Trainable via a variety of methods**

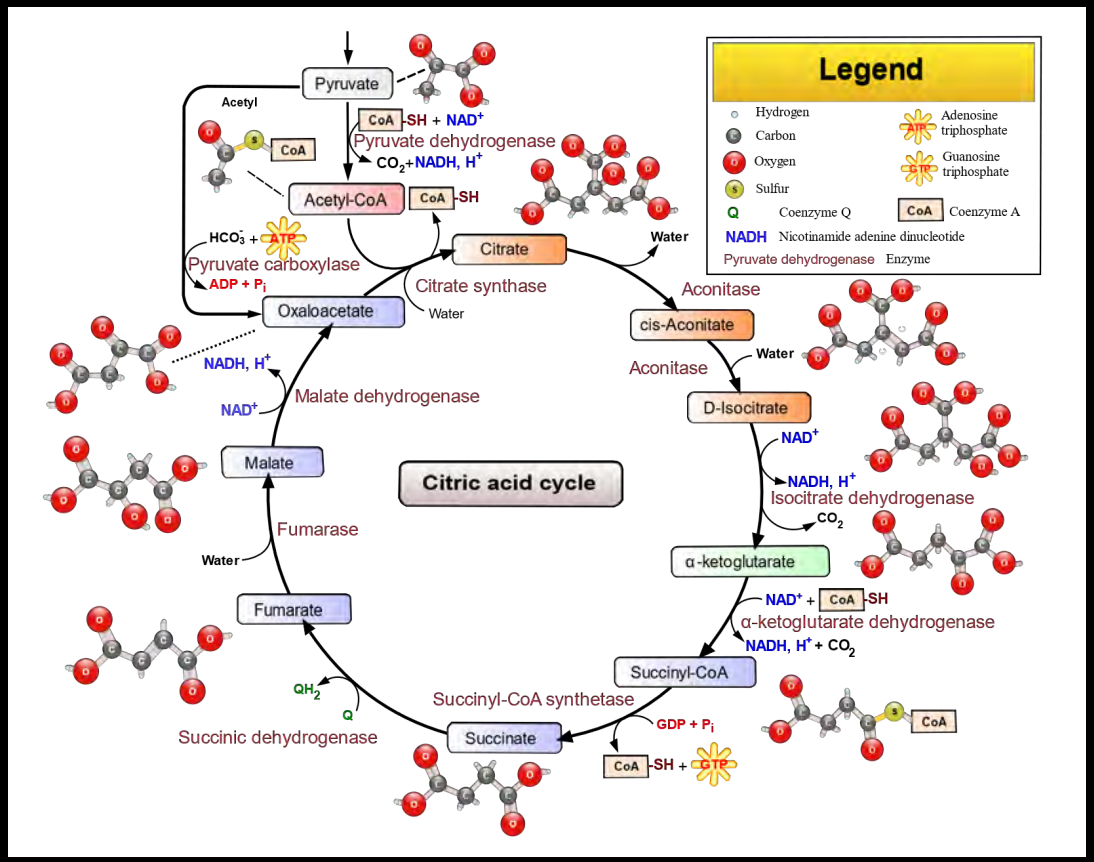
What is a Mitochondrion



PHYSIOLOGY 34: 56–70, 2019. Published December 12, 2018; doi:10.1152/physiol.00038.2018

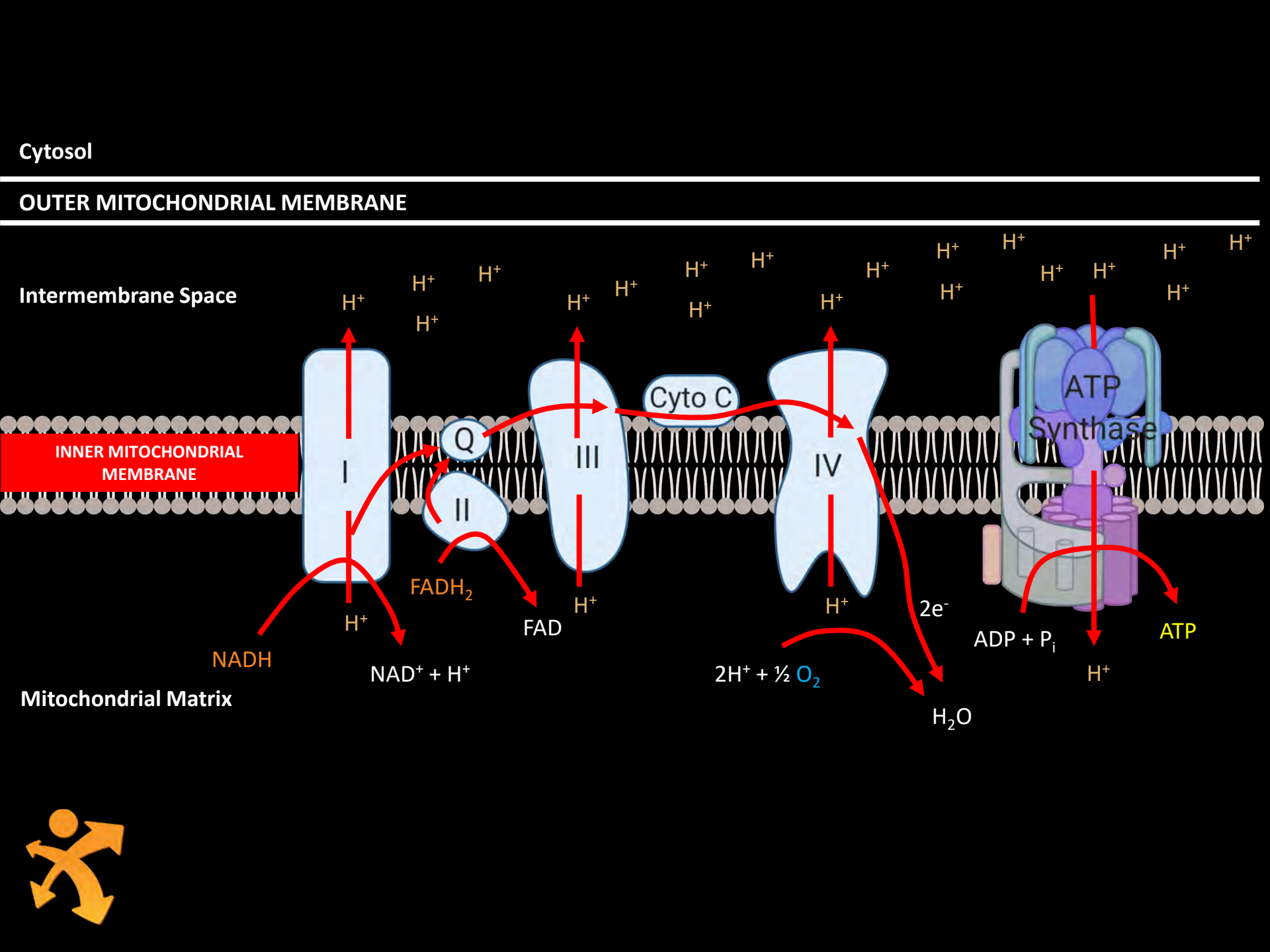
High-Intensity Exercise and Mitochondrial Biogenesis: Current Controversies and Future Research Directions

David J. Bishop,[1,2] Javier Botella,[1] Amanda J. Genders,[1] Matthew J-C. Lee,[1] Nicholas J. Saner,[1] Jujiao Kuang,[1] Xu Yan,[1] and Cesare Granata[1]

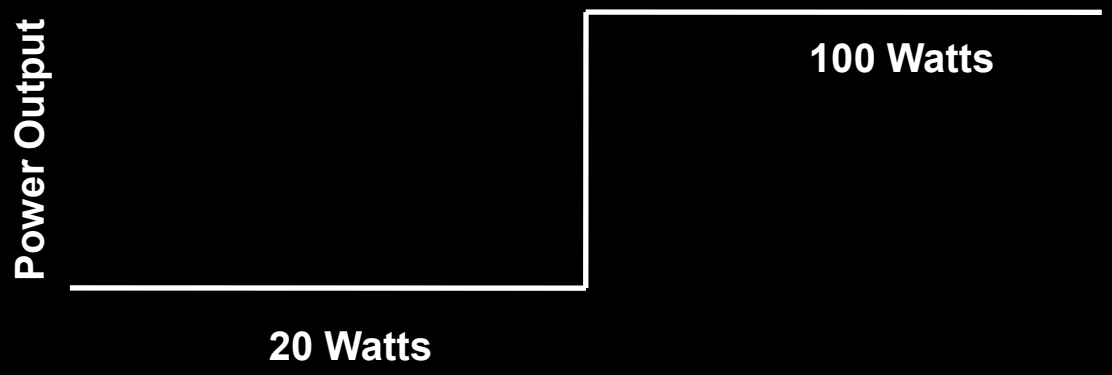


Citric Acid Cycle

The stuff of nightmares!

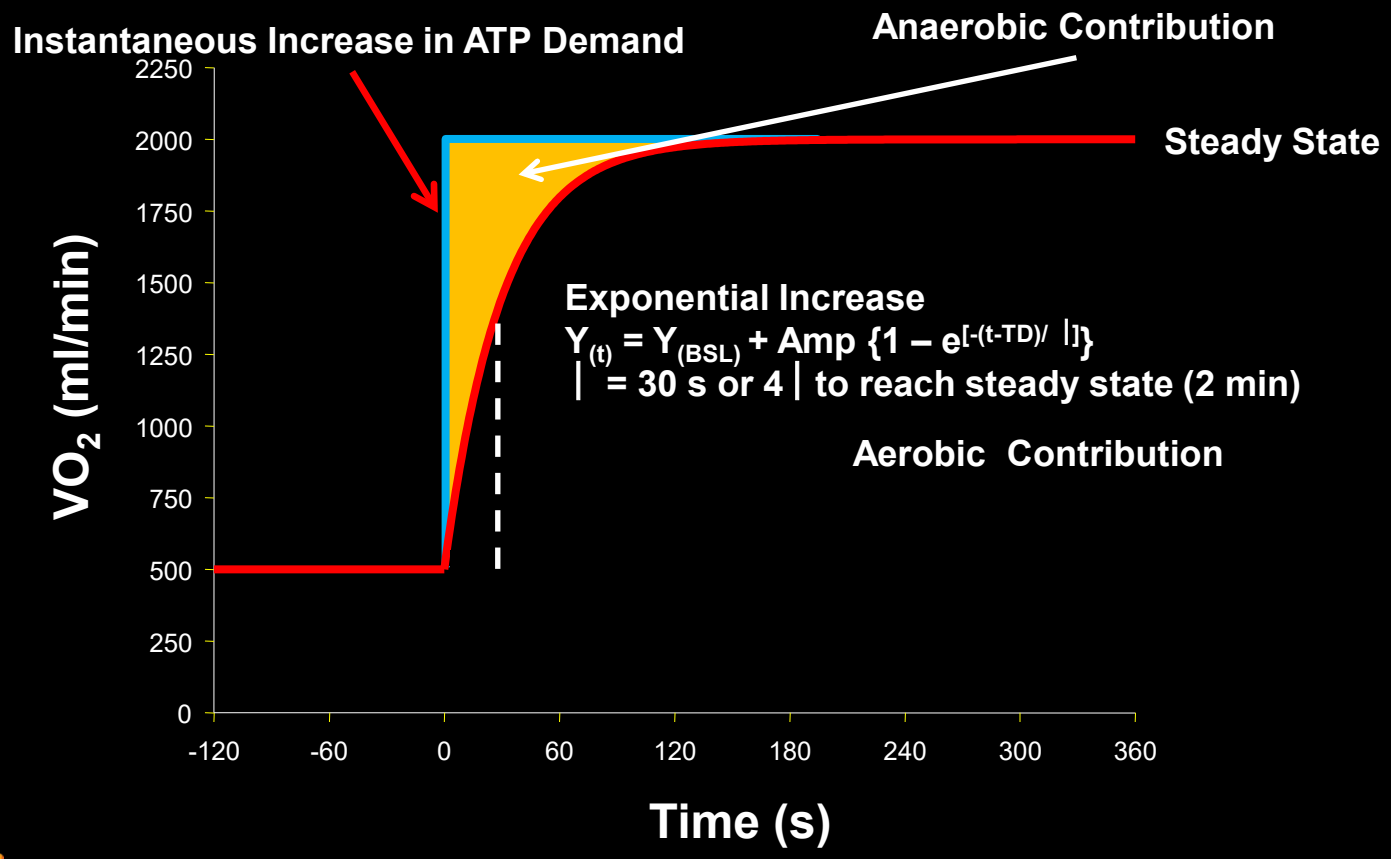

Cytosol
OUTER MITOCHONDRIAL MEMBRANE
Intermembrane Space
INNER MITOCHONDRIAL MEMBRANE
Mitochondrial Matrix
H+
I
II
Q
III
Cyto C
IV
ATP Synthase
NADH
NAD+ + H+
FADH2
FAD
2H+ + ½ O2
H2O
2e-
ADP + Pi
ATP

Instantaneous increase in ATP demand at exercise onset

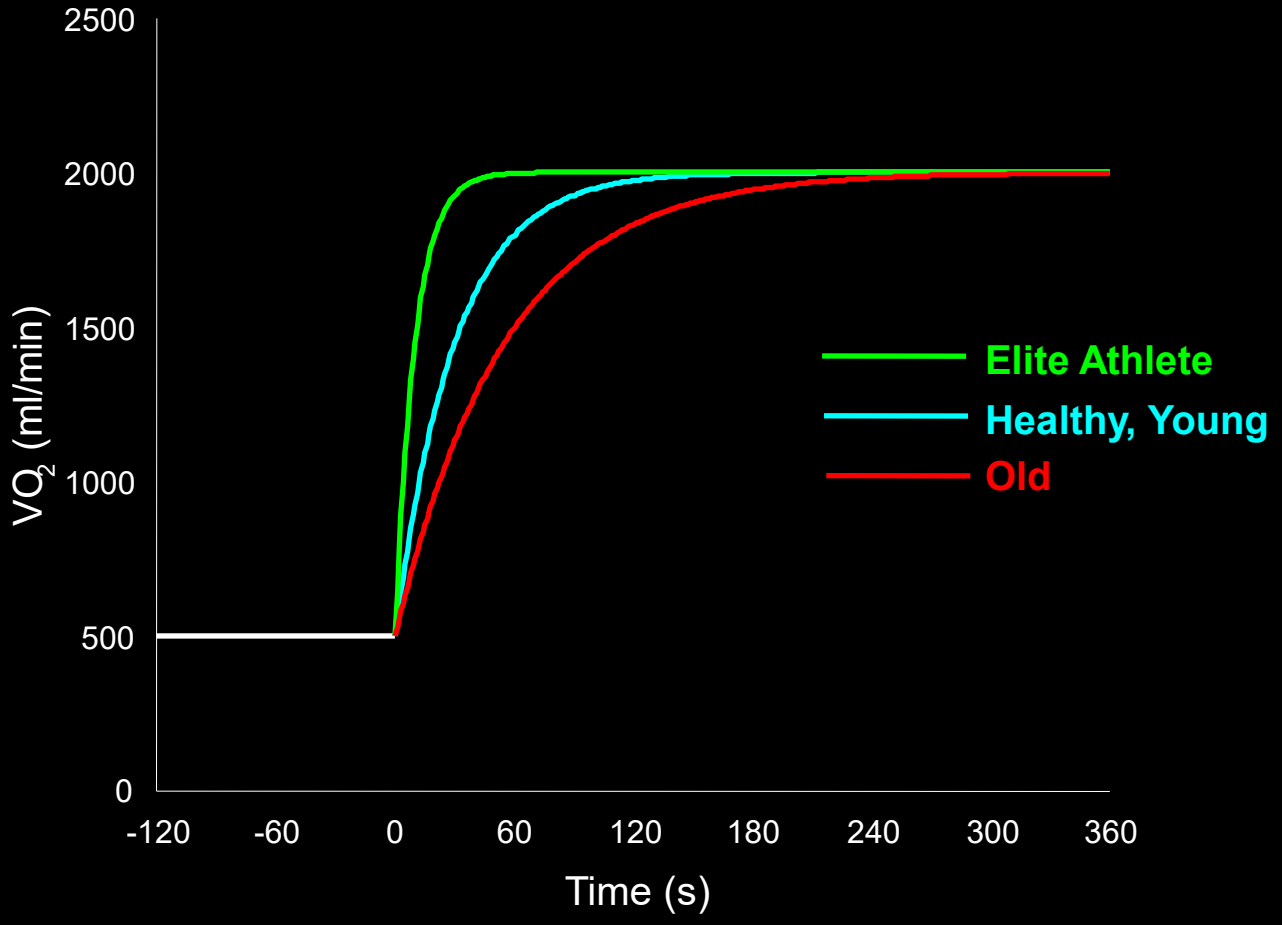


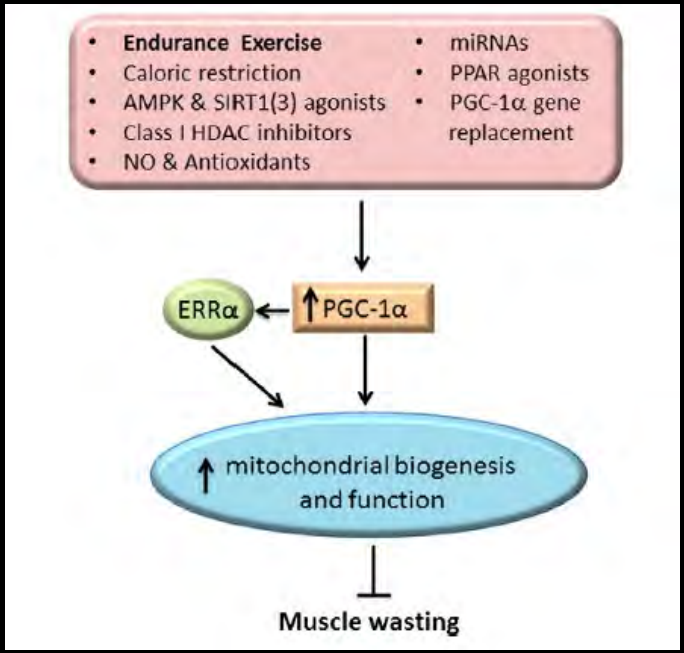
- Energy systems must coordinate to produce ATP to meet this demand

Aerobic Energy Production



Practical Example



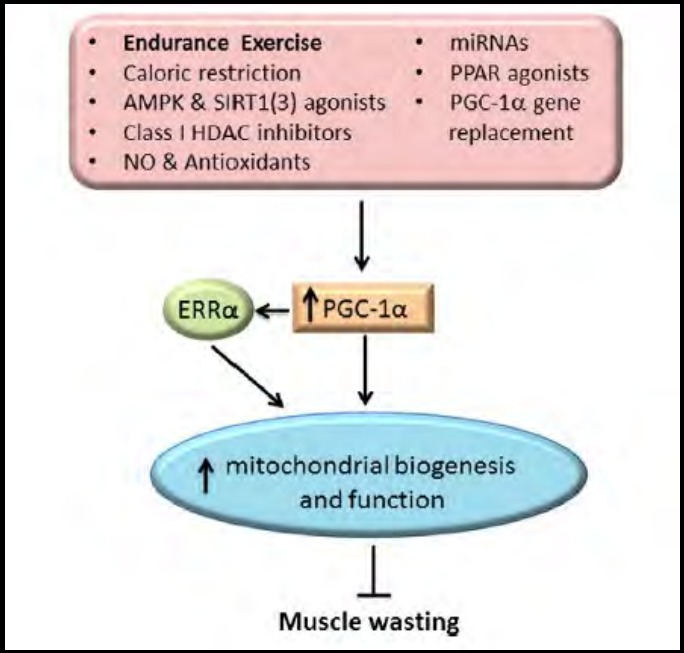


Good

Skeletal muscle mitochondria: A major player in exercise, health and disease☆

Biochimica et Biophysica Acta 1840 (2014) 1276–1284

Aaron P. Russell *, Victoria C. Foletta, Rod J. Snow, Glenn D. Wadley



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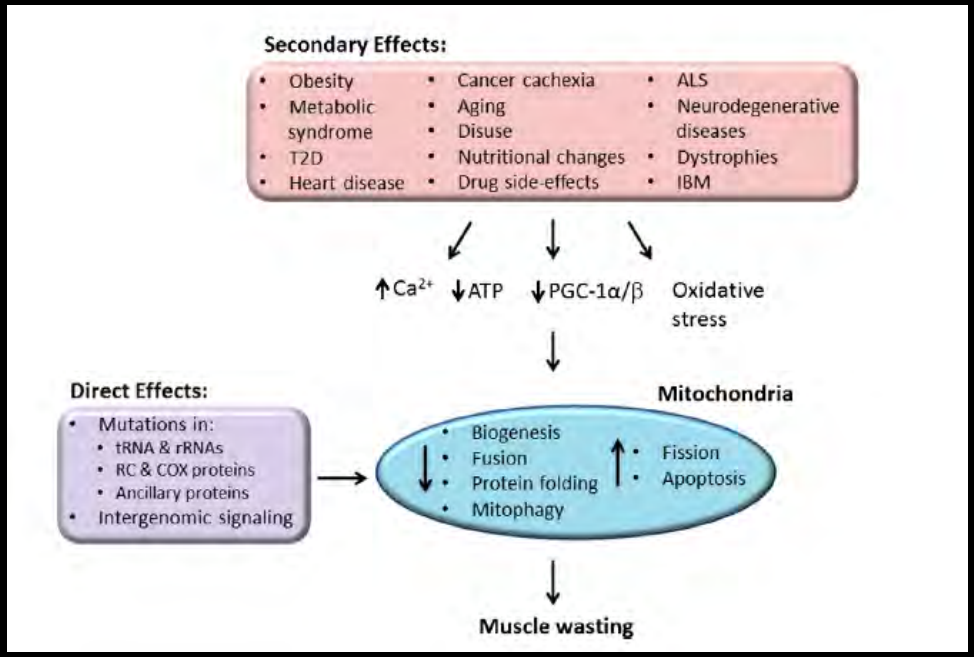

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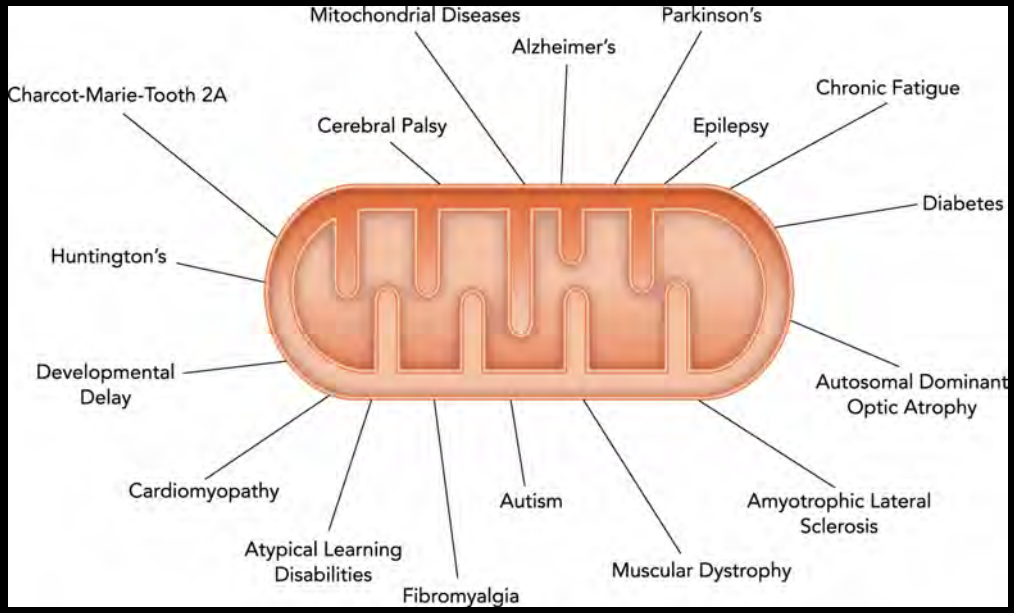

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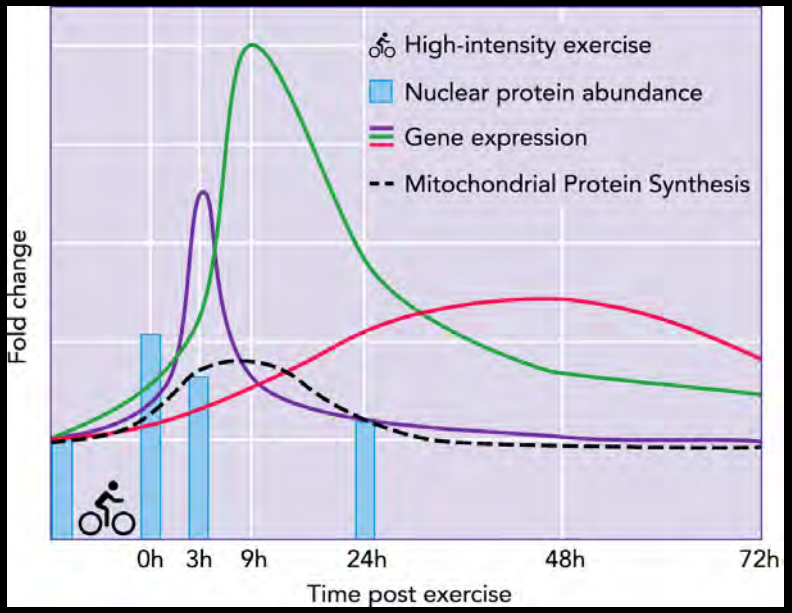

Time course of adaptation Fiber-type changes Intensity!

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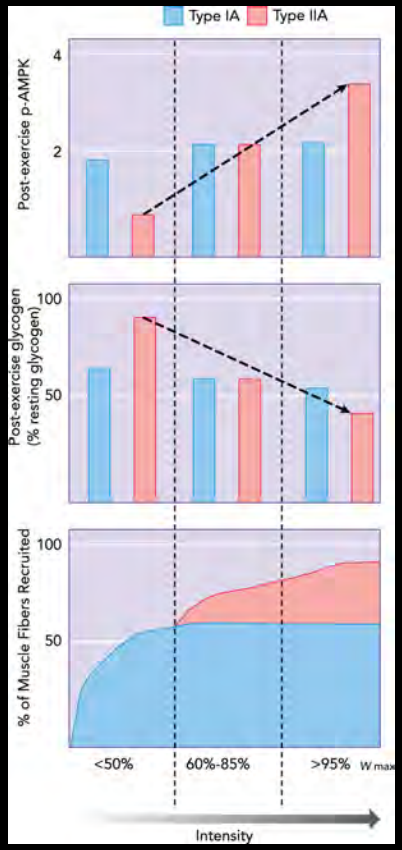

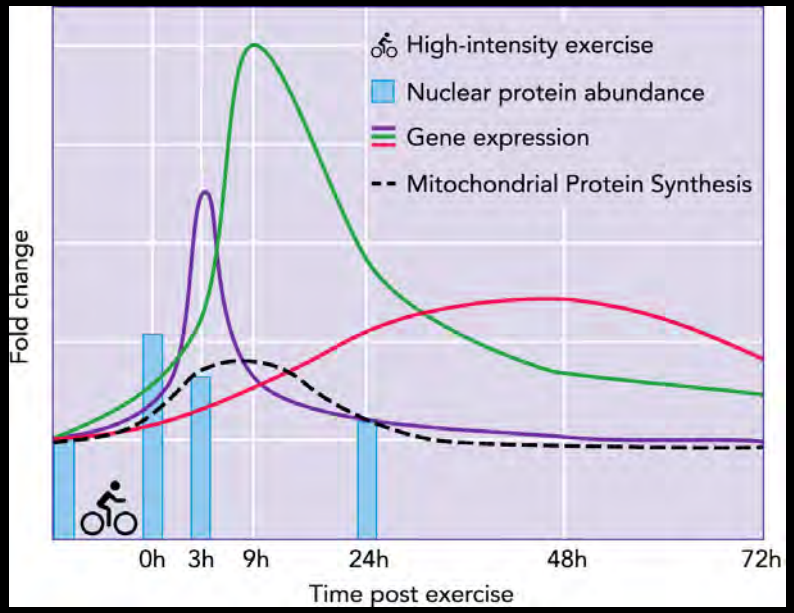

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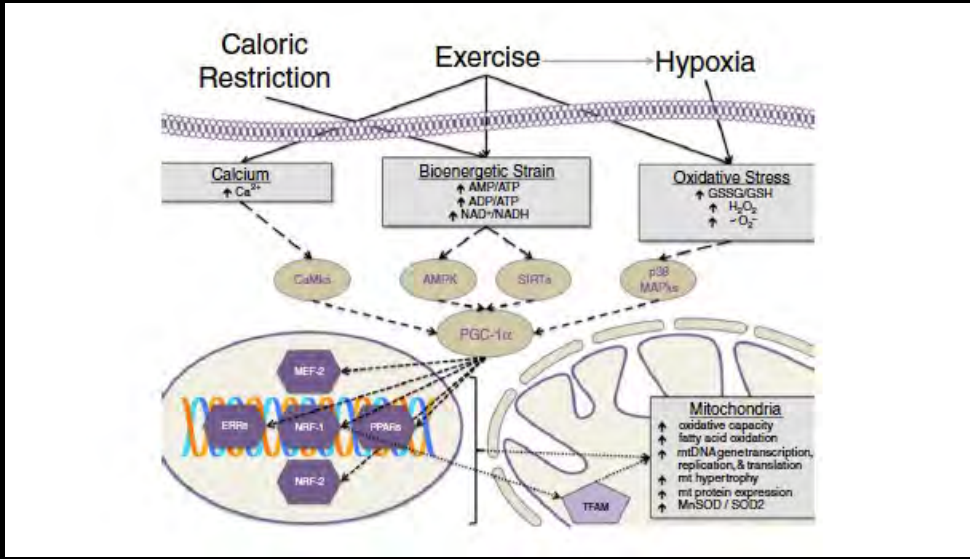
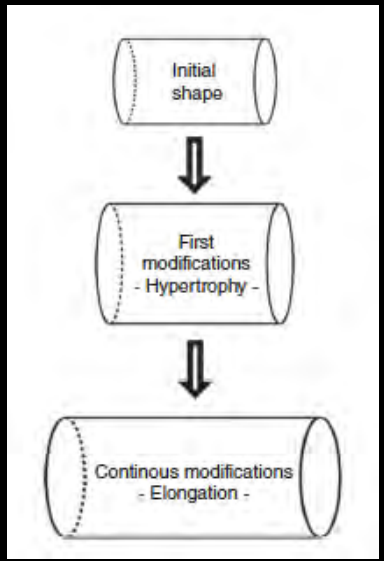
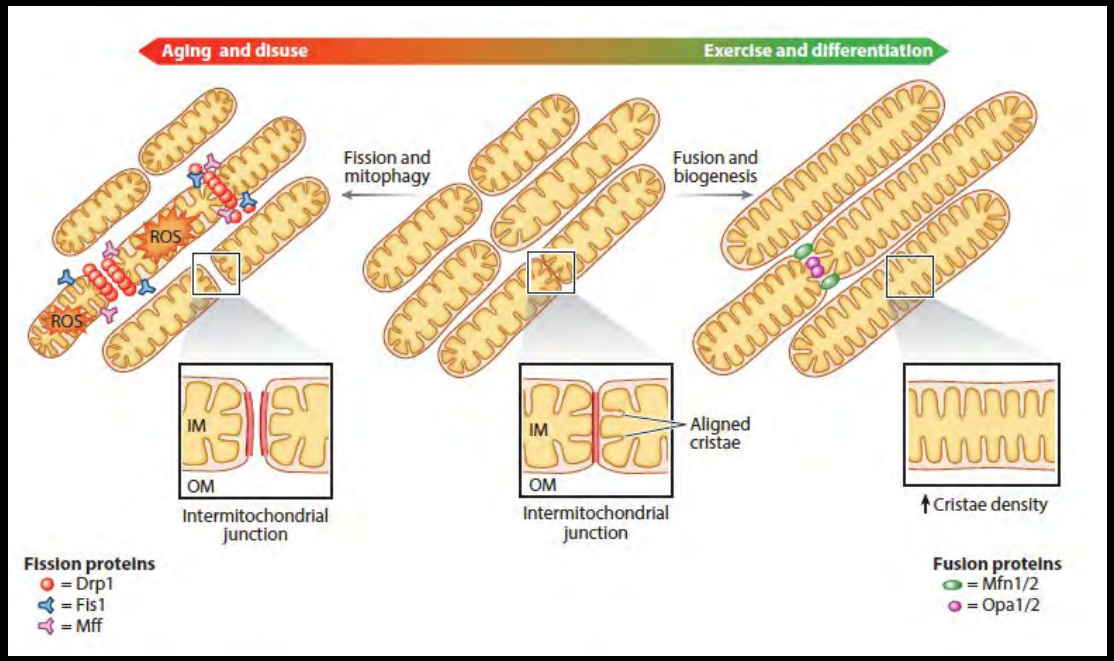




Training mitochondrial volume density increases due to 1) an increase cross sectional area and 2) longitudinal growth. Specific respiratory alterations appear dependent on exercise training intensity. Low-moderate endurance training primarily improves the capacity for fat oxidation whereas high-intensity interval training (HIT) improves global respiratory capacity.

Carsten Lundby[1] and Robert A. Jacobs[1,2,3] *Exp Physiol* 101.1 (2016) pp 17–22

Adaptations of skeletal muscle mitochondria to exercise training



Maintenance of Skeletal Muscle Mitochondria in Health, Exercise, and Aging

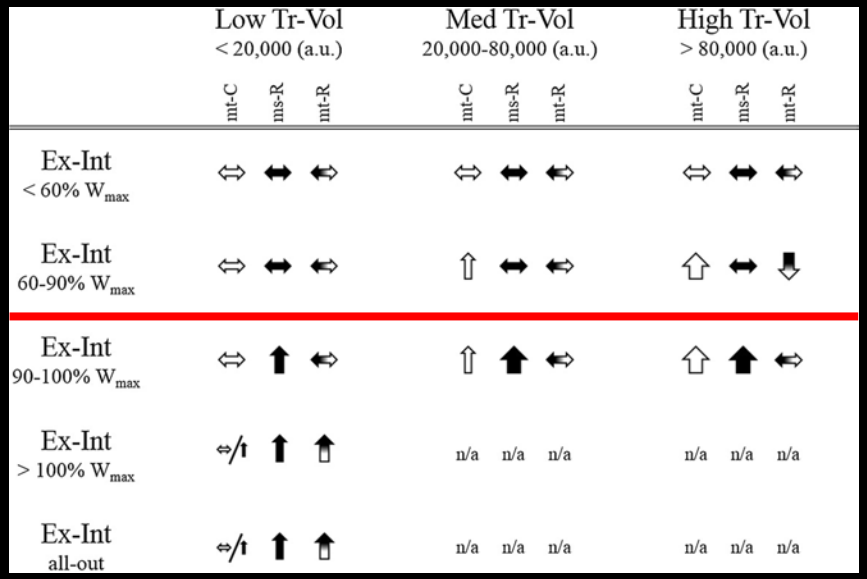
Annu. Rev. Physiol. 2019. 81:19–41

David A. Hood, Jonathan M. Memme,
Ashley N. Oliveira, and Matthew Triolo

Training-induced changes in mitochondrial content and function

SISS/SIIT

HISS/HIIT



	Low Tr-Vol < 20,000 (a.u.)			Med Tr-Vol 20,000-80,000 (a.u.)			High Tr-Vol > 80,000 (a.u.)		
	mt-C	ms-R	mt-R	mt-C	ms-R	mt-R	mt-C	ms-R	mt-R
Ex-Int < 60% W_{max}	⇔	⇔	⇔	⇔	⇔	⇔	⇔	⇔	⇔
Ex-Int 60-90% W_{max}	⇔	⇔	⇔	⇧	⇔	⇔	⇧	⇔	⇩
Ex-Int 90-100% W_{max}	⇔	⇑	⇔	⇧	⇑	⇔	⇧	⇑	⇔
Ex-Int > 100% W_{max}	⇔/↑	⇑	⇑	n/a	n/a	n/a	n/a	n/a	n/a
Ex-Int all-out	⇔/↑	⇑	⇑	n/a	n/a	n/a	n/a	n/a	n/a

mt-C – mitochondrial content related to CS or CAC

ms-R – mass-specific respiration (related to content) ATP production rate or ETC

mt-R – mitochondrial-specific respiration (not related to content) ATP production rate or ETC

Training-Induced Changes in Mitochondrial Content and Respiratory Function in Human Skeletal Muscle

Sports Med (2018) 48:1809–1828

Cesare Granata[1,2] · Nicholas A. Jamnick[1] · David J. Bishop[1,3]

Thoughts/Questions